FINAL REPORT

MULTIPLE ENCAPSULATION OF LANL WASTE USING POLYMERS

AUGUST 12, 1994

Contract Number 1064M0014-3B

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August 12, 1994

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Abstract

Polymer encapsulation of lead shielding/blasting grit (surrogate) mixed waste was optimized at bench scale using melamine formaldehyde, polyurethane, and butadiene thermosetting polymers. Three pellet-based intermediate waste forms, and a final waste form, were prepared, each providing an additional level of integrity. Encapsulated waste integrity was measured by chemical and physical techniques. Compliance was established using the Toxicity Characteristic Leaching Procedure. Equipment appropriate to pilot-scale demonstration of program techniques was investigated. A preliminary equipment list and layout, and process block flow diagram were prepared.

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MULTIPLE ENCAPSULATION OF LANL WASTE USING POLYMERS

SUMMARY

This document reports the results of research, testing and development work by IC Technologies (ICT), targeting polymer encapsulation of a waste stream generated at Los Alamos National Laboratory (LANL).

The Laboratory, under Subcontract Number 1064M0014-3B, commissioned ICT to optimize its multiple polymer encapsulation technology for a mixed (RCRA-hazardous & low-level radioactive) waste stream containing lead, Al_2O_3 grit, and uranium. A surrogate material, prepared under the direction of LANL technical representatives, was used in all development work.

The LANL Statement of Work (SOW) specified investigation of three levels of encapsulation: primary, secondary, and tertiary. The SOW established objectives, relating to chemical and physical integrity, for each level of encapsulation.

Waste Forms: Objectives and Description

- Primary (PE): Agglomeration of surrogate with a polymer to form robust pellets resistant to chemical attack. Nominal 9mm, roughly spherical pellets were prepared using a dry powder, water-activated polymer.
- Secondary (SE): Treatment of PE to satisfy regulatory (RCRA) requirements. PE were treated with each of three thermosetting liquid polymers. Testing showed that a double application of polymer was required to achieve regulatory compliance. Two intermediate waste forms, SE^1 & SE^2 , resulted.
- Tertiary (TE): Bulk sealing of SE to create a void-free monolithic waste form. Three agents, portland cement, and liquid and dry thermosetting polymers, were tested.

Integrity Evaluations & Results

The effectiveness of encapsulation was quantified for each of the waste forms. Leachability and physical strength were evaluated using several methods. The effect of temperature extremes on surface characteristics and leachability was also measured. Integrity evaluation techniques are described below.

Leachability

TCLP-M: A modified version of SW-846 Method 1311 (TCLP) using identical lixiviants, but with increased retention time and kinetic solution sampling. Agitation was by shaker table to simultaneously run as many as 16 tests.

**Pellet
Survival**

Rates: Performed to quantify attrition of PE during TCLP-M. The weight of intact pellets was expressed as a percentage.

**Sequential
Batch**

Testing: A nine-cell leach matrix using deionized water as the lixiviant. Pulp density and lixiviant composition varied within the matrix. Results were expressed as milligrams of lead released per kilogram of solids.

TCLP: SW-846 Method 1311; extraction and leachate analysis by an independent laboratory. This procedure was used to establish compliance of the final waste form (SE²).

Strength

Crush

Resistance: Resistance of waste forms was measured by application of increasing pressure to an unconfined specimen. The pass/fail criteria was 50 PSI applied pressure.

Compression

to Failure: The point of structural failure was established by application of pressure to an unconfined specimen.

EP Integrity: SW-846 Method 1310 integrity evaluation measuring impact resistance. A falling hammer impact test with pass/fail criteria.

Weathering

Freeze/

Thaw: Analogous to ASTM D-560. Effects of treatment were evaluated qualitatively by microscopy, and quantitatively by TCLP-M and crush resistance.

Surrogate Mixed Waste

A surrogate preparation consisting of 80% 60-mesh Al_2O_3 blasting grit, 20% minus 325-mesh Pb metal, and 15% moisture modelled the LANL stream. No radioactive material was used. Leachability of the surrogate was measured by TCLP-M procedure as a baseline data point. Results showed ~4800 mg/L Pb in TCLP-M leachate, representing ~50% of available lead.

Program Objectives and Testing

Primary Encapsulation

Polymers: Melamine formaldehyde; BTL Specialty Resins MF-836
Melamine formaldehyde; BTL Specialty Resins MF-829
Melamine formaldehyde; BTL Specialty Resins MF-817
Union Carbide coagulant; Polyox
Allied Colloids flocculant; Percol 351

SOW objectives were satisfied by program results for this level of encapsulation. Scoping tests examined the five polymers listed above. The coagulant and flocculant were rejected due to integrity deficiencies. First-level testing was conducted on the melamine formaldehydes. Optimization testing was performed using two MF polymers, with a single formulation advanced to secondary encapsulation test work. PE testing variables included polymer addition, cure time and temperature, and moisture content. BTL Specialty Resins MF-817 at an addition of 40% on a dry weight basis, using bentonite clay powder as a dehydrant additive, was the optimized PE design. Cure time and temperature were 1 hour and 50°C, respectively.

Integrity testing of optimized PE showed TCLP-M 18-hour leachate values of 100-130 mg/L Pb, demonstrating a reduction in contaminant mobility of more than an order of

magnitude compared to baseline data. The crush resistance criterion was exceeded on cured PE and TCLP-M - leached PE. Pellet survival rates exceeded 98% consistently.

Secondary Encapsulation

Polymers: Uniroyal Royalcast Polyurethane; 2-Part, Chemical Cure Initiation
Devcon Flexane 80 Polyurethane; 2-Part, Chemical Cure Initiation
Sartomer Polybutadiene Diacrylate; 2-Part w/Additives, Chemical Cure Initiation

SOW objectives were satisfied by program results for this level of encapsulation.

First-level testing used a single application of each polymer to cured PE pellets. The integrity of cured SE¹ (2 hours at 50° C, arbitrary)-was measured by TCLP-M, crush resistance, and freeze/thaw followed by TCLP-M and crush resistance. Cured strength criteria were exceeded, but leachability data showed only one polymer, Sartomer, satisfying TCLP leachate criteria with a small compliance margin. TCLP-M on freeze/thaw pellets showed no detrimental effect attributable to the temperature extremes.

The optimization design to achieve regulatory compliance for a secondary encapsulation waste form considered several methods; application of two cured polymer "envelopes" was chosen. Pellets prepared using that system were extensively evaluated by TCLP-M, crush resistance, EP Integrity, freeze/thaw, freeze/thaw - TCLP-M, freeze/thaw - crush resistance, sequential batch testing, and Method 1311 TCLP. Analytical values, obtained by ICT, on TCLP-M leachates establishing compliance by Method 1311 criteria were rechecked by independent laboratory. They showed a maximum of 1 mg/L Pb in leachate samples. All physical integrity evaluations were positive, with imposed criteria satisfied. TCLP extraction and leachate analysis by independent laboratory showed:

TCLP Results for SE²

Polymer	mg/L Pb
Uniroyal	3.2
Devcon	0.5
Sartomer	1.9

Sequential batch testing results showed analogous results for these polymers:

SBT Results for SE²

Polymer	mg/kg Pb Released
Uniroyal	11.2
Devcon	0.7
Sartomer	6.1

Devcon Flexane 80 demonstrated superior comparative performance, and was selected as the secondary encapsulation agent.

Process and media factors investigated during this phase of testing included cure technique and measurement of polymer adhesion. Microwave and infra-red (IR) curing were evaluated as alternatives to thermal convection. Thermal convection was used in all development work. It was observed that microwave curing tended to volatilize SE polymers; energy control failed to establish a level suitable for reliable curing. IR curing using lamps showed generally good results. Pellets were prepared from PE to SE² using IR cure, with integrity checked by TCLP-M. Leachate analysis showed no measurable difference from convection-cured pellets.

To measure polymer adhesion, and thereby evaluate PE-SE¹-SE² bonding, a series of cylinders (~1" x 2.5") was prepared using MF-817, Uniroyal, Devcon, and Sartomer polymers. Each cylinder was composed of two polymers, with an interface at the midpoint. Pressure was applied to the interface with cylinder ends supported. The point of failure was noted. Simulated PE polymer combinations showed the MF-Uniroyal bond to be the strongest, followed by MF-Devcon bond. SE simulations showed the Devcon-Devcon bond to be the strongest.

Tertiary Encapsulation

TE Agents: Portland Cement
Devcon Flexane 80 Polyurethane
BTL Resins MF-817

The majority of the SOW objectives were satisfied by program results for this level of encapsulation. Void-free monoliths were not consistently obtained due to the disparity of scale between SE² pellet size, and monolith cylinder size at bench scale. Preparation

of quantities of SE² and TE polymer sufficient to minimize the effect of scale differences was not within the scope of this program. ICT is confident that, at 25-gallon or larger scale, and with appropriate technique, void-free monoliths will be readily prepared.

Agents evaluated for tertiary encapsulation generally performed well. No incompatibilities between media types were observed. Integrity of TE monoliths was measured by crush resistance, EP Integrity, and compression to failure techniques. Results indicated best comparative performance by Devcon as the TE agent, regardless of SE² polymer. Next best TE agent was MF-817. The strength of portland cement was less than anticipated. It is suggested that, because full 28-day curing was not possible, cement/SE² monoliths were not at full cured strength at the time of evaluation.

Waste Loading

Average loadings for all waste forms are presented below.

Waste loading was calculated as:

$$\text{dry weight of surrogate} \div \text{dry weight of encapsulate pellet}$$

Waste Loading Data

Encapsulation Level	Waste Loading
PE	71%
SE ¹	67%
SE ²	64%
TE	29%

Waste loading was shown to be a function of SE polymer viscosity and, for TE, the polymers' density. Uniroyal, with the lowest viscosity, gave the lowest SE waste loadings. Portland cement, with the highest cured density, gave the lowest TE waste loadings.

The SOW criteria of >50% waste loading for secondary encapsulates was satisfied.

Equipment Evaluations

A process flow diagram, and corresponding equipment list, was developed through bench-scale encapsulation testing. Major envisioned equipment items, listed by encapsulation level, are presented below. A nominal production rate of 50-100 pounds SE² per hour was used to guide equipment selection.

- PE: A single- or double-screw extruder fed by a hopper/belt feeder (waste) and two screw feeders (MF-817 & bentonite) mixes PE components and discharges sized pellets through an extrusion plate and knife.
- SE: A custom-designed, inclined, linear motion double shaking tray apparatus performs SE¹ and SE² encapsulations. Pellets advance by linear motion, are coated with SE polymer, and are cured by integral IR cure hoods. The apparatus' conceptual design targeted the need for a low-maintenance device to handle short pot life polymers.
- TE: Using Devcon (or similar thermosetting polymer), this operation is handled by a drum conveyor where 55-gallon drums are charged with SE² while simultaneously filling with TE agent. Cure is by batch convection oven.

A preliminary major equipment cost of \$669,200 was estimated. The major contributor to this estimate was the SE apparatus, which will require prototype development.

1.0 INTRODUCTION

Los Alamos National Laboratory (LANL) authorized IC Technologies, Inc (ICT) to supply engineering and testing services necessary to perform and evaluate multiple encapsulation of surrogate mixed waste using polymers. The specifications for these services were set forth in the LANL Statement of Work (SOW) dated November 24, 1993, and in LANL Subcontract Number 1064M0014-3B. This document reports the results and outcome of those services and evaluations.

LANL is in the process of decontaminating lead shielding material. The procedure involves abrasive surface etching of the shielding to remove the outer layer of lead that contains the majority of the radioactive contaminants. This procedure generates a small volume of waste in the form of a moist residue containing lead, abrasive grit (Al_2O_3), uranium and water. The solubility of the lead contaminant in EPA's Toxicity Characteristic Leaching Procedure (TCLP), coupled with the presence of low-level radioactive isotope(s), classifies the waste as mixed. Mitigation of the characteristic hazard, allowing the waste to be regulated as low-level radioactive only, was a program goal.

A multiple encapsulation system, developed by ICT for use on contaminated soils, was recommended as an alternative to LANL for mitigation of the characteristic hazard in their blasting grit waste stream. The program objective, as set forth in the SOW, was to: "optimize to the extent practicable the subcontractor's multiple encapsulation system on LANL surrogate mixed waste."

The SOW identified three levels of encapsulation, primary, secondary, and tertiary, with specific objectives for each:

Primary

Encapsulation: The objective of primary treatment is to bind the unconsolidated waste into discrete large particles (~3/8") using a pelletizing technique. The resultant waste form will be cured to form strong, cohesive pellets with some resistance to chemical attack, and suitable for secondary treatment.¹

Secondary

Encapsulation: The objective of secondary treatment is to generate a final waste form capable of satisfying TCLP requirements for lead, maximizing waste loading to a minimum of 50% surrogate by weight on a dry basis, and minimizing cost.²

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¹LANL SOW & Subcontract #1064M0014-3B

²IBID

Tertiary

Encapsulation: The objective of this portion of the program is to physically seal the encapsulate pellets in a bulk monolith, creating a physically unified waste form free of cracks, voids, and significant imperfections.³

An earlier project performed by IC Technologies on the same LANL mixed waste demonstrated that simple, direct encapsulation, or sealing of the waste in polymers was not effective in reducing lead solubility. Specification of this series of encapsulation steps resulted from that initial scoping test program.

The final program objective was to investigate equipment appropriate for larger scale implementation of the encapsulation techniques identified and optimized in the research program. The investigation was to include preparation of a preliminary equipment list with approximate cost data, and a preliminary equipment layout based on the findings.

Sixteen weeks were estimated by ICT, and allotted by LANL, to satisfy program objectives and provide the deliverables set forth in the SOW. All program objectives were achieved, and all deliverables presented. This Final Report represents, and signifies, the successful completion of the project.

The following sections report the results of program research and investigations. Sections 1.0 through 4.0 provide information on waste forms, integrity testing protocols, and surrogate preparation and testing. Section 5.0 presents testing data for primary, secondary, and tertiary encapsulations, plus ancillary testing of curing techniques and polymer adhesion. Section 6.0 covers waste loading for all waste forms, and Section 7.0 discusses pilot-scale equipment investigations and estimated costs.

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³LANL SOW and Subcontract #1064M0014-3B

2.0 DESCRIPTION OF WASTE FORMS

Execution of the research program resulted in the development of three intermediate, and one final, waste forms. These waste forms correspond generally to the levels of encapsulation described in the Introduction (Section 1.0). To provide clarity for discussions and data presented herein, this section provides physical descriptions of the intermediate and final forms in terms of their preparation, sizing, and general characteristics.

Primary

Encapsulates (PE): Formed at bench scale by agglomeration of the LANL surrogate using a drum type pelletizer and various binding agents. Pellet size was controlled at 1/4" to 1/2" primarily by the addition of a dehydrant (bentonite) during agglomeration. The researcher rejected all binding agents that failed to generate cohesive pellets. Freshly prepared PE were cured at elevated temperature by various techniques, and were roughly spherical, gray to beige pellets.

Secondary

Encapsulates (SE): PE were overcoated with selected thermosetting polymers to create a barrier to contaminant diffusion. Leachability testing established the need for more than one application, resulting in two secondary encapsulate waste forms:

SE¹: A single overcoating application of thermosetting polymers to cured PE. Liquid polymers were applied using a modified technique with the agglomerator. Application thickness was a function of polymer viscosity. SE¹ were cured prior to testing or additional treatment.

SE²: Cured SE¹ were re-coated with identical polymer and cured at identical conditions. This represented the final waste form in terms of physical and chemical integrity verification.

Tertiary

Encapsulates (TE): Cylindrical containers were filled with SE², then overpoured with solidification media to form a structural monolith.

3.0 INTEGRITY EVALUATION TESTS

This section describes the procedures and methodologies used to evaluate the stability of primary, secondary, and tertiary waste forms. Note that not all waste forms were evaluated by each technique described. The SOW set forth integrity requirements, which were adhered to, and in some cases, exceeded, during integrity testing.

The nature and schedule of the program required innovation in terms of establishing

integrity testing protocols that would provide meaningful data on the stability of intermediate waste forms, yet be simple and straightforward in execution. The tests described below were used to provide not only absolute, but comparative data to aid and guide the development program. With the exception of SW-846 Method 1311 TCLP leachability, all tests were performed in-house by ICT.

3.1 Chemical Integrity Tests

The general dearth of published research relative to stabilization of wastes with polymers precluded the use of "traditional" chemical integrity, or leachability, tests in this program. EPA has documented a number of test procedures applicable to inorganically (cement, pozzolans) stabilized wastes that focus on particle size reduction and buffering capacity as those factors relate to inorganic media. It was ICT's recommendation that a limited mix of EPA-approved, modified, and non-traditional techniques be utilized for evaluation of the unique waste forms developed in this program.

TCLP-M: This procedure was used to guide the program by providing quantitative and comparative leachability data for encapsulant selection, dosage, curing technique, etc. Although methodological similarities to SW-846 Method 1311 are apparent, the test objective was not to establish regulatory compliance or non-compliance.

A modified version of SW-846 Method 1311, this test used Solution #2, acetic acid at pH 2.88. To provide a comprehensive evaluation, the lixiviant selection procedure set forth in Method 1311 was performed on primary encapsulates (PE). Results showed that the Method-determined lixiviant for the PE waste form was TCLP Solution #1 (pH 4.93). This lixiviant was used, in parallel with Solution #2, to evaluate PE.

The procedure consisted of introducing an aliquot of encapsulates into test lixiviant at ~5% solids in an Erlenmeyer flask. Mild agitation was provided by a shaking table. The typical retention time (shorter times were used for specific purposes) was 48 hours. Samples of test solution were removed at 8-14, 24, and 48 hours for lead analysis. Residual solids were either evaluated to establish Pellet Survival Rates (PE only), evaluated microscopically for surface flaws/features, or reserved for proper disposal.

**Pellet
Survival
Rates:**

Some attrition of PE, due to chemical attack and physical contact during the TCLP-M procedure, was anticipated. As an additional measure of stability for comparative purpose, solids recovered from TCLP-M were dried, segregated into integral pellets and attritioned fines, and weighed. The survival rate was calculated as a percentage: (intact pellet weight ÷ total solids weight) × 100.

Sequential
Batch
Testing:

This technique consisted of a nine-cell leach matrix. The lixiviant was deionized water; retention time for each cell/contact was 24 hours. Three aliquots of fresh solids (encapsulates) were contacted with three aliquots of fresh lixiviant. The schematic diagram below illustrates the procedure. Each of the nine aqueous samples was filtered and analyzed (flame AA) by ICT for lead; results were calculated to milligrams of lead liberated per kilogram of waste form and plotted. This testing methodology has been used to model percolation leaching potential, and similar procedures been applied to inorganically stabilized wastes by other researchers.

TCLP: Traditional SW-846 Method 1311; extraction and leachate analysis was performed by an independent local analytical laboratory to establish compliance of the final waste form (SE²). Encapsulates were carefully sized at 8.0-9.0mm to satisfy the Method 1311 particle size requirement.

3.2 Physical Integrity Tests

This testing attempted to quantify physical attributes of the waste forms. Physical strength was measured by three procedures: Crush Resistance, Compression to Failure, and EP Integrity impact resistance. Also evaluated was encapsulate response to freeze/thaw temperature extremes.

Uniaxial Unconfined Crush

Resistance: Pellets were placed below a pneumatic ram device. The piston was brought into contact with the pellet's surface; line pressure was slowly increased to a maximum of 50 PSI indicated pressure. The rating was pass/fail at 50 PSI applied pressure, with failure point noted. Pellets were unconfined during testing.

Uniaxial Unconfined Compression to

Failure: An hydraulic compression tester was used to apply gradually increasing pressure to unconfined specimens. Threshold pressure at the point of specimen structural failure was noted. Specimen deformation was not considered in assessing failure point.

EP Integrity Impact

Resistance: The EP Toxicity Test, forerunner to the TCLP, included an evaluation, for the purpose of determining sample crushing requirements, of impact resistance. A specimen of prescribed dimensions is placed in a holder (confined) and subjected to repeated impact from a falling hammer of prescribed weight, and over a prescribed distance. (Reference SW-846 Method 1310). Any loss of integrity fails the sample.

Freeze

/Thaw: A specimen was subjected to five freeze/thaw cycles of 16-hour/8-hour duration, respectively. Freeze temperature was 10-20°F; thaw was at ambient (~70°F) conditions. Specimens were evaluated visually for surface effects using binocular microscopy. The TCLP-M procedure was employed to evaluate before-and-after leachability characteristics.

4.0 SURROGATE MIXED WASTE

To model the LANL blasting grit waste stream, mixtures of nominal 60-mesh Al_2O_3 blasting grit and minus 325-mesh lead powder were prepared at a 4:1 (80%/20%) ratio. The surrogate was prepared in individual batches on an as-needed basis. This procedure was instituted due to significant differences in density and particle size between the alumina grit and lead powder that resulted in a tendency for the lead powder to separate out in dry mixtures. No bulk preparations of surrogate were used in the program. While the practice probably contributed to test-to-test variability in surrogate composition, it was judged to be a more accurate method than splitting small aliquots from a bulk sample.

Analogous LANL waste was described by LANL technical representatives as a moist

material. Earlier work (ICT Project 1261) established a saturated moisture content of ~17% for the surrogate waste; a target moisture content of 15% was defined for the program. Note that, for development purposes only, the surrogate was moistened during actual testing but prepared dry. This precaution prevented segregation of components and facilitated the bench-scale processes utilized for primary treatment testing. Larger scale stabilization mixing equipment described in a later section can handle moist waste.

4.1 Baseline Leachability Testing

To provide a basis of comparison, aliquots of surrogate waste were evaluated by the TCLP-M procedure. Both Solution #1 and Solution #2 were used as lixiviants. Analytical results showed:

	14-HR	24-HR	48-HR
Solution ID	mg/L Pb		
Method 1311; Solution #1	1046	1569	4420
Method 1311; Solution #2	1008	1008	5200

The maximum calculated concentration, assuming 100% dissolution of available lead, was 10,000 mg/L Pb. The test analytical data indicated that solubility was inhibited in some way, although factors typically associated with solubility such as the solubility product, particle size, and precipitation were not applicable in these tests. It is suggested that TCLP-M did not provide oxidation sufficient to allow solubilization of Pb metal by acetic acid. Oxidation potential was not measured during TCLP-M testing, however. Confirmation of the results was provided by data acquired in ICT's original development program (ICT Project 1261), which showed a lead concentration in TCLP extract of 4872 mg/L. While the reason for the data obtained was somewhat unclear, the test results served to provide the desired baseline for comparison.

5.0 SPECIFIC PROGRAM OBJECTIVES & DESCRIPTION OF EFFORT

Each of the broad program objectives set forth in a preceding section (1.0) included several sub-task objectives. This section discusses all program objectives in the context of descriptions of work performed and findings achieved.

5.1 Primary Treatment

5.11 Scoping Tests & Media Evaluations

Twenty-seven PE preparations were evaluated in the program. A series of scoping tests, designed to provide basic qualitative data on encapsulant preparation, adhesion, and pelletization characteristics, narrowed the choices of PE encapsulants. Media types evaluated at scoping conditions included:

- Melamine formaldehyde; BTL Specialty Resins MF-836
- Melamine formaldehyde; BTL Specialty Resins MF-829
- Melamine formaldehyde; BTL Specialty Resins MF-817
- Union Carbide coagulant; Polyox
- Allied Colloids flocculant; Percol 351

Coagulants and flocculants have historical uses as agglomerants for dusts, ash, and other fine-size materials. They are water-soluble polymers conventionally employed in flocculation of solids suspended in aqueous slurries. Their traditional use as agglomerants involved addition of low-concentration (~1 g/L) aqueous suspensions to achieve simple pelletization, rather than chemical stabilization of contained contaminants. In this program, attempts were made to introduce a concentrated solution to the surrogate to effect agglomeration and impart some level of chemical stability.

Solutions of Polyox and Percol were prepared at 20 grams per liter (g/L) using methylene glycol. The glycol wetted, but did not dissolve, the flocculant powders. Scoping tests showed that the polymers were activated upon addition of water, and that surrogate agglomerates formed. The agglomerates were, however, unstable and tended to adhere to each other and testing apparatus. Additionally, Polyox pellets were friable after curing and judged of insufficient strength. Percol agglomerates were more stable when cured, but the Percol/glycol suspension tended to polymerize after a few hours storage. Finally, the maximum dosages possible with coagulant polymer suspensions were insufficient to investigate dosage as a variable. Testing with coagulant-type polymers as the sole agglomerant was therefore terminated.

Initial testing with melamine formaldehyde (MF) showed promising results. This polymer is used commercially to manufacture inexpensive furniture, and as a component in high-pressure laminates like Formica®. Polymerization is initiated by addition of water to the

dry, fine melamine formaldehyde powder. Three scoping tests using MF-836 at 10%, 20% and 40% additions (dry basis) satisfied qualitative criteria. Pelletization was readily effected, pellets were of significant integrity, and cured pellets showed high strength.

Given the negative results shown by coagulant polymers, and the promising results with MF, optimization testing was redesigned to include three MF formulations (MF-836, -829, & -817) and to evaluate the addition of coagulant polymers as supplements to MF.

5.12 PE Investigations & Optimization

5.12.1 Initial Testing

Twenty-seven tests were performed to evaluate the effectiveness of PE media, and provide data for the selection of a single PE "recipe". Tables 1 and 2 present summaries of test conditions, integrity tests, and analytical results. Table 1 shows test numbers labeled "A" and "B". These designations denote two splits from a single PE preparation. Splits were evaluated for leachability using Solution #1 and #2 in TCLP-M. Also presented are approximate waste loading data, crush resistance measurements, and pellet survival rates after TCLP-M.

The three melamine formaldehyde polymers were tested at additions of 10%, 20%, and 40% based on surrogate and polymer dry weights. Note that clay (bentonite) was added as a dehydrant. It was found that, at the prescribed moisture content of 15%, agglomerates tended to agglomerate to sizes larger than specified (1/4" - 1/2"), to flatten after removal from the agglomerator, and to adhere to each other. Bentonite addition, while lowering waste loading, alleviated these factors. Based on the observations, it is suggested that dewatering LANL mixed waste by draining over filter cloth might be an appropriate pre-conditioning step.

Data acquired from tests 1028-(20-32) showed integrity, both physical and chemical, increased as a function of polymer addition for all polymers. Two tests (1028-(31 & 32)), using 10% MF-836 and 10% MF-817 plus 0.015 cc Polyox suspension per gram surrogate, showed no increase in stability attributable to the Polyox addition. Results were comparable to tests without coagulant additive, at identical MF additions. With those results, work with coagulants was abandoned. Test 1028-32 results indicated a potential performance advantage for MF-817; crush resistance and TCLP-M indicators showed higher strength and greater chemical resistance.

Results for MF-stabilized surrogate led to the following observations:

- ▶ Crush resistance in excess of the 50 PSI benchmark required polymer additions of at least 20%.
- ▶ Lead values below 100 mg/L Pb for TCLP-M leachate required 40% polymer additions.

TABLE 1
Primary Stabilization
Summary of Results
IC Technologies Project 1342

Test #			Surrogate Waste, Dry, Grams	Binder Components			Waste Form Data		TCLP-M Data					Pellet Survival Rate ^{3/}
				Polymer					Extract: mg/L Pb					
				ID	grams	100 g/L Polyox*	Clay, g (Nominal)	Waste Loading ^{1/}	Uniaxial Crush Resistance, PSI ^{2/}	Extract ID: TCLP Sol'n #	Hours			
									14	24	48			
1028-20	A	50	MF-836	20	--	3.5	68%	>50	1	83	108	179	100.0%	
	B		↓		--				2	101	132	230	100.0%	
1028-21	A	50		10	--	1.5	81%	>50	1	271	362	600	99.2%	
	B				--				2	395	550	980	99.1%	
1028-22	A	50		5	--	2.5	87%	29	1	920	1160	1850	100.0%	
	B		↓		--				2	1420	1760	2450	100.0%	
1028-25	A	50	MF-829	15.8	--	3.5	72%	>50	1	81	110	200	98.0%	
	B		↓		--				2	250	342	600	97.6%	
1028-26	A	50		10	--	1.5	81%	4	1	334	466	850	98.6%	
	B				--				2	441	600	1040	99.5%	
1028-27	A	50		5	--	2.5	87%	25	1	1050	1300	1920	98.8%	
	B		↓		--				2	1630	1930	2600	97.2%	
1028-28	A	50	MF-817	20	--	3.5	68%	>50	1	68	99	158	100.0%	
	B		↓		--				2	126	183	261	100.0%	
1028-29	A	50		10	--	1.5	81%	>50	1	340	457	680	99.0%	
	B				--				2	540	707	1065	99.7%	
1028-30	A	50		5	--	2.5	87%	15	1	1343	1509	2131	99.5%	
	B		↓		--				2	1286	1549	2027	99.1%	
1028-31	A	50	MF-836	5	0.75 cc	2.5	87%	10	1	1457	1470	2096	94.8%	
	B								2	1657	3615	2165	90.1%	
1028-32	A	50	MF-817	5	0.75 cc	2.5	87%	42	1	943	1112	1478	99.1%	
	B								2	1171	1430	2096	99.5%	

* In methylene glycol

○ This test consumed ICT's on-hand supply of MF-829; the target addition of 40% w/w was not achieved.

1/ Based on dry weights of total surrogate, clay and polymer (wt waste/(wt waste+wt clay+wt polymer)).

2/ Compressive strength of representative cured pellets was measured using a pneumatic ram device where pressure was gradually applied to roughly spherical pellets to an indicated (pressure gauge) application of 50 PSI or failure.

3/ This value determined by separation of fine solids from intact pellets following TCLP-M testing. Based on dry weights.

TABLE 2
Primary Stabilization
Summary of Optimization Tests
IC Technologies Project 1342

Binder Components	Polymer		Waste Form Data	Cure		Pellet Survival Rate %
	Surrogate Waste, Dry, Grams	ID grams Clay, g	Uniaxial Crush Resistance, PSI ²	After TCLP-M	Hours	
Test #	Surrogate Waste, Dry, Grams	ID grams Clay, g	Uniaxial Crush Resistance, PSI ²	After TCLP-M	Hours	Pellet Survival Rate %
1028- 40	50	MF-836 5	78%	15	>4 hrs	2655
1028- 22	50	MF-836 5	29	50	>4 hrs	1420 1760 2450
1028- 41	50	MF-836 20	58%	50	>4 hrs	355 415 725
1028- 20	50	MF-836 20	>50	50	>4 hrs	101 132 230
1028- 42	50	MF-817 5	73%	25	>4 hrs	1322 1513 2129
1028- 30	50	MF-817 5	15	50	>4 hrs	1286 1549 2027
1028- 43	50	MF-817 20	57%	50	>4 hrs	60 108 217
1028- 28	50	MF-817 20	>50	50	>4 hrs	126 183 261
1028- 44	50	MF-836 15	61%	50	>4 hrs	400 493 941
1028- 45	50	MF-817 15	64%	50	>4 hrs	168 179 377
1028- 46	50	MF-836 20	>50	25	24	504 560 878
1028- 47	50	MF-817 20	>50	25	24	568 657 960
1028- 48	50	MF-836 20	60%	40	~16	366 443 NA
1028- 49	50	MF-817 20	58%	27	~16	527 581 NA
1028- 50	50	MF-817 20	>50	50	1	172 205 388
1028- 51	50	MF-817 20	>50	50	2	265 314 542
1028- 52	50	MF-817 20	55%	50	4	228 280 519
1028- 53	50	MF-817 20	60%	50	8	512 586 993
1028- 54	50	MF-836 20	57%	50	2	340 414 NA
1028- 55	50	MF-836 20	59%	50	8	280 313 NA

Note: Data shown in *italics* is for duplicate (earlier) tests, and is presented for purposes of comparison.

NA = Not Analyzed

1/ Based on dry weights of total surrogate, clay and polymer (wt waste+wt clay+wt polymer).

2/ Compressive strength of representative cured pellets was measured using a pneumatic ram device where pressure was gradually applied to roughly spherical pellets to an indicated (pressure gauge) application of 50 PSI or failure.

3/ This value determined by separation of fine solids from intact pellets following TCLP-M testing. Based on dry weights.

- ▶ Pellet survival rates were proportional to polymer addition, for the most part. MF-836 was the exception, showing 100% survival at 10% polymer addition.
- ▶ TCLP-M leachate lead values as a guide to polymer selection were inconclusive.

Although higher polymer additions inhibited lead solubility, it was difficult to single out the best performer of the three MF formulations. Solution kinetic samples taken from TCLP-M leachates at 14, 24, and 48 hours showed lead concentrations increasing with time. The lowest value obtained was 68 mg/L Pb at 14 hours for TCLP Solution #1; MF-817. The highest value was 2600 mg/L Pb at 48 hours for TCLP Solution #2; MF-829. Figures 1 and 2 are plots of Pb concentration vs time, for TCLP Solutions 1 & 2, for all tests. With one exception the lead dissolution rate is first order.

Based on pellet survival rates and small differences in TCLP-M data, it was decided to advance two polymers, rather than one, to optimization testing. The initial data, although comprehensive, did not exhibit significant superiority for any one polymer. MF-836 and MF-817 were chosen for additional testing.

5.12.2 Optimization Test Work

Table 2 presents a summary of optimization test work. As part of QA/QC procedures, four tests from the first series were repeated to evaluate repeatability of results. Several factors were acknowledged before testing that would play a role in interpretation of TCLP-M (and other) results:

- ▶ *Representability with respect to particle size for PE waste form.* At a nominal agglomerate size of 3/8", proper representation could only be achieved by using two to three kilograms of PE for each TCLP-M evaluation. This constraint was felt to be unworkable given the time frame of the program and the purpose of the data. Because regulatory compliance was not an objective at the PE stage, and because data use was comparative rather than absolute, small samples were deemed appropriate with the understanding that repeatability would suffer.
- ▶ *Leachate lead concentrations were a function of both diffusion and exposure at the surface of the pellet.* The program, at the PE stage, could address only diffusion by selection of polymers. Earlier work (ICT Project 1261) established that no tested polymers were effective encapsulants for a microencapsulated waste form. In other words, lead metal particles located at the surface of the PE waste form were readily available to the leaching lixiviant, and no tested process or system control at the PE stage was effective in preventing that mode of solubilization. Therefore repeatability became a function of lead distribution through the pellet, which was an uncontrolled variable.
- ▶ *Pelletization at bench scale required, and benefitted from, operator familiarity and practice.* Repeatability therefore became partially a function of skill level, rather than more

FIGURE 1
Primary Encapsulation Testing
Pb Solubility vs Time
TCIP Solution #1

FIGURE 2
Primary Encapsulation Testing
Pb Solubility vs Time
TCLP Solution #2

controllable factors.

Given the caveats established above, repeatability was judged acceptable. Tests 1028-(40-43) repeated the conditions of tests 1028-(20, 22, 28, & 30), respectively, see Table 2. These were tests using MF-836 and MF-817 at 10% and 40% levels. Pellet survival rates decreased in every instance, perhaps implying a general curing deficiency. Information gleaned from the results implied that MF-817 was perhaps more consistent in its performance than MF-836. As an additional measure of structural integrity, crush resistance was evaluated on solids recovered from TCLP-M testing. These data showed a measurable decrease in crush resistance attributable to TCLP-M testing for PE prepared at 10% polymer addition only. Tests at higher polymer dosages did not reveal structural weakening detectable with the crush resistance evaluation.

Optimization tests 1028-(44-55) examined several variables and characteristics:

- ▶ Polymer addition of 30%; MF-817 & MF-836
- ▶ Cure temperature
- ▶ Cure time
- ▶ Clay requirement
- ▶ Before and after TCLP-M crush resistance

Evaluation of polymer additions of 30% was both a QA/QC exercise and a performance-oriented task. The plots of Pb concentration in TCLP-M leachates permitted an extrapolation of performance at the 30% addition, and the test results served to confirm those data. Additionally, cost savings could have resulted from a 25% reduction in polymer requirement at larger scale. The data (Tests 1028-(46, 47)) showed a significant increase in Pb solubility for MF-836, less so for MF-817.

Cure conditions were evaluated primarily using thermal convection equipment. Infra-red and microwave curing were tested on optimized SE² formulations. The standardized cure for all PE prior to examination as a variable was 50° C for at least 4 hours. Cure temperatures from ambient (25° C) to 100° C were evaluated. All PE for these evaluations were prepared with 40% polymer additions. Tests with ambient cure for 24 hours showed elevated Pb levels in TCLP-M leachates for both MF-817 and 836, see Tests 1028-(46, 47). High temperature cure, 100° C for ~16 hours, was not an advantage in TCLP-M leachability. Leachate Pb concentrations exceeded 350 mg/L in all cases.

Cure times from one to eight hours were tested at a temperature of 50° C. MF-817 was evaluated at 1, 2, 4, and 8 hours; MF-836 at 2, and 8 hours. Results showed that MF-817 could be sufficiently cured in one hour as measured by TCLP-M results, and stability was shown to be inversely proportional to cure time. For PE cured for one hour, the 14-hour TCLP-M leachate sample assayed 172 mg/L Pb, 24-hour leachate showed 205 mg/L Pb, and the 48-hour leachate assayed 388 mg/L Pb. Fourteen-hour lead values for 2-, 4-, and 8-hour cures showed 265, 228, and 512 mg/L Pb. MF-836 did not exhibit the same relationship,

showing stability to be proportional to cure time. Figure 3 shows the relationship between cure time and chemical stability.

Pellet survival rates were examined as a potential factor in leachability results. Some correspondence between high survivability rates and lower leachate Pb values was observed, but a consistent relationship was not apparent. It is suggested that a combination of diffusion (influenced by polymer type) and surface availability of contaminant was responsible for leachability results.

The clay required to absorb excess water during agglomeration was quantified during optimization test work, and averaged 34% for MF-817 at 40% addition level (surrogate dry weight basis). This was felt to be excessive; testing procedures were modified to reduce the clay addition. Another alternative, reduction in surrogate moisture content, was considered and, after testing, rejected to prevent introduction of an unknown, uncontrolled variable into the program. Three identical PE preparations, using the minimum water addition (average 10.7%) necessary to polymerize MF-817, were evaluated by TCLP-M. Reduction in moisture content permitted reduction of bentonite addition to ~50% of typical levels. TCLP-M data is shown below. Results indicate that dewatering of the LANL waste to ~10% may not be detrimental to contaminant stabilization with the MF-817 system.

	7-HR	24-HR
Test ID	mg/L Pb: TCLP-M Leachate	
1028-56	129	251
1028-57	75	184
1028-58	225	443

Curing of PE by alternative means was briefly investigated. Two techniques, infra-red (IR) lamps and microwave energy, were evaluated on PE, SE¹ and SE² waste forms. Results, which showed IR to be effective, and microwave energy to be unsuitable, are further discussed in Section 5.24.

A short cure at any temperature was judged to be a distinct advantage for continuous larger scale stabilization. Therefore, MF-817 was judged the better PE binder using that criterion. Additionally, it satisfied the SOW requirements and, through optimization, demonstrated significant ability to inhibit Pb solubility. An optimized PE recipe consisting of 40% MF-817 cured for one hour at 50° C was established for the next phase of work, secondary encapsulation.

The objectives stated in the LANL Statement of work for this task were satisfied.

FIGURE 3
The Effect of Cure Time on Chemical Stability of Primary Encapsulates

5.2 Secondary Encapsulation

PE testing demonstrated that, while significant reduction in contaminant solubility was effected, regulatory compliance for the characteristic hazard was not attained. This was not an unanticipated development due to earlier work's results, and was addressed by the SOW requirement for secondary treatment(s). The SOW called for evaluation of a maximum of three secondary treatment agents, applied as coatings to the optimized PE waste form. Also specified was verification of SE integrity through a series of chemical and physical tests. Figure 4 is a testing flow diagram for SE development work. Pellet survival rates for secondary encapsulates were not quantified; no visible degradation of the waste forms was evident through TCLP-M testing.

5.21 Secondary Treatment Agents

5.21.1 Polyurethanes

ICT's past experience was invaluable in the agent selection process. Being limited to three agents, selection was crucial to program success. Earlier work showed polyurethanes to be chemically resistant, easily prepared, structurally adequate, and readily obtainable. These were factors judged to be desirable from a technical perspective, and for Department of Energy procurement considerations. Accordingly, two polyurethanes, Devcon Flexane 80, and Uniroyal Royalcast, were chosen. ICT had worked with these polymers, the manufacturers and their technical representatives in the past. Note that Devcon and Uniroyal polyurethanes' cure is chemically, rather than thermally, initiated. Pot lives for these polymers was less than one hour.

Both polyurethanes were two-part formulations using no additives. One component of all polyurethanes is an isocyanate compound, usually dimethyl, diisocyanate or MDI. Isocyanates require specific Health & Safety precautions for safe use. Most modern polyurethanes do not liberate isocyanate during cure, and only require adequate ventilation and/or air-purifying respirators for their use. None of the components is flammable, but all are combustible. MSDS for Devcon and Uniroyal products are appended.

5.21.2 Polybutadiene Diacrylate

The third polymer chosen was Sartomer CN-300, an acrylate-terminated butadiene. Butadienes have been used for stabilization of low-level and hazardous wastes by other researchers. The company's technical information, and ICT's in-house experimentation, indicated that this polymer might provide advantages not available with other materials. One particularly noteworthy characteristic was the polymer's ability to incorporate water into the polymer matrix. Since LANL's blasting grit waste contained significant moisture, and the PE process generated a moist encapsulate (prior to curing), use of this polymer was

FIGURE 4
Secondary Encapsulation
Development Test Design

IC Technologies Project 1342

IC Technologies

encouraged. Sartomer PBDDA, as prepared and tested in this program, cures through chemical initiation of polymerization. ICT's efforts included investigation of curing oxidants with slower kinetics. Pot life was less than one hour.

Sartomer polybutadiene diacrylate (PBDDA) is prepared using CN-300 oligomer, SR-350 monomer, methyl-ethyl ketone peroxide (MEKP), and cobalt metal dryer. Preparation is more complex than that for polyurethanes and melamine formaldehyde, but can be readily facilitated at larger scale. Particular attention must be paid to the order of mixing of components, due to a potential explosion hazard presented by improper handling. Health and Safety factors are comparable to the polyurethanes, in that ventilation is required during preparation and initial cure. The components are combustible, but not flammable.

5.22 Initial Investigations - SE¹

A large quantity of primary encapsulates was prepared using the optimized recipe (1-hour cure) prior to secondary treatment testing. The objective was to work from a compositionally similar supply of PE prepared under consistent conditions, to minimize variability in PE and reduce the likelihood of interpretative error. Once prepared, four splits of PE were evaluated for leachability by TCLP-M, and crush resistance before and after TCLP-M. Results, presented in Table 3, showed TCLP-M leachate lead concentrations comparable to those achieved in PE development testing. (Note that the TCLP-M retention time was shortened to 18-24 hour maximum with a kinetic sample at 7-14 hours.) Crush resistance was also comparable, exceeding the 50 PSI benchmark for pre- and post- TCLP-M samples.

Secondary encapsulation was effected through application of liquid thermosetting polymers to cured PE surfaces. The same drum agglomerator used for PE work was employed. Polymer application was determined by weighing cured SE and subtracting known PE weight. SE were drained briefly after coating application to minimize polymer "pooling" and maximize thickness uniformity. This was only partially successful, as most SE showed excess polymer pooled at their base. It is anticipated that larger scale continuous equipment will eliminate this characteristic.

Because the effectiveness of secondary treatment depended almost exclusively on the strength and inertness of the polymers applied, few controllable variables were available. While testing was expedited as a result, it is important to note that the potential for optimization was limited. Important factors that developed through testing were:

- ▶ Coating thickness, and therefore waste loading, was a function of polymer viscosity. The data show that Uniroyal polymer, with a comparatively low viscosity, gave higher waste loadings, in general, than did Devcon or Sartomer products.
- ▶ A relationship between SE thickness and chemical resistance may be inferred from

TABLE 3
Secondary Encapsulation
Summary of Results
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Test No.	Medium ID	Encapsulation	Cure/Treatment	Polymer Addition	Uniaxial Crush Resistance		TCLP-M; mg/L Pb	
					PSI Indicated		7-14 HR	18-24 HR
					Cured	TCLP-M		
1028-59	MF-817	Primary/Bulk	1-HR@50°C	40%	>50	>50		
1028-60	MF-817	Primary/Bulk	1-HR@50°C	40%	>50	>50	80	107
1028-61	MF-817	Primary/Bulk	1-HR@50°C	40%	>50	>50		
1028-62	MF-817	Primary/Bulk	1-HR@50°C	40%	>50	>50	97	125
1028-63	Unlroyal Polyurethane	SE ¹	2-HR@50°C	3.1%	>50	>50	14	18
1028-64	Devcon Polyurethane	SE ¹	2-HR@50°C	10.9%	>50	>50	13	18
1028-65	Sartomer PBDDA	SE ¹	2-HR@50°C	10.9%	>50	>50	3	4
1028-63	Unlroyal Polyurethane	SE ¹	2HR@50°C; Freeze/Thaw	3.1%	>50	>50	10	12
1028-64	Devcon Polyurethane	SE ¹	2HR@50°C; Freeze/Thaw	10.9%	>50	>50	11	13
1028-65	Sartomer PBDDA	SE ¹	2HR@50°C; Freeze/Thaw	10.9%	>50	>50	3	3
1028-75	Unlroyal Polyurethane	SE ²	2-HR@50°C	~6%	>50	>50	1	1 (0.8)
1028-76	Devcon Polyurethane	SE ²	2-HR@50°C	~21%	>50	>50	0	0 (0.4)
1028-77	Sartomer PBDDA	SE ²	2-HR@50°C	~21%	>50	>50	2	0 (0.2)
1028-75	Unlroyal Polyurethane	SE ²	2HR@50°C; Freeze/Thaw	~6%	>50	>50	1	1
1028-76	Devcon Polyurethane	SE ²	2HR@50°C; Freeze/Thaw	~21%	>50	>50	0	0
1028-77	Sartomer PBDDA	SE ²	2HR@50°C; Freeze/Thaw	~21%	>50	>50	0	1
SW-846 1311								
1028-81	Unlroyal Polyurethane	SE ²	2-HR@50°C	~6%	NM	NM		3.2
1028-82	Devcon Polyurethane	SE ²	2-HR@50°C	~21%	NM	NM		0.5
1028-83	Sartomer PBDDA	SE ²	2-HR@50°C	~21%	NM	NM		1.9

Notes   NM = Not Measured

1. Bulk primary encapsulates were evaluated for chemical resistance by preparation of two composites for TCLP-M procedure.
2. Secondary encapsulations consisted of: a single application of specified polymers to cured primary encapsulates, as specified; an additional application of polymer with an intermediate cure stage between applications.
3. Test 1028-(63-65) and 1028-(75-77) encapsulates were evaluated by TCLP-M technique before and after the freeze/thaw procedure.
4. Analytical values shown in parentheses were reported by an independent laboratory as check/confirmation of ICT control analysis.
5. SW-846 Method 1311 results shown for tests 1028-(81-83) were reported by Evergreen Analytical, an independent laboratory.

the data, although this was not explored in the program.

- Cure time may be a variable influencing the chemical integrity of the waste form(s), although cure time was not directly evaluated in this program. With the understanding that the results of this program may be applied to an actual waste in a continuous or semi-continuous process, ICT sought to direct the program to that goal. In-process storage/cure of intermediate encapsulates being undesirable from that perspective, cure time was evaluated only indirectly.

Encapsulates prepared by single-coating PE with each of the three thermoset polymers, or SE¹, were cured for 2 hours at 50° C prior to integrity evaluation. Polymer applications averaged 3.1% for Uniroyal, and 10.9% for Devcon and Sartomer, using cured waste form weights as the basis for calculation.

SE¹ integrity was measured by crush resistance, freeze/thaw, and TCLP-M tests. Referring to Table 3, Sartomer PBDDA satisfied SW-846 Method 1311 criteria for lead, while Uniroyal and Devcon did not. The reduction in lead solubility in TCLP-M provided by first level secondary treatment was at least a factor of 6, and at best a factor of 40, over PE performance. Although these results were promising, and results for Sartomer essentially fulfilled the SOW requirements, the margin of compliance was felt to be inadequate.

Freeze/thaw testing is shown in Table 3 under the heading Cure/Treatment. The ASTM D-560 Freeze/Thaw test uses evaluation criteria not suited to the waste forms produced in this program, therefore ICT imposed alternative criteria. It was postulated that detrimental effects on SE waste forms caused by freeze/thaw conditions would be manifested by contaminant release. When visual inspections and weigh-back data failed to reveal compromised integrity, additional verification was implemented. The effect of freeze/thaw weathering tests conducted on SE¹ was gauged by TCLP-M. These data showed no increase in lead solubility; slight improvement in leachability was observed. It is suggested that, rather than compromising the polymer coating, freeze/thaw testing over 5 days allowed additional curing of the SE polymers and enhanced stability. SE¹ not tested by freeze/thaw technique cured for only a few additional hours at room temperature prior to TCLP-M.

Crush resistance data showed strength was not compromised by TCLP-M, nor by freeze/thaw + TCLP-M, regimens. All tests reported crush resistance values in excess of 50 PSI.

The decision to optimize secondary encapsulation beyond the SE¹ stage eliminated the requirement for additional integrity tests on this intermediate waste form. Instead, program focus shifted to examination of treatment alternatives. Two broad categories of alternatives were contemplated: experimentation with polymer formulation by working with the manufacturer to develop greater chemical inertness, and; application of another polymer to SE¹ surfaces to create not only additional thickness, but another "envelope" of protection. In resolution of the alternatives, ICT considered program requirements beyond those stated in

the SOW:

1. Treatments should be as simple as possible to minimize complexity at larger scale
2. Media should be commercial, non-proprietary, and readily available
3. Media preparations should be as straightforward as possible to prevent errors during actual stabilization operations that could result in non-compliance

Modification to polymer components to achieve greater inertness was rejected in deference to stated guidelines. Also rejected was the use of thermosetting polymers other than those already included in the program. Accordingly, test design focused on application of an additional layer of identical polymer to SE¹ surfaces. ICT-established guidelines were satisfied by this approach, and the SOW guideline specifying evaluation of a maximum of three polymers was followed.

5.23 Optimization - SE²

A short series of scoping tests quickly established the feasibility of double-coating PE. Testing proceeded to generation of large quantities for integrity testing. All SE² were cured at previously determined conditions for all intermediate waste forms: PE @ 1 hour; SE¹ @ 2 hours, SE² @ 2 hours; all at 50° C. The SE² preparation technique was identical to that for SE¹. As shown in Figure 4, verification of SE² forms consisted of several different methods.

TCLP-M: Table 3 shows analytical results for TCLP-M leachate samples taken at 7-14 and 18-24 hours, Tests 1028-(75-77). Significant reduction in contaminant mobility was achieved for all polymers. No value higher than 1 mg/L was reported by ICT analysis. (A value of 2 mg/L was reported for one 8-14 hour kinetic sample, however analysis of the 18-24 hour sample showed no detectable lead, and confirmation analysis agreed.) Values shown in parentheses in Table 3 report analysis on identical samples performed by an independent laboratory as part of program QA/QC. Agreement with ICT data resulted.

Freeze/Thaw;

TCLP-M: Effects of freeze/thaw weathering tests were again quantified by performing TCLP-M leachability tests on weathered SE². No measurable difference in contaminant mobility was observed for any of the polymers evaluated. Lead in leachates was reported at 1 mg/L or lower for all tests. Microscopic (binocular) inspection of SE² pellets that underwent freeze/thaw and freeze/thaw - TCLP-M revealed interesting characteristics. Pellets subjected to freeze/thaw cycling showed no surface flaws in side-by-side comparisons with unweathered pellets. Polymer thickness uniformity was shown to be partially a function of PE surface irregularities and polymer viscosity, however. Devcon thickness varied significantly, being thinner at "high" points in the PE surface, and thicker at depressions in the PE surface. Devcon therefore contributed to SE² sphericity. Uniroyal, with comparatively low viscosity, showed nearly uniform SE² thickness, while Sartomer coating uniformity fell between Devcon and Uniroyal.

Microscopic examination of SE² pellets recovered from freeze/thaw - TCLP-M testing revealed blue crystalline deposits on the pellet surfaces. These deposits were in evidence regardless of the SE² polymer used. Composition of the crystalline deposits was not determined due to the small quantity available, and genesis of this material was unclear. Other than the deposits, no significant surface flaws or features were observed.

Crush

Resistance: No structural failure of SE² waste forms up to 50 PSI applied pressure was noted.

EP

Integrity: The EP Integrity test calls for a cylindrical monolith of specified dimensions for impact testing. While this was performed in evaluation of tertiary waste forms, single SE² pellets were tested for integrity. Each pellet received the impact of a single hammer drop, and was inspected for damage. No significant damage to Devcon encapsulates was noted. Both Sartomer and Uniroyal encapsulates showed minimal damage in the form of small tears to the outer polymer coating.

TCLP;

Method

1311: Although ICT's Technology Development Center is equipped to perform the Method 1311 TCLP extraction and leachate analysis, SE² pellets were submitted to an independent laboratory for two reasons: to provide independent verification of compliance, and; to compare TCLP with TCLP-M results. Note that PE, SE¹, and SE² pellets were carefully prepared with respect to a maximum particle size of ~5/16" or about 8 millimeters. The laboratory was instructed to acknowledge the particle size, and refrain from size reduction typically performed on samples observed to be near or over the 9.5mm Method 1311 criterion. The laboratory was also instructed to minimize the headspace in the TCLP extraction vessel so that undue attrition would be avoided. Careful reading of Method 1311 will show that, for metallic contaminants, headspace is not specified except to recommend a vessel capable of containing the extractant and solids at ~5% solids pulp density. It also recommends, but does not specify, a quantity of 100 grams of solids for the test.

ICT's independent work has established that, for many stabilized materials, the TCLP extraction procedure, as implemented in many commercial laboratories, may bias results by using an excessively large container, or by using a 2-liter container for samples less than 100 grams in weight. In these circumstances, the end-over-end action of the agitation combined with excessive headspace in the vessel produce an attritioning effect. ICT has quantified this effect on a number of waste types and forms. Despite ICT's instruction, 50 gram samples of SE² were extracted in 2-liter vessels by the testing laboratory.

Extract analysis showed all polymers' SE² satisfying the regulatory criteria of <5.0 mg/L Pb, see Table 3. Devcon showed the best comparative result, with 0.5 mg/L Pb in TCLP leachate. Sartomer PBDDA showed 1.9 mg/L Pb, and Uniroyal showed 3.2 mg/L Pb. With an order-of-magnitude compliance margin for Devcon polyurethane, the leachability

criterion was satisfied per the SOW and ICT. Additionally, the TCLP data, in view of the excess headspace condition, may provide some insight into the resilience of each of the polymers. Sartomer and Uniroyal, in TCLP testing, showed less contaminant immobilization potential than was demonstrated in TCLP-M, perhaps due to structural weakness not measured by other testing.

Sequential

Batch

Testing: SBT results are presented in Figures 5 - 11. Figure 5 shows a schematic of the test procedure. An aliquot of fresh SE² is pulped in fresh lixiviant and gently agitated for 24 hours, Stage 1A. Pellets are separated from solution, solution is sampled and advanced to

FIGURE 5
Summary of Sequential Batch Testing Results
 Secondary (SE²) Encapsulates
IC Technologies Project 1342

Schematic of Sequential Batch Test Procedure

Analytical Results

Uniroyal Polyurethane		
ICT ID	No./Series	mg/L Pb
1028-78	1A	4
	1B	3
	1C	1
	2A	9
	2B	7
	3A	12
	2C	1
	3B	6
	3C	1

Devcon Polyurethane		
ICT ID	No./Series	mg/L Pb
1028-79	1A	0
	1B	0
	1C	0
	2A	1
	2B	1
	3A	2
	2C	0
	3B	0
	3C	0

Sartomer PBDDA		
ICT ID	No./Series	mg/L Pb
1028-80	1A	3
	1B	1
	1C	1
	2A	8
	2B	2
	3A	8
	2C	1
	3B	2
	3C	0

FIGURE 6
Summary of Sequential Batch Testing Results
 Secondary (SE²) Encapsulates
IC Technologies Project 1342

Uniroyal Polyurethane
mg Pb Solubilized per kg Waste Form

<u>1A</u>	<u>2A</u>	<u>3A</u>
4.0	4.9	3.0
<u>1B</u>	<u>2B</u>	<u>3B</u>
6.0	7.9	-2.0
<u>1C</u>	<u>2C</u>	<u>3C</u>
3.0	0.0	0.0

FIGURE 7
Summary of Sequential Batch Testing Results
 Secondary (SE²) Encapsulates
IC Technologies Project 1342

Uniroyal Polyurethane
mg Pb Solubilized per kg Waste Form

<u>1A</u>	<u>2A</u>	<u>3A</u>
4.0	4.9	3.0
<u>1B</u>	<u>2B</u>	<u>3B</u>
6.0	7.9	-2.0
<u>1C</u>	<u>2C</u>	<u>3C</u>
3.0	0.0	0.0

FIGURE 8
Summary of Sequential Batch Testing Results
 Secondary (SE²) Encapsulates
IC Technologies Project 1342

Devcon Polyurethane

mg Pb Solubilized per kg Waste Form

<u>1A</u>	<u>2A</u>	<u>3A</u>
0.0	1.0	1.0
<u>1B</u>	<u>2B</u>	<u>3B</u>
0.0	2.0	-2.0
<u>1C</u>	<u>2C</u>	<u>3C</u>
0.0	0.0	0.0

FIGURE 9
Summary of Sequential Batch Testing Results
 Secondary (SE²) Encapsulates
IC Technologies Project 1342

Devcon Polyurethane

mg Pb Solubilized per kg Waste Form

<u>1A</u>	<u>2A</u>	<u>3A</u>
0.0	1.0	1.0
<u>1B</u>	<u>2B</u>	<u>3B</u>
0.0	2.0	-2.0
<u>1C</u>	<u>2C</u>	<u>3C</u>
0.0	0.0	0.0

Devcon
mg/kg Pb Solubilized vs Solids Contact

FIGURE 10
Summary of Sequential Batch Testing Results
 Secondary (SE²) Encapsulates
IC Technologies Project 1342

Sartomer PBDDA

mg Pb Solubilized per kg Waste Form

<u>1A</u>	<u>2A</u>	<u>3A</u>
3.0	5.0	0.0
<u>1B</u>	<u>2B</u>	<u>3B</u>
2.0	2.0	0.0
<u>1C</u>	<u>2C</u>	<u>3C</u>
3.0	0.0	-2.9

Sartomer
mg/kg Pb Solubilized vs Solution Contact

FIGURE 11
Summary of Sequential Batch Testing Results
 Secondary (SE²) Encapsulates
IC Technologies Project 1342

Sartomer PBDDA

mg Pb Solubilized per kg Waste Form

<u>1A</u>	<u>2A</u>	<u>3A</u>
3.0	5.0	0.0
<u>1B</u>	<u>2B</u>	<u>3B</u>
2.0	2.0	0.0
<u>1C</u>	<u>2C</u>	<u>3C</u>
3.0	0.0	-2.9

Sartomer
mg/kg Pb Solubilized vs Solids Contact

Stage 2A. Pellets are advanced to Stage 1B. This general procedure is repeated for all nine cells in the test matrix. In contacts 1A, 1B, and 1C, one pellet aliquot is contacted with fresh lixiviant three times. In contacts 2A, 2B, and 2C, one pellet aliquot is contacted with solution cycled from Number 1 contacts. In contacts 3A, 3B, and 3C, pellets are contacted with solution cycled from Number 2 contacts. Pulp density decreases through Series A, B, and C, from 50% solids to 25% solids to prevent the contaminant solubility product from being exceeded.

Tabulated analytical data at the bottom of Figure 5 shows the results of lixiviant samples' lead analyses. These data can be misleading due to changes in pulp density and solids weights through the matrix, so results were calculated to milligrams lead solubilized per kilogram of waste for each cell. That data was plotted, see Figures 6 - 11. Two plots were prepared for each SE² polymer, one for solution contacts, and one for solids contacts.

In general, the data showed measurable contaminant release from the pellets through the first six stages (1A; 1B & 2A; 1C & 2B & 3A) for all polymers. The final three contacts (2C, 3B, 3C) showed essentially no contaminant release. For the polyurethanes, contact 2B, representing once-contacted (with once-cycled solution) solids plus once-cycled lixiviant, showed the highest contaminant release. For Sartomer PBDDA, the greatest contaminant release came in contact 2A, representing fresh solids and once-cycled lixiviant. The table below presents contaminant release data for each nine-cell test, and, for comparison, calculation of TCLP results to the same unit. These data, and the plots of contaminant release as a function of time, demonstrate, on a comparative basis, the superior performance of Devcon Flexane 80 polyurethane.

	mg Pb Released per Kg SE ²	
Polymer ID	SBT	TCLP
Uniroyal	11.2	128
Devcon	0.7	20
Sartomer	6.1	76

The objectives stated in the LANL Statement of work for this task were satisfied.

5.24 Curing Techniques

Both microwave and infra-red (IR) techniques were evaluated as curing techniques for PE-SE¹-SE² forms. IR was selected due to its prevalence in polymer curing equipment; microwave energy was thought to offer the potential of waste/polymer bonding. Microwave cure tests failed to produce a proper cure. Energy levels could not be lowered enough to eliminate volatilization of liquid polymers. Additionally, moisture trapped in PE

pellets could vaporize and destroy the pellet structure.

IR-cured encapsulates were prepared and evaluated by TCLP-M procedure. Results, below, showed the IR technique to be viable for use at larger-scale .

SE ^{1&2} Polymer ID	mg/L Pb; TCLP-M Extract
Uniroyal Polyurethane	<1.0
Devcon Polyurethane	<1.0
Sartomer PBDDA	1

5.25 Polymer Bonding

A set of tests designed to evaluate bond strength between subsequent layers of similar and dissimilar polymers was performed. The objective was to measure the degree of adhesion between PE & SE¹ and SE¹ & SE². The procedure involved casting cylinders containing two polymers. Each polymer was cured at prescribed conditions.

The resultant monoliths were assembled in a device schematically represented at left, and strained to the point of bond failure or failure of the polymer(s). The data, summarized below, showed Devcon and Uniroyal polyurethanes provided better performance than Sartomer PBDDA in both adhesion to primary encapsulates (melamine polymer) and in self-bonding. (Tests to evaluate bonding strengths of dissimilar SE polymers were not performed. It is suggested that that exercise would not have provided meaningful data, and that larger scale operations would be

simplified by the use of a single polymer for SE¹ and SE² steps.) All monoliths were cured for one week at ambient conditions prior to evaluation.

Polymer Combination	Stage Simulation	Interface Bond Failure; Kg-Meter
MF-817 / Uniroyal	PE/SE ¹	52
MF-817 / Devcon	PE/SE ¹	20
MF-817 / Sartomer	PE/SE ¹	<1.0
Uniroyal / Uniroyal	SE ¹ /SE ²	8.1
Devcon / Devcon	SE ¹ /SE ²	>35
Sartomer / Sartomer	SE ¹ /SE ²	8.1*

* Non-interface failure - tearing of polymer

Note that the MF-817/Sartomer test separated at <1.0 kg-m. There was no evidence of bonding between these polymers. Three monoliths were prepared, none of which survived removal from the mold intact. Interestingly, Sartomer SE² gave good results, comparable to Uniroyal and Devcon, in TCLP-M and other integrity testing.

5.3 Tertiary Encapsulation

The objective of tertiary encapsulation, as set forth in the LANL Statement of Work, was to "physically seal the encapsulate pellets in a bulk monolith, creating a physically unified waste form free of cracks, voids, and significant imperfections." Because the waste will already have been stabilized with respect to contaminant leachability, the tertiary encapsulation waste form need not be evaluated by TCLP-type evaluations. TCLP evaluation of monolithic waste forms requires crushing/grinding/cutting to satisfy SW-846 M-1311 particle size criteria; size reduction would obviously destroy the encapsulate structure(s).

Evaluation of the tertiary waste form was primarily qualitative, but included compressive strength (to 50 PSI; EP Integrity; to failure) measurements.

Tertiary encapsulation agents investigated included portland cement, MF-817, and Devcon polyurethane. Portland cement is a traditional media for bulk stabilization, and offers the benefits of reasonable cost, high cured strength, and ease of preparation. MF-817 is a low cost polymer with attractive characteristics including significant chemical resistance, good cured strength, and ease of preparation. Additionally, its use at large scale would eliminate purchase and handling of another component. Devcon polyurethane provides excellent all-around performance as developed in this program. Its use as a tertiary encapsulant would involve comparably higher cost, but advantages may influence the cost/benefit ratio.

Nine tests were performed in evaluation of tertiary encapsulation. Tertiary waste forms using two polymers and portland cement as encapsulates were prepared and evaluated. The basic waste form was composed of secondary encapsulate pellets encased in a monolith. Results showed that:

- ▶ The small scale of the tests (<200 cc) and large relative size of SE pellets caused an unrepresentative amount of void space in the monoliths. It is suggested that, at 25-gallon or larger monolith sizes, the effect of pellet size will be minimized, and voids will be few.
- ▶ Tertiary media differences caused a wide variation in monolith characteristics, see strength and crush resistance measurements.
- ▶ Voids, and the disproportionate effect of pellet size, resulted in monoliths with less-than-maximum strength.

The results of physical integrity testing are presented in the tables below. The data illustrated overall high levels of integrity for all tertiary encapsulates. Devcon polyurethane was clearly superior in performance. Compression-to-failure results for Devcon indicated an inability to quantify a failure point due to the resiliency of the cured polymer. Devcon monoliths "squashed" in the press without cracking, splitting, or other failure mode. Values

	EP Integrity Results		
SE ² Formulation	Portland Cement	MF-817	Devcon
Uniroyal	ME	NE	NE
Devcon	ME	NE	NE
Sartomer	ME	NE	NE

ME = Minimal Effect
NE = No Effect

	Crush Resistance (50 PSI Applied) Results		
SE ² Formulation	Portland Cement	MF-817	Devcon
Uniroyal	Passed	Passed	Passed
Devcon	Passed	Passed	Passed
Sartomer	Passed	Passed	Passed

	Compression (PSI; Actual) to Failure Results		
SE ² Formulation	Portland Cement	MF-817	Devcon
Uniroyal	~67	~230	>180
Devcon	~57	~190	>180
Sartomer	~53	~190	>180

All tertiary encapsulates, including cement, were cured at 50° C for ~12-14 hours.

shown represent the last accurate reading obtainable prior to excessive compression.

Portland cement showed good results in EP Integrity and Crush Resistance testing. The presence of voids in the monoliths, and the short cure time probably contributed to relatively low compression-to-failure values. Portland Type II cement, which requires a 28-day cure to full strength, was used. No incompatibility with SE pellets was observed.

Melamine formaldehyde (MF-817) was superior to portland cement as measured by the testing performed. Average compressive failure point was ~200 PSI. EP Integrity and Crush Resistance results were satisfactory.

The objectives stated in the LANL Statement of work for this task were satisfied. Although the waste form examples contained voids, the voids were judged to be a result, and function of, the scale of the tests, and the disproportionate relationship of pellet size to TE monolith volume.

6.0 WASTE LOADING

Table 4 summarizes waste loading calculations for all waste forms produced during program execution. A separate set of tests was performed for the singular purpose of waste loading determinations. The data in Table 4 is segregated by SE^{1&2} polymer, and includes waste loading for each TE media type. Note that waste loading was calculated as :

$$\text{dry weight surrogate} \div \text{dry weight of encapsulate}$$

The data show that waste loading for PE (@ 40% MF-817 addition) was about 71%. After SE¹ applications, loading drops to 65-70%, and SE² pellets show 62-67% waste loading. As discussed earlier, SE loading was a function of polymer viscosity, and therefore thickness. Uniroyal polyurethane, with the lowest viscosity, gave the highest waste loadings. The margin was no greater than ~5%, however.

Values for the three tertiary encapsulates, Devcon, MF-817, and portland cement, varied significantly. Cement showed the lowest waste loading values for all tests, due to its cured density. TE using cement averaged ~25% loading.

Devcon and MF-817 showed similar loading values; Devcon TE averaged ~31% waste loading, MF-817 TE averaged ~31% loading. Again, in a bulk encapsulation waste loading is controlled by density of the waste and media.

Waste loading criteria set forth in the LANL Statement of Work were satisfied by waste forms designed and modeled in this program.

TABLE 4
Waste Loading by Polymer and Stage
IC Technologies Project 1342

Test #	Description	Encapsulation ^{1/}	Encapsulate Wt., grams	Encapsulant Addition ^{2/}		Waste Loading % (w/w) ^{2/}
				grams	%	
1028-90	Surrogate	None	10.79			
	MF-817	PE	15.11	4.3	40%	71.4%
	Uniroyal	SE ¹	15.62	0.51	4.7%	69.1%
↓	Uniroyal	SE ²	16.11	0.49	4.5%	67.0%
1028-99	Surrogate	None	(26.56)			
	Uniroyal	SE ²	39.65			
↓	Cement/Uniroyal	TE	90.96	51.3	193%	29%
1028-102	Surrogate	None	(26.00)			
	Uniroyal	SE ²	38.81			
↓	MF-817/Uniroyal	TE	82.39	43.6	168%	32%
1028-105	Surrogate	None	(29.67)			
	Uniroyal	SE ²	44.29			
↓	Devcon/Uniroyal	TE	82.31	38.0	128%	36%
1028-91	Surrogate	None	10.90			
	MF-817	PE	15.26	4.4	40%	71.4%
	Devcon	SE ¹	16.42	1.16	10.6%	66.4%
↓	Devcon	SE ²	17.50	1.08	9.9%	62.3%
1028-100	Surrogate	None	(22.02)			
	Devcon	SE ²	35.36			
↓	Cement/Devcon	TE	98.05	62.7	285%	22%
1028-103	Surrogate	None	(24.23)			
	Devcon	SE ²	38.90			
↓	MF-817/Devcon	TE	80.43	41.5	171%	30%
1028-106	Surrogate	None	(22.51)			
	Devcon	SE ²	36.14			
↓	Devcon/Devcon	TE	76.84	40.7	181%	29%
1028-92	Surrogate	None	10.99			
	MF-817	PE	15.38	4.4	40%	71.4%
	Sartomer	SE ¹	16.53	1.15	10.5%	66.5%
↓	Sartomer	SE ²	17.61	1.08	9.8%	62.4%
1028-101	Surrogate	None	(22.44)			
	Sartomer	SE ²	35.97			
↓	Cement/Sartomer	TE	94.32	58.4	260%	24%
1028-104	Surrogate	None	(24.49)			
	Sartomer	SE ²	39.25			
↓	MF-817/Sartomer	TE	81.49	41.5	170%	30%
1028-107	Surrogate	None	(22.99)			
	Sartomer	SE ²	36.86			
↓	Devcon/Sartomer	TE	76.85	40.7	177%	29%

1/ PE=Primary; SE¹=1st-Stage Secondary; SE²=2nd-Stage Secondary; TE=Tertiary

2/ Calculated values based on dry weights of surrogate waste aliquot and stabilized waste forms.

7.0 PRE-PILOT EQUIPMENT EVALUATIONS

Los Alamos' ultimate goal being mitigation of the characteristic hazard in blasting grit mixed waste, the test program included a preliminary overview of pilot-scale equipment suitable for process demonstration. Because polymer stabilization of mixed waste has been limited, historically, to research efforts, identification of process-specific equipment was problematic. ICT chose to initiate discussions with equipment manufacturers whose specialties included materials and polymer handling. Those discussions, in concert with ongoing development at bench scale, served to refine equipment requirements and aided in the evolution of the process flow diagram. This section presents a review of processing requirements, ICT's approach to meeting them, and consequent specifics in terms of estimated equipment costs, preliminary equipment layout, and initial process flow diagram. See Figure 12 for equipment layout and general reference, and Figure 13 for the process block flow diagram. Table 5 presents estimated costs for major pilot scale components.

7.1 Primary Encapsulation

Preparation of the optimum PE waste form, in terms of chemical and physical integrity, will rely upon the following factors:

- ▶ *Intimate and thorough mixing of waste, dry MF-817 polymer, and clay (or other dehydrant, as necessary) components.* Testing showed that homogenous distribution of waste through each PE pellet was important in minimizing contaminant mobility and maximizing structural strength. Additionally, adequate wetting of dry MF-817 will also be a function of thorough mixing since water for polymer activation is contained in the moist waste.
- ▶ *Consistent production of uniformly sized PE pellets.* Compliance testing will require pellets smaller than 9.5mm to prevent destruction of the waste form by TCLP particle size reduction requirements. Development work also showed that SE thickness uniformity was partially a function of PE surface characteristics. Uniform PE size and surface smoothness will, to a degree, control final waste form characteristics.
- ▶ *Equipment versatility to permit modification of production rates, and change in, or addition of, additives.* Pilot demonstrations may evaluate SE² production rate, which will be controlled by PE preparation rate; actual mixed waste encapsulation operations may be enhanced by production flexibility. Additionally, the ability to readily introduce new additive(s) or alter waste/polymer/dehydrant addition rates will be required, especially at pilot scale.

Other factors included health and safety considerations, which encouraged selection of equipment capable of isolating PE components as much as possible.

For these reasons, proposed PE preparation equipment consisted of:

1. A variable speed, single-screw extruder fitted with a tungsten carbide rotor, special-order extrusion plate, and pellet knife. All mixing requirements can be satisfied with this device. PE pellets will be short (7-9mm) cylinders with elliptical cross section. Pre-heating the PE mix to initiate cure is also an option with this device. Only models with variable speed capability delivering mid-range output of 50-100 lbs/hr were evaluated. Tungsten carbide rotors are required to handle the abrasive Al_2O_3 . The extruder can be fitted with extra inlet ports, as necessary.
2. A variable speed, hooded belt feeder for introduction of waste to the extruder. A screw feeder was considered for this operation, but rejected due to the abrasiveness of the waste. The waste's moisture content should alleviate dust exposure potential, and the hooded belt can be fitted for negative pressure. The model selected operates within the feed rates proposed.
3. Variable speed screw feeders for MF-817 and clay (dehydrant) additions to the extruder. These hopper-fed feeders require ventilation to mitigate the dusting hazard presented by dry powders. Sufficient flexibility in flow rates ensures flexibility in operation.
4. Variable speed, conveyor belt, ventilated curing chamber. Pellets exiting the extruder drop to a moving belt and are transported through an IR cure chamber. ICT located optional Teflon-coated belts for this operation which will minimize polymer adhesion and maintenance. Control of belt speed will enable cure time variability for pilot work.
5. Constant speed conveyor for PE cooling/curing/transfer. Pellets exiting the cure chamber fall to an inclined belt conveyor providing additional curing time, and permitting some cooling prior to SE treatments.
6. A PE supply hopper fitted with an indexed drop tube. The hopper discharges PE by gravity to the drop tube suspended over the SE apparatus. An electronic feedback loop tied to SE polymer discharge rate will control the frequency of PE discharge to SE treatment.

7.2 Secondary Encapsulation

Specific requirements of this operation include application of uniform polymer coatings to PE, minimization of waste polymer, maximization of polymer recycle, and effective cure of SE¹ and SE² waste forms.

1. Prototype SE¹/SE² apparatus. This device was conceptually designed by ICT to apply chemically cured thermosetting polymers to PE. The primary design consideration was the short pot life of polymers. The device consists of two inclined Teflon-coated

trays with uncured polymer recycle capability. PE transport will be upgradient via linear motion of the trays. Polymer will be introduced by drip manifolds suspended over each tray; PE moving up the tray surface will be coated by movement through polymer on the tray surface and discharging from manifolds. Linear motion shaking will prevent excess polymer adhesion to pellets as they move up the tray. Each tray will be equipped with an IR cure chamber. Coated pellets moving up the table enter the cure chamber where curing sufficient to permit re-coating is effected. The first tray/cure generates SE¹; pellets fall to the second tray where identical treatment occurs. SE² fall from the second tray to a conveyor belt.

Polymer that drains back to the base of each tray will be captured in a small reservoir feeding a peristaltic pump for recycle to manifolds. It is expected that, even with the design controls described, curing polymer build-up will necessitate maintenance considerations. The trays' design includes interchange capability so that cured polymer build-up can be removed without affecting operations. When a tray's operation becomes impeded by polymer build-up, its Teflon-coated surface insert is removed and replaced.

This piece of equipment has no analogous counterpart in the polymer, or other, industry. Its design was necessitated by polymer pot life and cure characteristics, and waste form requirements. A local equipment design/fabrication firm provided ICT a preliminary cost for detail design, construction of three prototypes, and modelling. This cost represents the major item in the equipment list. Lower capital cost alternatives include belt transport through polymer baths, or similar methods. The trade-off with these methods is in maintenance costs. The device described is felt to represent a low maintenance alternative.

2. A constant-speed conveyor to transport and cool cured SE² to the TE operation. SE² falls to this conveyor (optional and recommended Teflon belt) for cooling and transfer to drums for TE application.

7.3 Tertiary Encapsulation

This operation is less complex than PE or SE steps; its objective is to seal SE² in a high integrity monolith. Development work showed that, for pilot scale operations, the TE media should be introduced simultaneously with SE² to minimize voids. The equipment layout addresses this need. Note that the equipment list and layout assume that a liquid polymer will be utilized for TE media. Devcon gave the best results in TE testing, and was selected for purposes of equipment definition. Another liquid polymer could be used with minimal change to equipment; use of melamine formaldehyde or portland cement would necessitate some modification to equipment, but would not appreciably affect costs.

1. A constant speed, on/off controlled drum conveyor belt. It was assumed that 55-

gallon barrels will be used as the receptacle for SE². An appropriately sized conveyor will transport three to four drums at one time. One drum will always be empty, awaiting advance to the SE² charging station. One drum will be filling simultaneously with SE² and TE media. One or two drums will be awaiting transfer to the TE cure oven. This operation, as envisioned, will require operator attention periodically to advance the belt and move filled drums to curing. Additional instrumentation and machinery could reduce operator attention significantly, if that is desired.

2. A batch curing oven for TE monoliths. This is a convection oven operating at 50-100° C. As designed, drums will be manually inserted and removed according to production rate and cure time requirements. The oven selected can be fitted with venting hardware.

7.4 Miscellaneous Equipment

7.41 Instrumentation

No attempt was made as part of this program's investigation to define specific instrumentation for pilot scale operations. Several levels of instrumentation are possible, from a primarily operator-controlled circuit to a nearly remote-operation configuration. A cost is shown for instrumentation in Table 5; that cost assumes a moderate level of instrumentation and a operations crew requirement of 2 personnel.

7.42 Piping, Flow Control and Valving

Preparation of itemized costs for piping and attendant hardware was judged to be a premature task given the current status of the program. An estimate was provided that was felt to be adequate for the circuit as currently envisioned. A more specific break-out of costs will require a more detailed, and confirmed, processing plan.

7.43 Ventilation Equipment

Several operations are projected to require ventilation due to dusting potential of dry powders, and in the event of malfunction or off-specification operational events. Ventilation equipment appropriate for the operations shown will require HEPA elements to capture any contaminant release resulting from those events. The circuit design attempts to minimize or prevent contaminant release, but release must be considered in planning. Although a complete ventilation system was not designed as part of the program, the projected cost shown in Table 5, is felt to be an appropriate estimate for the equipment configuration shown in Figure 12.

FIGURE 12

Pilot-Scale Polymer Stabilization
Preliminary Equipment Layout
IC Technologies Project 1342

IC Technologies

IC Technologies

1342
Preliminary Equipment Layout
REV: 8/94
RLS

FIGURE 13

Process Block Flow Diagram

TABLE 5

Preliminary Major Equipment List and Estimated Costs
IC Technologies Project 1342

Description	Model #	Quantity	Cost #1	Cost #2	Cost #3	Total
Primary Treatment						
Extruder; Warner-Pfleiderer twin-screw	ZSK-30	1	\$90,000			
Optional tungsten carbide screw (50lb/hr)		1	<u>\$20,000</u>			
Sub-Total:			\$110,000			
Extruder; Warner-Pfleiderer twin-screw	ZSK-40	1		\$210,000		
Optional tungsten carbide screw (200lb/hr)		1		<u>\$30,000</u>		
Sub-Total:				\$240,000		
Extruder; Killion 2" single-screw		1			\$50,000	
Carbide screw and cutter		1			<u>\$20,000</u>	
Sub-Total:					\$70,000	\$70,000
Sepor Belt Feeder (18-380 lb/hr) waste		1	\$10,000			\$10,000
Sepor Vibration Feeder (0-2 tons/hr)		2	\$1,800			\$3,600
Vibra Screw Versifeeder (0.14 - 2.8 ft ³ /hr)		2	\$4,200			\$8,400
Conor Belt Curing Oven w/exh 15'		1	\$25,000			\$25,000
Secondary Encapsulation						
SE Apparatus (CXE Design and Fabrication)						\$400,000
Conor Curing Oven w/exh 15'		1	\$25,000			
Conor Curing Oven w/exh 8'		1		\$15,000		\$15,000
Falcon Tubular Diaphragm Pump	500-T	2	\$1,100			\$2,200
Denver Industrial Metering Pump	CI31-25HV	2	\$1,000			\$2,000
Tertiary Encapsulation						
Barrel Conveyor		1	\$10,000			\$10,000
Batch Curing Oven (48" x 36" x 63")		1	\$8,000			\$8,000
Miscellaneous						
Valving, Flow Metering, Piping						\$25,000
Instrumentation						\$45,000
Ventilation Equipment						\$45,000

Estimated Total Equipment Cost: \$669,200

Conclusions & Recommendations

The test program described in this report met or exceeded the requirements and criteria set forth in the LANL Statement of Work.

The extensive testing and process development work performed in this program provide Los Alamos National Laboratory with a viable means, through multiple polymer encapsulation, of mitigating the characteristic hazard present in the blasting grit mixed waste stream. Treatment of the waste using the system described herein will enable its disposal as a low-level radioactive material, satisfying current EPA land disposal restrictions. The system developed at bench scale offers, in addition to satisfaction of compliance requirements, waste loading that compares favorably with alternative techniques. Implementation of multiple polymer encapsulation on actual waste at Los Alamos National Laboratory would benefit from additional development effort. The data and findings of this program have established and modelled the means and elementary procedures to achieve the desired end, however, immediate translation of this initial bench scale information to on-site treatment would be premature.

Waste forms developed in the program are unique. Even those forms with analogues in other areas, such as primary encapsulates, differ in their composition or end purpose. The production of those forms at larger scale, especially where consistency and compliance are concerned, will require attention to detail. Equipment investigations performed in this program were preliminary in nature. They focused on the set of polymers, chosen for their chemical resistance and other integrity factors, utilized in the program. Although those polymers were successful in achieving the program objectives, they may or may not be the ideal materials for full scale operations. As an extension of that postulate, the equipment selected may not be ideal for another polymer with different properties or handling characteristics.

For the reasons discussed above, IC Technologies recommends that additional work on equipment selection and polymer alternatives be considered. At minimum, it is suggested that the findings of this program be used as the basis of additional development.

FINAL REPORT

APPENDIX

MULTIPLE ENCAPSULATION
OF LANL WASTE
USING POLYMERS

AUGUST 12, 1994

Contract Number 1064M0014-3B

PREPARED FOR:

UNIVERSITY OF CALIFORNIA
LOS ALAMOS NATIONAL LABORATORY
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APPENDIX I
WEEKLY UPDATES

IC Technologies

MULTIPLE ENCAPSULATION TESTING

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

WEEK 1

IC Technologies Project 1342

MAY 4, 1994

Project Initiation

Initial work on the project, which commenced the week of April 25, consisted of a thorough review of the LANL Statement of Work, testing methodologies, and waste form verification methodologies. An initial series of tests to examine the potential of various primary encapsulants (PE) was designed. As set forth in the statement of work (SOW), primary encapsulation will serve to bind the unconsolidated surrogate waste, consisting of 80% Al₂O₃ / 20% Pb (as -325 mesh powder) into an intermediate waste form that provides some resistance to leachability, and imparts physical strength to the waste form.

The testing methodology employs an inclined rotary drum agglomerator, a device whose counterpart at pilot- or full-scale would likely be an extruder. The agglomerator requires minimal set-up and maintenance and expedites the evaluation of multiple compositional variables. A spherical waste form (pellet) is produced, rather than an extruder's short cylinder pellet.

The majority of materials required for project execution were ordered during week one. Adequate supplies of PE were on hand at ICT's Technology Development Center for the initiation of testing. Thermosetting polymers, to be used as secondary encapsulants, have relatively short shelf lives due to hydration, and must be fresh when applied. Procurement of these agents will take place immediately prior to their anticipated use.

Primary encapsulation involves the simultaneous blending and activation of polymers with the surrogate waste. To facilitate agglomeration, dry surrogate waste will be mixed with PE, rotated to blend, then agglomerated by addition of water or other solution to activate the polymer(s). (While it is understood that the true LANL waste will be formed as a moist solid, the procedure outlined above was implemented to permit the use of an agglomerator. Use of a pelletizer (or similar device) at larger scale will not require dewatering or drying of solids.) Sufficient solution is added to achieve the estimated moisture content of the waste, 15%. Past testing showed that this moisture level, representing saturation of the solids, is excessive for polymer activation and effective agglomeration/pelletization. To mitigate this effect, the test design employs bentonite to absorb excess moisture. Bentonite addition will be quantified during testing, and reflected in waste loading calculations. It is suggested that a dewatering step be considered for any larger scale operations, assuming waste moisture content is greater than ~5-10%.

Three systems are targeted for initial evaluation. Melamine formaldehyde (BTL Specialty Resins), a dry polymer used in the manufacture of Formica® laminates, and two coagulant-type polymers, Polyox (Union Carbide) and Percol 351 (Allied Colloids), will be used. Melamine will be added as a dry powder to the surrogate waste. The coagulant polymers will be prepared as

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

MAY 4, 1994

Page 2

high concentration solutions prior to addition to the surrogate waste. Each binding agent will be tested at three addition levels; pellets will be evaluated by modified TCLP (TCLP-M). Additionally, each coagulant will be evaluated in combination with Melamine formaldehyde, again at three addition levels. Resultant pellets will also be evaluated for chemical stability by TCLP-M procedure. The attached summary table shows testing conditions for each preparation. Note that addition of coagulant polymers is to be determined. The behavior of these polymers in binding this waste type has not yet been evaluated, so initial scoping tests will be performed to develop appropriate data.

The TCLP-M procedure consists of mild agitation of cured primary encapsulates in acetic acid solution for 48 hours. The SOW specifies TCLP Solution #2, at pH 2.88. It is suggested that the SW-846 Method 1311 solution determination procedure be performed on the pellets. If the determination indicates that TCLP Solution #1 is appropriate, a duplicate evaluation be performed on each primary encapsulate using TCLP Solution #1, pH 4.93. This procedure will provide a comprehensive set of leachability data.

A preliminary survey of equipment manufacturers was initiated in Week 1. A database of manufacturers and products will be compiled to aid in the selection of appropriate equipment for larger-scale evaluation of an optimized encapsulation technique.

Estimated Program Costs

Program costs will be reported in the Week 2 update. A cost-tracking spreadsheet to provide daily estimates of project cost is in preparation.

Prepared by:

IC Technologies

R. Leland Schwartz
Project Manager

Approved by:

John E. Litz
President

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Test Design
Primary Encapsulation of LANL Surrogate Waste
IC Technologies Project 1342

Surrogate Waste, Dry		Binder		Additives				Cure	
Test #	Grams	ID	grams or mls	H ₂ O, mls	AlCl ₃ (in H ₂ O), g	Clay, g	Melamine 836 + 4% AlCl ₃	Temp	Time
1	50	Melamine 836	20	8.8	2	as req'd	0	50°C	>4 hrs
2	50	Melamine 836	10	8.8	2	as req'd	0	50°C	>4 hrs
3	50	Melamine 836	5	8.8	2	as req'd	0	50°C	>4 hrs
4	50	20 gpl Polyox*	TBD	8.8	0	as req'd	0	50°C	>4 hrs
5	50	20 gpl Polyox*	TBD	8.8	0	as req'd	0	50°C	>4 hrs
6	50	20 gpl Polyox*	TBD	8.8	0	as req'd	0	50°C	>4 hrs
7	50	20 gpl Percol 351*	TBD	8.8	0	as req'd	0	50°C	>4 hrs
8	50	20 gpl Percol 351*	TBD	8.8	0	as req'd	0	50°C	>4 hrs
9	50	20 gpl Percol 351*	TBD	8.8	0	as req'd	0	50°C	>4 hrs
10	50	20 gpl Polyox*	TBD	8.8	0	0	as req'd	50°C	>4 hrs
11	50	20 gpl Polyox*	TBD	8.8	0	0	as req'd	50°C	>4 hrs
12	50	20 gpl Polyox*	TBD	8.8	0	0	as req'd	50°C	>4 hrs
13	50	20 gpl Percol 351*	TBD	8.8	0	0	as req'd	50°C	>4 hrs
14	50	20 gpl Percol 351*	TBD	8.8	0	0	as req'd	50°C	>4 hrs
15	50	20 gpl Percol 351*	TBD	8.8	0	0	as req'd	50°C	>4 hrs

* In methylene glycol

MULTIPLE ENCAPSULATION TESTING

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

WEEK 2

IC Technologies Project 1342

MAY 10, 1994

Work Completed

Testing

A series of pelletization tests were performed on LANL surrogate and on Pb-free blasting grit during Week 2. The tests defined in the Week 1 Update were performed, but due to the results of scoping tests evaluating the use of coagulant-type polymers, the test design was modified. Based on previous experience with agglomeration of contaminated soils using coagulant polymers, it was postulated that these agents could be an effective binder/primary encapsulant for LANL waste. Prior to attempting pelletization of LANL surrogate containing Pb powder, scoping tests were run using 60-mesh blasting grit (Al_2O_3). These tests showed coagulant polymers to be ineffective in creating a stable waste form. The enclosed Note-To-File describes the results of scoping tests with these agents. As stated, the use of coagulant polymers as the sole binder for LANL waste was discontinued based on results achieved.

In order to provide LANL with a sufficient set of primary encapsulation data, and because the performance of melamine formaldehyde polymer showed promise, the original test design was modified to include two additional formulations of this agent. The additional tests were substituted for those not run with coagulant polymers. ICT had on hand small samples of BTL Resins melamine 829 and 817 from previous work. These polymers, and formulation 836, differ in their plasticizer content, and have demonstrated differences in cured hardness and chemical resistance in past work. Formulations 817 and 829 were tested at conditions identical to formulation 836; observation showed that pelletization of LANL surrogate was readily accomplished with both formulations. A summary of the revised test design for primary encapsulation is enclosed.

Process Flow Diagram & Equipment Investigations

A very preliminary process flow diagram, based on the use of generalized polymer types for primary and secondary encapsulation, was prepared in Week 2 (see enclosed figure). The objective of this exercise was to provide a basis for initiation of discussions with equipment vendors. Several vendors were contacted in Weeks 1 & 2, and are providing product information on extruders, thermoset polymer application equipment, continuous curing chambers, and mixing and dispensation equipment.

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

MAY 10, 1994

Page 2

Work Scheduled

The compressive strength of cured, stabilized waste pellets will be evaluated. An air-actuated piston press capable of gradual application of pressure in small increments will be used. Pellets will be compressed to an indicated pressure of 50 PSI, or failure of the pellet structure, whichever comes first. Comparative results will be reported.

Waste stabilized by primary encapsulation will be evaluated for chemical resistance/leachability as described in ICT's Technical Approach. Small aliquots of pellets from each test (1-12, see table) will be mildly agitated in TCLP extract solution for a period of 48 hours. Solution samples taken periodically over the course of these tests will be analyzed for Pb to provide information on leaching kinetics. To provide more comprehensive information, pellets will be tested in TCLP Solution #1 (pH 4.93) and Solution #2 (pH 2.88).

The results of compressive strength and chemical resistance testing will provide data for optimization of the primary encapsulation technique.

Evaluation of pilot-scale equipment will continue; the process flow diagram will be further refined based on results of testing and investigations.

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

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Estimated Program Costs

The graph below illustrates estimated cumulative project cost to date. Labor and materials cost to date is estimated at \$3,262. Costs are summarized by task on the enclosed table, Project Cost Tracking.

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John E. Litz
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Several agglomeration/pelletization tests were attempted using Al_2O_3 grit and highly concentrated suspensions of coagulant-type polymers. The polymers were suspended at 100 g/L concentration in reagent grade ethylene glycol, which served to wet, but not dissolve the polymer powders. The addition of water to the waste/polymer suspension matrix would activate the polymers. Drops of the polymer suspensions were added to rotating Al_2O_3 in the attempt to form pellets. Successful pelletization was achieved with Percol; Polyox failed to generate integral pellets of the desired size. Pellets formed with Percol had relatively high integrity, but not compared to those generated using Melamine formaldehyde. Percol pellets cured at 50°C were hard and appeared durable. Cured Polyox pellets remained friable.

The high concentrations of the polymer suspensions failed to provide a significant addition of polymer, in comparison to the additions of MF-836. Polymer addition to the surrogate was stopped when pelletization occurred. Calculation showed that the maximum polymer suspension addition was ~1.5 cc, and that that volume contained ~0.14g polymer on a dry basis.

The Percol suspension, after aging ~4 hours, appeared to polymerize in the ethylene glycol. This behavior was not noted for Polyox suspension.

It was decided to temporarily abandon the idea of attempting pelletization using coagulant polymers exclusively, due to the factors cited above. These agents may be useful as additives to the Melamine system. It was further decided to explore the use of two other Melamine formulations in inventory, MF-817 and MF-829. These formulations vary in plasticizer content, according to BTL Specialty Resins technical information.

Coagulant polymer suspensions will be added to pre-moistened surrogate waste in additional scoping tests run as scheduling permits.

Multiple Encapsulation of LANL Waste
Revised Test Design - Primary Stabilization
IC Technologies Project 1342

Test #	Surrogate Waste, Dry, Grams	Binder			Additives				Cure	
		ID	grams	Waste Loading ^{1/}	H ₂ O, mls	AlCl ₃ (in H ₂ O),g	Clay, g	100 g/L Polyox in Glycol*	Temp	Time
1	50	Melamine 836	20	71%	8.8	2	as req'd	—	50°C	>4 hrs
2	50	Melamine 836	10	83%	8.8	2	as req'd	—	50°C	>4 hrs
3	50	Melamine 836	5	91%	8.8	2	as req'd	—	50°C	>4 hrs
4	50	Melamine 829	20	71%	8.8	2	as req'd	—	50°C	>4 hrs
5	50	Melamine 829	10	83%	8.8	2	as req'd	—	50°C	>4 hrs
6	50	Melamine 829	5	91%	8.8	2	as req'd	—	50°C	>4 hrs
7	50	Melamine 817	20	71%	8.8	2	as req'd	—	50°C	>4 hrs
8	50	Melamine 817	10	83%	8.8	2	as req'd	—	50°C	>4 hrs
9	50	Melamine 817	5	91%	8.8	2	as req'd	—	50°C	>4 hrs
10	50	Melamine 836	5	91%	8.8	2	as req'd	0.75 cc	50°C	>4 hrs
11	50	Melamine 829	5	91%	8.8	2	as req'd	0.75 cc	50°C	>4 hrs
12	50	Melamine 817	5	91%	8.8	2	as req'd	0.75 cc	50°C	>4 hrs

^{1/} Based on dry weights of total surrogate and polymer. Actual waste loading data will include clay addition as part of the calculation.

**Preliminary Process Flow Diagram
Multiple Encapsulation of LANL Waste**

IC Technologies Project 1342

5/10/94

[illegible]

\$782

[illegible]

MULTIPLE ENCAPSULATION TESTING

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

WEEK 3

IC Technologies Project 1342

MAY 16, 1994

Work Completed

Testing

Testing performed during Week 3 included evaluation of primary encapsulate compressive strength, and chemical resistance by TCLP-M procedure. Summarized data is presented in the enclosed table.

Compressive Strength

To provide comparative data on the compressive strength of primary encapsulates, a pneumatic ram device was constructed. Regulated air pressure actuates a piston which transfers energy to a cured pellet. Using this technique, gradual pressure can be applied to individual pellets and their response evaluated qualitatively. A maximum *indicated* pressure of 50 PSI was set as the pass/fail criteria. Pellets whose structural integrity was compromised at less than 50 PSI were identified, with threshold pressure noted. (It is stressed that the indicated pressure should not be interpreted as a quantitative measure of pellet strength. Because the pellets were irregular in shape, accurate determination of stress applied to individual pellets was problematic. Once a primary encapsulate mix design is confirmed, a cylinder will be cast to quantitatively evaluate compressive strength.) Results showed that pellets formed from all three melamine formaldehyde (MF) formulations (817, 829, 836) satisfied the 50 PSI criteria at 40% (w/w) addition. MF-836 and MF-817 also showed passing results at 20% addition; the value for MF-829 at 20% addition was only 4 PSI. It is suggested that this data point is not representative, as MF-829 at 10% addition withstood 24 PSI. All three polymer formulations at 10% addition failed to satisfy the 50 PSI criteria.

Three tests, designed to evaluate the potential effects of supplementary additions of coagulant polymer (Union Carbide Polyox), showed interesting results. Test design called for each melamine formaldehyde formulation (@10%) to be supplemented with ~0.2% coagulant in suspension. Unfortunately, ICT's supply of MF 829 was depleted by previous testing and that agent could not be evaluated. Data for MF-836 and MF-817 showed a decrease and increase in compressive strength, respectively. Although these were single data points and therefore must be regarded as preliminary, additional testing may be warranted.

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

MAY 16, 1994

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Chemical Resistance

Primary encapsulates prepared during Week 2 were evaluated for chemical stability in Week 3. The procedure involved mildly agitating ~10 grams of pellets at 5% solids in TCLP Solution #1 (acetic acid @ pH 4.93) and Solution #2 (acetic acid @ pH 2.88) for a period of 48 hours. Kinetic solution samples were removed from each test at 12-14, 24, and 48 hours, and analyzed for lead. Earlier testing, performed for LANL under ICT Project 1261, showed that no polymer tested was capable of satisfying the regulatory criteria for lead in TCLP extract (<5.0 mg/L). It was therefore not anticipated that any primary encapsulate mix design would achieve that level of performance. The objective of TCLP-M testing was to derive comparative data to aid in the selection of a single optimized mix design. Analysis of leachates of the first set of tests (MF-836 & 829) showed that TCLP Solution #2 solubilized more lead than Solution #1, although the differences varied by polymer formulation and time. Although a complete interpretation requires data from analyses in progress, initial results showed better performance by MF-836 than MF-829. As expected, lead in solution was inversely proportional to polymer addition (proportional to waste loading) for all tests. The plots below illustrate the response of primary encapsulates prepared with MF-836 and MF-829.

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

MAY 16, 1994

Page 3

Assuming a nominal weight of 10 grams pellets for TCLP-M, calculated maximum (100% dissolution) concentrations for lead in solution are 6800 mg/L, 8100 mg/L, and 8700 mg/L Pb for binder additions of 10%, 20%, and 40%, respectively. The calculation accounts for clay added as absorbent for excess moisture. Comparison of maximum leachability data with the kinetic sample data shows that significant encapsulation of the lead contaminant occurred. Two tests, currently in progress, will establish baseline lead leachability for the surrogate sample. TCLP-M tests (Solution #1 & #2) are being run on non-encapsulated surrogate waste samples to provide these data.

Results of solution analyses for MF-817 and coagulant-supplemented MF-836 & 817 primary encapsulates will be reported ASAP; optimization tests design can take place at that time.

Pellet Survival

Summarized data, enclosed, shows values for pellet survival after the TCLP-M procedure. Following completion of the chemical resistance tests, solids were filtered, dried, and separated to segregate integral pellets from fines generated during TCLP-M. The data show all pellet preparations exceeded 97% survival. The apparent effect of differing lixiviants on pellet survival indicates that Solution #2 was perhaps slightly more aggressive, however the differences shown were not considered significant.

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

MAY 16, 1994

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Process Flow Diagram & Equipment Investigations

Additional product information and technical literature relative to definition of pilot-scale process equipment for primary, secondary, and tertiary encapsulation of LANL $\text{Al}_2\text{O}_3/\text{Pb}$ waste was received in Week 3. It is anticipated that a two-tiered equipment list, showing alternative equipment selections for most operations, will be prepared. Selection is typically influenced by capital versus manpower costs, e.g., up-front versus operating costs. While it is advantageous to strike a balance, LANL input will be invaluable in this area.

Work Scheduled

All analytical results will be reviewed; LANL technical representatives will be contacted for input on optimization test design in order to establish priorities for encapsulate performance versus encapsulant cost. An optimization test protocol will be prepared and primary encapsulation tests performed and evaluations initiated. Secondary encapsulants will be ordered for subsequent testing. Data validation and reduction will continue. The process flow diagram will be updated with new information.

Scheduling

Reference to the Gantt chart provided with ICT's Response to Request for Proposal shows that the program is generally on schedule. Week 4 tasking called for formulation optimization; with analytical results for TCLP-M evaluations expected today (May 16, 1994), optimization design and testing can commence on schedule.

Identification and review of equipment was initiated early in the program. This task is slightly ahead of schedule.

Estimated Program Costs

The graph below illustrates estimated cumulative project cost to date. Labor and materials cost to date is estimated at \$4,997. Costs are summarized by task on the enclosed table, Project Cost Tracking.

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

MAY 16, 1994

Page 5

Prepared by:

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Approved by:

John E. Litz, VICE PRESIDENT
for President

PLEASE CALL WITH ANY QUESTIONS, COMMENTS, OR INPUT ON THE PROGRAM

Project Cost Tracking
IC Technologies Project 1342
5/17/94

Labor

[illegible]

Materials

~\$650
\$782

Estimated
Total Project Cost

[illegible]

Multiple Encapsulation of LANL Waste
Primary Stabilization - Summary of Preliminary Results
IC Technologies Project 1342

Test #		Surrogate Waste, Dry, Grams	Binder Components				TCLP-M Data						
			Polymer			Waste Form Data		Extract: mg/L Pb				Pellet Survival Rate ^{3/}	
			ID	grams	100 g/L Polyox in Glycol*	Clay, g (Nominal)	Waste Loading ^{1/}	Compressive Strength, PSI ^{2/}	Extract ID; TCLP Sol'n #	Hours			
										14	24		48
1028-20	A	50	MF-836	20	--	3.5	68%	>50	1	83	108	179	100.0%
	B			--					2	101	132	230	100.0%
1028-21	A	50	↓	10	--	1.5	81%	>50	1	271	362	600	99.2%
	B			--					2	395	550	980	99.1%
1028-22	A	50	↓	5	--	2.5	87%	29	1	920	1160	1850	100.0%
	B			--					2	1420	1760	2450	100.0%
1028-25	A	50	MF-829	15.8	--	3.5	72%	>50	1	81	110	200	98.0%
	B			--					2	250	342	600	97.6%
1028-26	A	50	↓	10	--	1.5	81%	4	1	334	466	850	98.6%
	B			--					2	441	600	1040	99.5%
1028-27	A	50	↓	5	--	2.5	87%	25	1	1050	1300	1920	98.8%
	B			--					2	1630	1930	2600	97.2%
1028-28	A	50	MF-817	20	--	3.5	68%	>50	1	IP	IP	IP	IP
	B			--					2	IP	IP	IP	IP
1028-29	A	50	↓	10	--	1.5	81%	>50	1	IP	IP	IP	IP
	B			--					2	IP	IP	IP	IP
1028-30	A	50	↓	5	--	2.5	87%	15	1	IP	IP	IP	IP
	B			--					2	IP	IP	IP	IP
1028-31	A	50	MF-836	5	0.75 cc	2.5	87%	10	1	IP	IP	IP	IP
	B								2	IP	IP	IP	IP
		50	MF-829	5	0.75 cc	This test not performed due to insufficient quantities of MF-829							
1028-32	A	50	MF-817	5	0.75 cc	2.5	87%	42	1	IP	IP	IP	IP
	B								2	IP	IP	IP	IP

* In methylene glycol IP = In Progress ○ This test consumed the remaining quantity of MF-829; the target addition of 40% w/w was not achieved.

1/ Based on dry weights of total surrogate, clay and polymer (wt waste/(wt waste+wt clay+wt polymer)).

2/ Compressive strength of representative cured pellets was measured using a pneumatic ram device where pressure was gradually applied to roughly spherical pellets to an indicated (pressure gauge) application of 50 PSI or failure.

3/ This value determined by separation of fine solids from intact pellets following TCLP-M testing. Based on dry weights.

MULTIPLE ENCAPSULATION TESTING

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

WEEK 4

IC Technologies Project 1342

MAY 16, 1994

25

Work Completed

Data Interpretation and Optimization Design

Analysis of TCLP-M extract samples from chemical resistance testing of primary encapsulates was completed in Week 4, permitting summarization (see enclosed table) and interpretation of all primary encapsulation testing performed to date. The plots of lead concentration in TCLP-M extracts as a function of time, presented in the Week 3 report, were updated with completed analytical results; those plots are enclosed. An information package containing these data was transmitted to the LANL technical contact at mid-week to assist in optimization test design. A series of recommended tests for optimization was enclosed with the package.

The data indicate that all three primary binding agents, in combination with surrogate waste, were similar in their response to chemical and crush resistance testing, especially at lower waste loadings. Formulations MF-817 and MF-836 appear to offer somewhat superior performance, based on chemical resistance testing. TCLP-M extracts showed lead concentrations ranging from 68 mg/L to 2600 mg/L for all tests at all conditions evaluated. Comparison of the effects of lixiviant strength showed that TCLP Solution #1 (pH 4.93) solubilized less lead than Solution #2 (pH 2.88) at lower waste loadings, with some exceptions. As waste loading increased, differences in lead solubilization decreased. Kinetic sampling of TCLP-M tests showed the expected increase in lead concentration with time. Imposing SW-846 Method 1311 retention time criteria (18-24 hours) on these tests, results were:

Binder Addition:		10%	20%	40%
Waste Loading:		~70%	81%	87%
		mg/L Pb		
MF-836	Solution #1	108	362	1160
	Solution #2	132	550	1760
MF-829	Solution #1	110	466	1300
	Solution #2	342	600	1930
MF-817	Solution #1	99	457	1509
	Solution #2	183	707	1549

Summary of TCLP-M Extract Analysis: 24 Hours

The data show that lead concentration in solution varies with binder formulation as a function of binder addition and lixiviant acidity. MF-836 appears to have provided the best performance

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

MAY 16 1994

Page 2

of binder addition and lixiviant acidity. MF-836 appears to have provided the best performance of the three binders evaluated. Generally, it showed a decreased sensitivity to lixiviant acidity, and lower lead solubilization than either MF-817 or MF-829. MF-817 was judged to be the next best performer, based on the same criteria, and with the additional criteria of pellet survival rate and crush resistance.

Based on data developed by the initial set of primary encapsulation tests, a series of additional tests to evaluate unexplored variables and improve formulations was designed, see the enclosed table. The objective of tests 1 - 4, identical to earlier tests, was QA verification of earlier results. Tests 5 & 6 evaluated a binder addition of 30% for MF-817 & MF-836. These tests provide additional QA verification and examine binder addition as a variable. Tests 7 - 10 will provide needed data relative to the effect of cure temperature on chemical and physical stability of the waste form. Tests 11 - 16 evaluate the effect of cure temperature. An additional objective of tests 7 - 16 is examination of variables affecting continuous operation and equipment selection.

Testing

Evaluation of optimization conditions will be by TCLP-M procedure, crush resistance, and pellet survival measurements. The TCLP-M procedure will utilize Solution #2 only; preliminary testing showed that, while results differed as a function of lixiviant acidity, Solution #2 was satisfactory in demonstrating relative encapsulate stability.

Process Flow Diagram & Equipment Investigations

Additional literature and product information continues to be received and compiled. The process flow diagram, see enclosed figure, was modified to reflect changes indicated by testing results.

Work Scheduled

Optimization testing began in Week 4 and continued into Week 5. Evaluations of optimized primary encapsulates are scheduled for Week 5. Analytical results may be available by the end of Week 5, or early in Week 6. Following interpretation of results and consultation with LANL technical representatives, a single "recipe" will be selected for preparation of bulk primary encapsulates.

Estimated Program Costs

The graph below illustrates estimated cumulative project cost to date. Labor and materials cost

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

MAY 16, 1994

Page 3

cost to date is estimated at \$8,135. The cumulative estimate provided in the Week 3 Update was erroneous due to miscalculation; the corrected estimate through Week 3 is \$6,518. Costs are summarized by task on the enclosed table, Project Cost Tracking.

Prepared by:

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John E. Litz
President

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Project Cost Tracking

IC Technologies Project 1342

Labor

[illegible]

Materials

[illegible]

Estimated
Total Project Cost

[illegible]

Multiple Encapsulation of LANL Waste
Primary Stabilization - Summary of Preliminary Results
IC Technologies Project 1342

Test #		Binder Components				Waste Form Data			TCLP-M Data				Pellet Survival Rate %
		Surrogate Waste, Dry, Grams	Polymer		Clay, g (Nominal)	Waste Loading %	Compressive Strength, PSI	Extract ID: TCLP Sol'n #	Extract: mg/L Pb				
			ID	grams					100 g/L Polyox in Glycol*	Hours	14	24	
1028-20	A	50	MF-836	20	--	3.5	68%	>50	1	83	108	179	100.0%
	B				--				2	101	132	230	100.0%
1028-21	A	50		10	--	1.5	81%	>50	1	271	362	600	99.2%
	B				--				2	395	550	980	99.1%
1028-22	A	50		5	--	2.5	87%	29	1	920	1160	1850	100.0%
	B				--				2	1420	1760	2450	100.0%
1028-25	A	50	MF-829	15.8	--	3.5	72%	>50	1	81	110	200	98.0%
	B				--				2	250	342	600	97.6%
1028-26	A	50		10	--	1.5	81%	4	1	334	466	850	98.6%
	B				--				2	441	600	1040	99.5%
1028-27	A	50		5	--	2.5	87%	25	1	1050	1300	1920	98.8%
	B				--				2	1630	1930	2600	97.2%
1028-28	A	50	MF-817	20	--	3.5	68%	>50	1	68	99	158	100.0%
	B				--				2	126	183	261	100.0%
1028-29	A	50		10	--	1.5	81%	>50	1	340	457	680	99.0%
	B				--				2	540	707	1065	99.7%
1028-30	A	50		5	--	2.5	87%	15	1	1343	1509	2131	99.5%
	B				--				2	1286	1549	2027	99.1%
1028-31	A	50	MF-836	5	0.75 cc	2.5	87%	10	1	1457	1470	2096	94.8%
	B								2	1657	3615	2165	90.1%
		50	MF-829	5	0.75 cc		This test not performed due to insufficient quantities of MF-829						
1028-32	A	50	MF-817	5	0.75 cc	2.5	87%	42	1	943	1112	1478	99.1%
	B								2	1171	1430	2096	99.5%

* In methylene glycol IP = In Progress ○ This test consumed the remaining quantity of MF-829; the target addition of 40% w/w was not achieved.

1/ Based on dry weights of total surrogate, clay and polymer (wt waste/(wt waste+wt clay+wt polymer)).

2/ Compressive strength of representative cured pellets was measured using a pneumatic ram device where pressure was gradually applied to roughly spherical pellets to an indicated (pressure gauge) application of 50 PSI or failure.

3/ This value determined by separation of fine solids from intact pellets following TCLP-M testing. Based on dry weights.

**Multiple Encapsulation of LANL Waste
Optimization Testing - Primary Stabilization
IC Technologies Project 1342**

Test #	Surrogate Waste, Dry, Grams	Binder			Additives			Cure		TCLP-M	Purpose of Proposed Test
		ID	grams	Waste Loading %	H ₂ O, mls	AlCl ₃ (in H ₂ O),g	Clay, g (Nominal)	Temp	Time		
1	50	Melamine 836	5	87%	8.8	2	2.5	50°C	>4 hrs	Sol'n #2	QA Verification
2	50	Melamine 836	20	68%	8.8	2	3.5	50°C	>4 hrs	Sol'n #2	QA Verification
3	50	Melamine 817	5	87%	8.8	2	2.5	50°C	>4 hrs	Sol'n #2	QA Verification
4	50	Melamine 817	20	68%	8.8	2	3.5	50°C	>4 hrs	Sol'n #2	QA Verification
5	50	Melamine 836	15	75%	8.8	2	2.0	50°C	>4 hrs	Sol'n #2	Evaluate Polymer Addition
6	50	Melamine 817	15	75%	8.8	2	2.0	50°C	>4 hrs	Sol'n #2	Evaluate Polymer Addition
7	50	Melamine 836	20	69%	8.8	2	2.0	25°C	>4 hrs	Sol'n #2	Evaluate Cure Temperature
8	50	Melamine 817	20	69%	8.8	2	2.0	25°C	>4 hrs	Sol'n #2	Evaluate Cure Temperature
9	50	Melamine 836	20	69%	8.8	2	2.0	100°C	>4 hrs	Sol'n #2	Evaluate Cure Temperature
10	50	Melamine 817	20	69%	8.8	2	2.0	100°C	>4 hrs	Sol'n #2	Evaluate Cure Temperature
11	50	Melamine 817	20	69%	8.8	2	2.0	50°C	1 hrs	Sol'n #2	Evaluate Cure Time
12	50	Melamine 817	20	69%	8.8	2	2.0	50°C	2 hrs	Sol'n #2	Evaluate Cure Time
13	50	Melamine 817	20	69%	8.8	2	2.0	50°C	4 hrs	Sol'n #2	Evaluate Cure Time
14	50	Melamine 817	20	69%	8.8	2	2.0	50°C	8 hrs	Sol'n #2	Evaluate Cure Time
15	50	Melamine 836	20	69%	8.8	2	2.0	50°C	2 hrs	Sol'n #2	Evaluate Cure Time
16	50	Melamine 836	20	69%	8.8	2	2.0	50°C	8 hrs	Sol'n #2	Evaluate Cure Time

TCLP Solution #1

Primary Encapsulation Testing
Pb Solubility vs Time
TCLP Solution #2

**Preliminary Process Flow Diagram
Multiple Encapsulation of LANL Waste**

IC Technologies Project 1342

MULTIPLE ENCAPSULATION TESTING

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

WEEK 5

IC Technologies Project 1342

June 2, 1994

Work Completed

Optimization Data - Interpretation

The series of primary encapsulation optimization tests described in the Week 4 Update were performed and evaluated in Week 5. Conditions and results are summarized in the enclosed table. Parameters and variables examined were:

- ▶ QC Duplicate Tests
- ▶ Polymer (Binder) Addition
- ▶ Curing Time & Temperature

TCLP-M extractions (Solution #2), crush resistance measurements, and pellet survival rates were used to quantify the variables' effects.

QC Testing: Four primary encapsulations of LANL surrogate waste were performed in this series. The objective was to evaluate the repeatability of results achieved in single tests. Accordingly, agglomerations were run using MF-836 and MF-817 at mix design specifications identical to earlier tests. Two binder additions, 10% and 40%, were evaluated. Curing conditions were as standardized, 50°C for at least 4 hours. TCLP-M extract sample (@ 12-14, 24, and 48 hours) analysis showed the consistency of results increasing, in general, with time. Binder addition did not appear to be a factor controlling consistency. Repeatability within a given range of values appeared to be attainable.

Concentrations of Pb in TCLP-M extracts are primarily controlled by two factors: the relative exposure of Pb at the pellets' surfaces, and the diffusion rate through each pellet. Control of Pb exposure at the pellet surface is not readily facilitated in the primary encapsulation step, as developed by ICT's earlier work with melamine formaldehyde and other polymeric binders. Diffusion rates are affected by the degree of individual waste particles' encapsulation, binder addition, and, to some extent, pellet size. Among these variables, binder addition is the only directly controllable element. The system design specifies a maximum pellet size of 3/8" to satisfy SW-846 Method 1311 requirements. Although pellet size uniformity has been an objective in testing, the disk pelletization technique precludes tight control, and gives rise to test-to-test variability. It is suggested that, by the use of a mixtruder for waste/binder mixing and pellet formation, sizing consistency and therefore exposure consistency will be optimized. Additionally, it is stressed that results obtained

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IC Technologies Project 1342

June 3, 1994

Page 2

pelletization are conservative, and can only be improved upon at larger scale with attendant tight control.

Binder

Addition: Two tests were performed evaluating an addition of 30% binder for both MF-836 and MF-817. TCLP-M analytical data show values for MF-836 fitting the concentration/time curves presented in the Week 4 Update. Results obtained for MF-817 at 30%, however, exceeded (resulted in lower Pb concentrations in TCLP-M extract samples) those for MF-817 at 20%. Again, it is felt that the data reflect a test-to-test variability attributable to the small sample quantities and pellet preparation technique.

Curing Time &

Temperature: Ten primary encapsulation tests, using MF-817 and MF-836 at 40% addition, were run in this series at conditions summarized below:

Binder	Cure Temperature, °C	Cure Time, Hours	mg/L Pb; 12-HR TCLP-M
MF-836	25	24	504
MF-817	25	24	568
MF-836	100	~16	366
MF-817	100	~16	527
MF-817	50	1	172
MF-817	50	2	265
MF-817	50	4	228
MF-817	50	8	512
MF-836	50	2	340
MF-836	50	8	280

The data shown above, and in the enclosed table, indicate that:

1. No measurable advantage, using the techniques employed, was gained by either low-temperature (25°C) or high-temperature (100°C) curing.
2. MF-817 binder cures adequately in as little as one hour at 50°C; curing for

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

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longer periods appeared to be detrimental to chemical stability, although earlier tests showed good results with a ~18 - 24-hr cure.

- MF-836 cured chemical stability appeared to be proportional to curing time, however the data points are not sufficiently disparate to draw a firm conclusion.

Longer term stability, as measured by TCLP-M solution samples at 24 and 48 hours, was consistent with the 12-hour results.

Pellet Survival and Crush

Resistance: Pellet survival was measured by separation and weighing of dried fines generated during TCLP-M testing. The data show survival rates for all optimized preparations ranging from 96.8% to 99.8%. This testing is particularly subject to individual pellet-to-pellet variability, but generally shows an acceptable level of physical integrity.

Crush resistance measurements (procedure described in an earlier update) were performed on cured pellets and pellets retrieved from TCLP-M residue samples. The objective was to compare optimized conditions with developmental testing results, and evaluate the effects of acidic solution attack on structural integrity. Interestingly, pellets prepared with both MF-817 & 836 showed decreased structural integrity after curing at 100°C and TCLP-M stability testing. All other formulations, before and after TCLP-M, demonstrated resistance to uniaxial pressures up to 50 PSI (indicated).

Recommendation

In order to proceed to secondary encapsulation testing, a primary encapsulation formulation must be agreed upon. The confirmed formulation will be followed in preparation of a bulk quantity of primary encapsulates for secondary encapsulation evaluations.

Based on testing results generated to date, on economic factors, and on waste form stability requirements, ICT recommends the following formulation:

Binder	Addition	Cure, °C	Cure, Hours
MF-817	40% (w/w)	50°C	1

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IC Technologies Project 1342

June 2, 1994

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MF-817 was selected over MF-836 due to its short-term cure strength and chemical stability. The curing conditions selected were shown in optimization testing to deliver acceptable performance as measured by the criteria imposed. Additions of less than 40% may prove adequate, and could be evaluated at pilot-scale if desired. Economic factors obviously influence this variable.

Work Scheduled

If LANL technical representatives concur with the recommended primary encapsulate formulation, preparation of bulk pellets for subsequent testing can begin. ICT's supply of MF-817 is close to depleted, but additional material was ordered when testing data indicated acceptable results from this polymer. It is anticipated that delivery time will not hinder progress on the program.

Estimated Program Costs

The graph below illustrates estimated cumulative project cost to date. Labor and materials cost to date is estimated at \$9,929. Costs are summarized by task on the enclosed table, Project Cost Tracking.

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

June 2, 1994

Page 5

Prepared by:

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6/2/94

Labor

[illegible]

Materials

[illegible]

Estimated
Total Project Cost

[illegible]

**Multiple Encapsulation of LANL Waste
Primary Stabilization - Summary of Preliminary Results
Optimization Tests
IC Technologies Project 1342**

Binder Components	Polymer		Waste Form Data		Cure		TCLP-M (Sol'n #2)		Pellet Survival Rate %
	Surrogate Waste, Dry Grams	ID grams	Crush Resistance, PSI ²	Waste "Cured" After TCLP-M	% C	Time	Extract: mg/L Pb	Hours	
1028-40	50	MF-836 5	8.9	78%	15	5	1008 1389 2655	1420 1760 2450	98.7%
1028-22	50	MF-836 5		29	50	>4 hrs			100.0%
1028-41	50	MF-836 20	15.6	58%	>50	>4 hrs	355 415 725		96.8%
1028-20	50	MF-836 20			50	>4 hrs	101 132 230		100.0%
1028-42	50	MF-817 5	13.2	73%	25	>4 hrs	1322 1513 2129		97.1%
1028-30	50	MF-817 5		15	50	>4 hrs	1286 1549 2027		99.5%
1028-43	50	MF-817 20	18.3	57%	>50	>4 hrs	60 108 217		99.7%
1028-28	50	MF-817 20		>50	50	>4 hrs	126 183 261		100.0%
1028-44	50	MF-836 15	16.8	61%	>50	>4 hrs	400 493 941		99.3%
1028-45	50	MF-817 15	12.9	64%	>50	>4 hrs	168 179 377		99.8%
1028-46	50	MF-836 20	19.2	56%	>50	24	504 560 878		98.5%
1028-47	50	MF-817 20	17.7	57%	>50	24	568 657 960		99.3%
1028-48	50	MF-836 20	13.2	60%	>50	~16	366 443 NA		99.9%
1028-49	50	MF-817 20	16.0	58%	>50	~16	527 581 NA		98.8%
1028-50	50	MF-817 20	16.4	58%	>50	1	172 205 388		99.8%
1028-51	50	MF-817 20	17.4	57%	>50	2	265 314 542		98.6%
1028-52	50	MF-817 20	21.5	55%	>50	4	228 280 519		96.8%
1028-53	50	MF-817 20	13.7	60%	>50	8	512 586 993		99.4%
1028-54	50	MF-836 20	17.9	57%	>50	2	340 414 NA		99.2%
1028-55	50	MF-836 20	14.7	59%	>50	50	280 313 NA		99.8%

Note: Data shown in *italics* is for duplicate (geolier) tests, and is presented for purposes of comparison.

NA = Not Analyzed

1/ Based on dry weights of total surrogate, clay and polymer (wt waste/wt clay+wt polymer).

2/ Compressive strength of representative cured pellets was measured using a pneumatic ram device where pressure was gradually applied to roughly spherical pellets to an indicated (pressure gauge) application of 50 PSI or failure.

3/ This value determined by separation of fine solids from intact pellets following TCLP-M testing. Based on dry weights.

Multiple Encapsulation of LANL Waste
Primary Stabilization - Summary of Preliminary Results
IC Technologies Project 1342

Time variable shown in legend(s) refers to TCLP-M kinetic solution sampling times.

MULTIPLE ENCAPSULATION TESTING

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

WEEK 6

IC Technologies Project 1342

June 9, 1994

Work Completed

Testing

All primary encapsulation optimization testing was completed in Week 5; tests run in that time frame but not yet discussed, and testing performed in Week 6, include:

- ▶ Solution blank and leachate analysis: TCLP-M blanks, QA/QC
- ▶ Control TCLP-M testing: TCLP-M procedure and analysis on surrogate waste
- ▶ Reduction of moisture content during pelletization: evaluation of effects

Solution Blanks: Performed as a development testing and analytical (ICT flame atomic absorption) quality assurance and control procedure, several blanks were prepared, carried through TCLP-M procedure, and analyzed. The extractions and analysis coincided with development test work, and so duplicated conditions present during those events. The procedure used SW-846 Method 1311 Solutions #1 & #2 from the same supply as TCLP-M test lixiviant. Analytical results showed no evidence of Pb at levels above the method detection limit.

Control TCLP-M: These tests were performed to provide baseline data on the solubility of Pb in the TCLP-M extraction matrix. As-prepared, unadulterated surrogate waste (80% Al₂O₃ + 20% Pb powder) was pulped at 4.8% solids in TCLP-M lixiviant and agitated under conditions identical to those established for development testing. Analysis of extracts showed:

	14-HR	24-HR	48-HR
Solution ID	mg/L Pb		
Method 1311; Solution #1	1046	1569	4420
Method 1311; Solution #2	1008	1008	5520

As reported in an earlier update, the maximum calculated solubility (100% dissolution) based on Pb available at a minimum 55% surrogate waste loading is ≥ 5500 mg/L Pb. The data verify that significant

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IC Technologies Project 1342

June 9, 1994

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stabilization of the contaminant was demonstrated by the primary waste form.

Moisture Content Evaluations:

Three tests were performed to study the effect of water addition on chemical stability of primary encapsulates. The objective was to evaluate waste de-watering prior to pelletization, thereby minimizing the need for an absorbent (bentonite, in development testing). Test conditions were identical, using MF-836 @ 40% (w/w). Sufficient water was added to effect pelletization, and measured. Results showed an average water requirement of 10.7%, based on surrogate dry weight. Clay additions decreased by over 50% as a function of minimization of water addition. TCLP-M results showed:

	7-HR	24-HR
Solution ID	mg/L Pb	
Test 1 (1028-56)	129	251
Test 2 (1028-57)	75	184
Test 3 (1028-58)	225	443

It may be inferred from the data that moist waste could be de-watered beyond the 15% moisture level arbitrarily chosen for development work with no adverse affects on stabilization.

Test Design - Secondary Encapsulation

Progress to date on the program is sufficient to move to the next level of testing. Primary encapsulation with MF-817 at 40% addition was confirmed as the optimum formulation. Accordingly, efforts were directed toward the preparation of bulk primary encapsulates and test design for secondary encapsulation testing. The figures enclosed, Secondary Encapsulation Development Test Design, and Sequential Leaching Test Flow Diagram, are presented to clarify upcoming test work.

Three thermoset polymers were selected for secondary encapsulation, Uniroyal Royalcast, Devcon Flexane 80, and Sartomer CN-300/Sr-350. The first two are polyurethanes, the Sartomer product is a acrylate-terminated polybutadiene. The polyurethanes have demonstrated excellent chemical and physical stability as encapsulants in previous work. A drawback to the use of polyurethanes is their reactivity with water. Use of these polymers will require drying of primary encapsulates before application. The Sartomer product is capable of incorporation of water into its matrix during cure, and may provide an advantage in continuous operations.

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As shown in the accompanying figure, testing will evaluate the stability of secondary encapsulates by TCLP-M, crush resistance, freeze/thaw, sequential leaching, and TCLP by independant laboratory. Development work will include TCLP-M, crush resistance, and freeze/thaw testing; optimization will be evaluated by sequential leaching and TCLP. It is anticipated that both single and double application of polymers to pellet surfaces will be tested.

Work Scheduled

Development of secondary encapsulation techniques will be the focus of Week 7 efforts.

Estimated Program Costs

The graph below illustrates estimated cumulative project cost to date. Labor and materials cost to date is estimated at \$12,606. Costs are summarized by task on the enclosed table, Project Cost Tracking.

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

June 8, 1994

Page 4

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6/8/94

[illegible][illegible][illegible]

Secondary Encapsulation Development Test Design

IC Technologies Project 1342

IC Technologies Project 1291

MULTIPLE ENCAPSULATION TESTING

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

WEEK 7

IC Technologies Project 1342

June 14, 1994

Work Completed

Testing

Testing and evaluation of secondary encapsulation techniques and materials began in Week 7. The flow diagram presented in the Week 6 Update was adhered to in terms of test design. A bulk quantity of primary encapsulates (PE) was prepared using the technique described in earlier Updates. Two splits of PE were evaluated, as part of development QA/QC efforts, by TCLP-M procedure to measure their relative chemical resistance in comparison to development testing. Results, presented in the enclosed table, showed reductions in Pb solubility commensurate with development work. Seven-hour TCLP-M leachate samples averaged 88.5 mg/L Pb; 24-hour leachate analysis showed an average of 116 mg/L Pb.

Secondary encapsulation media (thermosetting polymers) were two polyurethanes and a polybutadiene diacrylate (PBDDA). PE samples were overcoated with manufacturer-recommended formulations of each polymer. Coated PE samples were cured at 50°C for 2 hours, then advanced to evaluation testing:

- ▶ TCLP-M
- ▶ Freeze/Thaw → TCLP-M & Crush Resistance
- ▶ Uniaxial Crush Resistance

Because the freeze/thaw procedure required five 24-hour cycles, it was still in progress as this update is written. TCLP-M and crush resistance data will be reported as they become available. The enclosed table shows TCLP-M and crush resistance results for secondary encapsulates (SE), as well as polymer addition data. Polymer addition was not directly controlled in testing, e.g., PE samples were coated and excess polymer allowed to drain away. Back-calculation based on cured weights of PE and SE showed 3.1% addition for Uniroyal polyurethane, and 10.9% addition for both Devcon polyurethane and Sartomer PBDDA. It is suggested that the difference in additions was a function of polymer mix viscosity. Chemical resistance, as measured by TCLP-M, appeared not to be a function of coating thickness/addition, however. The Sartomer polymer demonstrated the best relative performance in TCLP-M, showing 7- and 24-hour leachate Pb concentrations of 3 and 4 mg/L, respectively. The polyurethanes showed nearly identical response, at ~13 and 18 mg/L Pb at 7- and 24-hour samplings.

The data indicate significant reductions in Pb solubility, in comparison to untreated surrogate and PE samples. Although TCLP criteria (<5 mg/L Pb) were met by one SE test, the margin of compliance was judged minimal. It is suggested that double-coating of PE during secondary encapsulation will deliver compliance with regulatory criteria and enhance the margin of

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IC Technologies Project 1342

June 14, 1994

Page 2

confidence.

Crush resistance was evaluated on SE samples; results showed that the arbitrary 50 PSI benchmark was exceeded by all SE samples.

Work Scheduled

- ▶ Testing to complete the evaluation of single-coated SE samples (freeze/thaw, TCLP-M) is in progress.
- ▶ Fresh PE samples to be prepared for additional testing
- ▶ Double-coating SE procedure to be evaluated
- ▶ Secondary encapsulation of *fresh, uncured* PE samples using Sartomer PBDDA to be tested

The last item above was included to investigate an inherent advantage of the Sartomer product, the ability to incorporate moisture during cure. If testing is successful, the Sartomer product would permit immediate secondary encapsulation of primary encapsulates during continuous operation, eliminating PE curing as an intermediate step in the process.

Estimated Program Costs

The graph below illustrates estimated cumulative project cost to date. Labor and materials cost to date is estimated at \$16,175. Costs are summarized by task on the enclosed table, Project Cost Tracking.

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

June 14, 1994

Page 3

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6/14/94

Labor

[illegible]

Materials

\$782   ~\$650   ~\$200

Estimated
Total Project Cost

[illegible]

Secondary Encapsulation Test Work
Summary of Available Results
IC Technologies Project 1342

Test No.	Medium ID	Encapsulation	Cure	Polymer Application	Uniaxial Crush Resistance		TCLP-M; mg/L Pb	
					PSI Indicated			
					Cured	TCLP-M	7-HR	24-HR
1028-59	MF-817	Primary/Bulk	1-HR@50°C	40%	>50	>50		
1028-60	MF-817	Primary/Bulk	1-HR@50°C	40%	>50	>50	80	107
1028-61	MF-817	Primary/Bulk	1-HR@50°C	40%	>50	>50		
1028-62	MF-817	Primary/Bulk	1-HR@50°C	40%	>50	>50	97	125
1028-63	Uniroyal Polyurethane	Secondary	2-HR@50°C	3.1%	>50	>50	14	18
1028-64	Devcon Polyurethane	Secondary	2-HR@50°C	10.9%	>50	>50	13	18
1028-65	Sartomer PBDDA	Secondary	2-HR@50°C	10.9%	>50	>50	3	4

Notes

1. Primary encapsulates were evaluated for chemical resistance by preparation of two composites for TCLP-M procedure.
2. Secondary encapsulation consisted of a *single* application of specified polymers to cured primary encapsulates.

MULTIPLE ENCAPSULATION TESTING

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

WEEK 8

IC Technologies Project 1342

June 23, 1994

Work Completed

Testing

This Update was intentionally delayed so that analytical data for Week 8 testing could be included.

Week 8 testing focused on evaluation of secondary encapsulate (SE) integrity. As scheduled in the Week 7 Update, several batches of primary encapsulates (PE) were prepared using 40% MF-817. Portions of the bulk preparations were carefully sized to minus 3/8" for TCLP evaluation after secondary encapsulation. Additionally, evaluation (by TCLP-M) of several batches of SE, prepared during Week 7, was completed.

Secondary Encapsulation

As described in the Week 7 Update, PE samples were overcoated with a single application of three different polymers. TCLP-M data showed that, although significant reduction in contaminant mobility was achieved and regulatory criteria for Pb met, optimization of the SE technique was warranted. Therefore, PE samples were overcoated with two applications of the thermoset polymers and evaluated by TCLP-M and sequential batch testing; carefully sized double-coated SE (SE²) will be submitted for TCLP by independent laboratory.

SE (single coat) prepared in Week 7 and subjected to 5-cycle freeze/thaw weathering evaluation were evaluated by TCLP-M. Results of the testing, summarized in the enclosed table, show that the freeze/thaw cycling and resultant expansion and contraction did not measurably affect the chemical stability of SE. Results showed an improvement over SE not subjected to freeze/thaw. It is suggested that the additional curing time afforded by the freeze/thaw testing might be responsible for the improvement.

Results for TCLP-M evaluations of SE² indicate that this treatment regime can successfully inhibit contaminant mobility and comfortably satisfy regulatory criteria for characteristically hazardous wastes. Each of the three thermoset polymers applied showed TCLP-M extract Pb values below the regulatory limit of 5 mg/L. Uniroyal polyurethane showed 1 mg/L Pb at 12 and 24 hours; Devcon polyurethane showed no Pb above method detection limit at both sampling times; and Sartomer PBDDA showed 2 mg/L Pb at 12 hours, and no detectable Pb at 24 hours. It is unlikely that solubilized Pb would return to the solid phase through ion exchange or precipitation in the TCLP-M lixiviant, therefore one of the analytical values for Sartomer PBDDA TCLP-M extract was in error. All extracts from SE² TCLP-M tests will be analyzed by an independent laboratory to confirm the control analyses performed by IC Technologies.

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Equipment Evaluations

Laboratory development testing with thermoset polymers demonstrated a series of requirements for secondary encapsulation equipment. Short curing times were viewed as a necessary feature in the selection of secondary encapsulation agents, however this feature impacts equipment selection and design. ICT's staff is investigating specialized equipment for the SE procedure using this class of polymer. Additionally, test results indicate the need for double-coat SE processing to consistently achieve program goals. The process flow diagram is evolving as testing results dictate.

Work Scheduled

- ▶ Secondary encapsulation of *fresh, uncured* PE samples using Sartomer PBDDA to be tested. This was to have been evaluated in Week 7, but was postponed.
- ▶ Use of microwave curing for first coat SE; evaluation by 6-8 hour TCLP-M
- ▶ Sequential batch testing of SE²
- ▶ Completion of testing and analysis in progress
- ▶ Modification and ongoing optimization of process flow diagram; equipment evaluations.

Estimated Program Costs

The graph below illustrates estimated cumulative project cost to date. Labor and materials cost to date is estimated at \$18,664. Costs are summarized by task on the enclosed table, Project Cost Tracking.

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Sequential Batch Testing

The enclosed figure/data summary reports results available to date for sequential batch testing (SBT). This procedure has as its objective the short-term simulation of aqueous percolation. De-ionized H₂O was used as the lixiviant; single-coated SE were evaluated. The schematic enclosed illustrates the solids and solution cycling matrix of the test design. Nine solid/solution contacts generate solution samples for analysis. Three samples of fresh solids and "barren" lixiviant are introduced to initiate the matrix. Results show that stage 3A lixiviant contained the highest concentration of Pb for the three polymers evaluated. This stage represents three successive 24-hour solution contacts with fresh SE. Devcon polyurethane showed the best result, with Pb analysis of lixiviants for stages 1A, 2A, & 3A of 0 (ND), 1, and 2 mg/L Pb, respectively. Sartomer PBDDA showed values of 3, 8, and 8 mg/L Pb for identical stages; Uniroyal polyurethane showed 4, 9, and 12 mg/L Pb for identical stages. The A series of contacts, run at 50% solids pulp density, should show the highest contaminant concentrations; B and C series contacts were run at 33% and 25% solids, respectively. Data currently available for B and C series contacts appears to reflect the influence of decreasing pulp density, showing lower relative Pb concentrations.

The SBT series, while not designed or intended to establish regulatory compliance data, provides information on contaminant diffusion rates in a controlled study. The data suggest that contaminant diffusion rates are limited and predictable. The plot at right implies that diffusion rates slow with subsequent solution contacts, e.g., contaminant concentrations level off rather than increase. Additional analytical data to be obtained during Week 9 will complete the SBT test series on single-coat SE.

It is anticipated that SE² will be evaluated using this technique, as well as TCLP-M and SW-846 1311 TCLP.

Labor

Materials

Estimated
Total Project Cost

[illegible]

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

June 2, 1994

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Prepared by:

IC Technologies

R. Leland Schwartz
Project Manager

Approved by:

John E. Litz
President

PLEASE CALL WITH ANY QUESTIONS, COMMENTS, OR INPUT ON THE PROGRAM

Secondary Encapsulation Test Work
Summary of Available Results
IC Technologies Project 1342

Test No.	Medium ID	Encapsulation	Cure	Polymer Application	Uniaxial Crush Resistance		TCLP-M; mg/L Pb	
					PSI Indicated			
					Cured	TCLP-M	7-14 HR	24-HR
1028-59	MF-817	Primary/Bulk	1-HR@50°C	40%	>50	>50		
1028-60	MF-817	Primary/Bulk	1-HR@50°C	40%	>50	>50	80	107
1028-61	MF-817	Primary/Bulk	1-HR@50°C	40%	>50	>50		
1028-62	MF-817	Primary/Bulk	1-HR@50°C	40%	>50	>50	97	125
1028-63	Uniroyal Polyurethane	Secondary/Single	2-HR@50°C	3.1%	>50	>50	14	18
1028-64	Devcon Polyurethane	Secondary/Single	2-HR@50°C	10.9%	>50	>50	13	18
1028-65	Sartomer PBDDA	Secondary/Single	2-HR@50°C	10.9%	>50	>50	3	4
1028-63	Uniroyal Polyurethane	Secondary/Single	Feeze/Thaw	3.1%	IP	IP	10	12
1028-64	Devcon Polyurethane	Secondary/Single	Feeze/Thaw	10.9%	IP	IP	11	13
1028-65	Sartomer PBDDA	Secondary/Single	Feeze/Thaw	10.9%	IP	IP	3	3
1028-75	Uniroyal Polyurethane	Secondary/Double	2-HR@50°C	~6%	IP	IP	1	1
1028-76	Devcon Polyurethane	Secondary/Double	2-HR@50°C	~21%	IP	IP	0	0
1028-77	Sartomer PBDDA	Secondary/Double	2-HR@50°C	~21%	IP	IP	2	0

Notes

1. Data shown in italic typeface was reported in an earlier update and is presented here for comparative purposes.
2. Primary encapsulates were evaluated for chemical resistance by preparation of two composites for TCLP-M procedure.
3. Secondary encapsulations consisted of: a single application of specified polymers to cured primary encapsulates, as specified; a double application of polymer to PE with an intermediate cure stage..
4. Tests 1028-(63-65) were evaluated by TCLP-M technique before and after the freeze/thaw procedure.

Summary of Sequential Batch Testing Results

Secondary (Single) Encapsulates

IC Technologies Project 1342

Schematic of Sequential Batch Test Procedure

General Conditions

Mild Agitation
De-Ionized H₂O Lixiviant
Ambient (~25°C) Temperature
24-Hour Retention Time per Stage

Uniroyal Polyurethane		
ICT ID	No./Series	mg/L Pb
1028-78	1A	4
1028-78	1B	3
1028-78	1C	1
1028-78	2A	9
1028-78	2B	7
1028-78	3A	12
1028-78	2C	IP
1028-78	3B	IP
1028-78	3C	IP

Devcon Polyurethane		
ICT ID	No./Series	mg/L Pb
1028-79	1A	0
1028-79	1B	0
1028-79	1C	0
1028-79	2A	1
1028-79	2B	1
1028-79	3A	2
1028-79	2C	IP
1028-79	3B	IP
1028-79	3C	IP

Sartomer PBDDA		
ICT ID	No./Series	mg/L Pb
1028-80	1A	3
1028-80	1B	1
1028-80	1C	1
1028-80	2A	8
1028-80	2B	2
1028-80	3A	8
1028-80	2C	IP
1028-80	3B	IP
1028-80	3C	IP

IP = In Progress

MULTIPLE ENCAPSULATION TESTING

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

WEEK 9

IC Technologies Project 1342

June 28, 1994

Work Completed

Week 9 activities included:

- ▶ Secondary encapsulation of *fresh, uncured* PE samples using Sartomer PBDDA.
- ▶ Microwave curing for first coat SE
- ▶ Completion of sequential batch testing of SE²
- ▶ Completion of testing and analysis in progress
- ▶ Modification and ongoing optimization of process flow diagram; equipment evaluations.

Secondary Encapsulation

One of the secondary encapsulation agents used in this program, Sartomer polybutadiene diacrylate, is capable of incorporating water/moisture into the cured, polymerized solid with minimal adverse effects. In an effort to simplify the encapsulation process, tests were performed to evaluate secondary encapsulation of uncured primary encapsulates (PE) using the Sartomer polymer. Observation of the secondary encapsulation showed that the uncured PE structure was insufficient to maintain intact pellets. The mild energy involved in overcoating PE was apparently enough to cause significant pellet elongation, de-pelletization, and clumping. This behavior was not readily corrected through modifications to pelletization or overcoating technique, therefore this potential processing option was abandoned.

Another technique evaluated was use of microwave energy to cure SE. It was postulated that a microwave cure might fuse the polymer overcoat to PE, enhancing integrity and stability. Several tests showed that microwave curing caused oxidation of secondary polymers, and volatilization at the surface of the pellets. This technique was judged unsuitable for use with the waste form optimized in this program.

Results for TCLP-M leachability testing of SE² subjected to freeze/thaw weathering tests were complete in Week 9. The enclosed table presents a summary of all TCLP-M results for secondary encapsulations. The data showed:

- ▶ Significant, measurable reductions in contaminant mobility/solubility as gauged by TCLP-M attributable to secondary encapsulation. Sartomer PBDDA showed the best results for single-coat SE; double-coat SE results for all three polymers were below the regulatory limit of 5.0 mg/L Pb. The TCLP-M procedure, coupled with ICT control analysis by flame AA, demonstrated essentially identical performance for all SE² preparations.

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

June 29, 1994

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- ▶ No measurable negative effect of freeze/thaw weathering on contaminant leachability for either SE or SE², regardless of SE polymer.

Sequential Batch Testing

CORRECTION: The Week 8 Update reported that the sequential batch testing procedure (SBT) was performed on single-coated secondary encapsulates. This statement was in error. Only double-coated secondary encapsulates were evaluated by this method.

Analysis of all SBT leachate samples was completed in Week 9. The data are presented in seven enclosed tables & figures. The first table provides a schematic representation of the SBT procedure and a summary of analytical results organized by polymer type. Analytical data suggest that the SBT, using deionized water, was more aggressive in solubilizing Pb than the TCLP-M procedure for SE² waste form. Careful evaluation showed that, in terms of milligrams of lead leached, the TCLP-M solubilized ~0.5 mg Pb (at a nominal lead concentration of 1.0 mg/L in leachate) or ~5 mg/kg. SBT results showed total mg Pb solubilized at 0.99, 0.06, and 0.54 for Uniroyal, Devcon, and Sartomer polymers, respectively, or 11, 0.7, and 6 mg/kg. (The calculation assumes that no Pb reported back to the solid phase during testing.) SBT was, therefore, similar to TCLP-M in aggressiveness as measured by contaminant leachability. SBT provided data on the diffusion rates of contaminant over time. Contaminant diffusion is represented by the tables and figures enclosed, which report and plot milligrams of lead solubilized per kilogram of waste form. The trends indicate that solubility tended to level off or decline by approximately the second contact in each Series for each polymer. This observation was true for both repeat solution and solids contacts. Note that negative values are reported for some solubility calculations - these are attributed to analytical error, and do not significantly affect the trends established.

TCLP Evaluation

Samples of SE² prepared with Uniroyal, Devcon, and Sartomer polymers, and sized to minus 9.5mm, were submitted on June 23 to a local laboratory for TCLP evaluation in adherence to SW-846 Method 1311. Results should be available during Week 11.

Equipment Evaluations

Definition of processing equipment was aided by the qualitative and quantitative results established in Week 9. Generally, the process as currently envisioned will include:

- ▶ Extruder/mixtruder with pellet chopping/sizing capability for mixing MF-817 with waste and dehydration agent(s), and PE formation; conveyor transport to:
- ▶ Intermediate curing by IR or convection, followed by:

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

June 28, 1994

Page 3

- ▶ Redundant secondary encapsulation equipment to create SE² waste form; intermediate curing between SE stages (short retention) and after SE (long retention)
- ▶ Tertiary encapsulation

Efforts are currently directed at design of equipment suitable for application of secondary encapsulation polymers. The short pot life characteristics of thermosetting polymers, coupled with the specific requirements of this program's goals, necessitate a careful review of available equipment to determine its applicability. Equipment reviewed to date appears inadequate in addressing processing requirements. It is possible that, for the SE step, semi-custom equipment may be required.

Work Scheduled

- ▶ Completion of crush-resistance testing on SE², TCLP-M - leached SE², and TCLP-M - leached, freeze/thaw treated SE²
- ▶ Microscopic evaluation of SE² surface characteristics
- ▶ Preparation of SE² to define waste loading at optimized conditions
- ▶ Evaluation of infra-red and convection cure techniques
- ▶ Data reduction, review, and validation for QA/QC objectives; supplemental testing as indicated and directed by QA/QC review.

Estimated Program Costs

The graph below illustrates estimated cumulative project cost to date. Labor and materials cost to date is estimated at \$22,099. Costs are summarized by task on the enclosed table, Project Cost Tracking.

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

June 28, 1994

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Project Cost Tracking
IC Technologies Project 1342
6/28/94

Labor

TASK	Week Number:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Test Design & Set-Up		\$638			\$353	\$45	\$140	\$183	\$266	\$203							
Primary Encapsulation Testing		\$632	\$1,127	\$1,090	\$755	\$1,090	\$1,090										
Secondary Encapsulations								\$1,720	\$1,732	\$1,678							
Tertiary Encapsulations																	
Confirmation Tests																	
Data Reduction & Validation					\$252	\$361	\$478	\$516	\$133	\$542							
Analytical/R&D QA/QC					\$201	\$136	\$408	\$210		\$176							
Equipment Evaluations			\$82	\$560	\$151	\$45				\$271							
Reporting			\$266	\$319	\$202	\$226	\$140	\$531	\$246	\$316							
Clerical		\$251															
Project Management			\$266	\$638	\$151	\$90	\$422	\$409	\$113	\$248							
Totals:		\$1,521	\$1,740	\$2,607	\$2,067	\$1,994	\$2,677	\$3,569	\$2,489	\$3,435	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Cumulative Totals:		\$1,521	\$3,262	\$5,868	\$7,935	\$9,929	\$12,606	\$16,175	\$18,664	\$22,099	\$0	\$0	\$0	\$0	\$0	\$0	\$0

Materials

\$782		~\$650	~\$200														

Estimated
Total Project Cost

Weekly:	\$2,303	\$1,740	\$3,257	\$2,267	\$1,994	\$2,677	\$3,569	\$2,489	\$3,435	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Cumulative Weekly:	\$2,303	\$4,044	\$7,300	\$9,567	\$11,561	\$14,238	\$17,807	\$18,664	\$22,099	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

**Secondary Encapsulation Test Work
Summary of Available Results
IC Technologies Project 1342**

Test No.	Medium ID	Encapsulation	Cure	Polymer Application	Uniaxial Crush Resistance		TCLP-M; mg/L Pb	
					PSI Indicated		7-14 HR	24-HR
					Cured	TCLP-M		
1028-59	MF-817	Primary/Bulk	1-HR@50°C	40%	>50	>50		
1028-60	MF-817	Primary/Bulk	1-HR@50°C	40%	>50	>50	80	107
1028-61	MF-817	Primary/Bulk	1-HR@50°C	40%	>50	>50		
1028-62	MF-817	Primary/Bulk	1-HR@50°C	40%	>50	>50	97	125
1028-63	Uniroyal Polyurethane	Secondary/Single	2-HR@50°C	3.1%	>50	>50	14	18
1028-64	Devcon Polyurethane	Secondary/Single	2-HR@50°C	10.9%	>50	>50	13	18
1028-65	Sartomer PBDDA	Secondary/Single	2-HR@50°C	10.9%	>50	>50	3	4
1028-63	Uniroyal Polyurethane	Secondary/Single	Freeze/Thaw	3.1%	IP	IP	10	12
1028-64	Devcon Polyurethane	Secondary/Single	Freeze/Thaw	10.9%	IP	IP	11	13
1028-65	Sartomer PBDDA	Secondary/Single	Freeze/Thaw	10.9%	IP	IP	3	3
1028-75	Uniroyal Polyurethane	Secondary/Double	2-HR@50°C	~6%	IP	IP	1	1
1028-76	Devcon Polyurethane	Secondary/Double	2-HR@50°C	~21%	IP	IP	0	0
1028-77	Sartomer PBDDA	Secondary/Double	2-HR@50°C	~21%	IP	IP	2	0
1028-75	Uniroyal Polyurethane	Secondary/Double	Freeze/Thaw	3.1%	IP	IP	1	1
1028-76	Devcon Polyurethane	Secondary/Double	Freeze/Thaw	10.9%	IP	IP	0	0
1028-77	Sartomer PBDDA	Secondary/Double	Freeze/Thaw	10.9%	IP	IP	0	1

Notes

1. Data shown in *italic* typeface were reported in an earlier update and is presented here for comparative purposes.
2. Primary encapsulates were evaluated for chemical resistance by preparation of two composites for TCLP-M procedure.
3. Secondary encapsulations consisted of: a single application of specified polymers to cured primary encapsulates, as specified; an additional application of polymer with an intermediate cure stage between applications.
4. Test 1028-(63-65) and 1028-(75-77) encapsulates were evaluated by TCLP-M technique before and after the freeze/thaw procedure.

Summary of Sequential Batch Testing Results

Secondary (SE²) Encapsulates

IC Technologies Project 1342

Schematic of Sequential Batch Test Procedure

Uniroyal Polyurethane

ICT ID	No./Series	mg/L Pb
1028-78	1A	4
	1B	3
	1C	1
	2A	9
	2B	7
	3A	12
	2C	1
	3B	6
	3C	1

Devcon Polyurethane

ICT ID	No./Series	mg/L Pb
1028-79	1A	0
	1B	0
	1C	0
	2A	1
	2B	1
	3A	2
	2C	0
	3B	0
	3C	0

Sartomer PBDDA

ICT ID	No./Series	mg/L Pb
1028-80	1A	3
	1B	1
	1C	1
	2A	8
	2B	2
	3A	8
	2C	1
	3B	2
	3C	0

Summary of Sequential Batch Testing Results

Secondary (SE²) Encapsulates

IC Technologies Project 1342

mg Pb Solubilized per kg Waste Form

Uniroyal		
1A	2A	3A
4.0	4.9	3.0
1B	2B	3B
6.0	7.9	-2.0
1C	2C	3C
3.0	0.0	0.0

Summary of Sequential Batch Testing Results

Secondary (SE²) Encapsulates

IC Technologies Project 1342

mg Pb Solubilized per kg Waste Form

Devcon		
1A	2A	3A
0.0	1.0	1.0
1B	2B	3B
0.0	2.0	-2.0
1C	2C	3C
0.0	0.0	0.0

Summary of Sequential Batch Testing Results

Secondary (SE²) Encapsulates

IC Technologies Project 1342

mg Pb Solubilized per kg Waste Form

Sartomer		
1A	2A	3A
2.98	4.95	0.00
1B	2B	3B
1.98	1.98	0.00
1C	2C	3C
2.98	0.00	-2.89

Summary of Sequential Batch Testing Results

Secondary (SE²) Encapsulates

IC Technologies Project 1342

mg Pb Solubilized per kg Waste Form

Uniroyal		
<u>1A</u>	<u>2A</u>	<u>3A</u>
4.0	4.9	3.0
<u>1B</u>	<u>2B</u>	<u>3B</u>
6.0	7.9	-2.0
<u>1C</u>	<u>2C</u>	<u>3C</u>
3.0	0.0	0.0

Summary of Sequential Batch Testing Results

Secondary (SE²) Encapsulates

IC Technologies Project 1342

mg Pb Solubilized per kg Waste Form

Devcon		
1A	2A	3A
0.0	1.0	1.0
1B	2B	3B
0.0	2.0	-2.0
1C	2C	3C
0.0	0.0	0.0

Summary of Sequential Batch Testing Results

Secondary (SE²) Encapsulates

IC Technologies Project 1342

mg Pb Solubilized per kg Waste Form

Sartomer		
1A	2A	3A
3.0	5.0	0.0
1B	2B	3B
2.0	2.0	0.0
1C	2C	3C
3.0	0.0	-2.9

MULTIPLE ENCAPSULATION TESTING

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

WEEK 10

IC Technologies Project 1342

July 7, 1994

Work Completed

- ▶ Crush-resistance testing on SE² waste forms
- ▶ SE² surface characteristics were evaluated by binocular microscopy
- ▶ SE² were prepared to define waste loading at optimized conditions
- ▶ Infra-red and convection cure techniques were evaluated
- ▶ Data reduction, review and validation was initiated; the project management team met to examine program results, direction, data quality, and QC efforts.

Crush resistance to 50 PSI was evaluated on all SE² pellets, including those having undergone freeze/thaw, TCLP-M, SBT, and freeze/thaw/TCLP-M integrity testing. Test data showed that all encapsulates, regardless of treatment or history, satisfied the 50 PSI criteria. As part of the strength evaluation, EP impact testing will be performed on SE². It is anticipated that the failure rate using EP Structural Integrity testing will be higher than for crush resistance testing.

Qualitative evaluations of SE² surface features were performed using binocular microscopy. Encapsulates from all testing histories were included. These evaluations are being written up, and should be available in the Week 11 Update.

One of the project deliverables is optimization of waste loading. While waste loading is second in importance to the chemical/physical stability of the waste form, it is nevertheless an important variable in determination of operating costs, and in comparison with other potential treatment techniques. Test design to date has been driven largely by chemical stability requirements; waste loading has only been examined as an ancillary variable. Data available through testing to date shows that waste loading through the preparation of SE² waste form ranges from 60% - 70% (w/w basis). This level of waste loading satisfies the specification ($\geq 50\%$) set forth in the LANL Statement of Work. In order to confirm waste loading data, testing will be conducted to quantify this variable. It should be understood that waste loading as a variable cannot be directly affected in the system developed for LANL by IC Technologies, except for primary encapsulation. In other words, secondary encapsulation is a coating whose thickness is a function of media viscosity, and is not a controlled variable.

Two parallel series of pellets were prepared from PE through SE² to evaluate the effect(s) of infra-red (IR) thermal curing on contaminant leachability. Each cure stage, PE, SE¹, SE², was accomplished using both IR and convection techniques. TCLP-M data for both cure techniques will be reported in the Week 11 Update. One interesting development was the failure of Uniroyal polymer to completely cure under IR cure conditions.

Project management and technical personnel met to evaluate the LANL development program

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

July 7, 1994

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on a comprehensive basis. Conclusions and findings were:

- ▶ The program is proceeding generally on schedule and at or under budget projections
- ▶ Satisfaction of the primary program objective of RCRA contaminant fixation appears imminent based on data available to date.
- ▶ Additional data for stability verifications would be helpful to LANL; suggested were EP Integrity Test, and unspecified "aging".
- ▶ Also suggested was an evaluation of bonding/interaction at the PE-SE¹-SE² interfaces
- ▶ A general discussion of equipment investigations and the conceptual encapsulation process provided needed perspective.

Equipment Evaluations

The level of detail in the Conceptual Process Flow Diagram has increased over the course of the program. Current efforts are focused on the selection of appropriate major equipment items, as well as support and ancillary items such as feeders, pumps, piping, etc.

Work Scheduled

1. Evaluation of cure techniques - TCLP-M
2. EP Integrity Testing
3. Encapsulant interfacial bonding evaluations
4. Data reduction & interpretation - reporting of SW-846 1311 TCLP results
5. Conceptual PFD finalization

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

July 7, 1994

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Estimated Program Costs

The graph below illustrates estimated cumulative project cost to date. Labor and materials cost to date is estimated at \$25,362. Costs are summarized by task on the enclosed table, Project Cost Tracking.

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MULTIPLE ENCAPSULATION TESTING

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

WEEK 11

IC Technologies Project 1342

July 15, 1994

Work Completed and/or In Progress

- ▶ Evaluation of cure techniques
- ▶ EP Integrity Testing
- ▶ Encapsulant interfacial bonding evaluations
- ▶ SW-846 1311 TCLP results for SE²
- ▶ Conceptual PFD finalization

IR Curing Evaluation

To allow the widest possible range of curing techniques for consideration in continuous processing, ICT evaluated both microwave and infra-red methods. As reported in an earlier Update, the SE¹ and SE² waste forms were shown to be highly sensitive to microwave curing. Infra-red curing was evaluated in Week 10 & 11 testing; each intermediate waste form (PE, SE¹, SE²) was cured using IR lamps. The effectiveness of the IR cure was gauged by TCLP-M procedure and in comparison with existing results for thermal convection curing. Results are summarized below.

Polymer ID	mg/L Pb; TCLP-M Extract
Uniroyal Polyurethane	<1.0
Devcon Polyurethane	<1.0
Sartomer PBDDA	1

The data indicate that IR curing may be utilized for continuous processing without negative effects on waste form chemical stability.

Integrity Testing

The precursor to the Toxicity Characteristic Leaching Procedure was the EP Toxicity Test, which included a method to evaluate the structural integrity of monolithic waste forms. The objective of the test was to provide guidance on sample sizing requirements; it continues to serve as an established method for gauging impact or shock resistance of cohesive solids. ICT constructed an appropriate falling hammer tester, using SW-846 Method 1310 specifications, for this purpose. The device, and original procedure, requires preparation or sizing of a cylindrical monolith of prescribed dimensions so that the waste form is fully supported in the test apparatus. Because the ICT-developed LANL waste form is a

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

July 15, 1994

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~spherical pellet, strict adherence to the test protocol was not possible; results, however, can be considered conservative. Three SE² pellets for each secondary encapsulant were evaluated, using a single drop of the device's hammer. Results showed all pellets surviving the impact with minimal to no damage. Devcon polyurethane performed well in that only a slight deformation of the waste form was noted; the polymer coating was not compromised. Uniroyal and Sartomer pellets retained their physical shape, but suffered slight damage to coatings in the form of tears or chips.

Interface Bonding

To evaluate the degree of physical bonding between similar and dissimilar polymers, a series of cylindrical monoliths were prepared. One set of three tests used melamine formaldehyde (MF-817) cured at established conditions, followed by overpour of Uniroyal, Devcon, and Sartomer polymers, which were also cured at established conditions. The second set of three tests used twin pours of each secondary encapsulant with curing after each pour. Once curing has occurred, the strength of interface bonding will be quantified by progressive application of pressure to the interface to the point of separation. The diagram at left illustrates the proposed technique. The cylindrical monoliths have been prepared and will be evaluated in Week 12.

SW-846 1311 TCLP Results

Representative portions of SE² prepared from LANL surrogate waste were submitted to an independent laboratory for TCLP extraction and leachate analysis. The pellets were carefully sized/prepared to less than 9.5mm in diameter; each secondary encapsulant, Uniroyal, Devcon, and Sartomer, was represented. The results for leachate analysis were reported in Week 11 and are shown below.

Polymer ID	mg/L Pb; TCLP Extract
Uniroyal Polyurethane	3.2
Devcon Polyurethane	0.5
Sartomer PBDDA	1.9

The regulatory criterion for lead of 5.0 mg/L was satisfied by all encapsulates, and therefore all polymers. Devcon polyurethane provided an order-of-magnitude compliance factor and is therefore the favored secondary encapsulate.

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

July 15, 1994

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Equipment Evaluations

The choice of secondary encapsulates to evaluate was made in the early stages of this program, and was based on ICT's previous experience with those and similar polymers. The materials chosen had demonstrated superior performance and were judged to be appropriate for the significant contaminant solubility of the LANL surrogate waste. Results developed to date through performance of the Statement of Work indicate that these polymers, in combination with the methodology developed, provide the required level of integrity.

Continued evaluation of larger-scale continuous equipment needs, as directed by program results, has pointed up potential alternatives in the area of secondary encapsulation. The SE polymers' cures are rapid, and pot lives are short. These characteristics are advantages in terms of process control and consistency of waste form integrity, however they require consideration in equipment selection. Although secondary encapsulation with the chosen polymer(s) can be readily accomplished provided adequate attention is given to equipment design, appropriate equipment is likely to be semi-custom in design and manufacture. Exploration of alternative polymers may provide a means of reducing SE equipment complexity and cost. ICT has worked with heat- or force-cured thermoset polymers that possess long, sometimes indeterminate, pot lives at "ambient" conditions, but which set at slightly elevated (50-100°C) temperatures. Use of this family of polymers for SE is an option for LANL to consider in the implementation of larger scale operations.

Equipment investigations will continue to target the SE polymers optimized in this program. ICT will provide LANL technical representatives with basic information on alternative SE polymers over the course of this program.

Work Scheduled

- ▶ Equipment investigation, PFD optimization
- ▶ Tertiary encapsulation and evaluation
- ▶ Completion of interface bonding tests
- ▶ Data interpretation, initiate final report organization

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

July 13, 1994

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Estimated Program Costs

The graph below illustrates estimated cumulative project cost to date. Labor and materials cost to date is estimated at \$28,623. Costs are summarized by task on the enclosed table, Project Cost Tracking.

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MULTIPLE ENCAPSULATION TESTING

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

WEEK 12

IC Technologies Project 1342

July 20, 1994

Work Completed and/or In Progress

- ▶ Interface bonding evaluations completed
- ▶ Tertiary encapsulation test design completed
- ▶ Heat-set/force-cured polymers investigated (ongoing)
- ▶ Equipment evaluations ongoing
- PFD modifications & additions ongoing

Interface Bonding

The Week 11 Update illustrated and described a set of tests designed to evaluate bond strength between subsequent layers of similar and dissimilar polymers. Briefly, the procedure involved casting cylinders containing two polymers. Each polymer was cured at prescribed conditions. The resultant monoliths were assembled in a device schematically represented at left, and strained to the point of bond failure or failure of the polymer(s). The data, summarized below, show Devcon and Uniroyal polyurethanes providing better performance than Sartomer PBDDA in both adhesion to primary encapsulates (melamine polymer) and in self-bonding. (Tests to evaluate bonding strengths of dissimilar SE polymers were not performed. It is suggested that that exercise would not have provided meaningful data, and that larger scale operations would be simplified by the use of a single polymer for SE¹ and SE² steps.) All monoliths were cured for one week at ambient conditions prior to evaluation.

Polymer Combination	Stage Simulation	Interface Bond Failure; Kg-Meter
MF-817 / Uniroyal	PE/SE ¹	52
MF-817 / Devcon	PE/SE ¹	20
MF-817 / Sartomer	PE/SE ¹	<1.0
Uniroyal / Uniroyal	SE ¹ /SE ²	8.1
Devcon / Devcon	SE ¹ /SE ²	>35
Sartomer / Sartomer	SE ¹ /SE ²	8.1*

* Non-interface failure - tearing of polymer

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

July 20, 1994

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Note that the MF-817/Sartomer test separated at <1.0 kg-m. There was no evidence of bonding between these polymers. Three monoliths were prepared, none of which survived removal from the mold intact. Interestingly, Sartomer SE² gave good results, comparable to Uniroyal and Devcon, in TCLP-M and other integrity testing.

Tertiary Encapsulation Test Design

The objective of tertiary encapsulation, as set forth in the LANL Statement of Work, is to "physically seal the encapsulate pellets in a bulk monolith, creating a physically unified waste form free of cracks, voids, and significant imperfections." Because the waste will already have been stabilized with respect to contaminant leachability, the tertiary encapsulation waste form need not be evaluated by TCLP-type evaluations. TCLP evaluation of monolithic waste forms requires crushing/grinding/cutting to satisfy SW-846 M-1311 particle size criteria; size reduction would obviously destroy the encapsulate structure(s).

Evaluation of the tertiary waste form will be primarily qualitative, but will include compressive strength (to 50 PSI; EP Integrity; to failure) measurements.

Tertiary encapsulation agents to be investigated include portland cement, MF-817, and Devcon polyurethane. Portland cement is a traditional media for bulk stabilization, and offers the benefits of reasonable cost, high cured strength, and ease of preparation. MF-817 is a low cost polymer with attractive characteristics including significant chemical resistance, good cured strength, and ease of preparation. Additionally, its use at large scale would eliminate purchase and handling of another component. Devcon polyurethane provides excellent performance as developed in this program. Its use as a tertiary encapsulant would involve comparably higher cost, but advantages may influence the cost/benefit ratio. A summary of tests to be performed is presented below.

	Tertiary Encapsulation Medium		
SE ² Formulation	Portland Cement	MF-817	Devcon
Uniroyal	X	X	X
Devcon	X	X	X
Sartomer	X	X	X

Heat-Set/Force-Cured Polymers

As discussed in an earlier update, program developments have demonstrated that an alternative to polymers with short pot lives could benefit the equipment selection process. Uniroyal,

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

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Page 3

Devcon, and Sartomer manufacturers' technical representatives were contacted and interviewed regarding modification of their polymer's curing and pot life characteristics. Specifically, a technique to extend pot life or alter formulations to heat-set curing was sought. Results of those interviews are summarized below.

- Uniroyal: An additive is available that extends pot life to ~30-45 minutes. ICT has experimented with this additive in the past, and found it to be effective. It is suggested that the gain in pot life is insufficient to be advantageous. The pot life is not increased by increasing additive addition. Heat-setting is not an option with this polymer.
- Devcon: No increase in pot life is possible, either by chemical additive or heat-set.
- Sartomer: A substitution of oxidant in formulation can significantly extend the pot life of this polymer. Sartomer PBDDA is typically prepared using methyl ethyl ketone peroxide, but a slower acting oxidant is available, and can extend pot life to several hours.

Equipment Evaluations

Now that development testing, with the exception of tertiary encapsulation, is nearly complete, efforts are focused on equipment selection, definition of specifications, preparation of a preliminary equipment layout, and finalization of the process flow diagram.

Work Scheduled

- ▶ Tertiary encapsulation testing
- ▶ Preliminary equipment layout
- ▶ PFD development & modification
- ▶ Final report preparation

Estimated Program Costs

The graph below illustrates estimated cumulative project cost to date. Labor and materials cost to date is estimated at \$32,313. An arithmetic error (\$101) in the Week 4 estimated costs was discovered and corrected in Week 12. Corrected costs are summarized by task on the enclosed table, Project Cost Tracking.

Project Cost Tracking
IC Technologies Project 1342
7/7/94

Labor

TASK	Week Number:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Test Design & Set-Up		\$638			\$353	\$45	\$140	\$183	\$266	\$203	\$227						
Primary Encapsulation Testing		\$632	\$1,127	\$1,090	\$755	\$1,090	\$1,090										
Secondary Encapsulations								\$1,720	\$1,732	\$1,678	\$1,258						
Tertiary Encapsulations																	
Confirmation Tests																	
Data Reduction & Validation																	
Analytical/R&D QA/QC																	
Equipment Evaluations			\$82	\$560	\$151	\$45				\$271							
Reporting			\$266	\$319	\$202	\$226	\$140	\$531	\$246	\$316	\$416						
Clerical		\$251															
Project Management			\$266	\$638	\$151	\$90	\$422	\$409	\$113	\$248	\$416						
Totals:		\$1,521	\$1,740	\$2,607	\$2,067	\$1,994	\$2,677	\$3,569	\$2,489	\$3,435	\$3,263	\$0	\$0	\$0	\$0	\$0	\$0
Cumulative Totals:		\$1,521	\$3,262	\$5,868	\$7,935	\$9,929	\$12,606	\$16,175	\$18,664	\$22,099	\$25,362	\$0	\$0	\$0	\$0	\$0	\$0

Materials

\$782																	

Estimated

Total Project Cost

Weekly:	\$2,303	\$1,740	\$3,257	\$2,267	\$1,994	\$2,677	\$3,569	\$2,489	\$3,435	\$3,263	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Cumulative Weekly:	\$2,303	\$4,044	\$7,300	\$9,567	\$11,561	\$14,238	\$17,807	\$18,664	\$22,099	\$25,362	\$0	\$0	\$0	\$0	\$0	\$0	\$0

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

July 20, 1994

Page 4

Prepared by:

IC Technologies

R. Leland Schwartz
Project Manager

Approved by:

John E. Litz
President

PLEASE CALL WITH ANY QUESTIONS, COMMENTS, OR INPUT ON THE PROGRAM

Project Cost Tracking
IC Technologies Project 1342
7/20/94

Labor

TASK	Week Number:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Test Design & Set-Up		\$638			\$303	\$45	\$140	\$183	\$266	\$203	\$227	\$223	\$320				
Primary Encapsulation Testing		\$632	\$1,127	\$1,090	\$755	\$1,090	\$1,090										
Secondary Encapsulations								\$1,720	\$1,732	\$1,678	\$1,258	\$1,342	\$671				
Tertiary Encapsulations																	
Confirmation Tests													\$503				
Data Reduction & Validation					\$202	\$361	\$478	\$516	\$133	\$542	\$682	\$446	\$553				
Analytical/R&D QA/QC					\$201	\$136	\$408	\$210		\$176	\$264	\$353	\$264				
Equipment Evaluations			\$82	\$560	\$151	\$45				\$271		\$56	\$503				
Reporting			\$266	\$319	\$202	\$226	\$140	\$531	\$246	\$316	\$416	\$279	\$527				
Clerical		\$251											\$16				
Project Management			\$266	\$638	\$151	\$90	\$422	\$409	\$113	\$248	\$416	\$562	\$433				
Totals:		\$1,521	\$1,740	\$2,607	\$1,966	\$1,994	\$2,677	\$3,569	\$2,489	\$3,435	\$3,263	\$3,262	\$3,790	\$0	\$0	\$0	\$0
Cumulative Totals:		\$1,521	\$3,262	\$5,868	\$7,834	\$9,828	\$12,505	\$16,074	\$18,563	\$21,998	\$25,261	\$28,522	\$32,313	\$0	\$0	\$0	\$0

Materials

	\$782			~\$650	~\$200												

Estimated
Total Project Cost

Weekly:	\$2,303	\$1,740	\$3,257	\$2,166	\$1,994	\$2,677	\$3,569	\$2,489	\$3,435	\$3,263	\$3,262	\$3,790	\$0	\$0	\$0	\$0	\$0
Cumulative Weekly:	\$2,303	\$4,044	\$7,300	\$9,466	\$11,460	\$14,137	\$17,706	\$18,563	\$21,998	\$25,261	\$28,522	\$32,313	\$0	\$0	\$0	\$0	\$0

MULTIPLE ENCAPSULATION TESTING

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

WEEKS 13 & 14

IC Technologies Project 1342

August 2, 1994

This Update is the final scheduled weekly progress report for the program. The final report, including all development data, preliminary equipment list, layout, and process block flow diagram, will be issued at the end of Week 16, and should arrive at LANL on August 15 or 16.

Work Completed and/or In Progress

All waste form development work has been completed. Tertiary waste forms using two polymers and portland cement as encapsulates were prepared and evaluated. The basic waste form was composed of secondary encapsulate pellets encased in a monolith. Results showed that:

- ① The small scale of the tests (<200 cc) and large relative size of SE pellets caused an unrepresentative amount of void space in the monoliths. It is suggested that, at 25-gallon or larger monolith sizes, the effect of pellet size will be minimized, and voids will be few.
- ② Tertiary media differences caused a wide variation in monolith characteristics, see strength and crush resistance measurements.
- ③ Voids, and the disproportionate effect of pellet size, resulted in monoliths with less-than-maximum strength.

	EP Integrity Results		
SE ² Formulation	Portland Cement	MF-817	Devcon
Uniroyal	ME	NE	NE
Devcon	ME	NE	NE
Sartomer	ME	NE	NE

ME = Minimal Effect

NE = No Effect

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

August 2, 1994

Page 2

	Crush Resistance (50 PSI Applied) Results		
SE ² Formulation	Portland Cement	MF-817	Devcon
Uniroyal	Passed	Passed	Passed
Devcon	Passed	Passed	Passed
Sartomer	Passed	Passed	Passed

	Compression (PSI; Actual) to Failure Results		
SE ² Formulation	Portland Cement	MF-817	Devcon
Uniroyal	~67	~230	>180
Devcon	~57	~190	>180
Sartomer	~53	~190	>180

All tertiary encapsulates, including cement, were cured at 50° C for ~12-14 hours.

The data illustrate overall high levels of integrity for all tertiary encapsulates. Devcon polyurethane was clearly superior in performance. Compression-to-failure results indicate an inability to quantify a failure point due to the resiliency of the cured polymer. Devcon monoliths "squashed" in the press without cracking, splitting, or other failure mode. Values shown represent the last accurate reading obtainable prior to excessive compression.

Portland cement showed good results in EP Integrity and Crush Resistance testing. The presence of voids in the monoliths, and the short cure time probably contributed to relatively low compression-to-failure values. Portland Type II cement, which requires a 28-day cure to full strength, was used. No incompatibility with SE pellets was exhibited.

Melamine formaldehyde (MF-817) was superior to portland cement as measured by the testing performed. Average compressive failure point was ~200 PSI. EP Integrity and Crush Resistance results were satisfactory.

Waste loading calculations for encapsulation through tertiary waste form will be included in the Final Report. Visual inspection of the tertiary encapsulation waste form revealed that, even with close packing of SE pellets, significant inter-pellet void space existed. Complete filling of those voids with encapsulant will lower waste loading.

PROJECT UPDATE TO LOS ALAMOS NATIONAL LABORATORY

IC Technologies Project 1342

August 2, 1994

Page 3

Work Scheduled

Work remaining on the project includes completion of data reduction tasks, the final report, equipment lists & layout, and process block flow diagram.

Estimated Program Costs

The graph below illustrates estimated cumulative project cost to date. Labor and materials cost to date is estimated at \$38,284. Costs are summarized by task on the enclosed table, Project Cost Tracking.

Prepared by:

IC Technologies

R. Leland Schwartz
Project Manager

Approved by:

John E. Litz - VICE PRESIDENT
for President

PLEASE CALL WITH ANY QUESTIONS, COMMENTS, OR INPUT ON THE PROGRAM

APPENDIX II

ANALYSIS REPORTS

IC Technologies

SKYLINE LABS, INC.

SPECIALISTS IN EXPLORATION GEOCHEMISTRY

12090 WEST 50TH PLACE • WHEAT RIDGE, COLORADO 80033 • TEL: (303) 424-7718

REPORT OF ANALYSIS

JOB NO. HQK 171

May 12, 1994

P.O. NO. 2245

IG Technologies, Inc.

Attn: Phil Flynn

4880 Robb Street #3

Wheat Ridge, Colorado 80033

Analysis of 36 Solution Samples

ITEM	SAMPLE NUMBER	Pb (mg/L)

1	1028-20A-1	83.
2	1028-20A-2	108.
3	1028-20A-3	179.
4	1028-20B-1	101.
5	1028-20B-2	132.
6	1028-20B-3	230.
7	1028-21A-1	271.
8	1028-21A-2	362.
9	1028-21A-3	600.
10	1028-21B-1	395.
11	1028-21B-2	550.
12	1028-21B-3	980.
13	1028-22A-1	920.
14	1028-22A-2	1160.
15	1028-22A-3	1850.
16	1028-22B-1	1420.
17	1028-22B-2	1760.
18	1028-22B-3	2450.
19	1028-25A-1	81.
20	1028-25A-2	110.
21	1028-25A-3	200.
22	1028-25B-1	250.
23	1028-25B-2	342.
24	1028-25B-3	600.
25	1028-26A-1	334.

ITEM	SAMPLE NUMBER	Pb (mg/L)

26	1028-26A-2	466.
27	1028-26A-3	850.
28	1028-26B-1	441.
29	1028-26B-2	600.
30	1028-26B-3	1040.
31	1028-27A-1	1050.
32	1028-27A-2	1300.
33	1028-27A-3	1920.
34	1028-27B-1	1630.
35	1028-27B-2	1930.
36	1028-27B-3	2600.

Gordon H. VanSickle
Manager

SKYLINE LABS, INC.
SPECIALISTS IN EXPLORATION GEOCHEMISTRY

IC Technologies - Analysis Report

Date: 5/17/94
Matrix: Liquors
Method: AA
Client: ICT 1342

Element: Lead (Pb)

Note: 1 equals no dilution

SAMPLE ID		Dil. #1	Dil. #2	Dil. #3	Abs.	Ppm	mg/l
1028 -27A-1		10	10	10	0.029	1.00	997
1028 -27-A2		10	10	10	0.037	1.27	1271
1028 -27A-3		10	10	10	0.050	1.72	1718
1028 30A-2		10	10	10	0.045	1.55	1546
1028 -30B-2		10	10	10	0.042	1.44	1443
1028 -31A-2		10	10	10	0.047	1.62	1615
1028 -31B-2		10	10	10	0.094	3.23	3230
1028 -32A-2		10	10	10	0.036	1.24	1237
1028 -32B-2		10	10	10	0.043	1.48	1478
1028 28A-3		10	10	1	0.046	1.58	158
1028 -28B-3		10	10	1	0.076	2.61	261
1028 -29A-3		10	10	1	0.198	6.80	680
1028 -29B-3		10	10	10	0.031	1.07	1065
1028 -30A-3		10	10	10	0.062	2.13	2131
1028 -30B-3		10	10	10	0.059	2.03	2027
1028 -31A-3		10	10	10	0.061	2.10	2096
1028 -31B-3		10	10	10	0.063	2.16	2165
1028 -32A-3		10	10	10	0.043	1.48	1478
1028 -32B-3		10	10	10	0.061	2.10	2096
Std No.	Ppm.		Abs.	Blank	Net Abs.	Factor	Avg. (f)
1	1		0.034		0.034	0.0340	0.0291
2	2		0.056		0.056	0.0280	
3	5		0.139		0.139	0.0278	
4	10		0.266		0.266	0.0266	
blank							

IC Technologies - Analysis Report

Date: 5/13/94
Matrix: Liquors
Method: AA
Client: ICT 1342

Element: Lead (Pb)

Note: 1 equals no dilution

[illegible]

IC Technologies - Analysis Report

Date: 5/16/94
Matrix: Liquors
Method: AA
Client: ICT 1342

Element: Lead (Pb)

Note: 1 equals no dilution

SAMPLE ID	Dil. #1	Dil. #2	Dil. #3	Abs.	Ppm	mg/l
1028 -28A-2	10	10	1	0.025	0.99	99
1028 -28B-2	10	10	1	0.046	1.83	183
1028 -29A-2	10	10	1	0.115	4.57	457
1028 -29B-2	10	10	1	0.178	7.07	707
1028 -30A-2	10	10	10	0.038	1.51	1509
1028 -30B-2	10	10	10	0.039	1.55	1549
1028 -31A-2	10	10	10	0.037	1.47	1470
1028 -31B-2	10	10	10	0.091	3.61	3615
1028 -32A-2	10	10	10	0.028	1.11	1112
1028 -32B-2	10	10	10	0.036	1.43	1430
1028 -33-1	1	1	1	0.002	0.08	0
1028 -34-1	1	1	1	0.001	0.04	0
1028 -26A-1	10	10	1	0.089	3.54	354
1028 -26A-2	10	10	1	0.121	4.81	481
1028 -26A-3	10	10	1	0.202	8.02	802
1028 -27A-1	10	10	10	0.033	1.31	1311
1028 -27A-2	10	10	10	0.037	1.47	1470
1028 -27A-3	10	10	10	0.045	1.79	1787
Std No.	Ppm.	Abs.	Blank	Net Abs.	Factor	Avg. (f)
1	1	0.027		0.027	0.0270	0.0252
2	2	0.048		0.048	0.0240	
3	5	0.125		0.125	0.0250	
4	10	0.247		0.247	0.0247	
blank						

blank
blank

IC Technologies - Analysis Report

Date: 5/27/94
Matrix: Liquors **Element:** Lead (Pb)
Method: AA
Client: ICT 1342

Note: 1 equals no dilution

SAMPLE ID	Dil. #1	Dil. #2	Dil. #3	Abs.	Ppm	mg/l	
1028 -48-1	100	1	1	0.098	3.66	366	
1028 -49-1	100	1	1	0.141	5.27	527	
1028 -50-1	100	1	1	0.046	1.72	172	
1028 -50-2	100	1	1	0.055	2.05	205	
1028 -50-3	100	1	1	0.104	3.88	388	
1028 -51-1	100	1	1	0.071	2.65	265	
1028 51-2	100	1	1	0.084	3.14	314	
1028 -51-3	100	1	1	0.145	5.42	542	
1028 -52-1	100	1	1	0.061	2.28	228	
1028 -52-2	100	1	1	0.075	2.80	280	
1028 -52-3	100	1	1	0.139	5.19	519	
1028 -53-1	100	1	1	0.137	5.12	512	
1028 -53-2	100	1	1	0.157	5.86	586	
1028 -53-3	100	1	1	0.266	9.93	993	
1028 -54-1	100	1	1	0.091	3.40	340	
1028 -55-1	100	1	1	0.075	2.80	280	
1028 -35-1	200	5	1	0.028	1.05	1046	
1028 -35-2	200	5	1	0.042	1.57	1569	
1028 -35-3	200	5	1	0.059	2.20	2204	
1028 -36-1	200	5	1	0.027	1.01	1008	
1028 -36-2	200	5	1	0.027	1.01	1008	
1028 -36-3	200	5	1	0.055	2.05	2054	
Std No.	Ppm.		Abs.	Blank	Net Abs.	Factor	Avg. (f)
1	1		0.025		0.025	0.0250	0.0268
2	2		0.055		0.055	0.0275	
3	5		0.140		0.140	0.0280	
4	10		0.266		0.266	0.0266	
blank							

IC Technologies - Analysis Report

Date: 5/27/94
Matrix: Liquors **Element:** Lead (Pb)
Method: AA
Client: ICT 1342

Note: 1 equals no dilution

SAMPLE ID	Dil. #1	Dil. #2	Dil. #3	Abs.	Ppm	mg/l	
1028 -40-1	100	3	1	0.090	3.36	1008	
1028 -40-2	100	3	1	0.124	4.63	1389	
1028 40-3	100	3	1	0.237	8.85	2655	
1028 -41-1	100	1	1	0.095	3.55	355	
1028 41-2	100	1	1	0.111	4.15	415	
1028 -41-3	100	1	1	0.194	7.25	725	
1028 -42-1	100	3	1	0.118	4.41	1322	
1028 -42-2	100	3	1	0.135	5.04	1513	
1028 -42-3	100	3	1	0.190	7.10	2129	
1028 -43-1	100	1	1	0.016	0.60	60	
1028 43-2	100	1	1	0.029	1.08	108	
1028 -43-3	100	1	1	0.058	2.17	217	
1028 -44-1	100	1	1	0.107	4.00	400	
1028 -44-2	100	1	1	0.132	4.93	493	
1028 -44-3	100	1	1	0.252	9.41	941	
1028 -45-1	100	1	1	0.045	1.68	168	
1028 -45-2	100	1	1	0.048	1.79	179	
1028 -45-3	100	1	1	0.101	3.77	377	
1028 -46-1	100	1	1	0.135	5.04	504	
1028 -46-2	100	1	1	0.150	5.60	560	
1028 -46-3	100	1	1	0.235	8.78	878	
1028 -47-1	100	1	1	0.152	5.68	568	
1028 -47-2	100	1	1	0.176	6.57	657	
1028 -47-3	100	1	1	0.257	9.60	960	
Std No.	Ppm		Abs.	Blank	Net Abs.	Factor	Avg. (f)
1	1		0.025		0.025	0.0250	0.0268
2	2		0.055		0.055	0.0275	
3	5		0.140		0.140	0.0280	
4	10		0.266		0.266	0.0266	
blank							

IC Technologies - Analysis Report

Date: 5/31/94
Matrix: Liquors
Method: AA
Client: ICT 1342

Element: Lead (Pb)

Note: 1 equals no dilution

SAMPLE ID	Dil. #1	Dil. #2	Dil. #3	Abs.	Ppm	mg/l
1028 48-2	100	1	1	0.109	4.43	443
1028 48-3(112)	100	3	1	0.175	7.11	2132
1028 49-2	100	1	1	0.143	5.81	581
1028 49-3(112)	100	3	1	0.182	7.39	2217
1028 54-2	100	1	1	0.102	4.14	414
1028 54-3(112)	100	3	1	0.164	6.66	1998
1028 55-2	100	1	1	0.077	3.13	313
1028 55-3(112)	100	3	1	0.126	5.12	1535
Std No.	Ppm.	Abs.	Blank	Net Abs.	Factor	Avg. (f)
1	1	0.026		0.026	0.0260	0.0246
2	2	0.051		0.051	0.0255	
3	5	0.120		0.120	0.0240	
4	10	0.230		0.230	0.0230	
blank						

IC Technologies - Analysis Report

Date: 6/13/94
Matrix: Liquors
Method: AA
Client: ICT 1342

Element: Lead (Pb)

Note: 1 equals no dilution

[illegible]

IC Technologies - Analysis Report

Date: 6/24/94
Matrix: Liquors
Method: AA
Client: ICT 1342

Element: Lead (Pb)

Note: 1 equals no dilution

[illegible]

IC Technologies - Analysis Report

Date: 6/21/94
Matrix: Liquors
Method: AA
Client: ICT 1342

Element: Lead (Pb)

Note: 1 equals no dilution

SAMPLE ID	Dil. #1	Dil. #2	Dil. #3	Abs.	Ppm	mg/l
1028 -63-1 FT	5	1	1	0.060	1.95	10
1028 -63-2 FT	5	1	1	0.072	2.35	12
1028 -64-1 FT	5	1	1	0.066	2.15	11
1028 -64-2 FT	5	1	1	0.082	2.67	13
1028 -65-1 FT	1	1	1	0.082	2.67	3
1028 -65-2 FT	1	1	1	0.101	3.29	3
1028 -75-1 13	1	1	1	0.024	0.78	1
1028 -75-2 24	1	1	1	0.021	0.68	1
1028 -76-1 13	1	1	1	0.014	0.46	0
1028 -76-2 24	1	1	1	0.012	0.39	0
1028 -77-1 13	1	1	1	0.055	1.79	2
1028 -77-2 24	1	1	1	0.004	0.13	0
1028 -78-1A A-1	1	1	1	0.133	4.33	4
1028 -78-1B B-1	1	1	1	0.083	2.70	3
1028 -78-1C C-1	1	1	1	0.033	1.07	1
1028 -78-2A A-2	1	1	1	0.263	8.57	9
1028 -78-2B B-2	1	1	1	0.217	7.07	7
1028 -78-3A A-3	5	1	1	0.075	2.44	12
1028 -79-1A	1	1	1	0.011	0.36	0
1028 -79-1B	1	1	1	0.002	0.07	0
1028 -79-1C	1	1	1	0.002	0.07	0
1028 -79-2A	1	1	1	0.035	1.14	1
1028 -79-2B	1	1	1	0.022	0.72	1
1028 -79-3A	1	1	1	0.057	1.86	2
Std No.	Ppm.	Abs.	Blank	Net Abs.	Factor	Avg. (f)
1	1	0.032		0.032	0.0320	0.0307
2	2	0.062		0.062	0.0310	
3	5	0.153		0.153	0.0306	
4	10	0.292		0.292	0.0292	
blank						

Single
Duplicate
75
75 dev

IC Technologies - Analysis Report

Date: 6/21/94
Matrix: Liquors
Method: AA
Client: ICT 1342

Element: Lead (Pb)

Note: 1 equals no dilution

SAMPLE ID	Dil. #1	Dil. #2	Dil. #3	Abs.	Ppm	mg/l
1028 -80-1A	1	1	1	0.100	3.26	3
1028 -80-1B	1	1	1	0.018	0.59	1
1028 -80-1C	1	1	1	0.016	0.52	1
1028 -80-2A	1	1	1	0.244	7.95	8
1028 -80-2B	1	1	1	0.062	2.02	2
1028 -80-3A	1	1	1	0.258	8.40	8
Std No.	Ppm.	Abs.	Blank	Net Abs.	Factor	Avg. (f)
1	1	0.032		0.032	0.0320	0.0307
2	2	0.062		0.062	0.0310	
3	5	0.153		0.153	0.0306	
4	10	0.292		0.292	0.0292	
blank						

SKYLINE LABS, INC.

SPECIALISTS IN EXPLORATION GEOCHEMISTRY

12090 WEST 50TH PLACE • WHEAT RIDGE, COLORADO 80033 • TEL.: (303) 424-7718

REPORT OF ANALYSIS

JOB NO. HQK 175

June 7, 1994

P.O. NO. 2258

IC Technologies, Inc.

Attn: Phil Flynn

4880 Robb Street #3

Wheat Ridge, Colorado 80033

Analysis of 11 Solution Samples

ITEM	SAMPLE NUMBER	Pb (mg/L)
1	1028-35-3	4420.
2	1028-36-3	5200.
3	1028-40-2	2190.
4	1028-41-2	434.
5	1028-42-2	1500.
6	1028-50-1	171.
7	1028-50-2	203.
8	1028-50-3	380.
9	1028-53-1	510.
10	1028-53-2	600.
11	1028-53-3	1060.

Gordon H. VanSickle
Manager

IC Technologies - Analysis Report

Date: 6/10/94
Matrix: Liquors
Method: AA
Client: ICT 1342

Element: Lead (Pb)

Note: 1 equals no dilution

[illegible]

SKYLINE LABS, INC.

SPECIALISTS IN EXPLORATION GEOCHEMISTRY

12090 WEST 50TH PLACE • WHEAT RIDGE, COLORADO 80033 • TEL.: (303) 424-7718

REPORT OF ANALYSIS

JOB NO. HQK 182

June 28, 1994

P.O. NO. 2269

IC Technologies, Inc.

Attn: Phil Flynn

4880 Robb Street #3

Wheat Ridge, Colorado 80033

Analysis of 3 Solution Samples

ITEM	SAMPLE NUMBER	Pb (mg/L)

1	1028-75-2	.8
2	1028-76-2	.4
3	1028-77-2	.2

Gordon H. VanSickle
Manager

July 8, 1994

MR PHIL FLYNN
IC TECHNOLOGIES
4880 ROBB STREET #3
WHEAT RIDGE CO 80033

Data Report : 94-2328
Client Project :

Dear Mr. Flynn:

Enclosed are the analytical results for the samples shown in the Sample Log Sheet. The enclosed data have been reviewed for quality assurance. If you have any questions concerning the reported information, please contact Carl Smits, Vice President of Quality Assurance, or me.

Please Note: Samples marked for return on the Sample Log Sheet are considered hazardous, unsuitable for municipal disposal or were placed on hold at your request. Samples considered hazardous or unsuitable for municipal disposal will be returned to you immediately. Samples placed on hold will be returned and samples not considered hazardous will be disposed of one (1) month from the date of this letter.

The invoice for this work will be mailed to your Accounts Payable department shortly.

Thank you for using the services of Evergreen Analytical.

Sincerely,

Jack Barney
President

TM

Project # 94-2328

Date Due: 7-8-94

Holding Time(s): - -

Rush STANDARD

Shipping Charges N/A

E.A. Cooler # N/A

Airbill # HD

Custody Seal Intact?	N

Cooler _____ Bottles _____

COC Present **Y**

Sample Tags Present? Y

Sample Tags Listed?	Y

Sample(s)	Sealed?	Y

Special Instructions SAMPLES HAVE BEEN SIZED TO 3/8 FOR TCLP. PLEASE MINIMIZE HEAD SPACE AVAILABLE IN THE EXTRACTION VESSEL.

:=Sample to be returned

To

SxRec   C   Adm   C   QA/QC   C   Sales   C   File   Orig

∴ -12/10/23/94
R/B

IC Technologies, Inc.

4880 Robb Street, #3

Wheat Ridge, CO 80033

Phone: (303) 424-6581 FAX: (303) 422-4382

Analytical Request Work Sheet

Page   of

ICT Project Number

Analysis Requests

Standard turn

Date Submitted: 6-23-94 ICT P.O. #: 2267

Requestor: PHIL FLYNN

Laboratory: EVERGREEN

Sample Identification	ICT Control Number	Matrix	Units:	TCLP Pb only																Notes
(1) 1028-81 -3/8 INCH *	ICT 1342		ESTIMATES	✓																
(2) 1028-82 -3/8 INCH *	ICT 1342			✓																
(3) 1028-83 -3/8 INCH *	ICT 1342			✓																
(4)																				
(5)																				
(6)																				
(7)																				
(8)																				
(9)																				
(10)																				
(11)																				
(12)																				
(13)																				
(14)																				
(15)																				
(16)																				
(17)																				
(18)																				
(19)																				
(20)																				

smpllog.xls *THE SAMPLES HAVE BEEN SIZED TO -3/8 INCH FOR TCLP

DO NOT PREP OR CRUSH SAMPLES.

PLEASE MINIMIZE THE HEAD SPACE AVAILABLE IN THE EXTRACTION VESSEL

Evergreen Analytical Sample Receipt/Check-in Record

Date & Time Rec'd: 6/23/94 1145 Shipped Via: H.D.

Client: ICTECH (Airbill # if applicable)

Client Project ID(s): _____

EAL Project #(s): 94-2328 EAL Cooler(s): Y (N)

Cooler# none

Ice packs Y (N) Y N Y N Y N Y N

Temperature °C Room

	Y	N	N/A
1. Custody seal(s) present:		<u>X</u>	
Seals on cooler intact			<u>X</u>
Seals on bottle intact			<u>X</u>
2. Chain of Custody present:	<u>X</u>		
3. Containers broken or leaking:		<u>X</u>	
(Comment on COC if Y)			
4. Containers labeled:	<u>X</u>		
5. COC agrees w/ bottles received:	<u>X</u>		
(Comment on COC if N)			
6. COC agrees w/ labels:	<u>X</u>		
(Comment on COC if N)			
7. Headspace in VOA vials-waters only			<u>X</u>
(comment on COC if Y)			
8. VOA samples preserved:			<u>X</u>
9. pH measured on metals, cyanide or phenolics*:			<u>X</u>
List discrepancies _____			
*Non-EAL provided containers only, water samples only.			
10. Dissolved metals samples present:		<u>X</u>	
To be preserved:			<u>X</u>
To be filtered:			<u>X</u>
11. Short holding times:		<u>X</u>	
Specify parameters _____			
12. Multi-phase sample(s) present:		<u>X</u>	
13. COC signed w/ date/time:	<u>X</u>		

Comments: _____

(Additional comments on back)

Custodian Signature/Date: Joe W. Pres 6/23/94

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

TCLP, METALS

Date Sampled :Not Specified   Client :IC Technologies
Date Received:06/23/94   Lab Project No.:94-2328
Date Prepared:06/24,28/94   Method :40 CFR 261.24
Date Analyzed:07/05/94   Matrix :Solid

Units: mg/L

Client	1028-81	1028-82	1028-83
Sample#	-3/8 Inch*	-3/8 Inch*	-3/8 Inch*

Evergreen Sample#	X89996	X89997	X89998	TCLP LIMITS
Pb	3.2	0.5	1.9	5.0

NOTE: Results are reported on the leachate from the TCLP extraction.

* - Samples were sized by IC Technologies, no size measurement or reduction was done by Evergreen Analytical. A 2.0 liter container was used for the leaching as required by the TCLP procedure.

M.C.

Analyst

WKA

Approved

APPENDIX III

TEST WORKSHEETS

IC Technologies

ICT P/N: 1342 Waste Encapsulation/Stabilization Worksheet Date: 5-2-94
 ICT NB #: 1028-20 Rev: 3/29 Operator: PF
 Objective: AGGLOMERATION

Medium Information

Classification: MALAMINE 836
 Manufacturer: _____
 Name: _____

Waste Information

Classification: _____
 Source: _____
 ICT ID Number: _____
 Client ID Number: _____

Medium Formulation

# of Components: _____
 Component ID: MALAMINE (20g)
AlCl₃ (20%) (11g)
CLAY AS REQ'D

Waste Contaminants: AlCl₃ 8070 (408)
Ph 200% (10g)
 _____
 _____

% or ppm

Mix Composition

Wt % or
 lbs/gal Vol %

_____ g Waste
 _____ g or cc's medium
 _____ g additive
 _____ g additive
 _____ g additive

Mix and Monolith Characteristics

Mixing Technique: _____
 Pot Life, Minutes: _____ Viscosity: _____
 Cure Peak Temp, °C: _____ Cure, Hrs: _____
 Monolith Integrity: _____ Dispersion: _____
 Durometer Hardness, kg/cm²: _____

Encapsulation/Stabilization Procedure

- 1.) _____
- 2.) _____
- 3.) _____
- 4.) _____
- 5.) _____
- 6.) _____

Notes & Remarks CRUSH TEST PERFORMED PELLETT IT EXCEEDED 50PSI

Sample ID
 Number: _____

Sample
 Wt, g: _____

85.2g wet wt
 Dry wt 77.90

Sample left in agglomeration bucket

ICT P/N: 1342
 ICT NB #: 1028-21

Waste Encapsulation/Stabilization Worksheet

Date: 5-29-94

Rev: 3/29

Operator: PFObjective: AGGLOMERATIONMedium InformationClassification: MALAMINE 836

Manufacturer: _____

Name: _____

Waste Information

Classification: _____

Source: _____

ICT ID Number: _____

Client ID Number: _____

Medium Formulation

# of Components: _____

Component ID: MALAMINE (10g)
AlCl₃ (20%) (11g)
CLAY AS REQ'D

Waste Contaminants: _____

Al₂O₃ 80% (40g)
Pb 20% (10g)

% or ppm

Mix Composition

Wt % or

lbs/gal

Vol %

Mix and Monolith Characteristics

_____ g Waste _____

Mixing Technique: _____

_____ g or cc's medium _____

Pot Life, Minutes: _____ Viscosity: _____

_____ g additive _____

Cure Peak Temp, °C: _____ Cure, Hrs: _____

_____ g additive _____

Monolith Integrity: _____ Dispersion: _____

_____ g additive _____

Durometer Hardness, kg/cm²: _____Encapsulation/Stabilization Procedure

- 1.) _____
- 2.) _____
- 3.) _____
- 4.) _____
- 5.) _____
- 6.) _____

Notes & RemarksCRUSH TEST PERFORMED ON PELLET IT EXCEEDED 50PSI

Sample ID
 Number: _____

Sample
 Wt, g: _____

Wet weight - 81.5
 Dry weight 73.04

ICT P/N: 1392

Waste Encapsulation/Stabilization Worksheet

Date: 5-29-94ICT NB #: 1028-22

Rev: 3/29

Operator: PFObjective: AGGLOMERATIONMedium InformationClassification: MALAMINE 836

Manufacturer: _____

Name: _____

Waste Information

Classification: _____

Source: _____

ICT ID Number: _____

Client ID Number: _____

Medium Formulation

# of Components: _____

Component ID: MALAMINE (5g)
AlCl₃ (20%) (11g)
CLAY AS REQ'DWaste Contaminants: Al₂O₃

% or ppm

80% (40g)Pb20% (10g)Mix Composition

Wt % or

lbs/gal

Vol %

_____ g Waste

_____ g or cc's medium

_____ g additive

_____ g additive

_____ g additive

Mix and Monolith Characteristics

Mixing Technique: _____

Pot Life, Minutes: _____ Viscosity: _____

Cure Peak Temp, °C: _____ Cure, Hrs: _____

Monolith Integrity: _____ Dispersion: _____

Durometer Hardness, kg/cm²: _____Encapsulation/Stabilization Procedure

- 1.) _____
- 2.) _____
- 3.) _____
- 4.) _____
- 5.) _____
- 6.) _____

Notes & RemarksCRUSH TEST PERFORMED ON PELLET IT CRUSHED AT 29 PSISample ID
Number: _____Sample
Wt, g: _____

Wet weight - 66.7

Dry weight - 58.34

ICT P/N: 1342

Waste Encapsulation/Stabilization Worksheet

Date: 5-6-94ICT NB #: 1028-25

Rev: 3/29

Operator: PFObjective: AGGLOMERATIONMedium InformationClassification: MALAMINE 829

Manufacturer: _____

Name: _____

Waste Information

Classification: _____

Source: _____

ICT ID Number: _____

Client ID Number: _____

Medium Formulation

% or ppm

# of Components: _____

Waste Contaminants: Al₂O₃ 80% (40g)Component ID: MALAMINE (20g) 15.81Pb 20% (10g)Al₂O₃ (20%) (11g)(LAY AS REQ'D)Mix Composition

Wt % or

lbs/galVol %Mix and Monolith Characteristics

_____ g Waste _____

Mixing Technique: _____

_____ g or cc's medium _____

Pot Life, Minutes: _____ Viscosity: _____

_____ g additive _____

Cure Peak Temp, °C: _____ Cure, Hrs: _____

_____ g additive _____

Monolith Integrity: _____ Dispersion: _____

_____ g additive _____

Durometer Hardness, kg/cm²: _____Encapsulation/Stabilization Procedure

1.) _____

2.) _____

3.) _____

4.) _____

5.) _____

6.) _____

Notes & RemarksCRUSH TEST PERFORMED ON PELLET IT EXCEEDED 50PSISample ID
Number: _____Sample
Wt, g: _____Net weight 91.5
1 lb 83.02Drum res - 5.6g

ICT P/N: 1342

Waste Encapsulation/Stabilization Worksheet

Date: 5-6-94ICT NB #: 1028-26

Rev: 3/29

Operator: PFObjective: AGGLOMERATIONMedium InformationClassification: MALAMINE 829

Manufacturer: _____

Name: _____

Waste Information

Classification: _____

Source: _____

ICT ID Number: _____

Client ID Number: _____

Medium Formulation

# of Components: _____

Waste Contaminants: _____

% or ppm

Component ID: MALAMINE (10g)AlCl₃ (20%) (11g)(LAY AS REQ'D)Al₂O₃ 80% (40g)Pb 20% (10g)Mix Composition

Wt % or

lbs/gal

Vol %

_____ g Waste _____

_____ g or cc's medium _____

_____ g additive _____

_____ g additive _____

_____ g additive _____

Mix and Monolith Characteristics

Mixing Technique: _____

Pot Life, Minutes: _____ Viscosity: _____

Cure Peak Temp, °C: _____ Cure, Hrs: _____

Monolith Integrity: _____ Dispersion: _____

Durometer Hardness, kg/cm²: _____Encapsulation/Stabilization Procedure

1.) _____

2.) _____

3.) _____

4.) _____

5.) _____

6.) _____

Notes & RemarksCRUSH TEST PERFORMED ON PELLET IT CRUSHED AT 4 PSISample ID
Number: _____Sample
Wt, g: _____Net weight 79.6gDrum res- 3.7g

ICT P/N: 1342

Waste Encapsulation/Stabilization Worksheet

Date: 5-6-94ICT NB #: 1028-27

Rev: 3/29

Operator: PFObjective: AGGLOMERATIONMedium InformationClassification: MALAMINE 829

Manufacturer: _____

Name: _____

Waste Information

Classification: _____

Source: _____

ICT ID Number: _____

Client ID Number: _____

Medium Formulation

# of Components: _____

Component ID: MALAMINE (5g)
AlCl₃ (20%) (11g)
(LAY AS REQ'D)

Waste Contaminants: _____

Al₂O₃ 80% (40g)
Pb 20% (10g)

% or ppm

Mix Composition

Wt % or

lbs/galVol %Mix and Monolith Characteristics

_____ g Waste _____

_____ g or cc's medium _____

_____ g additive _____

_____ g additive _____

_____ g additive _____

Mixing Technique: _____

Pot Life, Minutes: _____ Viscosity: _____

Cure Peak Temp, °C: _____ Cure, Hrs: _____

Monolith Integrity: _____ Dispersion: _____

Durometer Hardness, kg/cm²: _____Encapsulation/Stabilization Procedure

- 1.) _____
- 2.) _____
- 3.) _____
- 4.) _____
- 5.) _____
- 6.) _____

Notes & RemarksCRUSH TEST PERFORMED ON PEALET IT CRUSHED AT 25PSISample ID
Number: _____Sample
Wt, g: _____Wet weight 73.5g
dry 64.7g

Drum res - 1.12g

ICT P/N: 1342 Waste Encapsulation/Stabilization Worksheet Date: 5-6-94
ICT NB #: 1028-28 Rev: 3/29 Operator: PF
Objective: AGGLOMERATION

Medium InformationClassification: MALAMINE 817

Manufacturer: _____

Name: _____

Waste Information

Classification: _____

Source: _____

ICT ID Number: _____

Client ID Number: _____

Medium Formulation

# of Components: _____

Component ID: MALAMINE (20g)
AlCl₃ (20%) (11g)
(LAY AS REQ'D)Waste Contaminants: Al₂O₃ 80% (40g)Pb 20% (10g)Mix Composition

Wt % or

lbs/galVol %

_____ g Waste
_____ g or cc's medium
_____ g additive
_____ g additive
_____ g additive

Mix and Monolith Characteristics

Mixing Technique: _____

Pot Life, Minutes: _____ Viscosity: _____

Cure Peak Temp, °C: _____ Cure, Hrs: _____

Monolith Integrity: _____ Dispersion: _____

Durometer Hardness, kg/cm²: _____Encapsulation/Stabilization Procedure

- 1.) _____
- 2.) _____
- 3.) _____
- 4.) _____
- 5.) _____
- 6.) _____

Notes & RemarksCRUSH TEST PERFORMED ON PELLET IT EXCEEDED 50PSISample ID
Number: _____Sample
Wt, g: _____Wet weight 93.7
Dry weight 83.85Drum wt 1.60g

ICT P/N: 1342
 ICT NB #: 1028-29

Waste Encapsulation/Stabilization Worksheet

Date: 5-6-94

Rev: 3/29

Operator: PFObjective: AGGLOMERATIONMedium InformationClassification: MALAMINE 817

Manufacturer: _____

Name: _____

Waste Information

Classification: _____

Source: _____

ICT ID Number: _____

Client ID Number: _____

Medium Formulation

# of Components: _____

Component ID: MALAMINE (10g)
AlCl₃ (20%) (1g)
(LAY AS REQ'D)

Waste Contaminants: _____

Al₂O₃ 80% (40g)
Pb 20% (10g)

% or ppm

Mix Composition

Wt % or

lbs/gal

Vol %

_____ g Waste

_____ g or cc's medium

_____ g additive

_____ g additive

_____ g additive

Mix and Monolith Characteristics

Mixing Technique: _____

Pot Life, Minutes: _____ Viscosity: _____

Cure Peak Temp, °C: _____ Cure, Hrs: _____

Monolith Integrity: _____ Dispersion: _____

Durometer Hardness, kg/cm²: _____Encapsulation/Stabilization Procedure

- 1.) _____
- 2.) _____
- 3.) _____
- 4.) _____
- 5.) _____
- 6.) _____

Notes & RemarksCRUSH TEST PREFORMED ON PELLET IT EXCEEDED 50PSI

Sample ID
 Number: _____

Sample
 Wt, g: _____

Wet weight 85.8g
 Dry weight 76.14g

Drawn wt 1.0

ICT P/N: 1342

IC Technologies

Date: 5-9-94ICT NB# 1028-20A

TCLP-M Test Report

Operator: PFObjective: PRIMARY STABILIZATIONSolid
Sample
Description:PILLETS

Variable

Tested: MELAMINE 836 29%

Extract Determination:

Extract Fluid:

Extraction:

QA/QC:

NA g SolidsSolution Extract ID

Particle Size

(List NB ID's for each applicable item)

1st pH Value

5.05 pH Value11.34 g Solids

Matrix Spike ?

2nd pH Value

2.27 mls Initial5-9-94-1700 Start Time

Duplicate ?

mls Extract

5-11-94-1500 End Time

Blank ?

Procedure:

Extract NB ID#

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 8 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

LEACHATE ANALYSIS

Hours:	8	24	48
WT			
Sample Vol, mls:			<u>191.8g</u>
mg/L Pb:			

RESIDUE PARTICLE SIZING

	Wet Solids	Dry Solids	+10-mesh	-10-mesh
Weight, g:				
Percent				

NOTES AND OBSERVATIONS

THE TCLP SOLUTIONS INCREASED TEMP TO ~32°C WHILE
BEING SHAKEN

ICT P/N: 1342

IC Technologies

Date: 5-9-94ICT NB# 1028-203

TCLP-M Test Report

Operator: PFObjective: PRIMARY STABILIZATIONSolid
Sample
Description: PELLETSVariable
Tested: MELAMINE 836 - 29%

Extract Determination:	Extract Fluid:	Extraction:	QA/QC:
<u>NA</u> g Solids	<u>SOLUTION #2</u> Extract ID	Particle Size	(List NB ID's for each applicable item)
1st pH Value	<u>3.03</u> pH Value	<u>10.84</u> g Solids	Matrix Spike ?
2nd pH Value	<u>217</u> mls Initial	<u>5-9-94-1700</u> Start Time	Duplicate ?
	mls Extract	<u>5-11-94-1500</u> End Time	Blank ?

Procedure: Extract NB ID#

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 8 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

LEACHATE ANALYSIS

Hours:	8	24	48
Sample Volume <u>WT</u> mls:			<u>179.6g</u>
mg/L Pb:			

RESIDUE PARTICLE SIZING

	Wet Solids	Dry Solids	+10-mesh	-10-mesh
Weight, g:				
Percent:				

NOTES AND OBSERVATIONS

ICT P/N: 1342
ICT NB# 1028-21A

IC Technologies
TCLP-M Test Report

Date: 5-9-94
Operator: PF

Objective: PRIMARY STABILIZATION

Solid
Sample
Description: PELLETS

Variable
Tested: MELAMINE 836 - 1770

Extract Determination:	Extract Fluid:	Extraction:	QA/QC:
<u>NA</u> g Solids	<u>SOLUTION #1</u> Extract ID	Particle Size	(List NB ID's for each applicable item)
1st pH Value	<u>5.05</u> pH Value	<u>12.23</u> g Solids	Matrix Spike ?
2nd pH Value	<u>245</u> mls Initial	<u>5-9-94-1700</u> Start Time	Duplicate ?
	mls Extract	<u>5-11-94-1500</u> End Time	Blank ?

Procedure: Extract NB ID#

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 8 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

LEACHATE ANALYSIS

Hours:	8	24	48
Sample Volume (mL):			<u>208.9g</u>
mg/L Pb:			

RESIDUE PARTICLE SIZING

	Wet Solids	Dry Solids	+10-mesh	-10-mesh
Weight, g:				
Percent:				

NOTES AND OBSERVATIONS

ICT P/N: 1342

IC Technologies

Date: 5-9-94ICT NB# 1028-21B

TCLP-M Test Report

Operator: PFObjective: PRIMARY STABILIZATIONSolid
Sample
Description: PELLETSVariable
Tested: MELAMINE 836 1770

Extract Determination:

Extract Fluid:

Extraction:

QA/QC:

NA g Solids SOLUTION#2 Extract ID _____ Particle Size _____
(List NB ID's for each applicable item)
_____ 1st pH Value 3.03 pH Value 10.97 g Solids _____ Matrix Spike ?
_____ 2nd pH Value 219 mls Initial 5-9-94-1700 Start Time _____ Duplicate ?
_____ mls Extract 5-11-94-1500 End Time _____ Blank ?

Procedure: _____ Extract NB ID# _____

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 8 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

LEACHATE ANALYSIS

Hours:	8	24	48
Sample Volume: <u>WT</u>	_____	_____	<u>183.2g</u>
mg/L Pb:	_____	_____	_____

RESIDUE PARTICLE SIZING

	Wet Solids	Dry Solids	+10-mesh	-10-mesh
Weight, g:	_____	_____	_____	_____
Percent:	_____	_____	_____	_____

NOTES AND OBSERVATIONS

ICT P/N: 1342

IC Technologies

Date: 5-9-94ICT NB# 1028-224

TCLP-M Test Report

Operator: PFObjective: PRIMARY STABILIZATIONSolid
Sample
Description: PELLETSVariable
Tested: MELAMINE 836 - 9%

Extract Determination:	Extract Fluid:	Extraction:	QA/QC:
<u>NA</u> g Solids	<u>SOLUTION #1</u> Extract ID	Particle Size	(List NB ID's for each applicable item)
1st pH Value	<u>5.05</u> pH Value	<u>10.70</u> g Solids	Matrix Spike ?
2nd pH Value	<u>214</u> mls Initial	<u>5-9-94-1700</u> Start Time	Duplicate ?
	mls Extract	<u>5-11-94-1500</u> End Time	Blank ?

Procedure: _____ Extract NB ID#

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 8 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

LEACHATE ANALYSIS

Hours:	8	24	48
Sample Volume, mL:	_____	_____	<u>178.3g</u>
mg/L Pb:	_____	_____	_____

RESIDUE PARTICLE SIZING

	Wet Solids	Dry Solids	+10-mesh	-10-mesh
Weight, g:	_____	_____	_____	_____
Percent:	_____	_____	_____	_____

NOTES AND OBSERVATIONS

ICT P/N: 1342

IC Technologies

Date: 5-9-94ICT NB# 1028-22B

TCLP-M Test Report

Operator: PFObjective: PRIMARY STABILIZATIONSolid
Sample
Description:PELLETS

Variable

Tested: MELAMINE 836 - 9%

Extract Determination:

Extract Fluid:

Extraction:

QA/QC:

NA g SolidsSOLUTION #2 Extract ID

Particle Size

(List NB ID's for each applicable item)

1st pH Value

3.03

pH Value

10.61

g Solids

Matrix Spike ?

2nd pH Value

212

mls Initial

5-9-94-1700

Start Time

Duplicate ?

mls Extract

5-11-94-1500

End Time

Blank ?

Procedure:

Extract NB ID#

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 8 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

LEACHATE ANALYSIS

Hours:	8	24	48
Sample Volume, mL:			<u>172.6g</u>
mg/L Pb:			

RESIDUE PARTICLE SIZING

	Wet Solids	Dry Solids	+10-mesh	-10-mesh
Weight, g:				
Percent:				

NOTES AND OBSERVATIONS

ICT P/N: 1342

IC Technologies

Date: 5-9-94ICT NB# 1028-25A

TCLP-M Test Report

Operator: PFObjective: PRIMARY STABILIZATIONSolid
Sample
Description:PELLETS

Variable

Tested: MELAMINE 829-23%

Extract Determination:

Extract Fluid:

Extraction:

QA/QC:

NA g SolidsSOLUTION #1 Extract ID

Particle Size

(List NB ID's for each applicable item)

1st pH Value

5.05 pH Value10.91 g Solids

Matrix Spike ?

2nd pH Value

218 mls Initial5-9-94-1700 Start Time

Duplicate ?

mls Extract

5-11-94-1500 End Time

Blank ?

Procedure:

Extract NB ID#

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 8 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

LEACHATE ANALYSIS

Hours:	8	24	48
Sample ~~Volume, mls~~ ^{WT}	_____	_____	<u>179.4g</u>
mg/L Pb:	_____	_____	_____

RESIDUE PARTICLE SIZING

	Wet Solids	Dry Solids	+10-mesh	-10-mesh
Weight, g:	_____	_____	_____	_____
Percent:	_____	_____	_____	_____

NOTES AND OBSERVATIONS

ICT P/N: 1342

IC Technologies

Date: 5-9-94ICT NB# 1028-25B

TCLP-M Test Report

Operator: PFObjective: PRIMARY STABILIZATIONSolid
Sample
Description: PELLETSVariable
Tested: MELAMINE 829 - 23%

Extract Determination:	Extract Fluid:	Extraction:	QA/QC:
<u>NA</u> g Solids	<u>SOLUTION #2</u> Extract ID	Particle Size	(List NB ID's for each applicable item)
1st pH Value	<u>3.03</u> pH Value	<u>11.85</u> g Solids	Matrix Spike ?
2nd pH Value	<u>2.37</u> mls Initial	<u>5-9-94-1700</u> Start Time	Duplicate ?
	mls Extract	<u>5-11-94-1500</u> End Time	Blank ?

Procedure: Extract NB ID#

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 8 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

LEACHATE ANALYSIS

Hours:	8	24	48
Sample Volume, mls:			<u>185.8g</u>
mg/L Pb:			

RESIDUE PARTICLE SIZING

	Wet Solids	Dry Solids	+10-mesh	-10-mesh
Weight, g:				
Percent:				

NOTES AND OBSERVATIONS

ICT P/N: 1342

IC Technologies

Date: 5-9-94ICT NB# 1028-26A

TCLP-M Test Report

Operator: PFObjective: PRIMARY STABILIZATIONSolid
Sample
Description: PERLETSVariable
Tested: MELAMINE 829-17%

Extract Determination:	Extract Fluid:	Extraction:	QA/QC:
<u>NA</u> g Solids	<u>SOLUTION #1</u> Extract ID	Particle Size	(List NB ID's for each applicable item)
1st pH Value	<u>5.05</u> pH Value	<u>10.57</u> g Solids	Matrix Spike ?
2nd pH Value	<u>211</u> mls Initial	<u>5-9-94-1700</u> Start Time	Duplicate ?
	mls Extract	<u>5-11-94-1500</u> End Time	Blank ?

Procedure: Extract NB ID#

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 8 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

LEACHATE ANALYSIS

Hours:	8	24	48
Sample Volume, mL:			<u>166.8g</u>
mg/L Pb:			

RESIDUE PARTICLE SIZING

	Wet Solids	Dry Solids	+10-mesh	-10-mesh
Weight, g:				
Percent:				

NOTES AND OBSERVATIONS

ICT P/N: 1342

IC Technologies

Date: 5-9-94ICT NB# 1028-26B

TCLP-M Test Report

Operator: PFObjective: PRIMARY STABILIZATIONSolid
Sample
Description:PELLETS

Variable

Tested: MELAMINE 829-1790

Extract Determination:

Extract Fluid:

Extraction:

QA/QC:

NA g SolidsSOLUTION #2 Extract ID

Particle Size

(List NB ID's for each applicable item)

1st pH Value

3.03 pH Value11.10 g Solids

Matrix Spike ?

2nd pH Value

222 mls Initial5-9-94-1700 Start Time

Duplicate ?

mls Extract

5-11-94-1500 End Time

Blank ?

Procedure:

Extract NB ID#

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 8 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

LEACHATE ANALYSIS

Hours:	8	24	48
Sample Weight:			<u>184.4g</u>
mg/L Pb:			

RESIDUE PARTICLE SIZING

	Wet Solids	Dry Solids	+10-mesh	-10-mesh
Weight, g:				
Percent:				

NOTES AND OBSERVATIONS

ICT P/N: 1342

IC Technologies

Date: 5-9-94ICT NB# 1028-27A

TCLP-M Test Report

Operator: PFObjective: PRIMARY STABILIZATIONSolid
Sample
Description: PELLETSVariable
Tested: MELAMINE 829 - 9%

Extract Determination:

Extract Fluid:

Extraction:

QA/QC:

NA g SolidsSOLUTION # 1 Extract ID

Particle Size

(List NB ID's for each applicable item)

1st pH Value

5.05 pH Value10.70 g Solids

Matrix Spike ?

2nd pH Value

2.14 mls Initial5-9-94-1700 Start Time

Duplicate ?

mls Extract

5-11-94-1500 End Time

Blank ?

Procedure: Extract NB ID#

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 8 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

LEACHATE ANALYSIS

Hours:	8	24	48
Sample Volume:	<u>WT</u>		<u>174.7g</u>
mg/L Pb:			

RESIDUE PARTICLE SIZING

	Wet Solids	Dry Solids	+10-mesh	-10-mesh
Weight, g:				
Percent:				

NOTES AND OBSERVATIONS

Date: 5-9-94

Operator: *PF*

Objective: PRIMARY STABILIZATION

Solid
Sample
Description: PELLETS

Variable
Tested: MELAMINE 829 - 9%

Extract Determination:

Extract Fluid:

Extraction:

QA/QC:

NA g Solids

SOLUTION #2 Extract ID

Particle Size

(List NB ID's for each applicable item)

1st pH Value

3.03 pH Value

10.07 g Solids

Matrix Spike ?

2nd pH Value

201 mls Initial

5-9-94-1700 Start Time

Duplicate ?

2mls Extract

5-11-94-1500 End Time

Blank ?

Procedure: _____ **Extract NB ID#** _____

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 8 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

LEACHATE ANALYSIS

Hours: 8 24 48

Sample Volume: WT _____ 157.7g

mg/L Pb: _____

RESIDUE PARTICLE SIZING

	<u>Wet Solids</u>	<u>Dry Solids</u>	<u>+10-mesh</u>	<u>-10-mesh</u>
Weight, g:	_____	_____	_____	_____
Percent	_____	_____	_____	_____

NOTES AND OBSERVATIONS

ICT P/N: 1342

Waste Encapsulation/Stabilization Worksheet

Date: 5-6-94ICT NB #: 1028-30

Rev: 3/29

Operator: PFObjective: AGGLOMERATIONMedium InformationClassification: MALAMINE 817

Manufacturer: _____

Name: _____

Waste Information

Classification: _____

Source: _____

ICT ID Number: _____

Client ID Number: _____

Medium Formulation

# of Components: _____

Component ID: MALAMINE 5g
AlCl₃ (20%) 11g
(LAY AS REQ'D)

Waste Contaminants: _____

Al₂O₃ 80% (40g)
Pb 20% (10g)

% or ppm

Mix Composition

Wt % or

lbs/gal

Vol %

_____ g Waste _____

_____ g or cc's medium _____

_____ g additive _____

_____ g additive _____

_____ g additive _____

Mix and Monolith Characteristics

Mixing Technique: _____

Pot Life, Minutes: _____ Viscosity: _____

Cure Peak Temp, °C: _____ Cure, Hrs: _____

Monolith Integrity: _____ Dispersion: _____

Durometer Hardness, kg/cm²: _____Encapsulation/Stabilization Procedure

- 1.) _____
- 2.) _____
- 3.) _____
- 4.) _____
- 5.) _____
- 6.) _____

Notes & RemarksCRUSH TEST PERFORMED ON PELLET IT CRUSHED AT 15 PSISample ID
Number: _____Sample
Wt, g: _____Net weight 71.8g
Lot # 23632Drum into 0.70g

ICT P/N: 1342

Waste Encapsulation/Stabilization Worksheet

Date: 5-6-94ICT NB #: 1028-31

Rev: 3/29

Operator: PFObjective: AGGLOMERATIONMedium InformationClassification: MALAMINE 836

Manufacturer: _____

Name: _____

Waste Information

Classification: _____

Source: _____

ICT ID Number: _____

Client ID Number: _____

Medium Formulation

# of Components: _____

Component ID: MALAMINE (5g)AlCl₃ (20%) (11g)(LAW AS REQ'D)POLYOX 1009/L (40 drops)Waste Contaminants: Al₂O₃

% or ppm

80% (40g)Pb20% (10g)Mix Composition

Wt % or

lbs/gal

Vol %

_____ g Waste _____

_____ g or cc's medium _____

_____ g additive _____

_____ g additive _____

_____ g additive _____

Mix and Monolith Characteristics

Mixing Technique: _____

Pot Life, Minutes: _____ Viscosity: _____

Cure Peak Temp, °C: _____ Cure, Hrs: _____

Monolith Integrity: _____ Dispersion: _____

Durometer Hardness, kg/cm²: _____Encapsulation/Stabilization Procedure:

- 1.) I ADDED THE POLYOX AS A LIQUID IN 4
- 2.) ~~PORTIONS~~ PORTIONS WHILE ADDING THE AlCl₃ SOLUTION
- 3.) _____
- 4.) _____
- 5.) _____
- 6.) _____

Notes & RemarksCRUSHTEST PERFORMED ON PELLET IT CRUSHED AT 10 PSISample ID
Number: _____Sample
Wt, g: _____Net weight 79.2gSum res 1.6g

ICT P/N: 1342
ICT NB #: 1028-32

Waste Encapsulation/Stabilization Worksheet

Date: 5-6-94

Rev: 3/29

Operator: PFObjective: AGGLOMERATION

Medium Information

Classification: MALAMINE 817

Manufacturer: _____

Name: _____

Waste Information

Classification: _____

Source: _____

ICT ID Number: _____

Client ID Number: _____

Medium Formulation

of Components: _____

Component ID: MALAMINEAl₂O₃ (20%)(LAW AS REQ'D)POLVOX 100g/l (40g/gal)

% or ppm

Waste Contaminants: Al₂O₃ 80% (40g)Pb 20% (10g)

Mix Composition

Wt % or

lbs/gal

Vol %

_____ g Waste _____

_____ g or cc's medium _____

_____ g additive _____

_____ g additive _____

_____ g additive _____

Mix and Monolith Characteristics

Mixing Technique: _____

Pot Life, Minutes: _____ Viscosity: _____

Cure Peak Temp, °C: _____ Cure, Hrs: _____

Monolith Integrity: _____ Dispersion: _____

Durometer Hardness, kg/cm²: _____

Encapsulation/Stabilization Procedure

1.) _____

2.) _____

3.) _____

4.) _____

5.) _____

6.) _____

Notes & Remarks

CRUSH TEST PERFORMED ON PELLETT IT CRUSHED AT 42 PSISample ID
Number: _____Sample
Wt, g: _____Wet weight 75.3gGrum res - 1.3g

$$\frac{43}{36}$$

$$\frac{927}{835}$$

1342

28A m. tasked IT 10.86

B unlabeled IT 12.30

29A ET log - 10.41

B IT .039 11.82

30A IT .059 9.59

B IT .10 10.68

31A m. tasked ~~IT~~ some fragmentation 9.61 .59

B IT " " 9.27 .929

32A IT 11.59 .109

B 11.42 .1069

~~33A~~
~~33B~~

20A 11.07 IT

20B 10.57 IT

21A 11.71 IT 0.1 fine

21B 10.39 " "

22A 10.05 IT

22B 9.77 IT

25A 10.57 IT 0.22

25B 11.22 IT 0.29

26A 10.19 IT 0.15

26B 10.62 IT 0.05

27A 10.02 IT 0.13

27B 9.23 IT 0.28

~~28A~~

ICT P/N: 1342
ICT NB #: 1028-33

Waste Pelletization/TCLP-M Worksheet

Rev: 5/13/94

Date: 5-16-94
Operator: PF

Objective: BLANK

Encapsulation Protocol: ☐ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 0 % Pb Other: _____

Medium Information

ID: _____

Type: _____

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: 0

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

Mix Composition

0 g Surrogate Waste
_____ g or cc's medium
_____ g/mls additive
_____ g/mls additive
_____ g/mls additive
_____ g/mls additive

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
<u>SOLUTION #</u> Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
<u>5.05</u> pH Value	g Solids	Duplicate ?	
<u>200</u> mls Initial	Start Date/Time	Blank ?	
_____ mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets			0	0			
	Mix Reject							
	TCLP Extract					0	0	0
	TCLP Solids			0	0			

Notes

ICT P/N: 1342
ICT NB #: 1028-34

Waste Pelletization/TCLP-M Worksheet

Rev: 5/13/94

Date: 5-16-94
Operator: PF

Objective: BLANK

Encapsulation Protocol: ☐ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 0 % Pb Other: _____

Medium Information

ID: _____

Type: _____

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent

☐ Fair ☐ Fair

☐ Poor ☐ Poor

Observations

Mix Composition

_____ g Surrogate Waste

_____ g or cc's medium

_____ g/mls additive

_____ g/mls additive

_____ g/mls additive

_____ g/mls additive

TCLP-M Data

Extract Fluid:

Extraction:

QA/QC:

Data:

SOLUTION #2

Extract ID

Particle Size

(List NB ID's for each applicable item)

Temp, °C

pH Value

g Solids

Duplicate ?

200 mls Initial

Start Date/Time

Blank ?

mls Extract

End Date/Time

Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight; g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					0	0	0
	TCLP Solids							

Notes

ICT P/N: 1342
ICT NB #: 1028-35

Waste Pelletization/TCLP-M Worksheet

Rev: 5/13/94

Date: 5-16-94
Operator: PF

Objective: LEACH OF UNTREATED WASTE

Encapsulation Protocol: ☐ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20% % Pb Other: 80% Al₂O₃

Medium Information

ID: _____

Type: _____

Mix Composition

10.0 g Surrogate Waste

_____ g or cc's medium

_____ g/mls additive

_____ g/mls additive

_____ g/mls additive

_____ g/mls additive

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: NA

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent

☐ Fair ☐ Fair

☐ Poor ☐ Poor

Observations

TCLP-M Data

Extract Fluid:

Extraction:

QA/QC:

Data:

Solution # / Extract ID

_____ Particle Size

(List NB ID's for each applicable item)

_____ Temp, °C

505 pH Value

_____ g Solids

_____ Duplicate ?

200 mls Initial

_____ Start Date/Time

_____ Blank ?

_____ mls Extract

_____ End Date/Time

_____ Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					1046	1569	2204
	TCLP Solids				10			

Notes

ICT P/N: 1342
ICT NB #: 1028-36

Waste Pelletization/TCLP-M Worksheet

Rev: 5/13/94

Date: 5-16-94
Operator: PF

Objective: LEACH OF UNTREATED WASTE

Encapsulation Protocol: ☐ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: 80% Al₂O₃

Medium Information

ID: _____

Type: _____

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: NA

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

Mix Composition

10.0 g Surrogate Waste

_____ g or cc's medium

_____ g/mls additive

_____ g/mls additive

_____ g/mls additive

_____ g/mls additive

TCLP-M Data

Extract Fluid:

Extraction:

QA/QC:

Data:

Solution #2 Extract ID

_____ Particle Size

(List NB ID's for each applicable item)

_____ Temp, °C

3.03 pH Value

_____ g Solids

_____ Duplicate ?

200 mls Initial

_____ Start Date/Time

_____ Blank ?

_____ mls Extract

_____ End Date/Time

_____ Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					1008	1008	2054
	TCLP Solids							

Notes

ICT P/N: 1342
ICT NB #: 1028-40

Waste Pelletization/TCLP-M Worksheet

Rev: 5/13/94

Date: 5-20-94

Operator: PF

Objective: OPTIMIZATION TESTING - PRIMARY STABILIZATION

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: A1203

Medium Information

ID: MAHAMINE

Type: 836

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: 15 PSI

Pelletization Pellet Integrity LEACH- 5 PSI

☒ Excellent ☒ Excellent

☐ Fair ☐ Fair

☐ Poor ☐ Poor

Observations

WET WT 72.03g

RESIDUE IN DRUM 1.0g

Mix Composition

50 g Surrogate Waste

5 g or cc's medium

8.8 g/mls additive

2.0 g/mls additive

8.87 g/mls additive

           g/mls additive

H₂O

AlCl₃

CLAY

DRY WT 64.11g

TCLP-M Data

Extract Fluid:

#2 Extract ID

Extraction:

           Particle Size

QA/QC:

(List NB ID's for each applicable item)

Data:

           Temp, °C

3.03 pH Value 10.02 g Solids

           Duplicate ?

200 mls Initial   Start Date/Time

           Blank ?

           mls Extract   End Date/Time

           Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					1008	1389	2655
	TCLP Solids	10.02	9.03	8.91	0.12			

Notes

ICT P/N: 1342
ICT NB #: 1028-41

Waste Pelletization/TCLP-M Worksheet

Rev: 5/13/94

Date: 5-20-94
Operator: PF

Objective: OPTIMIZATION TESTING - PRIMARY STABILIZATION

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: A1203

Medium Information

ID: MAHAMINE
Type: 836

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: 750 PSI
each - 750 PSI

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☒ Fair ☒ Fair
☐ Poor ☐ Poor

Observations

WFT WT 96.67 DRY WT 88.20
RESIDUE IN DRUM 2.50

Mix Composition

50 g Surrogate Waste
20 g or cc's medium
8.8 g/mls additive H₂O
2.0 g/mls additive AlCl₃
15.6 g/mls additive CLAY
g/mls additive

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
<u>#2</u> Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
<u>3.23</u> pH Value	<u>10.00</u> g Solids	Duplicate ?	
<u>200</u> mls Initial	Start Date/Time	Blank ?	
mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					355	415	725
	TCLP Solids	10.00	9.11	8.83	0.28			

Notes

ICT P/N: 1342
ICT NB #: 1028-42

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 5-20-94
Operator: PF

Objective: OPTIMIZATION TESTING - PRIMARY STABILIZATION

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: Al₂O₃

Medium Information

ID: MEAMINE
Type: 817

Mix Composition

50 g Surrogate Waste
5 g or cc's medium
8.8 g/mls additive H₂O
2.0 g/mls additive AlCl₃
1323 g/mls additive CLAY
g/mls additive

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: 2.5 PSE

4 EACH - 5 PSI

Excellent ☒ Pellet Integrity ☒ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

WET WT - 76.50g DRY 68.71g
RESIDUE IN DRUM - 0.62g

TCLP-M Data

Extract Fluid: #2 Extraction: 10.15 QA/QC: 10.15 Data: 10.15
Extract ID: 3.03 Particle Size: 10.15 (List NB ID's for each applicable item)
pH Value: 20.3 g Solids: 10.15 Duplicate ?
mls Initial: 20.3 Start Date/Time: Blank ?
mls Extract: End Date/Time: Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					1322	1513	2129
	TCLP Solids	10.15	9.34	9.08	0.26			

Notes

ICT P/N: 1342-43

Waste Pelletization/TCLP-M Worksheet

Date: 5-20-94ICT NB #: 1028

Rev: 5/13/94

Operator: PFObjective: OPTIMIZATION TESTING - PRIMARY STABILIZATION

Encapsulation Protocol:

Primary

Secondary

Tertiary

Surrogate Composition:

20

% Pb

Other:

Al₂O₃

Medium Information

ID: MEAMINEType: 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI:

750 PSI

Pelletization Pellet Integrity

LEACH - > 50 PSI☐ Excellent☐ Excellent☒ Fair☒ Fair☐ Poor☐ Poor

Observations

WET wt - 96.04g DRY 87.5g
RESIDUE IN DRUM - 1.50g

Mix Composition

50 g Surrogate Waste20 g or cc's medium8.8 g/mls additiveH₂O2.0 g/mls additiveAlCl₃18.33 g/mls additiveCLAY   g/mls additive

TCLP-M Data

Extract Fluid:

#2

Extraction:

Particle Size

QA/QC:

(List NB ID's for each applicable item)

Data:

Temp, °C

3.03

pH Value

10.37

g Solids

Duplicate ?

207

mls Initial

Start Date/Time

Blank ?

mls Extract

End Date/Time

Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					60	108	217
	TCLP Solids	10.37	10.06	10.03	0.03			

Notes

ICT P/N: 1342
ICT NB #: 1028-44

Waste Pelletization/TCLP-M Worksheet

Rev: 5/13/94

Date: 5-20-94

Operator: PF

Objective: OPTIMIZATION TESTING - PRIMARY STABILIZATION

Encapsulation Protocol:

Primary

Secondary

Tertiary

Surrogate Composition:

20 % Pb

Other:

Al₂O₃

Medium Information

ID: MEAMINE

Type: 836

Pelletized Waste Data

Uniaxial Compressive Strength, PSI:

750 PSI

Pelletization Pellet Integrity

LEACH - 750 PSI

☐ Excellent

☐ Excellent

☒ Fair

☒ Fair

☐ Poor

☐ Poor

Observations

WET WT - 87.83g DRY 79.80g

RESIDUE IN DRUM - 2.30g

Mix Composition

50 g Surrogate Waste

15 g or cc's medium

8.8 g/mls additive

H₂O

2.0 g/mls additive

AlCl₃

16.81 g/mls additive

CLAY

                     g/mls additive

TCLP-M Data

Extract Fluid:

#2

Extract ID

Extraction:

Particle Size

QA/QC:

(List NB ID's for each applicable item)

Data:

Temp, °C

3.03 pH Value

10.05 g Solids

Duplicate ?

200 mls Initial

Start Date/Time

Blank ?

mls Extract

End Date/Time

Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					400	493	941
	TCLP Solids	10.05	9.41	9.34	0.07			

Notes

ICT P/N: 1342

Waste Pelletization/TCLP-M Worksheet

Date: 5-20-94ICT NB #: 1028-45

Rev: 5/13/94

Operator: PFObjective: OPTIMIZATION TESTING - PRIMARY STABILIZATION

Encapsulation Protocol:

Primary

Secondary

Tertiary

Surrogate Composition: 20 % PbOther: Al₂O₃

Medium Information

ID: MEAMINEType: 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: 750 PSI

Pelletization Pellet Integrity

☒ Excellent ☒ Excellent☐ Fair ☐ Fair☐ Poor ☐ Poor

WEACH - 750 PSI

Observations

WET WT - 87.33g DRY 78.61
RESIDUE IN DRUM - 0.50g

Mix Composition

50 g Surrogate Waste15 g or cc's medium8.8 g/mls additive2.0 g/mls additive12.93 g/mls additive   g/mls additiveH₂OAlCl₃CLAY

TCLP-M Data

Extract Fluid:

#2

Extract ID

Extraction:

Particle Size

QA/QC:

(List NB ID's for each applicable item)

Data:

Temp, °C

303

pH Value

10.09

g Solids

Duplicate ?

200

mls Initial

Start Date/Time

Blank ?

mls Extract

End Date/Time

Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					168	179	377
	TCLP Solids	10.09	9.77	9.75	0.02			

Notes

ICT P/N: 1342 Waste Pelletization/TCLP-M Worksheet Date: 5-20-94
ICT NB #: 1028-46 Rev: 5/13/94 Operator: PF

Objective: OPTIMIZATION TESTING - PRIMARY STABILIZATION

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: Al₂O₃

Medium Information

ID: MELAMINE

Type: 836

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: 750 PSI

Pelletization Pellet Integrity LEACH - 750 PSI

☐ Excellent ☐ Excellent
☒ Fair ☐ Fair
☐ Poor ☒ Poor

Observations

WET wt - 94.29g DRY 89.80g
RESIDUE IN DRUM - 3.40g

Mix Composition

50 g Surrogate Waste
20 g or cc's medium
8.8 g/mls additive H₂O
2.0 g/mls additive AlCl₃
19.2 g/mls additive CLAY
g/mls additive

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
<u>#2</u> Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
<u>303</u> pH Value	<u>10.41</u> g Solids	Duplicate ?	
<u>208</u> mls Initial	Start Date/Time	Blank ?	
mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

NB#	Description	Weight, g or Volume, mls		mg/L Pb		
		As Prep'd	Dried	+10M	-10M	
	Pellets					
	Mix Reject					
	TCLP Extract					
	TCLP Solids	10.41	9.27	9.13	0.14	

Notes

air dry 24 HRS

ICT P/N: 1342

Waste Pelletization/TCLP-M Worksheet

Date: 5-20-94ICT NB #: 1028-47

Rev: 5/13/94

Operator: PFObjective: OPTIMIZATION TESTING - PRIMARY STABILIZATION

Encapsulation Protocol:

Primary

Secondary

Tertiary

Surrogate Composition: 20 % PbOther: Al₂O₃

Medium Information

ID: MEAMINEType: 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI:

>50 PSI

Pelletization

Pellet Integrity

LEACH - >50 PSI☐ Excellent☐ Excellent☒ Fair☐ Fair☐ Poor☒ Poor

Observations

WET WT - 95.05g DRY 90.79gRESIDUE IN DRUM - 1.20g

Mix Composition

50 g Surrogate Waste20 g or cc's medium8.8 g/mls additive2.0 g/mls additive17.72 g/mls additive   g/mls additiveH₂OAlCl₃CLAY

TCLP-M Data

Extract Fluid:

#2

Extraction:

QA/QC:

Data:

Extract ID

Particle Size

(List NB ID's for each applicable item)

Temp, °C

3.03

pH Value

10.04

g Solids

Duplicate ?

200

mls Initial

Start Date/Time

Blank ?

mls Extract

End Date/Time

Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					568	657	960
	TCLP Solids	10.04	8.94	8.98	0.06			

Notes

an dry24HR

ICT P/N: 1242
ICT NB #: 1028-48

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 5-24-94
Operator: PF

Objective: OPTIMIZATION TESTING - PRIMARY STABILIZATION

Encapsulation Protocol: ☐ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: A1203

Medium Information

ID: MELAMINE

Type: 836

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: 750 PSI

Pelletization Pellet Integrity

☒ Excellent ☒ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

LEACH - 40 PSI

Observations

WET WT 91.31 DRY- 80.70g
RESIDUE IN DRUM 2.0g

Mix Composition

50 g Surrogate Waste

20 g or cc's medium

8.8 g/mls additive

20 g/mls additive

13.15 g/mls additive

g/mls additive

H₂O

AlCl₃

CLAY

TCLP-M Data

Extract Fluid:

#2 Extract ID

303 pH Value

mls Initial

mls Extract

Extraction:

Particle Size

10.25 g Solids

Start Date/Time

End Date/Time

QA/QC:

(List NB ID's for each applicable item)

Duplicate ?

Blank ?

Baseline ?

Data:

Temp, °C

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd		Dried		+10M		-10M		12-14 hrs	24 hrs	~~48 hrs~~
	Pellets											
	Mix Reject											
	TCLP Extract									366	443	2132 (112HR)
	TCLP Solids	10.25	9.82			9.81	0.01					

Notes

Cure at 100°C over night

ICT P/N: 1342
ICT NB #: 1028-49

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 5-24-94
Operator: PF

Objective: OPTIMIZATION TESTING- PRIMARY STABILIZATION

Encapsulation Protocol: ☐ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: Al₂O₃

Medium Information

ID: MAHAMINE
Type: 817

Mix Composition

50 g Surrogate Waste
20 g or cc's medium
8.8 g/mls additive H₂O
20 g/mls additive AlCl₃
15.97 g/mls additive CLAY
g/mls additive

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: 750 PSI

Pelletization Pellet Integrity

☐ Excellent ☒ Excellent
☒ Fair ☐ Fair
☐ Poor ☐ Poor

LEACH - 27 PSI

Observations

WET WT 93.95 DRY 86.16g
RESIDUE IN DRUM 2.3g

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
<u>#2</u> Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
<u>3.03</u> pH Value	<u>10.10</u> g Solids	Duplicate ?	
mls Initial	Start Date/Time	Blank ?	
mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	~~48 hrs~~
	Pellets							
	Mix Reject							
	TCLP Extract					527	581	2217(112AR)
	TCLP Solids	10.10	9.64	9.53	0.11			

Notes

Cure at 100°C over night

ICT P/N: 1342 Waste Pelletization/TCLP-M Worksheet Date: 5-20-94
 ICT NB #: 1028-50 Rev: 5/13/94 Operator: PF

Objective: OPTIMIZATION TESTING - PRIMARY STABILIZATION

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: Al₂O₃

Medium Information

ID: MEAMINE

Type: ~~838~~ 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: 750 PSI

Pelletization Pellet Integrity LEACH - 750 PSI

☒ Excellent ☒ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

WET WT - 96.59 g DRY - 88.06
RESIDUE IN DRUM - 0.60g

Mix Composition

50 g Surrogate Waste
20 g or cc's medium
8.8 g/mls additive H₂O
2.0 g/mls additive AlCl₃
16.40 g/mls additive CLAY
         g/mls additive

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
<u>#2</u> Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
<u>303</u> pH Value	<u>10.22</u> g Solids	Duplicate ?	
<u>204</u> mls Initial	Start Date/Time	Blank ?	
mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					172	205	388
	TCLP Solids	10.22	9.64	9.62	0.02			

Notes

Cure time is 1 hour at 50°C

ICT P/N: 1342
ICT NB #: 1028-51

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 5-20-94
Operator: PF

Objective: OPTIMIZATION TESTING - PRIMARY STABILIZATION

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: Al₂O₃

Medium Information

ID: MEAMINE

Type: 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: > 50 PSI

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☒ Fair ☒ Fair
☐ Poor ☐ Poor

HEACH - > 50 PSI

Observations

WET wt - 95.58g DRY - 88.84g
RESIDUE IN DRUM - 1.20g

Mix Composition

50 g Surrogate Waste

20 g or cc's medium

8.8 g/mls additive

2.0 g/mls additive

17.43 g/mls additive

           g/mls additive

H₂O

AlCl₃

CLAY

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
<u>#2</u> Extract ID	<u> </u> Particle Size	(List NB ID's for each applicable item)	<u> </u> Temp, °C
<u>3.03</u> pH Value	<u>10.03</u> g Solids	<u> </u> Duplicate ?	<u> </u>
<u>200</u> mls Initial	<u> </u> Start Date/Time	<u> </u> Blank ?	<u> </u>
<u> </u> mls Extract	<u> </u> End Date/Time	<u> </u> Baseline ?	<u> </u>

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					265	314	542
	TCLP Solids	10.03	9.25	9.12	0.13			

Notes

ICT P/N: 1342
ICT NB #: 1028-52

Waste Pelletization/TCLP-M Worksheet

Rev: 5/13/94

Date: 5-20-94
Operator: PF

Objective: OPTIMIZATION TESTING - PRIMARY STABILIZATION

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: Al₂O₃

Medium Information

ID: MEAMINE
Type: 817

Mix Composition

50 g Surrogate Waste
20 g or cc's medium
8.8 g/mls additive H₂O
2.0 g/mls additive AlCl₃
21.5g g/mls additive CLAY
g/mls additive

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: 750 PSI

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☒ Fair ☒ Fair
☐ Poor ☐ Poor

LEACH - > 50 PSI

Observations

WET WT - 100.43g DRY - 91.66g
RESIDUE IN DRUM - 1.0g

TCLP-M Data

Extract Fluid:

Extraction:

QA/QC:

Data:

#2 Extract ID
3.03 pH Value
2/1 mls Initial
mls Extract

Particle Size
10.55 g Solids
Start Date/Time
End Date/Time

(List NB ID's for each applicable item)
Duplicate ?
Blank ?
Baseline ?

Temp, °C

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					228	280	519
	TCLP Solids	10.55	9.90	9.59	0.31			

Notes

Cure time 4 hours at 50°C

ICT P/N: 1342 Waste Pelletization/TCLP-M Worksheet Date: 5-20-94
 ICT NB #: 1028-53 Rev: 5/13/94 Operator: PF

Objective: OPTIMIZATION TESTING - PRIMARY STABILIZATION

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: Al₂O₃

Medium Information

ID: MEAMINE

Type: 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: 750 PSI

Pelletization Pellet Integrity

☒ Excellent ☒ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

LEACH - 750 PSI

Observations

WET WT - 91.71 g DRY - 82.47
RETAINED ON DRUM 2.0 g

Mix Composition

50 g Surrogate Waste

20 g or cc's medium

8.8 g/mls additive

2.0 g/mls additive

13.68 g/mls additive

           g/mls additive

H₂O

AlCl₃

CLAY

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
<u>#2</u> Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
<u>3.03</u> pH Value	<u>10.25</u> g Solids	Duplicate ?	
<u>205</u> mls Initial	Start Date/Time	Blank ?	
mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					512	586	993
	TCLP Solids	10.25	9.59	9.53	0.06			

Notes

Cure time 8 hours at 50°C

ICT P/N: 1342
ICT NB #: 1028-54

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 5-20-94
Operator: PF

Objective: OPTIMIZATION TESTING - PRIMARY STABILIZATION

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: Al₂O₃

Medium Information

ID: MEAMINE

Type: _____

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: 750

Pelletization Pellet Integrity LEACH - >50

☐ Excellent ☐ Excellent

☒ Fair ☒ Fair

☐ Poor ☐ Poor

Observations

WET wt - 95.35 DRY - 90.37
RESIDUE IN DRUM - 2.50

Mix Composition

50 g Surrogate Waste

20 g or cc's medium

8.8 g/mls additive

2.0 g/mls additive

17.92 g/mls additive

_____ g/mls additive

H₂O

AlCl₃

CLAY

TCLP-M Data

Extract Fluid:

#2 Extract ID

3.03 pH Value

_____ mls Initial

_____ mls Extract

Extraction:

_____ Particle Size

10.41 g Solids

_____ Start Date/Time

_____ End Date/Time

QA/QC:

(List NB ID's for each applicable item)

_____ Duplicate ?

_____ Blank ?

_____ Baseline ?

Data:

_____ Temp, °C

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
_____	Pellets							
_____	Mix Reject							
_____	TCLP Extract					340	414	1998(1124A)
_____	TCLP Solids	10.41	9.21	9.14	0.07			

Notes

ICT P/N: 1342

Waste Pelletization/TCLP-M Worksheet

Date: 5-20-94ICT NB #: 1028-55

Rev: 5/13/94

Operator: PFObjective: OPTIMIZATION TESTING - PRIMARY STABILIZATION

Encapsulation Protocol:

Primary

Secondary

Tertiary

Surrogate Composition: 20 % PbOther: Al₂O₃

Medium Information

ID: MEAMINEType: 836

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: 750 PSI

Pelletization Pellet Integrity

☒ Excellent☒ Excellent☐ Fair☐ Fair☐ Poor☐ Poor

Observations

WET DT - ~~1.40g~~ 91.97g DRY 84.8
RESIDUE IN DRUM - 1.40g

Mix Composition

50 g Surrogate Waste20 g or cc's medium8.8 g/mls additive2.0 g/mls additive14.70 g/mls additive   g/mls additiveH₂OAlCl₃CLAY

TCLP-M Data

Extract Fluid:

#2 Extract ID3.03 pH Value   mls Initial   mls Extract

Extraction:

           Particle Size10.39 g Solids   Start Date/Time   End Date/Time

QA/QC:

(List NB ID's for each applicable item)

           Duplicate ?   Blank ?   Baseline ?

Data:

           Temp, °C

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	~~48 hrs~~
	Pellets							
	Mix Reject							
	TCLP Extract					280	313	1535 (112 Hrs)
	TCLP Solids	10.39	9.67	9.65	0.02			

Notes

Cure time 8 HRS 50 °C

ICT P/N: 1342
ICT NB #: 1028-56

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 6-2-94
Operator: PF

Objective: EVALUATE EFFECTS OF A LESSER WATER ADDITION

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb(10g) Other: Al₂O₃ (40g)

Medium Information **Mix Composition**

ID: MALAMINE 50g g Surrogate Waste
Type: 836 g or cc's medium

Pelletized Waste Data 20 g/mls additive MALAMINE 836

Uniaxial Compressive Strength, PSI: > 50 PSI 1.24g AlCl₃ + 4.98g/mls additive 6.22g AlCl₃ (20%)

Pelletization Pellet Integrity REACHED > 50 PSI 4.75 g/mls additive CLAY

☐ Excellent ☐ Excellent Observations g/mls additive
☒ Fair ☒ Fair WET WEIGHT - 77.53 DRY WEIGHT - 74.13
☐ Poor ☐ Poor GRAMS IN DRUM 2.4g

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
<u>SOLUTION #2</u> Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
<u>303</u> pH Value	<u>10.44</u> g Solids	Duplicate ?	
<u>209</u> mls Initial	Start Date/Time	Blank ?	
mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-ml solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data		Weight, g or Volume, mls				mg/L Pb		
NB#	Description	As Prep'd	Dried	+10M	-10M	~~12 hrs~~ 24 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject					7HR	24HR	
	TCLP Extract					129	251	—
	TCLP Solids	10.44	9.84	9.82	0.02			

Notes
CURE AT 50°C FOR 17 HRS

ICT P/N: 1342
ICT NB #: 1028-57

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 6-2-94
Operator: PF

Objective: EVALUATE EFFECTS OF A LESSER WATER ADDITION

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb(19) Other: Al₂O₃ (40%)

Medium Information

ID: MALAMINE
Type: 8.36

Mix Composition

50g g Surrogate Waste
g or cc's medium

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: 750PSI 7.45g (1.49 Al₂O₃ + 5.96 wt%) g/mls additive

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☒ Fair ☒ Fair
☐ Poor ☐ Poor

LEACHED > 50PSI

20 g/mls additive
8.58 g/mls additive
g/mls additive

MALAMINE 836
AlCl₃ (20%)
CLAY

Observations

WET WEIGHT - 82.90 DRY WEIGHT - 78.15
GRAMS IN DRUM 2.0g

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
<u>SOLUTION #2</u> Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
<u>3.03</u> pH Value	<u>10.36</u> g Solids	Duplicate ?	
<u>207</u> mls Initial	Start Date/Time	Blank ?	
mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	15 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject					74R	24HR	
	TCLP Extract					75	184	-
	TCLP Solids	12.36	9.82	9.80	0.02			

Notes

CURE AT 50°C FOR 17 HRS

ICT P/N: 1342
ICT NB #: 1028-58

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 6-2-94
Operator: PF

Objective: EVALUATE EFFECTS OF A LESSER WATER ADDITION

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb(1g) Other: Al₂O₃ (40g)

Medium Information

ID: MALAMINE

Type: 836

Mix Composition

50g g Surrogate Waste

         g or cc's medium

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: 750PSI 6.40g (1.28g Al₂O₃ + 5.12g) g/mls additive

Pelletization Pellet Integrity REACHED 750PSI 5.8g g/mls additive

☐ Excellent ☐ Excellent

☒ Fair ☒ Fair

☐ Poor ☐ Poor

Observations

WET WEIGHT - 79.07 DRY WEIGHT - 74.43

GRAMS IN DRUM 1.8g

MALAMINE 836

AlCl₃ (20g)

CLAY

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
<u>SOLUTION #2</u> Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
<u>303</u> pH Value	<u>10.04</u> g Solids	Duplicate ?	
<u>200</u> mls Initial	<u>20</u> Start Date/Time	Blank ?	
<u> </u> mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	15 min	24 hrs	48 hrs
	Pellets							
	Mix Reject					7HR	24HR	
	TCLP Extract					225	443	-
	TCLP Solids	10.04	9.45	9.39	0.06			

Notes

CURE AT 50°C FOR 17 HRS

ICT P/N: 1342
ICT NB #: 1028-59

Waste Pelletization/TCLP-M Worksheet

Rev: 5/13/94

Date: 6-6-94
Operator: PF

Objective: BATCH PRODUCTION OF PELLETS

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb (40g) Other: Al₂O₃ (160g)

Medium Information

ID: MALAMINE
Type: 817

Mix Composition

200 g Surrogate Waste
- g or cc's medium
80 g/mls additive MALAMINE 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: 750 - 750 - 750 6.0g AlCl₃ + 35g H₂O g/mls additive 43g AlCl₃ (20%)
LEACHED 66.35 g/mls additive CLAY

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

WFT 364.96 -8 DRY WT. 339.28
DRUM RES. 7.8 g

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
<u>Solution #2</u> Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
<u>3.03</u> pH Value	g Solids	Duplicate ?	
mls Initial	Start Date/Time	Blank ?	
mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

CURE AT 50°C FOR ~~24 HRS~~ 1HR

ICT P/N: 1342

Waste Pelletization/TCLP-M Worksheet

Date: 6-6-94ICT NB #: 1028-10

Rev: 5/13/94

Operator: PFObjective: BATCH PRODUCTION OF PELLETS

Encapsulation Protocol:

Primary

Secondary

Tertiary

Surrogate Composition:

20 % Pb (40g) Other: Al₂O₃ (160g)

Medium Information

ID: MALAMINEType: 817

Mix Composition

200 g Surrogate Waste- g or cc's medium80 g/mls additive MALAMINE 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI:

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent☐ Fair ☐ Fair☐ Poor ☐ PoorLEACHED

Observations

WFT 362.29 DRY WT. - 347.31g
DRUM RES. 4.9 g6.0g AlCl₃ + 35g H₂O g/mls additive 43g66.4 g/mls additive

g/mls additive

AlCl₃ (20%)CLAY

TCLP-M Data

Extract Fluid:

Extraction:

QA/QC:

Data:

SOLUTION #2

Extract ID

Particle Size

(List NB ID's for each applicable item)

Temp, °C

3.03 pH Value

g Solids

Duplicate ?

mls Initial

Start Date/Time

Blank ?

mls Extract

End Date/Time

Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

CURE AT 50°C FOR ~~2 HRS~~ 1 HR

ICT P/N: 1342

Waste Pelletization/TCLP-M Worksheet

Date: 6-6-94ICT NB #: 1028-61

Rev: 5/13/94

Operator: PFObjective: BATCH PRODUCTION OF PELLETS

Encapsulation Protocol:

Primary

Secondary

Tertiary

Surrogate Composition:

20 % Pb (40g) Other: Al₂O₃ (160g)

Medium Information

ID: MALAMINEType: 817

Mix Composition

200 g Surrogate Waste- g or cc's medium

Pelletized Waste Data

80 g/mls additive MALAMINE 817

Uniaxial Compressive Strength, PSI:

8.0g AlCl₃ + 35g H₂O g/mls additive 43g AlCl₃ (20%)

Pelletization Pellet Integrity

LEACHED☐ Excellent ☐ Excellent☐ Fair ☐ Fair☐ Poor ☐ Poor

Observations

WET 369.3 DRY WT 348.08g
DRUM RES. 6.5 g

TCLP-M Data

Extract Fluid:

Extraction:

QA/QC:

Data:

SOLUTION #2 Extract ID

Particle Size

(List NB ID's for each applicable item)

Temp, °C

3.03 pH Value

g Solids

Duplicate ?

mls Initial

Start Date/Time

Blank ?

mls Extract

End Date/Time

Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

CURE AT 50°C FOR 1HR

ICT P/N: 1342 Waste Pelletization/TCLP-M Worksheet Date: 6-6-94
ICT NB #: 1028-62 Rev: 5/13/94 Operator: PF

Objective: BATCH PRODUCTION OF PELLETS

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb (40g) Other: Al₂O₃ (160g)

Medium Information

ID: MALAMINE

Type: 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity LEACHED

☐ Excellent ☐ Excellent

☐ Fair ☐ Fair

☐ Poor ☐ Poor

Mix Composition

200 g Surrogate Waste

- g or cc's medium

80 g/mls additive MALAMINE 817

6.0g AlCl₃ + 35g H₂O g/mls additive 43g AlCl₃ (20%)

61.3 g/mls additive CLAY

_____ g/mls additive

WFT 365.66 g DRY WT - 346.03

DRUM RES. 4.9 g

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
<u>SOLUTION #2</u> Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
<u>3.03</u> pH Value	g Solids	Duplicate ?	
_____ mls Initial	Start Date/Time	Blank ?	
_____ mls Extract	End Date/Time	Baseline ?	

- Procedure:
- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
  - (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
  - (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
  - (4) Filter solids at 48 hours; sample extract, dry solids.
  - (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data		Weight, g or Volume, mls				mg/L Pb		
NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

CURE AT 50°C FOR ~~24 HRS~~ 1 HR

ICT P/N: 1342
ICT NB #: 1028-63

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 6-7-94
Operator: PF

Objective: BULK PELLETIZATION 1028-59762 COMP (SECONDARY INCAPSULATION)

Encapsulation Protocol: ☐ Primary ☒ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: A/203

Medium Information

ID: ROYAL CAST (3100)
Type: (3105) 77% PART A (15%)
Pelletized Waste Data (3101) 23% PART B (4%)

Uniaxial Compressive Strength, PSI: 750 PSI

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☒ Fair ☐ Fair
☐ Poor ☐ Poor

LEACH - 750 PSI
FREEZE
Observations

Mix Composition

250.0 g Surrogate Waste (COMP (SURROGATE WASTE))
____ g or cc's medium
____ g/mls additive
____ g/mls additive
____ g/mls additive
____ g/mls additive

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
<u>SOLUTION #2</u> Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
<u>3.03</u> pH Value	<u>75.17</u> g Solids	Duplicate ?	
<u>1500</u> mls Initial	Start Date/Time	Blank ?	
mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data		Weight, g or Volume, mls				mg/L Pb		
NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					14	18	-
	TCLP Solids		73.92	73.86	0.06			
	Notes							

TESTED SAMPLE STUCK TO GLASS TRAY WHILE CURING. I WAS ABLE TO
OVER ONLY A 70 OF THE PELLETS FOR TESTING.

75.17%
= 83.74%

ICT P/N: 1342

Waste Pelletization/TCLP-M Worksheet

Date: 6-7-94ICT NB #: 1028-64

Rev: 5/13/94

Operator: PFObjective: BULK PELLETIZATION 1028-59 → 62 COMP (SECONDARY INCAPSULATION)Encapsulation Protocol: ☐ Primary ☒ Secondary ☐ TertiarySurrogate Composition: 20 % Pb Other: A1203

Medium Information

ID: DEVCON FLEXANE 80Type: 77% PART A (154)Pelletized Waste Data 23% PART B (46g)Uniaxial Compressive Strength, PSI: 750 PSI

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent☒ Fair ☐ Fair☐ Poor ☐ PoorLEACH >50 PSI
FREEZE

Observations

Mix Composition

250.0 g Surrogate Waste COMP (SURROGATE WASTE)

_____ g or cc's medium

_____ g/mls additive

_____ g/mls additive

_____ g/mls additive

_____ g/mls additive

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
<u>SOLUTION #2</u> Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
<u>3.03</u> pH Value	<u>50.0</u> g Solids	Duplicate ?	
<u>1000</u> mls Initial	Start Date/Time	Blank ?	
_____ mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					13	18	-
	TCLP ~~8.5~~		49.04	49.04	0			

Notes

PELLETS STUCK TO GLASS TRAY

50.0g

49.15

ICT P/N: 1342 Waste Pelletization/TCLP-M Worksheet Date: 6-9-94
 ICT NB #: 1028-65 Rev: 5/13/94 Operator: PF

Objective: BULK PELLETIZATION 1028-59762 COMP (SECONDARY INCAPSUATION)

Encapsulation Protocol: ☐ Primary ☒ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb (50g) Other: A12O3 (200g)

Medium Information MIKP

Mix Composition
250.0 g Surrogate Waste (COMP) (SURROGATE WASTE)

ID: SARTOMER CN-300 OLIGOMER

Type: SR 350 MONOMER

Pelletized Waste Data COBALT DRIER 1270

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☒ Fair ☐ Fair
☐ Poor ☐ Poor

LEACH -
 FREEZE -

Observations

POLYMERS MUST BE MIXED AS FOLLOWS

SR 350 AND COBALT DRIER COMBINED AND MIXED WELL. CN-300 THEN

TCLP-M Data ADDED AND MIXED WELL LASTLY ADD MIKP AND MIX WELL.

Extract Fluid:	Extraction:	QA/QC:	Data:
<u>SOLUTION #2</u> Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
<u>3.03</u> pH Value	<u>75.31</u> g Solids	Duplicate ?	
<u>1500</u> mls Initial	Start Date/Time	Blank ?	
mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data		Weight, g or Volume, mls				mg/L Pb		
NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					3	4	—
	TCLP Solids							

Notes

TREATED SAMPLE STUCK TO A SHEET OF POLY-PROP WE NEED TO TRY LUBRICATING THE SURFISE.

TCLP 75.31g
 FREEZE 67.97g
 SR-350 - 12.5g
 MIKP - 1.0g

ICT P/N: 1342
ICT NB #: 1028-66

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 6-7-94
Operator: PF

Objective: BULK PELLETIZATION 1028-59→62 COMP (CONTROL TEST PRIMARY)

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: A1203

Medium Information

ID: MAKAMINE
Type: 817

Mix Composition

_____ g Surrogate Waste
_____ g or cc's medium
_____ g/mls additive
_____ g/mls additive
_____ g/mls additive
_____ g/mls additive

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: >50 PSI

Pelletization Pellet Integrity LEACHED >50 PSI

☒ Excellent ☒ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

TCLP-M Data

Extract Fluid: SOLUTION #2 Extraction: _____ QA/QC: _____ Data: _____
Extract ID _____ Particle Size _____ (List NB ID's for each applicable item) _____ Temp, °C
3.03 pH Value 75.15 g Solids _____ Duplicate ? _____
1500 mls Initial _____ Start Date/Time _____ Blank ? _____
_____ mls Extract _____ End Date/Time _____ Baseline ? _____

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					80	107	
	TCLP Solids	~~71.19~~	71.21	71.19	0.02			

Notes

ICT P/N: 1342
ICT NB #: 1028-67

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 6-7-94
Operator: PF

Objective: BULK PELLETIZATION 1028-59-62 COMP (CONTROL TEST PRIMARY)

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: Al₂O₃

Medium Information

ID: MALAMINE

Type: 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: > 50 PSI

Pelletization Pellet Integrity

☒ Excellent ☒ Excellent

☐ Fair ☐ Fair

☐ Poor ☐ Poor

LEACHED > 50 PSI

Observations

Mix Composition

_____ g Surrogate Waste

_____ g or cc's medium

_____ g/mls additive

_____ g/mls additive

_____ g/mls additive

_____ g/mls additive

TCLP-M Data

Extract Fluid:

Extraction:

QA/QC:

Data:

SOLUTION #2 Extract ID _____ Particle Size _____ (List NB ID's for each applicable item) _____ Temp, °C
3.03 pH Value 75.25 g Solids _____ Duplicate ? _____
1500 mls Initial _____ Start Date/Time _____ Blank ? _____
_____ mls Extract _____ End Date/Time _____ Baseline ? _____

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract					97	125	
	TCLP Solids		71.21	71.20	0.01			

Notes

ICT P/N: 1342
ICT NB #: 1028-68

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 6-13-94
Operator: PF

Objective: BATCH PRODUCTION OF PELLETS

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb (40g) Other: A/2 O3 (160g)

Medium Information

ID: MAHAMINE

Type: 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

WET WT - 374.1 DRY WT 362.12
DRUM RESIDUE - 84

Mix Composition

200 g Surrogate Waste

- g or cc's medium

80 g/mls additive MAHAMINE 817

8.0g AlCl3 + 35g H2O g/mls additive (43g) A/Cl3 (20%)

71.6 g/mls additive CLAY

_____ g/mls additive

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
_____ Extract ID	_____ Particle Size	(List NB ID's for each applicable item)	_____ Temp, °C
_____ pH Value	_____ g Solids	_____ Duplicate ?	_____
_____ mls Initial	_____ Start Date/Time	_____ Blank ?	_____
_____ mls Extract	_____ End Date/Time	_____ Baseline ?	_____

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

CURE AT 50°C FOR 1HR.

ICT P/N: 1342
ICT NB #: 1028-69

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 6-13-94
Operator: PF

Objective: BATCH PRODUCTION OF PELLETS

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb (40g) Other: Al₂O₃ (160g)

Medium Information

ID: MAHAMINE

Type: 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

WET WT - 362.0 DRY WT 346.48
DRUM RESIDUE - 8.9

Mix Composition

200 g Surrogate Waste
- g or cc's medium
80 g/mls additive MAHAMINE 817
8.4g AlCl₃ + 35g H₂O g/mls additive (43g) AlCl₃ (20%),
65.7 ~~87.8~~ g/mls additive CLAY
_____ g/mls additive

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
_____ Extract ID	_____ Particle Size	(List NB ID's for each applicable item)	_____ Temp, °C
_____ pH Value	_____ g Solids	_____ Duplicate ?	_____
_____ mls Initial	_____ Start Date/Time	_____ Blank ?	_____
_____ mls Extract	_____ End Date/Time	_____ Baseline ?	_____

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

CURE AT 50°C FOR 1HR.

ICT P/N: 1342
ICT NB #: 1028-70

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 6-13-94
Operator: PF

Objective: BATCH PRODUCTION OF PELLETS

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb (40g) Other: A12O3 (160g)

Medium Information

ID: MALAMINE

Type: 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

WET WT - 372.5 DRY WT 353.8
DRUM RESIDUE - 6.1

Mix Composition

200 g Surrogate Waste

- g or cc's medium

80 g/mls additive MALAMINE 817

8.4g AlCl3 + 35g H2O g/mls additive (43g) AlCl3 (20%)

64.8 g/mls additive

- g/mls additive

CLAY

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
pH Value	g Solids	Duplicate ?	
mls Initial	Start Date/Time	Blank ?	
mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

CURE AT 50°C FOR 1HR.

ICT P/N: 1342
ICT NB #: 1028-71

Waste Pelletization/TCLP-M Worksheet

Rev: 5/13/94

Date: 6-13-94
Operator: PF

Objective: BATCH PRODUCTION OF PELLETS

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb(40g) Other: A/2 0.3 (160g)

Medium Information

ID: MAHAMINE

Type: 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

WET WT - 376.8

DRUM RESIDUE -

Mix Composition

200 g Surrogate Waste

- g or cc's medium

80 g/mls additive MAHAMINE 817

8.4g AlCl₃ + 35g H₂O g/mls additive (43g) AlCl₃ (20%)

68.1 g/mls additive

- g/mls additive

CLAY

DRY WT 359.4

TCLP-M Data

Extract Fluid:

Extraction:

QA/QC:

Data:

_____ Extract ID

_____ Particle Size

(List NB ID's for each applicable item)

_____ Temp, °C

_____ pH Value

_____ g Solids

_____ Duplicate ?

_____ mls Initial

_____ Start Date/Time

_____ Blank ?

_____ mls Extract

_____ End Date/Time

_____ Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

CURE AT 50°C FOR 1HR.

ICT P/N: 1342
ICT NB #: 1028-72

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 6-13-94
Operator: PF

Objective: BATCH PRODUCTION OF PELLETS

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb (40g) Other: A/2 O.3 (160g)

Medium Information

ID: MAHAMINE

Type: 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

WET WT - 356.3 DRY WT 338.5
DRUM RESIDUE - 8.4

Mix Composition

200 g Surrogate Waste

- g or cc's medium

80 g/mls additive MAHAMINE 817

8.4g AlCl₃ + 35g H₂O g/mls additive (43g) AlCl₃ (20%)

56.8 g/mls additive CLAY

_____ g/mls additive

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
_____ Extract ID	_____ Particle Size	(List NB ID's for each applicable item)	_____ Temp, °C
_____ pH Value	_____ g Solids	_____ Duplicate ?	_____
_____ mls Initial	_____ Start Date/Time	_____ Blank ?	_____
_____ mls Extract	_____ End Date/Time	_____ Baseline ?	_____

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

CURE AT 50°C FOR 1HR.

ICT P/N: 1342
ICT NB #: 1028 73

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 6-13-94
Operator: PF

Objective: BATCH PRODUCTION OF PELLETS

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb (40g) Other: A/2 0.3 (160g)

Medium Information

ID: MAHAMINE

Type: 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

WET WT - ~~44.2~~ 347.0 DRY WT 325.8g
DRUM RESIDUE - 6.4

Mix Composition

200 g Surrogate Waste

- g or cc's medium

80 g/mls additive MAHAMINE 817

8.4g AlCl₃ + 35g H₂O g/mls additive (43g) AlCl₃ (20%)

4.2 g/mls additive

- g/mls additive

CLAY

TCLP-M Data

Extract Fluid:

Extraction:

QA/QC:

Data:

_____ Extract ID

_____ Particle Size

(List NB ID's for each applicable item)

_____ Temp, °C

_____ pH Value

_____ g Solids

_____ Duplicate ?

_____ mls Initial

_____ Start Date/Time

_____ Blank ?

_____ mls Extract

_____ End Date/Time

_____ Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

CURE AT 50°C FOR 1HR.

ICT P/N: 1342
ICT NB #: 1028 74

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 6-13-94
Operator: PF

Objective: BATCH PRODUCTION OF PELLETS

Encapsulation Protocol: ☒ Primary ☐ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb (40g) Other: A12 O3 (160g)

Medium Information

ID: MAHAMINE

Type: 817

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

WET WT - 356.6 DRY WT 337.14
DRUM RESIDUE - 7.3

Mix Composition

200 g Surrogate Waste
- g or cc's medium
80 g/mls additive MAHAMINE 817
8.4g AlCl3 + 35g H2O g/mls additive (43g) AlCl3 (20%)
53.0 g/mls additive CLAY
- g/mls additive

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
pH Value	g Solids	Duplicate ?	
mls Initial	Start Date/Time	Blank ?	
mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-ml solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

CURE AT 50°C FOR 1HR.

ICT P/N: 1342

Waste Pelletization/TCLP-M Worksheet

Date: 6-14-94ICT NB #: 1028-75

Rev: 5/13/94

Operator: PFObjective: FERTILIZER INCAPSULATION OF BULK PELLETS PRODUCED IN 1028-68-75

Encapsulation Protocol:

Primary

Secondary

Tertiary

Surrogate Composition:

20 % Pb

Other:

A1203

Medium Information

ID: ROYALCAST (3100)Type: (3105) 77% PART A (154g)Pelletized Waste Data (3101) 23% PART B (46g)

Uniaxial Compressive Strength, PSI:

Pelletization Pellet Integrity

Excellent

Excellent

Fair

Fair

Poor

Poor

LEACH -

FREEZE -

Observations

Mix Composition

250.0 g Surrogate Waste COMP(SURROGATE WASTE,

g or cc's medium

g/mls additive

g/mls additive

g/mls additive

g/mls additive

TCLP-M Data

Extract Fluid:

Extraction:

QA/QC:

Data:

SOLUTION #2 Extract ID

Particle Size

(List NB ID's for each applicable item)

Temp, °C

3.03 pH Value50.17 g Solids

Duplicate ?

1000 mls Initial

Start Date/Time

Blank ?

mls Extract

End Date/Time

Baseline ?

Procedure:

(1) Weigh cured, dry agglomerates, place in Erlenmeyer flask

(2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation

(3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours

(4) Filter solids at 48 hours; sample extract, dry solids.

(5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP ~~Sample~~							
	TCLP ~~Sample~~		50.17	49.14	0			

Notes

1028-78-87² - 25.42
12.661st OVERCOAT 219.792nd OVERCOAT - TCLP 50.17

ICT P/N: 1342 Waste Pelletization/TCLP-M Worksheet Date: 6-14-94
ICT NB #: 1028-76 Rev: 5/13/94 Operator: PF

Objective: TERTIARY INCAPSULATION OF BULK PELLETS PRODUCED IN 1028-68-77

Encapsulation Protocol: ☐ Primary ☐ Secondary ☒ Tertiary

Surrogate Composition: 20 % Pb Other: A1203

Medium Information

ID: DEV CON FLEXANE80
Type: 77% PART A (154g)
Pelletized Waste Data: 23% PART B (46g)

Mix Composition

250.0 g Surrogate Waste COMP (SURROGATE WASTE)
____ g or cc's medium
____ g/mls additive
____ g/mls additive
____ g/mls additive
____ g/mls additive

Uniaxial Compressive Strength, PSI:

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

LEACH -
FREEZE -
Observations

TCLP-M Data

Extract Fluid: SOLUTION #2 Extraction: 3.03 QA/QC: 50.31 Data: 1000
Extract ID: 3.03 Particle Size: 50.31 (List NB IC's for each applicable item) Temp, °C
pH Value: 50.31 g Solids: 50.31 Duplicate ?
mls Initial: 1000 Start Date/Time: Blank ?
mls Extract: End Date/Time: Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids. place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

NE#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP ~~50.31~~							
	TCLP ~~50.31~~		50.31	49.29	0			

Notes

2nd OVERCOAT - TCLP - 50.31
SEQUENTIAL 50.31
" " 2 25.6
" " 3 12.2
" " 4 0.8

1st OVERCOAT 215.64

ICT P/N: 1342
ICT NB #: 1028-77

Waste Pelletization/TCLP-M Worksheet

Rev: 5/13/94

Date: 6-14-94

Operator: PF

Objective: TERTIARY INCAPSULATION OF BULK PELLETS PRODUCED IN 1028-68-77

Encapsulation Protocol:

☐

Primary

☐

Secondary

☒

Tertiary

Surrogate Composition:

20 % Pb

Other:

A1203

Medium Information

ID: SARTOMER ^{MKP} CN-300 OLIGOMER

Type: SR 350 MONOMER

Pelletized Waste Data COBALT PRIER 1270

Uniaxial Compressive Strength, PSI:

Pelletization Pellet Integrity

☐

Excellent

☐

Excellent

☐

Fair

☐

Fair

☐

Poor

☐

Poor

TCLP-M Data

Mix Composition

250.0 g Surrogate Waste COMP (SURROGATE WASTE)

g or cc's medium

g/mls additive

g/mls additive

g/mls additive

g/mls additive

LEACH -

FREEZE -

Observations

POLYMERS MUST BE MIXED AS FOLLOWS

SR 350 AND COBALT PRIER COMBINED AND MIXED WELL.
CN-300 THEN ADDED AND MIXED WELL LASTLY ADD MKP AND
MIX WELL

Extract Fluid:

Extraction:

QA/QC:

Data:

SOLUTION #2 Extract ID

Particle Size

(List NB ID's for each applicable item)

Temp, °C

3.03 pH Value

g Solids

Duplicate ?

1000 mls Initial

Start Date/Time

Blank ?

mls Extract

End Date/Time

Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-ml solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP ~~Reject~~		<u>50.40</u>	<u>49.79</u>	<u>0</u>			

Notes

2nd OVERCOAT - TCLP 50.40

SEQUENTIAL STG #1 50.40

2 25.23

3 12.97

1st OVERCOAT 257.28

DEFECT 13.08

FREEZE 111.80 SR-350 - 12.5g

IC Technologies DEFECTIVE 38.08 COBALT - 1.0g

ICT P/N: 1342

Waste Pelletization/TCLP-M Worksheet

Date: 6-16-94ICT NB #: 1028-81

Rev: 5/13/94

Operator: PFObjective: TO PRODUCE 3/8 INCH PELLETS FOR ANALYSIS AT EVERGREEN

Encapsulation Protocol:

☐

Primary

☐

Secondary

☒

Tertiary

Surrogate Composition:

20 % Pb

Other:

Al₂O₃

Medium Information

Mix Composition

ID:

ROYAL CAST (3100)149.56 ~~150.40~~ g Surrogate Waste

Type:

(3105) 77% PART A (154g)

g or cc's medium

Pelletized Waste Data (3101) 23% PART B (46g)

g/mls additive

Uniaxial Compressive Strength, PSI:

g/mls additive

Pelletization

Pellet Integrity

☐

Excellent

☐

Excellent

☐

Fair

☐

Fair

☐

Poor

☐

Poor

Observations

g/mls additive

g/mls additive

TCLP-M Data

Extract Fluid:

Extraction:

QA/QC:

Data:

Extract ID

Particle Size

(List NB ID's for each applicable item)

Temp, °C

pH Value

g Solids

Duplicate ?

mls Initial

Start Date/Time

Blank ?

mls Extract

End Date/Time

Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

1st OVERCOAT 162.26
DEFECT REJECT 7.512nd OVERCOAT
DEFECT REJECT

ICT P/N: 1342
ICT NB #: 1028-82

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 6-16-94
Operator: PF

Objective: TO PRODUCE 3/8 INCH PELLETS FOR ANALYSIS AT EVERGREEN

Encapsulation Protocol: ☐ Primary ☐ Secondary ☒ Tertiary

Surrogate Composition: 20 % Pb Other: Al₂O₃

Medium Information

ID: DEVCON FLEXANE 80
Type: 77% PART A (154g)
Pelletized Waste Data: 23% PART B (46g)

Mix Composition

150.0 g Surrogate Waste
____ g or cc's medium
____ g/mls additive
____ g/mls additive
____ g/mls additive
____ g/mls additive

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
____ Extract ID	____ Particle Size	(List NB ID's for each applicable item)	____ Temp, °C
____ pH Value	____ g Solids	____ Duplicate ?	____
____ mls Initial	____ Start Date/Time	____ Blank ?	____
____ mls Extract	____ End Date/Time	____ Baseline ?	____

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes 1st OVERCOAT 187.02
DEFECT REJECT 6.23

2nd OVERCOAT
DEFECT REJECT

ICT P/N: 1342

Waste Pelletization/TCLP-M Worksheet

Date: 6-16-94ICT NB #: 1028-83

Rev: 5/13/94

Operator: PFObjective: TO PRODUCE $\frac{3}{8}$ INCH PELLETS FOR ANALYSIS AT EVERGREENEncapsulation Protocol: ☐ Primary ☐ Secondary ☒ TertiarySurrogate Composition: 20 % Pb Other: Al₂O₃

Medium Information

ID: MIRP SARTOMER CN-300 OLIGOMERType: SR 350 MONOMERPelletized Waste Data COBALT PRIER 1270

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☐ Excellent	☐ Excellent
☐ Fair	☐ Fair
☐ Poor	☐ Poor

Observations

Mix Composition

150.0 g Surrogate Waste

_____ g or cc's medium

_____ g/mls additive

_____ g/mls additive

_____ g/mls additive

_____ g/mls additive

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
_____ Extract ID	_____ Particle Size	(List NB ID's for each applicable item)	_____ Temp, °C
_____ pH Value	_____ g Solids	_____ Duplicate ?	_____
_____ mls Initial	_____ Start Date/Time	_____ Blank ?	_____
_____ mls Extract	_____ End Date/Time	_____ Baseline ?	_____

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

1st OVERCOAT 175.71
DEFECT REJECT 6.262nd OVERCOAT
DEFECT REJECTSR-350-12.5g
COBALT-1.0

ICT P/N: 1342 Waste Pelletization/TCLP-M Worksheet Date: 7-5-94
ICT NB #: 1028-90 Rev: 5/13/94 Operator: PF

Objective: DEFINE WASTE LOADING

Encapsulation Protocol: ☐ Primary ☒ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: _____

Medium Information Mix Composition

ID: ROYAL CAST (3100) 15.11 g Surrogate Waste 15.11
Type: (3105) 77% PART A (154g) 15 g or cc's medium
Pelletized Waste Data (3101) 23% PART B (46g) _____ g/mls additive

Uniaxial Compressive Strength, PSI: _____ g/mls additive

Pelletization Pellet Integrity
☐ Excellent ☐ Excellent Observations _____ g/mls additive
☐ Fair ☐ Fair
☐ Poor ☐ Poor
FIRST OVERCOAT DRY WT ~~15.62~~ 15.62
SECOND OVERCOAT DRY WT 16.11

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
_____ Extract ID	_____ Particle Size	(List NB ID's for each applicable item)	_____ Temp, °C
_____ pH Value	_____ g Solids	_____ Duplicate ?	_____
_____ mls Initial	_____ Start Date/Time	_____ Blank ?	_____
_____ mls Extract	_____ End Date/Time	_____ Baseline ?	_____

- Procedure:
- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
  - (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
  - (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
  - (4) Filter solids at 48 hours; sample extract, dry solids.
  - (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data		Weight, g or Volume, mls				mg/L Pb		
NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes
The second coat of the TR test didn't cure during a 2 hour 60°C exposure

ICT P/N: 1342 **Waste Pelletization/TCLP-M Worksheet** Date: 7-5-94
 CT NB #: 1028-91 Rev: 5/13/94 Operator: PF

Objective: DEFINE WASTE LOADING

Encapsulation Protocol: ☐ Primary ☒ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: _____

Medium Information **Mix Composition**

ID: <u>DEUCON FLEXANE 80</u> Type: <u>77% PART A (154g)</u> Pelletized Waste Data <u>23% PART B (46g)</u> Uniaxial Compressive Strength, PSI: _____ Pelletization Pellet Integrity ☐ Excellent ☐ Excellent ☐ Fair ☐ Fair ☐ Poor ☐ Poor	15.26 g Surrogate Waste _____ g or cc's medium _____ g/mls additive _____ g/mls additive _____ g/mls additive _____ g/mls additive Observations <u>FIRST OVERCOAT DRY WT 16.42</u> <u>SECOND OVERCOAT DRY WT 17.50</u>

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
_____ Extract ID	_____ Particle Size	(List NB ID's for each applicable item)	_____ Temp, °C
_____ pH Value	_____ g Solids	_____ Duplicate ?	_____
_____ mls Initial	_____ Start Date/Time	_____ Blank ?	_____
_____ mls Extract	_____ End Date/Time	_____ Baseline ?	_____

- Procedure:**
- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
  - (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
  - (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
  - (4) Filter solids at 48 hours; sample extract, dry solids.
  - (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data		Weight, g or Volume, mls				mg/L Pb		
NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

9:42
12:27

ICT P/N: 1342
ICT NB #: 1028-92

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 7-5-94
Operator: PF

Objective: DEFINE WASTE LOADING

Encapsulation Protocol: ☐ Primary ☒ Secondary ☐ Tertiary

Surrogate Composition: 20 % Pb Other: _____

Medium Information

ID: ~~XXXX~~ MIKP SARTOMER CN-300 OLIGOMER
Type: SR-350 MONOMER
Pelletized Waste Data COBALT DRIER 1270

Mix Composition

~~XXXX~~ g Surrogate Waste 1538
_____ g or cc's medium
_____ g/mls additive
_____ g/mls additive
_____ g/mls additive
_____ g/mls additive

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

FIRST OVERCOAT DRY WT 16.53
SECOND OVERCOAT DRY WT ~~16.53~~ 17.61

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
_____ Extract ID	_____ Particle Size	(List NB ID's for each applicable item)	_____ Temp, °C
_____ pH Value	_____ g Solids	_____ Duplicate ?	_____
_____ mls Initial	_____ Start Date/Time	_____ Blank ?	_____
_____ mls Extract	_____ End Date/Time	_____ Baseline ?	_____

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

SEE TEST 1028-65 FOR SPECIAL MIXING INSTRUCTIONS

CT P/N: 1342
CT NB #: 1028-100

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 7-21-94
Operator: PF

Objective: TERTIARY ENCAPSULATION OF TREATED PELLETS

Encapsulation Protocol: ☐ Primary ☐ Secondary ☒ Tertiary

Surrogate Composition: _____ % Pb Other: _____

Medium Information

ID: PORTLAND CEMENT OVER COAT

Type: DEVCON PELLETS

Pelletized Waste Data WATER WT

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☒ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

TARE - 33.24
34.52

Mix Composition

g Surrogate Waste DEVCON PELLET COATED

VESSEL SIZE	13 DRAM	40 DRAM
PELLET WT	29.57	25.31
TOTAL WT	108.76	147.46
OVER COAT WET WT	75.22	112.81
OVER COAT DRY WT	67.39	98.38
TRIMMED WT	67.03	98.00
TRIM MINUS PELLET WT	37.46	62.69

TCLP-M Data

220 cement to 100 ml = 320g

Extract Fluid:	Extraction:	QA/QC:	Data:
Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
pH Value	g Solids	Duplicate ?	
mls Initial	Start Date/Time	Blank ?	
mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

MOISTURE HAD LARGE SURFACE VOIDS AND SOME CRACKS
FP INTEGRITY - ONE SMALL CHIP ON TOP
COMPRESS TO FRACTURE - ~60PSI

ICT P/N: 1342 Waste Pelletization/TCLP-M Worksheet Date: 7-21-94
 ICT NB #: 1028-101 Rev: 5/13/94 Operator: PF

Objective: TERTIARY ENCAPSULATION OF TREATED PELLETS

Encapsulation Protocol: ☐ Primary ☐ Secondary ☒ Tertiary

Surrogate Composition: _____ % Pb Other: _____

Medium Information		Mix Composition																						
ID: <u>PORTLAND CEMENT OVER COAT</u>		_____ g Surrogate Waste <u>SARTOMER PELLET COATED</u>																						
Type: <u>SARTOMER PELLETS</u>		_____ g or cc's medium	<table border="1"> <tr> <td>VESSEL SIZE</td> <td>13 DRAM</td> <td>40 DRAM</td> </tr> <tr> <td>PELLET WT</td> <td>30.42</td> <td>35.95</td> </tr> <tr> <td>TOTAL WT</td> <td>111.78</td> <td>141.9</td> </tr> <tr> <td>OVER COAT WET WT</td> <td>78.92</td> <td>107.5</td> </tr> <tr> <td>OVER COAT DRY WT</td> <td>68.77</td> <td>94.86</td> </tr> <tr> <td>TRIM WGT</td> <td>67.64</td> <td>94.3</td> </tr> <tr> <td>TRIM WT MINUS PELLET WT</td> <td>37.22</td> <td>58.3</td> </tr> </table>	VESSEL SIZE	13 DRAM	40 DRAM	PELLET WT	30.42	35.95	TOTAL WT	111.78	141.9	OVER COAT WET WT	78.92	107.5	OVER COAT DRY WT	68.77	94.86	TRIM WGT	67.64	94.3	TRIM WT MINUS PELLET WT	37.22	58.3
VESSEL SIZE	13 DRAM	40 DRAM																						
PELLET WT	30.42	35.95																						
TOTAL WT	111.78	141.9																						
OVER COAT WET WT	78.92	107.5																						
OVER COAT DRY WT	68.77	94.86																						
TRIM WGT	67.64	94.3																						
TRIM WT MINUS PELLET WT	37.22	58.3																						
Pelletized Waste Data <u>WATER WT.</u>		_____ g/mls additive																						
Uniaxial Compressive Strength, PSI: _____		_____ g/mls additive																						
Pelletization Pellet Integrity		_____ g/mls additive																						
☒ Excellent ☐ Excellent	Observations	_____ g/mls additive																						
☐ Fair ☐ Fair	<u>TARE 32.86</u>																							
☐ Poor ☐ Poor	<u>34.39</u>																							

TCLP-M Data 220g Cement to 100ml water = 320g

Extract Fluid: _____	Extraction: _____	QA/QC: _____	Data: _____
_____ Extract ID	_____ Particle Size	(List NB IDs for each applicable item)	_____ Temp, °C
_____ pH Value	_____ g Solids	_____ Duplicate ?	
_____ mls Initial	_____ Start Date/Time	_____ Blank ?	
_____ mls Extract	_____ End Date/Time	_____ Baseline ?	

- Procedure:
- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
  - (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
  - (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
  - (4) Filter solids at 48 hours; sample extract, dry solids.
  - (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data		Weight, g or Volume, mls				mg/L Pb		
NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

MONOLITH HAD LARGE SURFACE VOIDS AND SOME CRACKS

EP INTEGRITY - ONE SMALL CHIP OFF TOP

COMPRESS TO FRACTURE - ~55PSI

IC Technologies

ICT P/N: 1342
ICT NB #: 1028-102

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 7-21-94
Operator: PF

Objective: TERTIARY ENCAPSULATION OF TREATED PELLETS

Encapsulation Protocol: ☐ Primary ☐ Secondary ☒ Tertiary

Surrogate Composition: _____ % Pb Other: _____

Medium Information

Mix Composition

ID: MALAMINE 817 OVER COAT (70g 817)

g Surrogate Waste UNIROVAL PELLET COATED

Type: UNIROVAL PELLETS

g or cc's medium

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

tare 32.91
tare 34.49

g/mls additive

g/mls additive

g/mls additive

g/mls additive

VESSEL SIZE	13 DRAH	40 DRAH
PELLET WT	26.48	38.8
TOTAL WT	92.67	126.
OVER COAT WET WT	59.76	91.6
OVER COAT DRY WT	54.20	83.
TRIMMED WT	53.58	82.
TRIM WT MINUS PELLET WT	27.10	43.5

TCLP-M Data

Extract Fluid:

Extraction:

QA/QC:

Data:

Extract ID

Particle Size

(List NB IC's for each applicable item)

Temp, °C

pH Value

g Solids

Duplicate ?

mls Initial

Start Date/Time

Blank ?

mls Extract

End Date/Time

Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

LARGE
SURFACE HAD A GREAT DEAL OF SURFACE CRACKING
MONOWITH HAD LARGE SURFACE VOIDS

EP INTEGRITY - NO EFFECT
COMPRESS TO FRACTURE - ~240 PSI

ICT P/N: 1342
ICT NB #: 1028-103

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 7-21-94
Operator: PF

Objective: TERTIARY ENCAPSULATION OF TREATED PELLETS

Encapsulation Protocol: ☐ Primary ☐ Secondary ☒ Tertiary

Surrogate Composition: _____ % Pb Other: _____

Medium Information

ID: MALAMINE 817 OVER COAT

Type: DEVCON PELLETS

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☒ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

TARE ~~32.89~~ 32.89

TARE ~~32.89~~ 34.31

Mix Composition

g Surrogate Waste DEVCON PELLET COATED

g or cc's medium

g/mls additive

g/mls additive

g/mls additive

g/mls additive

VESSEL SIZE	13 DRAM	40 DRAM
PELLET WT	27.07	38.96
TOTAL WT	93.88	122.8
OVER COAT WET WT	60.77	88.6
OVER COAT DRY WT	55.30	81.5
TRIMMED WT	53.93	80.4
TRIM WT MINUS PELLET WT	26.86	41.5

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
pH Value	g Solids	Duplicate ?	
mls Initial	Start Date/Time	Blank ?	
mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids. place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

LARGE
↓
SURFACE HAD A GREAT DEAL OF SURFACE CRACKING
MONOLITH HAD LARGE SURFACE VOIDS

EP INTEGRITY

- NO EFFECT

COMPRESS TO FRACTURE

- ~200 PSI

ICT P/N: 1342

Waste Pelletization/TCLP-M Worksheet

Date: 7-21-94ICT NB #: 1028-104

Rev. 5/13/94

Operator: PFObjective: TERTIARY ENCAPSULATION OF TREATED PELLETSEncapsulation Protocol: ☐ Primary ☐ Secondary ☒ Tertiary

Surrogate Composition: _____ % Pb Other: _____

Medium Information

ID: MAKAMINE 817 OVER COATType: SARTOMER PELLETS

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☒ Excellent	☐ Excellent
☐ Fair	☐ Fair
☐ Poor	☐ Poor

Observations

TART 33.08TART 34.42

Mix Composition

g Surrogate Waste SARTOMER PELLET COATED

g or cc's medium

g/mls additive

g/mls additive

g/mls additive

g/mls additive

VESSEL SIZE	13 DRAM	40 DRAM
PELLET WT	26.72	39.25
TOTAL WT	92.06	123.3
OVER COAT WET WT	58.98	88.9
OVER COAT DRY WT	54.04	82.7
TRIMMED WT	52.09	81.4
TRIM WT MINUS PELLET WT	25.37	42.2

TCLP-M Data

Extract Fluid:

Extraction:

QA/QC:

Data:

Extract ID

Particle Size

(List NB ID's for each applicable item)

Temp, °C

pH Value

g Solids

Duplicate ?

mls Initial

Start Date/Time

Blank ?

mls Extract

End Date/Time

Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids. place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NE#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

SURFACE HAD A GREAT DEAL OF LARGE SURFACE CRACKING
MONOLITH HAD LARGE SURFACE VOIDS

EP INTEGRITY- NO EFFECTCOMPRESS TO FRACTURE- ~200 PSI

IC Technologies

ICT P/N: 1342
ICT NB #: 1028-105

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 7-21-94
Operator: PF

Objective: TERTIARY ENCAPSULATION OF TREATED PELLETS

Encapsulation Protocol: ☐ Primary ☐ Secondary ☒ Tertiary

Surrogate Composition: _____ % Pb Other: _____

Medium Information

ID: DEVCON OVER COAT

Type: UNI ROYAL PELLETS

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

COOPM-TARE 33.59
TARE 35.09

Mix Composition

g Surrogate Waste	<u>UNI ROYAL PELLET COATED</u>		
g or cc's medium	VESSEL SIZE	13 DRAM	40 DRAM
g/mls additive	PELLET WT	24.57	44.29
g/mls additive	TOTAL WT	88.98	117.2
g/mls additive	OVER COAT WET WT	55.39	82.2
g/mls additive	OVER COAT DRY WT	53.45	82.2
	TRIMMED WT	53.40	82.31
	TRIM WT MINUS PELLET WT	30.83	38.0

TCLP-M Data

Extract Fluid:	Extraction:	QA/QC:	Data:
Extract ID	Particle Size	(List NB ID's for each applicable item)	Temp, °C
pH Value	g Solids	Duplicate ?	
mls Initial	Start Date/Time	Blank ?	
mls Extract	End Date/Time	Baseline ?	

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

NB#	Description	Weight, g or Volume, mls				mg/L Pb		
		As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

MONOLITH HAD 3705 SMALL VOIDS NO CRACKING

EP INTEGRITY - NO EFFECT

COMPRESS TO FRACTURE - ~190PSI CONTINUED TO COMPRESS NO CRACKS

ICT P/N: 1342
ICT NB #: 1028-106

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 7-21-94
Operator: PF

Objective: TERTIARY ENCAPSULATION OF TREATED PELLETS

Encapsulation Protocol: ☐ Primary ☐ Secondary ☒ Tertiary

Surrogate Composition: _____ % Pb Other: _____

Medium Information

ID: DEVCON OVER COAT
Type: DEVCON PELLETS

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☐ Excellent ☐ Excellent
☐ Fair ☐ Fair
☐ Poor ☐ Poor

Observations

TARE 33.35
34.52

Mix Composition

g Surrogate Waste DEVCON PELLET COATED

g or cc's medium

g/mls additive

g/mls additive

g/mls additive

g/mls additive

VESSEL SIZE	13 DRAM	40 DRAM
PELLET WT	37.76	37.1
TOTAL WT	67.06	111.3
OVER COAT WET WT	53.71	76.8
OVER COAT DRY WT	53.79	76.9
TRIMMED WT	53.42	76.6
TRIM WT MINUS PELLET WT	25.66	40.7

TCLP-M Data

Extract Fluid:

Extraction:

QA/QC:

Data:

Extract ID

Particle Size

(List NB ID's for each applicable item)

Temp, °C

pH Value

g Solids

Duplicate ?

mls Initial

Start Date/Time

Blank ?

mls Extract

End Date/Time

Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

MONOLITH HAD 3705 SMALL VOIDS NO CRACKING
EP INTEGRITY - NO EFFECT
COMPRESS TO FRACTURE - ~190 PSI CONTINUED TO COMPRESS NO CRACKING
IC Technologies

ICT P/N: 1342
ICT NB #: 1028-107

Waste Pelletization/TCLP-M Worksheet
Rev: 5/13/94

Date: 7-21-94
Operator: PF

Objective: TERTIARY ENCAPSULATION OF TREATED PELLETS

Encapsulation Protocol:

☐

Primary

☐

Secondary

☒

Tertiary

Surrogate Composition:

% Pb

Other: _____

Medium Information

ID: DEVCON OVER COAT

Type: SARTOMER PELLETS

Pelletized Waste Data

Uniaxial Compressive Strength, PSI: _____

Pelletization Pellet Integrity

☐

Excellent

☐

Excellent

☐

Fair

☐

Fair

☐

Poor

☐

Poor

Observations

TARE 34.36

34.64

Mix Composition

g Surrogate Waste SARTOMER PELLETS COATED

g or cc's medium

g/mls additive

g/mls additive

g/mls additive

g/mls additive

VESSEL SIZE	13 DRAIN	40 DRAIN
PELLET WT	21.73	36.84
TOTAL WT	86.07	112.3
OVER COAT WET WT	57.71	77.6
OVER COAT DRY WT	57.64	77.5
TRIMMED WT	54.84	76.8
TRIM WT MINUS PELLET WT	30.11	39.9

TCLP-M Data

Extract Fluid:

Extraction:

QA/QC:

Data:

Extract ID

Particle Size

(List NB ID's for each applicable term)

Temp, °C

pH Value

g Solids

Duplicate ?

mls Initial

Start Date/Time

Blank ?

mls Extract

End Date/Time

Baseline ?

Procedure:

- (1) Weigh cured, dry agglomerates, place in Erlenmeyer flask
- (2) Add indicated TCLP solution to agglomerates to give 5% solids, place flask on shaking table, begin agitation
- (3) Settle or filter solids to provide ~25-mL solution sample for analysis at 12-14 & 24 hours
- (4) Filter solids at 48 hours; sample extract, dry solids.
- (5) Screen solids at 10-mesh (2mm); report weights of plus and minus fractions

Sample ID and Data

Weight, g or Volume, mls

mg/L Pb

NB#	Description	As Prep'd	Dried	+10M	-10M	12-14 hrs	24 hrs	48 hrs
	Pellets							
	Mix Reject							
	TCLP Extract							
	TCLP Solids							

Notes

MONDAY HAS 3705 SMALL VOIDS NO CRACKING
EP INTEGRITY - NO EFFECT
COMPRESS TO FRACTURE - ~190PSI CONTINUED TO COMPRESS NO CRACK

APPENDIX IV
POLYMER MSDS

IC Technologies

Material Safety Data Sheet

BTL Specialty Resins Corp.
2112 Sylvan Avenue
P.O. Box 2570
Toledo, Ohio 43606

Product: BTL-M-817

MSDS No: BTL / BTLMB17
Date: July 13, 1988

National Paint
and Coatings
Association

Hazardous Material
Identification
System

HEALTH HAZARD	3 - Serious
FLAMMABILITY HAZARD	2 - Moderate
REACTIVITY HAZARD	0 - Minimal
PERSONAL PROTECTION	J - Goggles, Gloves, Apron, Dust / Vapor Resp

SECTION I. MATERIAL IDENTIFICATION

Trade/Material Name: BTL-M-817

Description: Melamine Formaldehyde Resin Powder

CAB: 9003-08-1

Manufacturers: BTL Specialty Resins Corp.
2112 Sylvan Avenue
P. O. Box 2570
Toledo, OH 43606

EMERGENCY CONTACT: CHEMTREC

Phone: (800) 424-9300

Phone: (419) 244-5856

SECTION II. INGREDIENTS AND HAZARDS

Ingredient Name:	CAB Number:	Percent:	Exposure Limits:
Melamine/Formaldehyde Resin	9003-08-1	>99%	TLV-Not Established
Free Formaldehyde	50-00-0	<0.99%	OSHA 8 hour TWA-0.75 ppm; OSHA 15 minute STEL-2 ppm; OSHA Action Level-0.5 ppm 8 hour TWA; NIOSH TLV Ceiling-0.8 ppm; ACGIH TWA 1 ppm; ACGIH STEL 2 ppm

SECTION III. PHYSICAL DATA

Appearance & Odor: Free flowing, white powder - slight formaldehyde odor

Water solubility (%): Limited

Specific gravity (H₂O=1): 0.45 - 0.70
Melting point: 90 - 100°C

BTL Speciality Resins Corp.
2112 Sylvan Avenue
P.O. Box 2570
Toledo, Ohio 43606

Product: BTLM-817

MSDS No: BTL / BTLM817

Date: July 13, 1988

SECTION IV. FIRE AND EXPLOSION DATA

NFPA Fire Hazard Symbol Codes: Flammability: 2 Health: 3 Reactivity: 0 Special: NA

Extinguishing Media: Water spray, CO₂, dry chemical

Unusual fire or explosion hazards: Possible dust explosion if dispersed in air in large quantities.

Special fire-fighting procedures: MSHA/NIOSH approved self-contained breathing apparatus.

SECTION V. REACTIVITY DATA

Material is stable Hazardous polymerization will not occur

Chemical incompatibilities: Strong oxidizing agents

Conditions to avoid: Heat, open flame, prolonged storage at elevated temperatures and ignition sources.

Hazardous decomposition Products: Thermal decomposition or combustion may produce carbon monoxide, carbon dioxide, formaldehyde, ammonia and/or oxides of nitrogen

SECTION VI. HEALTH HAZARD INFORMATION

Summary of risks: Formaldehyde is an irritant to eyes, lungs and skin. Listed by IARC (Group 2B) as probably carcinogenic to humans on the basis of animal evidence but human data are inadequate. Listed by the NTP as reasonably anticipated to be carcinogenic.

Medical conditions which may be aggravated by contact: Exposure may aggravate preexisting conditions such as colds, allergies, asthma, emphysema and psoriasis.

Target organs: Skin, eyes, lungs, respiratory system

Primary entry route(s): Ingestion, inhalation, skin and eye contact

Signs & symptoms of overexposure:

Eye contact: A resin containing formaldehyde can cause irritation, redness and tearing.

Skin contact: Repeated skin contact with a resin containing formaldehyde can lead to sensitization and dermatitis.

Inhalation: Breathing of dust or vapor from a resin containing formaldehyde can cause irritation of nasal and respiratory tracts. Formaldehyde vapor may cause a form of nasal cancer.

Ingestion: A resin containing formaldehyde can cause gastrointestinal irritation, vomiting, diarrhea, sweating, weakness and headache.

Material Safety Data Sheet

BTL Specialty Resins Corp.
2112 Sylvan Avenue
P.O. Box 2570
Toledo, Ohio 43606

Product: BTLM-017
MSDS No: BTL / BTLM817
Date: July 13, 1988

HEALTH HAZARD INFORMATION continued from page 2

First aid:

Eye contact: Flush eyes with large amounts of water for 15 minutes.
Get medical attention.

Skin contact: Wash affected area thoroughly with soap and water.
Remove contaminated clothing and launder before reuse.
If irritation persists, get medical attention.

Inhalation: Remove from exposure to fresh air. Restore breathing.
Get medical attention.

Ingestion: Give large quantities of water and induce vomiting.
Get medical attention. Do not make an unconscious
person vomit.

SECTION VII. SPILL, LEAK AND DISPOSAL PROCEDURES

Spill / Leak procedures: Respirators and protective equipment should be worn.
Collect the material for reclaim or place in a covered waste
disposal container. Avoid generating dust.

Waste management / Disposal: Bury or incinerate in accordance with local, state and
federal regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Personal protective equipment:

Goggles: Safety glasses with side shields.

Gloves: Recommended (polychloroprene - nitrile rubber).

Respirators: NIOSH/MSHA approved respirators if TLVs are exceeded.

Other: Eye wash facility - safety shower.

Workplace considerations:

Ventilation: Local exhaust to remove dust and vapors evolved during use.
Mechanical dust collection system. "NIOSH Recommended Industrial
Ventilation Guidelines" BPD #017-003-00136-7, available from the U.S.
Government Printing Office, offers ventilation guidelines.

SECTION IX. SPECIAL PRECAUTIONS

Storage segregation: Store in a cool, dry place. Keep containers closed to avoid
contamination.

Special handling / storage: Avoid excessive heat and sources of ignition. Avoid
repeated skin contact. Observe good housekeeping
practices. Prevent accumulation of dust.

DOT Class: Not regulated

Material Safety Data Sheet
BTL Speciality Resins Corp.
2112 Sylvan Avenue
P.O. Box 2570
Toledo, Ohio 43606

Product: BTLM-017
MSDS No: BTL / BTLM017
Date: July 13, 1988

SPECIAL PRECAUTIONS continued from page 3

Prepared/revised by: Andrew Fairchild
January 19, 1993

NOTIFICATION OF SARA TITLE III. The ingredients with established Threshold Limit Values (TLV), listed in Section II of this Material Safety Data Sheet, are subject to reporting requirements under Section 311, 312 and 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986, and 40 CFR Part 372. Section II of this Material Safety Data Sheet also lists the percentage of those ingredients, along with their respective CAS registry numbers.

This information is furnished without warrant, representation, inducement or license of any kind, except that it is accurate to the best of BTL Specialty Resins Corp.'s knowledge, or obtained from sources believed by BTL Specialty Resins Corp. to be accurate and BTL Specialty Resins Corp. does not assume any legal responsibility for use or reliance upon same. Customers are encouraged to conduct their own tests. Before using any product, read its label.

Material Safety Data Sheet

Uniroyal Chemical Company, Inc.
World Headquarters
Middlebury, CT 06749

UNIROYAL Emergency Phone: (203) 723-3670
CHEMTREC Transportation Emergency Phone: 1-800-424-9300
SAFETY DATA Information (203) 573-3303

MSDS No. V768007

Date Issued: 5/21/86

IDENTIFICATION

Date Revised: 12/9/91

R-1

Trade Name: ROYALCAST® 3105 Part A

CAS Number: NA

Chemical Name: Reaction product of a polyether blend
with diphenylmethane diisocyanate (MDI) Chemical Family: Polyurethane

SPECIAL REGULATORY HAZARDS

<u>Ingredient</u>	<u>CAS No.</u>	<u>Exposure Limit</u>	<u>OSHA (1910.1200)</u>	<u>EEC*</u>
MDI	101-68-8	0.02 ppm, ceiling (OSHA) 0.005 ppm, TWA (ACGIH)	Sensitizer	Sensitizer

Hazard assessment based on available data.

Transportation: NA

PHYSICAL DATA

Appearance and Odor: Viscous liquid; slight odor

Solubility: Reacts in water, soluble in
THF, DMF, or methylene chloride

Melting Point: ND

Boiling Point: ND

Other Data: Reactive Isocyanate (NCO): 10.0% - 20%

Specific Gravity (H₂O = 1): 1.05 - 1.15

Vapor Pressure @ 20°C: ND

Vapor Density (Air = 1): ND

Volatility @ 70°F: Low

FIRE AND EXPLOSION HAZARD DATA

Flash Point: 400°F (204°C) CC

Autoignition Temp: ND

Extinguishing Media: Water spray, dry chemical

Flammable Limits: ND

Special Fire Fighting Procedures: Protect against inhalation of cyanate vapors and other decomposition/combustion products.

Unusual Hazards: None identified.

REACTIVITY DATA

Stability: Stable at ambient temperatures and pressures.

Incompatibility: Avoid contamination with water, strong oxidizers or alcohol.

Decomposition Products: High temperatures will release cyanates and hydrocarbons. Oxides of carbon, nitrogen and small amount of HCN under burning conditions.

NA = Not Applicable

ND = Not Determined

*European Economic Community

Uniroyal makes no representation or warranty with respect to the information in this Material Safety Data Sheet. The information is however, as of this date provided, true and accurate to the best of Uniroyal's knowledge. This list of information is not intended to be all inclusive. Actual conditions of use and handling may require considerations of information other than, or in addition to, that which is provided herein.

SPECIAL PROTECTION INFORMATION

Engineering Controls: Local exhaust ventilation strongly recommended.

Personal Protection Equipment: Chemical resistant gloves and goggles should be worn. Avoid breathing vapors. In the absence of good ventilation, under emergency situations or for high concentrations, self-contained or air-supplied respiratory protection is recommended.

STORAGE, SPILLS AND DISPOSAL INFORMATION

Storage: Store away from sources of direct heat and moisture. Seal containers with a dry nitrogen blanket and keep closed when not in use. Moisture contamination will evolve CO₂ and create pressure in closed systems.

Spills: Absorb on inert carrier. Transfer to open containers outside or in well-ventilated area. Soak with dilute ammonia hydroxide or water alcohol mixture. Allow time for reaction to be complete before disposal.

Disposal: In a well ventilated area, fill drums with a couple of inches of water. Leave bung off and slowly shake and roll drum to allow water contact. Leave open to air for sufficient time to cure. Cured polyurethane is not a RCRA hazardous waste. Dispose of in accordance with local, state or federal regulations regarding polymeric waste. WARNING! Burning this material can produce toxic fumes.

Environmental Information: Environmental effects have not been determined.

HEALTH RELATED DATA

Specific Hazard(s): Contact with eyes and skin may cause irritation. Repeated, minimal contact with skin may cause sensitization. Exposure to vapor can cause irritation to eyes, lungs and mucous membranes. Repeated inhalation of minimal amounts of vapor can cause respiratory sensitization and asthma. Individuals with respiratory problems should avoid exposure to this material.

Primary Route(s) of Entry: Inhalation, skin absorption.

First Aid Procedures: **Eye contact:** Flush with water for 15 minutes. Get medical attention.

Skin contact: Wipe excess. Wash with rubbing alcohol, if available, followed by soap and water. Discard shoes if contaminated.

Inhalation: Remove to fresh air. **Physician** - treat for potential respiratory irritation.

Toxicology Information:

Sensitization: Respiratory and dermal sensitizer based upon human experience (MDI)

Mutagenicity: Ames *Salmonella* - positive (MDI)

SARA TITLE III (40CFR 372) SECTION 313 TOXIC CHEMICALS NOTIFICATION

TOXIC CHEMICAL	CAS #	% (BY WT.)
Diphenylmethane diisocyanate	101-68-8	40%
Diocyladipate	103-23-1	34%

Carcinogenic per NTP _____ IARC _____ OSHA _____ None X

Material Safety Data Sheet

Uniroyal Chemical Company, Inc.
World Headquarters
Middlebury, CT 06749

UNIROYAL Emergency Phone: (203) 723-3670
CHEMTREC Transportation Emergency Phone: 1-800-424-9300
SAFETY DATA Information (203) 573-3303

MSDS No. V768008

Date Issued: 10/27/87

IDENTIFICATION

Trade Name: ROYALCAST® 3101 Part B-60

CAS Number: NA

Chemical Name: Polyol

Chemical Family: Polyol

SPECIAL REGULATORY HAZARDS

<u>Ingredient</u>	<u>CAS No.</u>	<u>Exposure Limit</u>	<u>OSHA (1910.1200)</u>	<u>EEC*</u>
Product	NA	ND	Not hazardous	Not hazardous

Hazard assessment based on available data.

Transportation: NA

PHYSICAL DATA

Appearance and Odor: Clear, viscous liquid, mild odor.

Solubility: Slightly soluble in water

Specific Gravity (H₂O = 1): 1.09

Vapor Pressure @ 20°C: Nil

Melting Point: NA

Vapor Density (Air = 1): NA

Boiling Point: NA

Volatility @ 70°F: Nil

Other Data: NA

FIRE AND EXPLOSION HAZARD DATA

Flash Point: 390°F (199°C) PMCC

Autoignition Temp: ND

Extinguishing Media: Water fog, CO₂, dry chemical

Flammable Limits: ND

Special Fire Fighting Procedures: Use water spray to cool fire exposed containers.

Unusual Hazards: None identified.

REACTIVITY DATA

Stability: Stable at ambient temperatures and pressures.

Incompatibility: Strong oxidizers.

Decomposition Products: Oxides of carbon under burning conditions.

NA = Not Applicable

ND = Not Determined

*European Economic Community

Uniroyal makes no representation or warranty with respect to the information in this Material Safety Data Sheet. The information is however, as of this date provided, true and accurate to the best of Uniroyal's knowledge. This list of information is not intended to be all inclusive. Actual conditions of use and handling may require considerations of information other than, or in addition to, that which is provided herein.

SPECIAL PROTECTION INFORMATION

Engineering Controls: Sufficient ventilation to minimize vapor exposure.

Personal Protection Equipment: Avoid all personal contact. Observe good personal hygiene. Impervious gloves and goggles should be worn when handling. In the absence of adequate ventilation, use NIOSH-certified respiratory protection for organic vapors.

STORAGE, SPILLS AND DISPOSAL INFORMATION

Storage: Store away from sources of direct heat in a dry area. Keep containers closed when not in use.

Spills: Absorb on inert material. Shovel into secure containers for proper disposal. Use personal protective equipment as outlined above.

Disposal: In accordance with any applicable local, state, or federal regulations regarding organic waste.

Environmental Information: Environmental effects have not been determined.

HEALTH RELATED DATA

Specific Hazard(s): Contact with eyes or skin may cause irritation. No chronic health hazards have been identified. There are no known medical conditions that are aggravated by exposure to this material.

Primary Route(s) of Entry: Skin absorption.

First Aid Procedures: **Eye contact:** Flush with water for 15 minutes.

Skin contact: Wash with soap and water.

Ingestion: Drink a large quantity of whole or condensed milk.

Toxicology Information:

There is no toxicology data on this material, however, it is not expected to exhibit any significant acute toxicity.

Carcinogenic per NTP _____ IARC _____ OSHA _____ None X

MATERIAL SAFETY DATA SHEET

Index STOCK NO. 15800

FLEXANE 80 LIQUID RESIN

ITW Deycon, 30 Endicott St., Danvers, Massachusetts 01923
Emergency Telephone No.: (800) 424-9300 (CHEMTREC); Other calls: (508) 777-1100

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM RATINGS:

HEALTH: 3*
FLAMMABILITY: 1
REACTIVITY: 1
0318

REVISED: June 8, 1992

SECTION 1. PRODUCT IDENTITY

TRADENAME: FLEXANE 80 LIQUID RESIN
CHEMICAL FAMILY: Aliphatic polyisocyanate adduct

OTHER PRODUCT INFORMATION: This product is not hazardous when mixed with hardener and cured.

SECTION 2. HAZARDOUS INGREDIENTS

INGREDIENT(S)	WEIGHT PCT.	CAS NO.	TLV-TWA1,2	Notes
Methylenebis(4-cyclohexyl isocyanate) ("PICM")	10-15	5124301	.005 ppm	
Skin, respiratory sensitizer; skin, eye and respiratory irritant.				
Related polymers of above	80-90	53170039	n/e	
Skin and eye irritant; skin sensitizer.				

- "TLV" means the Threshold Limit Value exposure (8-hour time-weighted average, unless otherwise noted) established by ACGIH. "OSHA PEL" refers to the Permissible Exposure Limits for airborne contaminants as specified in 29 CFR 1900.1000.
- "N/E" indicates that neither TLV nor OSHA Permissible Exposure Limit has been established.

NOTES: A1--human carcinogen. A2--suspect carcinogen. C--ceiling limit (not a TWA). D--the TLV applies to dusts; this ingredient is not a dust as sold in our product. S--absorption through skin may be a significant route of exposure. "TC" indicates a "Toxic Chemical" subject to the reporting requirements of SARA Section 313 (40 CFR Sec. 372).

SECTION 3. PHYSICAL PROPERTIES

BOILING POINT (F): >300 VAPOR DENSITY (Air=1): n/d EVAPORATION RATE (BuAc=1): n/d
MELTING POINT (F): n/d SPECIFIC GRAVITY: 1.04 SOLUBILITY IN WATER: Nil
PERCENT SOLIDS BY WEIGHT: 100 VAPOR PRESSURE (mmHg): <.001 at 70 F
PH (5% by weight in water): 7.0 APPEARANCE AND ODOR: Clear liquid with faint odor.

VOLATILE ORGANIC COMPOUNDS (VOC): 0 lbs/gal (EPA Reference Method 24)

NOTE: "n/d" = "not determined".

SECTION 4. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: >400 F; METHOD: TCC EXPLOSIVE LIMITS IN AIR: Lower--n/d;
Upper--n/d
EXTINGUISHING MEDIA: Water CO2 Dry chemical Foam Alcohol foam
no yes yes yes no

SPECIAL FIREFIGHTING PROCEDURES: Firefighters should wear self-contained breathing apparatus and protective clothing.
UNUSUAL FIRE AND EXPLOSION HAZARDS: During a fire, irritating and/or toxic gases or mists may be present as a result of thermal decomposition or combustion.

SECTION 5. HEALTH HAZARD DATA

EMERGENCY AND FIRST AID PROCEDURES--

EYES: Flush eye with clean water for at least 15 minutes while gently holding eyelids open. Get immediate medical attention.

SKIN: Wash thoroughly with soap and warm water. Consult a physician if irritation develops.

INHALATION: Remove patient to fresh air. Administer oxygen if breathing is difficult. Get medical attention.

INGESTION: Consult a physician immediately. Do not induce vomiting.

=====

SECTION 5. HEALTH HAZARD DATA (cont'd)

TOXICITY DATA--Oral LD50 (rat): >11,000 mg/kg
Dermal LD50 (rabbit): >10000 mg/kg
Inhalation LC50 (rat): 28 ppm (data for pure PICM); Exposure time: 4 hours

=====

SYMPTOMS OF ACUTE OVEREXPOSURE--

EYES: Extremely irritating; may cause burns or permanent damage.
SKIN: Irritant. PICM can cause redness, swelling, pain; prolonged contact with PICM can cause blistering.
INHALATION: May cause respiratory irritation (dry throat, coughing, shortness of breath, chest tightness) or allergic reaction.
INGESTION: No specific data found, but may be expected to cause gastrointestinal irritation.

EFFECTS OF CHRONIC OVEREXPOSURE: Prolonged or repeated overexposure by skin contact or inhalation can cause skin irritation and sensitization, with itching, swelling, rashes, and/or an asthma-like respiratory reaction on later exposure even to very small amounts of airborne isocyanates

MEDICAL CONDITIONS WHICH EXPOSURE MAY AGGRAVATE: Asthma, bronchitis, allergies and other respiratory disorders may be aggravated by exposure to isocyanate vapors.

CARCINOGENICITY--OSHA regulated? no ACGIH? no Other? no
National Toxicology Program? no
International Agency for Research on Cancer? no
Ingredient(s) listed: None

=====

SECTION 6. REACTIVITY DATA

STABILITY: Chemically stable
Conditions to avoid: Excessive heat and open flames.
Materials to avoid: Water or moisture can cause rupture of closed containers due to pressure buildup.
Hazardous decomposition products: Oxides of carbon and nitrogen

HAZARDOUS POLYMERIZATION: will not occur.
Conditions to avoid: None

=====

SECTION 7. SPILL OR LEAK PROCEDURES

SPILL CONTROL: Prevent skin & eye contact. Absorb spill on inert compound; transfer to an open container in a well ventilated area; treat with dilute or household ammonia for 24 hrs. before disposal. Do not seal containers. Wash area with heavy duty detergent.

WASTE DISPOSAL: Remove to a waste disposal facility operating in compliance with state and local regulations.

Applicable CERCLA/RCRA Hazardous Waste Codes: None
Reportable Quantity under CERCLA, in pounds: ---

=====

SECTION 8. PROTECTIVE EQUIPMENT

EYES: Safety glasses with side shields or splashproof goggles.
SKIN: Chemical resistant rubber gloves and other protective gear as required to prevent skin contact.
RESPIRATORY: None required at normal handling temperatures with good ventilation. In cases of poor ventilation and/or at elevated temperatures an air supplying respirator should be used.
VENTILATION: Provide enough ventilation to keep airborne isocyanate below the TLV. General mechanical ventilation is normally adequate for occasional uses in open areas; local exhaust should be provided in confined spaces.

=====

SECTION 9. PRECAUTIONS FOR STORAGE, HANDLING, ETC.

---Store well closed in a cool, dry place.use.
---Prevent material contact with water or moisture. Isocyanates react slowly with water with release of carbon dioxide, a gas; pressure could build up in moisture-contaminated, closed containers, causing bursting.
---Keep hands away from eyes when handling material or before washing after use.
---Wash thoroughly after using, particularly before eating or smoking.

PROPER SHIPPING NAME: Not regulated.
O.O.T. HAZARD CLASS: None

ITW Devcon Corporation bases the information and recommendations in this document on data believed to be correct. No warranty of any kind, however, is made as to the information in this document.

MATERIAL SAFETY DATA SHEET

FLEXANE 80 LIQUID CURING AGENT

Index STOCK NO. 15800

ITW Devcon, 30 Endicott St., Danvers, Massachusetts 01923
Emergency Telephone No.: (800) 424-9300 (CHEMTREC); Other calls: (508) 777-1100

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM RATINGS:

HEALTH: 1*
FLAMMABILITY: 1
REACTIVITY: 1
0305

REVISED: June 8, 1992

SECTION 1. PRODUCT IDENTITY

TRADENAME: FLEXANE 80 LIQUID CURING AGENT
CHEMICAL FAMILY: Polyamine solution

OTHER PRODUCT INFORMATION: This information applies to the hardener component of the two-part kit. After proper mixing and curing, Flexane 80 Liquid is not hazardous.

SECTION 2. HAZARDOUS INGREDIENTS

INGREDIENT(S)	WEIGHT PCT.	CAS NO.	TLV-TWA1,2	Notes
Aromatic amine (NOT HDA) Toxic by skin absorption. Feeding study showed carcinogenic evidence.	30-40	Trade Secre	n/e	S A2

- "TLV" means the Threshold Limit Value exposure (8-hour time-weighted average, unless otherwise noted) established by ACGIH. "OSHA PEL" refers to the Permissible Exposure Limits for airborne contaminants as specified in 29 CFR 1900.1000.
- "N/E" indicates that neither TLV nor OSHA Permissible Exposure Limit has been established.

NOTES: A1--human carcinogen. A2--suspect carcinogen. C--ceiling limit (not a TWA). D--the TLV applies to dusts; this ingredient is not a dust as sold in our product. S--absorption through skin may be a significant route of exposure. "TC" indicates a "Toxic Chemical" subject to the reporting requirements of SARA Section 313 (40 CFR Sec. 372).

SECTION 3. PHYSICAL PROPERTIES

BOILING POINT (F): >500	VAPOR DENSITY (Air=1): >1	EVAPORATION RATE (BuAc=1): <<1
MELTING POINT (F): n/d	SPECIFIC GRAVITY: 1.08	SOLUBILITY IN WATER: Nil
PERCENT SOLIDS BY WEIGHT: 100		VAPOR PRESSURE (mmHg): <1 at 70 F
pH (5% by weight in water): 7-8	APPEARANCE AND ODOR: Mobile, black liquid with mild, ammonia-like odor.	
VOLATILE ORGANIC COMPOUNDS (VOC): 0 lbs/gal (EPA Reference Method 24)		NOTE: "n/d" = "not determined".

SECTION 4. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: >275 F; METHOD: TCC	EXPLOSIVE LIMITS IN AIR: Lower--n/d; Upper--n/d			
EXTINGUISHING MEDIA: Water yes	CO2 yes	Dry chemical yes	Foam yes	Alcohol foam

SPECIAL FIREFIGHTING PROCEDURES: Avoid breathing fumes. In fires where large amounts of this product are stored, firefighters should wear full protective gear and self-contained breathing apparatus

UNUSUAL FIRE AND EXPLOSION HAZARDS: Water or foam may cause frothing.

SECTION 5. HEALTH HAZARD DATA

EMERGENCY AND FIRST AID PROCEDURES--

EYES: Flush eye with clean water for at least 15 minutes while gently holding eyelids open. Get medical attention.

SKIN: Remove contaminated clothing and shoes. Wash thoroughly with soap and warm water. Consult a physician if irritation develops.

INHALATION: Unlikely unless material is heated. Remove patient to fresh air; consult a physician.

INGESTION: If patient is conscious, dilute with at least two glasses of water and induce vomiting. Get immediate medical attention.

SECTION 5. HEALTH HAZARD DATA (cont'd)

TOXICITY DATA--Oral LD50 (rat): 485 mg/kg (Aromatic amine)
Dermal LD50 (rabbit): 700 mg/kg (Aromatic amine)
Inhalation LC50 (rat): No data; Exposure time: hours

SYMPTOMS OF ACUTE OVEREXPOSURE--

EYES: Animal tests have found the hardener not to be a primary eye irritant.
SKIN: No irritation found in animal tests.
INHALATION: Not expected to be a significant route of exposure because of low volatility. However heated material may give off significant vapors.
INGESTION: Expected to be toxic.

EFFECTS OF CHRONIC OVEREXPOSURE: Rare instances of sensitization to the polyamine curing agent have been reported. A two year feeding study in rats showed that the aromatic amine caused effects in the liver thyroid and eyes. An increase in the number of liver and thyroid tumors was also found.

MEDICAL CONDITIONS WHICH EXPOSURE MAY AGGRAVATE: None reported.

CARCINOGENICITY--OSHA regulated? no ACGIH? no Other? yes
National Toxicology Program? no International Agency for Research on Cancer? no
Ingredient(s) listed: Amine

SECTION 6. REACTIVITY DATA

STABILITY: Chemically stable
Conditions to avoid: Extreme heat and open flame.
Materials to avoid: Strong acids and oxidizers.
Hazardous decomposition products: Oxides of carbon and nitrogen; aldehydes & nitro compounds from incomplete combustion.

HAZARDOUS POLYMERIZATION: will not occur.
Conditions to avoid: None.

SECTION 7. SPILL OR LEAK PROCEDURES

SPILL CONTROL: Avoid contamination of soil, waters, and sewers. Absorb on inert material and transfer to impermeable containers for disposal. Clean residue from spill area with strong detergent and water.

WASTE DISPOSAL: Discard as non-hazardous waste in accordance with applicable federal, state, and local regulation.

Applicable CERCLA/RCRA Hazardous Waste Codes: None
Reportable Quantity under CERCLA, in pounds: ---

SECTION 8. PROTECTIVE EQUIPMENT

EYES: Safety glasses with side shields, or splashproof goggles.
SKIN: Chemical resistant rubber gloves (neoprene or nitrile) and other protective gear as required to prevent skin contact.
RESPIRATORY: None required with adequate ventilation. If the material is heated, wear NIOSH-approved organic vapor respirator.
VENTILATION: Local exhaust is recommended where the material is heated. General mechanical ventilation is adequate for normal use.

SECTION 9. PRECAUTIONS FOR STORAGE, HANDLING, ETC.

---Store well closed in a cool, ventilated area away from ignition sources.
---Avoid contact of this material with skin and eyes.
---Use only in accordance with directions.
---Do not contaminate soil, waters or sewers with unmixed hardener.

PROPER SHIPPING NAME: Not regulated
D.O.T. HAZARD CLASS: None

ITW Devcon Corporation bases the information and recommendations in this document on data believed to be correct. No warranty of any kind, however, is made as to the information in this document.

RAYNOR 300 OLIGOMER

DS ID: D-007371

1 - GENERAL INFORMATION

SARTOMER COMPANY, INC.
OAKLANDS CORPORATE CENTER
468 THOMAS JONES WAY
EXTON, PENNSYLVANIA 19341

EMERGENCY PHONE NUMBERS:
800/424-9300 (CHEMTREC)
215/692-8401 (SARTOMER CO., INC.)
PRODUCT INFORMATION:
215/363-4100

TRADE NAME
CRAYNOR 300 OLIGOMER (FORMERLY CD-5000 OLIGOMER)
GENERIC NAME
ACRYLATE TERMINATED POLYBUTADIENE
DOT PROPER SHIPPING NAME UN/NA NUMBER
NOT REGULATED N/AP
DOT HAZARD CLASS
NOT REGULATED
REVISION: 2 DATE: 05/30/90

2 - SUMMARY OF HAZARDS

WARNING

PHYSICAL HAZARDS: UNSTABLE (REACTIVE) UPON DEPLETION OF INHIBITOR

ACUTE HEALTH EFFECTS: SLIGHT EYE IRRITANT
(SHORT-TERM) SLIGHT SKIN IRRITANT
MAY CAUSE ALLERGIC SKIN REACTION
MISTS/AEROSOLS MAY CAUSE RESPIRATORY TRACT
IRRITATION
NOT A SKIN ABSORPTION HAZARD BASED ON DATA FOUND
NOT AN INGESTION HAZARD BASED ON DATA FOUND

CHRONIC HEALTH EFFECTS: NO CHRONIC HEALTH EFFECTS DATA AVAILABLE.
(LONG-TERM)

3 - COMPONENTS

COMPONENT NAME	CAS NUMBER	% COMPOSITION BY (WT.)
ACRYLATE TERMINATED POLYBUTADIENE	PROPRIETARY	GT 99
BUTYLATED HYDROXY TOLUENE	128-37-0	LT .1

4 - PHYSICAL AND CHEMICAL DATA

BOILING POINT	PH
UK	AP 6.8 TO 7.2
FREEZING POINT	DRY POINT
UK	UK
SPECIFIC GRAVITY (H2O=1 AT 39.2F)	VOLATILE CHARACTERISTICS
AP .91 AT 25C	NEGLIGIBLE
VISCOSITY UNITS, TEMP. (BROOK)	SOLUBILITY IN WATER
AP 5000 25C	NEGLIGIBLE

AYNOR 300 OLIGOMER

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- PHYSICAL AND CHEMICAL DATA (continued)

VAPOR PRESSURE	STABILITY
NEGLIGIBLE	STABLE
VAPOR SP GR (AIR=1 AT 60 - 90F)	HAZARDOUS POLYMERIZATION
UK	MAY OCCUR

APPEARANCE AND ODOR
CLEAR, YELLOW, VISCOUS LIQUID WITH HYDROCARBON ODOR.

CONDITIONS AND MATERIALS TO AVOID

HEAT, OXIDIZING CONDITIONS, UV RADIATION, DIRECT SUNLIGHT.
STRONG OXIDIZERS, FREE RADICAL INITIATORS, STRONG ACIDS.

HAZARDOUS DECOMPOSITION PRODUCTS
ACRID SMOKE - FUMES/CARBON MOXIDE/CARBON DIOXIDE MAY BE RELEASED DURING
A FIRE.

- OCCUPATIONAL EXPOSURE LIMITS

SUBSTANCE	SOURCE	DATE	TYPE	VALUE	TIME
A PEL OR TLV HAS NOT BEEN ESTABLISHED.					

- FIRE AND EXPLOSION

FLASH POINT METHOD=(CC)
AP 240F

AUTOIGNITION TEMP. METHOD=
UK

FLAMMABLE LIMITS (% VOLUME IN AIR)
LOWER: UK

UPPER: UK

FIRE AND EXPLOSION HAZARDS
HIGH TEMPERATURES/INHIBITOR DEPLETION/ACCIDENTAL IMPURITIES/EXPOSURE TO
RADIATION/OXIDIZERS MAY CAUSE SPONTANEOUS POLYMERIZING REACTION, GENERATING
HEAT/PRESSURE. CLOSED CONTAINERS MAY RUPTURE/EXPLODE DURING RUNAWAY
POLYMERIZATION.

EXTINGUISHING MEDIA
DRY CHEMICAL
CO2
WATER SPRAY
FOAM
WATER FOG

SPECIAL FIREFIGHTING PROCEDURES
DO NOT ENTER FIRE AREA WITHOUT PROPER PROTECTION. SEE SECTION ON DECOMPO-
SITION PRODUCTS POSSIBLE. FIGHT FIRE FROM SAFE DISTANCE/PROTECTED LOCATION.
HEAT/IMPURITIES MAY INCREASE TEMPERATURE/BUILD PRESSURE/RUPTURE CLOSED
CONTAINERS, SPREADING FIRE, INCREASING RISK OF BURNS/INJURIES. WATER MAY BE
INEFFECTIVE IN FIREFIGHTING DUE TO LOW SOLUBILITY. USE WATER SPRAY/FOG FOR
COOLING. PRESSURE RELIEF SYSTEM MAY PLUG WITH SOLIDS, INCREASING RISK OF
OVERPRESSURE. NOTIFY AUTHORITIES IF LIQUID ENTERS SEWER/PUBLIC WATERS.

- HEALTH HAZARDS

ROUTES OF EXPOSURE
INHALATION
INHALATION EXPOSURE IS NOT LIKELY AT STANDARD CONDITIONS DUE TO THE LOW
VOLATILITY OF THIS MATERIAL. HOWEVER, OVEREXPOSURE TO MISTS/AEROSOLS OR
VAPORS THAT MAY BE GENERATED AT ELEVATED PROCESSING TEMPERATURES MAY CAUSE
RESPIRATORY TRACT IRRITATION SUCH AS COUGH, MUCOUS PRODUCTION, SHORTNESS OF
BREATH.

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- HEALTH HAZARDS (continued)

EYE CONTACT -- PRIMARY ROUTE
MAY CAUSE MINOR EYE IRRITATION.
SYMPTOMS OF IRRITATION MAY INCLUDE: EXCESSIVE TEARING, REDNESS AND BLINKING.

SKIN ABSORPTION
NO SIGNIFICANT SIGNS OR SYMPTOMS INDICATIVE OF ANY HEALTH HAZARD ARE
EXPECTED TO OCCUR AS A RESULT OF SKIN ABSORPTION EXPOSURE.

SKIN IRRITATION -- PRIMARY ROUTE
MAY PRODUCE SKIN IRRITATION.

INGESTION
NO SIGNIFICANT SIGNS OR SYMPTOMS INDICATIVE OF ANY ADVERSE HEALTH HAZARD
ARE EXPECTED TO OCCUR AS A RESULT OF INGESTION.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
NO ADDITIONAL MEDICAL INFORMATION FOUND.

- PROTECTIVE EQUIPMENT / CONTROL MEASURES

RESPIRATORY PROTECTION
IF THIS MATERIAL IS HANDLED AT ELEVATED TEMPERATURE OR UNDER MIST FORMING
CONDITIONS, NIOSH/MSHA APPROVED RESPIRATORY PROTECTION EQUIPMENT SHOULD BE
USED.

EYE PROTECTION
EYE PROTECTION SUCH AS CHEMICAL SPLASH GOGGLES AND/OR FACE SHIELD MUST BE
WORN WHEN POSSIBILITY EXISTS FOR EYE CONTACT DUE TO SPLASHING OR SPRAYING
LIQUID, AIRBORNE PARTICLES, OR VAPOR. CONTACT LENSES SHOULD NOT BE WORN.

SKIN PROTECTION
DEPENDING ON THE CONDITIONS OF USE, PROTECTIVE GLOVES, APRON, BOOTS, HEAD
AND FACE PROTECTION SHOULD BE WORN. THIS EQUIPMENT SHOULD BE CLEANED
THOROUGHLY AFTER EACH USE.

ENGINEERING CONTROLS
IF HANDLING RESULTS IN MIST/AEROSOL/VAPOR GENERATION, LOCAL EXHAUST
VENTILATION IS RECOMMENDED.

OTHER HYGENIC PRACTICES
EMERGENCY EYE WASH FOUNTAINS AND SAFETY SHOWERS SHOULD BE AVAILABLE IN THE
IMMEDIATE VICINITY OF ANY POTENTIAL EXPOSURE.

OTHER WORK PRACTICES
USE GOOD PERSONAL HYGIENE PRACTICES. WASH HANDS BEFORE EATING, DRINKING,
SMOKING, OR USING TOILET FACILITIES. PROMPTLY REMOVE SOILED CLOTHING/WASH
THOROUGHLY BEFORE REUSE. SHOWER AFTER WORK USING PLENTY OF SOAP AND WATER.

- EMERGENCY AND FIRST AID

INHALATION
IF OVERCOME BY EXPOSURE, REMOVE VICTIM TO FRESH AIR IMMEDIATELY. GIVE
OXYGEN OR ARTIFICIAL RESPIRATION AS NEEDED. OBTAIN EMERGENCY MEDICAL
ATTENTION. PROMPT ACTION IS ESSENTIAL.

EYE CONTACT
IN CASE OF EYE CONTACT, IMMEDIATELY RINSE WITH CLEAN WATER FOR 20-30
MINUTES. RETRACT EYELIDS OFTEN. OBTAIN EMERGENCY MEDICAL ATTENTION IF
PAIN, BLINKING, TEARS OR REDNESS PERSIST.

SKIN CONTACT
REMOVE CONTAMINATED CLOTHING AS NEEDED. WASH SKIN THOROUGHLY WITH MILD
SOAP/WATER. FLUSH WITH LUKEWARM WATER FOR 15 MINUTES. IF STICKY, USE WATER-
LESS CLEANER FIRST.

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- EMERGENCY AND FIRST AID (continued)

INGESTION

INGESTION UNLIKELY. HOWEVER, IF INGESTED, OBTAIN EMERGENCY MEDICAL ATTENTION.

EMERGENCY MEDICAL TREATMENT PROCEDURES

TREAT SYMPTOMATICALLY.

AFTER ADEQUATE FIRST AID, NO FURTHER TREATMENT IS REQUIRED, UNLESS SYMPTOMS REAPPEAR.

0 - SPILL AND DISPOSAL

PRECAUTIONS IF MATERIAL IS SPILLED OR RELEASED

SPILLED/ RELEASED MATERIAL MAY POLYMERIZE AND RELEASE HEAT/GASES.

EXTINGUISH ALL IGNITION SOURCES. BLANKET WITH FIREFIGHTING FOAM. IMPOUND/ RECOVER LARGE LAND SPILL; SOAK UP SMALL SPILL WITH INERT SOLIDS. ON WATER, CONTAIN/MINIMIZE DISPERSION/COLLECT. REPORT PER REGULATORY REQUIREMENTS.

WASTE DISPOSAL METHODS

CONTAMINATED PRODUCT/SOIL/WATER MAY BE RCRA/OSHA HAZARDOUS WASTE DUE TO POTENTIAL FOR INTERNAL HEAT GENERATION (SEE 40 CFR 261 AND 29 CFR 1910). LANDFILL SOLIDS AT PERMITTED SITES. USE REGISTERED TRANSPORTERS. BURN CONCENTRATED LIQUIDS IN SYSTEMS THAT USE COMPATIBLE FUEL. DILUTE WITH CLEAN, LOW VISCOSITY FUEL. AVOID FLAMEOUTS. ASSURE EMISSIONS COMPLY WITH APPLICABLE REGULATIONS. DILUTE AQUEOUS WASTE MAY BIODEGRADE. AVOID OVER-LOADING/POISONING PLANT BIOMASS. ASSURE EFFLUENT COMPLIES WITH APPLICABLE REGULATIONS.

1 - ADDITIONAL PRECAUTIONS

HANDLING AND STORAGE PROCEDURES

UNLESS INHIBITED, PRODUCT CAN POLYMERIZE, RAISING TEMPERATURE AND PRESSURE, POSSIBLY RUPTURING CONTAINER. CHECK INHIBITOR CONTENT OFTEN, ADDING TO BULK LIQUID IF NEEDED. DO NOT BLANKET OR MIX WITH OXYGEN-FREE GAS AS IT RENDERS INHIBITOR INEFFECTIVE. DO NOT STORE AT OR BELOW 32F -- INHIBITOR CAN SEPARATE AS A SOLID. IF FROZEN, MATERIAL MUST BE WARMED AND REMIXED GENTLY (<90F). STORE IN TIGHTLY CLOSED, PROPERLY VENTED CONTAINERS AWAY FROM HEAT, SPARKS, OPEN FLAME, STRONG OXIDIZERS, RADIATION, AND OTHER INITIATORS. PREVENT CONTAMINATION BY FOREIGN MATERIALS. USE ONLY NON-SPARKING TOOLS AND LIMIT STORAGE TIME. PREVENT MOISTURE CONTACT.

DECONTAMINATION PROCEDURES

FOLLOW STANDARD PLANT PROCEDURES OR SUPERVISOR'S INSTRUCTIONS FOR DECONTAMINATION OPERATIONS.

2 - LABEL INFORMATION

USE STATEMENT

FOR INDUSTRIAL USE ONLY

KEEP OUT OF REACH OF CHILDREN

SIGNAL WORD

WARNING

PHYSICAL HAZARDS

UNSTABLE (REACTIVE) UPON LOSS OF INHIBITOR

HEALTH HAZARDS

MAY CAUSE EYE, SKIN AND RESPIRATORY IRRITATION

PRECAUTIONARY MEASURES

AVOID HEAT, HIGH TEMPERATURE, AND SHOCKS.

MATERIAL IS UNSTABLE AND HAZARDOUS POLYMERIZATION MAY OCCUR.

DO NOT HANDLE NEAR HEAT, SPARKS, OR OPEN FLAME.

AVOID CONTACT WITH EYES.

AVOID PROLONGED OR REPEATED CONTACT WITH SKIN.

Printed 05-18-1993

MATERIAL SAFETY DATA SHEET

Page 5

RAYNOR 300 OLIGOMER

MSDS ID: D-007371

2 - LABEL INFORMATION (continued)

WASH THOROUGHLY AFTER HANDLING.

3 - SUPPLEMENT

NPCA HMIS RATING

HEALTH	1
FLAMMABILITY	1
REACTIVITY	2
PERSONAL PROTECTION**	D

**RESPIRATORY PROTECTION MAY BE NECESSARY DEPENDING ON CONDITIONS OF USE.
REFER TO SECTION 8 OF THIS MSDS FOR RESPIRATORY PROTECTION GUIDELINES.

NOTE -- QUALIFIERS AND CODES USED IN THIS MSDS

EQ = EQUAL	AP = APPROXIMATELY
LT = LESS THAN	GT = GREATER THAN
TR = TRACE	UK = UNKNOWN
N/AP = NOT APPLICABLE	N/P = NO APPLICABLE INFORMATION FOUND
N/DA = NO DATA AVAILABLE	

4 - DISCLAIMERS

SOME OF THE INFORMATION PRESENTED AND CONCLUSIONS DRAWN HEREIN ARE FROM SOURCES OTHER THAN DIRECT TEST DATA ON THE PRODUCT ITSELF.

THE INFORMATION IN THIS MSDS WAS OBTAINED FROM SOURCES WHICH WE BELIEVE ARE RELIABLE. HOWEVER, THE INFORMATION IS PROVIDED WITHOUT ANY WARRANTY, EXPRESS OR IMPLIED, REGARDING ITS CORRECTNESS.

THE CONDITIONS OR METHODS OF HANDLING, STORAGE, USE AND DISPOSAL OF THE PRODUCT ARE BEYOND OUR CONTROL AND MAY BE BEYOND OUR KNOWLEDGE. FOR THIS AND OTHER REASONS, WE DO NOT ASSUME RESPONSIBILITY AND EXPRESSLY DISCLAIM LIABILITY FOR LOSS, DAMAGE OR EXPENSE ARISING OUT OF OR IN ANY WAY CONNECTED WITH THE HANDLING, STORAGE, USE OR DISPOSAL OF THE PRODUCT.

THIS MSDS WAS PREPARED AND IS TO BE USED ONLY FOR THIS PRODUCT. IF THE PRODUCT IS USED AS A COMPONENT IN ANOTHER PRODUCT, THIS MSDS INFORMATION MAY NOT BE APPLICABLE.

THIS MSDS HAS BEEN PREPARED IN ACCORDANCE WITH THE REQUIREMENTS OF THE OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200).

RTOMER(R) 350 MONOMER

S ID: D-006142

- GENERAL INFORMATION

SARTOMER COMPANY, INC.
OAKLANDS CORPORATE CENTER
468 THOMAS JONES WAY
EXTON, PENNSYLVANIA 19341

EMERGENCY PHONE NUMBERS:

800/424-9300 (CHEMTREC)

215/692-8401 (SARTOMER CO., INC.)

PRODUCT INFORMATION:

215/363-4100

TRADE NAME

GENERIC NAME

TRIMETHYLOLPROPANE TRIMETHACRYLATE

DOT PROPER SHIPPING NAME

UN/NA NUMBER

NOT REGULATED

N/AP

DOT HAZARD CLASS

NOT REGULATED

REVISION 2 DATE: 12/6/89

- SUMMARY OF HAZARDS

WARNING

PHYSICAL HAZARDS:

UNSTABLE (REACTIVE) UPON DEPLETION OF INHIBITOR.

ACUTE HEALTH HAZARDS:
(SHORT-TERM)

MODERATE EYE IRRITANT

MODERATE SKIN IRRITANT/ALLERGIC SKIN SENSITIZER

NO INHALATION HAZARD IDENTIFIED FROM DATA FOUND

NO INGESTION HAZARD IDENTIFIED FROM DATA FOUND

NO DATA ON SKIN ABSORPTION FOUND

CHRONIC HEALTH HAZARDS:
(LONG-TERM)SEE SUPPLEMENT SECTION FOR CHRONIC HEALTH
EFFECTS EXPLANATION.-----
- COMPONENTS

COMPONENT NAME

CAS NUMBER % COMPOSITION BY (WT.)

TRIMETHYLOLPROPANE

TRIMETHACRYLATE ESTERS

3290-92-4

AP

100

- PHYSICAL AND CHEMICAL DATA

BOILING POINT

N/DA

PH

AP 6.8 TO 7.2

FREEZING POINT

N/DA

DRY POINT

N/DA

SPECIFIC GRAVITY (H2O=1 AT 39.2F)

AP 1.065 AT 25C

VOLATILE CHARACTERISTICS

NEGLECTIBLE

VISCOSITY UNITS, TEMP. (BROOK)

AP 40 TO 50 CPS AT 25C

SOLUBILITY IN WATER

NEGLECTIBLE

VAPOR PRESSURE

N/DA

STABILITY

STABLE

VAPOR SP GR (AIR=1 AT 60 - 90F)

N/DA

HAZARDOUS POLYMERIZATION

MAY OCCUR

APPEARANCE AND ODOR

CLEAR STRAW COLORED LIQUID WITH A MILD ODOR.

RTOMER(R) 350 MONOMER

S ID: D-006142

- PHYSICAL AND CHEMICAL DATA (continued)

CONDITIONS AND MATERIALS TO AVOID
HEAT, DIRECT SUNLIGHT, STRONG OXIDIZING
CONDITIONS, ULTRAVIOLET RADIATION, INERT GAS
BLANKETING.
STRONG OXIDIZERS, FREE RADICAL INITIATORS, INERT
GASES, OXYGEN SCAVENGERS.
HAZARDOUS DECOMPOSITION PRODUCTS
ACRID SMOKE - FUMES/CARBON MONOXIDE/CARBON DIOXIDE MAY BE RELEASED DURING A
FIRE.

- OCCUPATIONAL EXPOSURE LIMITS

SUBSTANCE	SOURCE	DATE	TYPE	VALUE	TIME

A PEL OR TLV HAS NOT BEEN ESTABLISHED.

- FIRE AND EXPLOSION

FLASH POINT	METHOD=(PMCC)	AUTOIGNITION TEMP.	METHOD=
GT	200F		N/DA

FLAMMABLE LIMITS (% VOLUME IN AIR)	
LOWER: N/DA	UPPER: N/DA

FIRE AND EXPLOSION HAZARDS
HIGH TEMPERATURES/INHIBITOR DEPLETION/ACCIDENTAL IMPURITIES/EXPOSURE TO
RADIATION/OXIDIZERS MAY CAUSE SPONTANEOUS POLYMERIZING REACTION, GENERATING
HEAT/PRESSURE. CLOSED CONTAINERS MAY RUPTURE/EXPLODE DURING RUNAWAY
POLYMERIZATION.

EXTINGUISHING MEDIA
DRY CHEMICAL
CO2
WATER SPRAY
FOAM
WATER FOG

SPECIAL FIREFIGHTING PROCEDURES
DO NOT ENTER FIRE AREA WITHOUT PROPER PROTECTION. SEE SECTION ON DECOMPO-
SITION PRODUCTS POSSIBLE. FIGHT FIRE FROM SAFE DISTANCE/PROTECTED LOCATION.
HEAT/IMPURITIES MAY INCREASE TEMPERATURE/BUILD PRESSURE/RUPTURE CLOSED
CONTAINERS, SPREADING FIRE, INCREASING RISK OF BURNS/INJURIES. WATER MAY BE
INEFFECTIVE IN FIREFIGHTING DUE TO LOW SOLUBILITY. USE WATER SPRAY/FOG FOR
COOLING. PRESSURE RELIEF SYSTEM MAY PLUG WITH SOLIDS, INCREASING RISK OF
OVERPRESSURE. NOTIFY AUTHORITIES IF LIQUID ENTERS SEWER/PUBLIC WATERS.

- HEALTH HAZARDS

ROUTES OF EXPOSURE

INHALATION
NO SIGNIFICANT SIGNS OR SYMPTOMS INDICATIVE OF ANY ADVERSE HEALTH HAZARD
ARE EXPECTED TO OCCUR AS A RESULT OF INHALATION EXPOSURE.

EYE CONTACT -- PRIMARY ROUTE
MAY CAUSE MODERATE IRRITATION, INCLUDING BURNING SENSATION, TEARING,
REDNESS OR SWELLING.

SKIN ABSORPTION
NO APPROPRIATE HUMAN OR ANIMAL HEALTH EFFECTS DATA ARE KNOWN TO EXIST.

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7 - HEALTH HAZARDS (continued)

SKIN IRRITATION -- PRIMARY ROUTE
MAY CAUSE DELAYED SKIN IRRITATION AND BLISTERING.
REPEATED EXPOSURE MAY CAUSE SKIN SENSITIZATION (AN ALLERGIC SKIN REACTION).

INGESTION
THIS MATERIAL MAY BE A SLIGHT HEALTH HAZARD IF INGESTED IN LARGE
QUANTITIES.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
MEDICAL INFORMATION REGARDING SPECIAL HEALTH EFFECTS IS NOT CONCLUSIVE.

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8 - PROTECTIVE EQUIPMENT / CONTROL MEASURES

RESPIRATORY PROTECTION
NO OCCUPATIONAL EXPOSURE STANDARDS HAVE BEEN DEVELOPED FOR THIS MATERIAL.
WHERE EXPOSURE THROUGH INHALATION MAY OCCUR FROM USE, NIOSH/MSHA APPROVED
RESPIRATORY PROTECTION EQUIPMENT IS RECOMMENDED.

EYE PROTECTION
EYE PROTECTION SUCH AS CHEMICAL SPLASH GOGGLES AND/OR FACE SHIELD MUST BE
WORN WHEN POSSIBILITY EXISTS FOR EYE CONTACT DUE TO SPLASHING OR SPRAYING
LIQUID, AIRBORNE PARTICLES, OR VAPOR. CONTACT LENSES SHOULD NOT BE WORN.

SKIN PROTECTION
WHEN SKIN CONTACT IS POSSIBLE, PROTECTIVE CLOTHING INCLUDING GLOVES, APRON,
SLEEVES, BOOTS, HEAD AND FACE PROTECTION SHOULD BE WORN. THIS EQUIPMENT
MUST BE CLEANED THOROUGHLY AFTER EACH USE.

ENGINEERING CONTROLS
NO SPECIAL VENTILATION IS RECOMMENDED UNDER ANTICIPATED CONDITIONS OF NOR-
MAL USE BEYOND THAT NEEDED FOR NORMAL COMFORT CONTROL.

OTHER HYGENIC PRACTICES
EMERGENCY EYE WASH FOUNTAINS AND SAFETY SHOWERS SHOULD BE AVAILABLE IN THE
IMMEDIATE VICINITY OF ANY POTENTIAL EXPOSURE.

OTHER WORK PRACTICES
USE GOOD PERSONAL HYGIENE PRACTICES. WASH HANDS BEFORE EATING, DRINKING,
SMOKING, OR USING TOILET FACILITIES. PROMPTLY REMOVE SOILED CLOTHING/WASH
THOROUGHLY BEFORE REUSE. SHOWER AFTER WORK USING PLENTY OF SOAP AND WATER.

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9 - EMERGENCY AND FIRST AID

INHALATION
NOT EXPECTED TO PRESENT A SIGNIFICANT INHALATION HAZARD UNDER ANTICIPATED
CONDITIONS OF NORMAL USE.
HOWEVER, IF BREATHING BECOMES DIFFICULT, REMOVE TO FRESH AIR. IF BREATHING
DIFFICULTY CONTINUES, ADMINISTER OXYGEN OR ARTIFICIAL RESPIRATION AS NEEDED
AND OBTAIN EMERGENCY MEDICAL ATTENTION.

EYE CONTACT
IN CASE OF EYE CONTACT, IMMEDIATELY RINSE WITH CLEAN WATER FOR 20-30
MINUTES. RETRACT EYELIDS OFTEN. OBTAIN EMERGENCY MEDICAL ATTENTION.

SKIN CONTACT
IMMEDIATELY REMOVE CONTAMINATED CLOTHING. WASH SKIN THOROUGHLY WITH MILD
SOAP/WATER. FLUSH W/ LUKEWARM WATER FOR 15 MINUTES. IF STICKY, USE WATERLESS
CLEANER FIRST. SEEK MEDICAL ATTENTION IF ILL EFFECT OR IRRITATION DEVELOPS.

INGESTION
IF LARGE QUANTITY SWALLOWED, GIVE LUKEWARM WATER (PINT) IF VICTIM
COMPLETELY CONSCIOUS/ALERT. DO NOT INDUCE VOMITING/RISK OF DAMAGE TO LUNGS
EXCEEDS POISONING RISK. OBTAIN EMERGENCY MEDICAL ATTENTION.

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9 - EMERGENCY AND FIRST AID (continued)

EMERGENCY MEDICAL TREATMENT PROCEDURES

PROLONGED OBSERVATION MAY BE INDICATED.

IF EYE PAIN, BLINKING, TEARS, OR REDNESS CONTINUE, PATIENT SHOULD CONTACT
OPHTHALMOLOGIST.

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10 - SPILL AND DISPOSAL

PRECAUTIONS IF MATERIAL IS SPILLED OR RELEASED

RELEASE CAN CAUSE FIRE/EXPLOSION. MAY POLYMERIZE/RELEASE HEAT/GASES.

EXTINGUISH ALL IGNITION SOURCES. BLANKET WITH FIREFIGHTING FOAM. IMPOUND/
RECOVER LARGE LAND SPILL; SOAK UP SMALL SPILL. ON WATER, CONTAIN/MINIMIZE
DISPERSION/COLLECT. REPORT PER REGULATORY REQUIREMENTS.

WASTE DISPOSAL METHODS

CONTAMINATED PRODUCT/SOIL/WATER MAY BE RCRA/OSHA HAZARDOUS WASTE DUE TO
POTENTIAL FOR INTERNAL HEAT GENERATION (SEE 40 CFR 261 AND 29 CFR 1910).
LANDFILL SOLIDS AT PERMITTED SITES. USE REGISTERED TRANSPORTERS. BURN
CONCENTRATED LIQUIDS IN SYSTEMS THAT USE COMPATIBLE FUEL. DILUTE WITH
CLEAN, LOW VISCOSITY FUEL. AVOID FLAMEOUTS. ASSURE EMISSIONS COMPLY WITH
APPLICABLE REGULATIONS. DILUTE AQUEOUS WASTE MAY BIODEGRADE. AVOID OVER-
LOADING/POISONING PLANT BIOMASS. ASSURE EFFLUENT COMPLIES WITH APPLICABLE
REGULATIONS.

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11 - ADDITIONAL PRECAUTIONS

HANDLING AND STORAGE PROCEDURES

UNLESS INHIBITED, PRODUCT CAN POLYMERIZE, RAISING TEMPERATURE AND PRESSURE,
POSSIBLY RUPTURING CONTAINER. CHECK INHIBITOR CONTENT OFTEN, ADDING TO BULK
LIQUID IF NEEDED. DO NOT BLANKET OR MIX WITH OXYGEN-FREE GAS AS IT RENDERS
INHIBITOR INEFFECTIVE. PREVENT FREEZING; INHIBITOR SEPARATES AS SOLID. IF
FROZEN, MATERIAL MUST BE WARMED AND REMIXED GENTLY (<90F). PREVENT MOISTURE
CONTACT. STORE IN TIGHTLY CLOSED, PROPERLY VENTED CONTAINERS AWAY FROM
HEAT, SPARKS, OPEN FLAME, STRONG OXIDIZERS, RADIATION, AND OTHER INITIATORS.
PREVENT CONTAMINATION BY FOREIGN MATERIALS. USE ONLY NON-SPARKING TOOLS AND
LIMIT STORAGE TIME.

DECONTAMINATION PROCEDURES

FOLLOW STANDARD PLANT PROCEDURES OR SUPERVISOR'S INSTRUCTIONS FOR
DECONTAMINATION OPERATIONS.

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12 - LABEL INFORMATION

USE STATEMENT

FOR INDUSTRIAL USE ONLY

KEEP OUT OF REACH OF CHILDREN

SIGNAL WORD

WARNING

PHYSICAL HAZARDS

UNSTABLE (REACTIVE) UPON LOSS OF INHIBITOR

HEALTH HAZARDS

EYE IRRITANT

SKIN IRRITANT/MAY CAUSE ALLERGIC SKIN REACTION

PRECAUTIONARY MEASURES

AVOID HEAT, HIGH TEMPERATURE, AND SHOCKS.

MATERIAL IS UNSTABLE AND HAZARDOUS POLYMERIZATION MAY OCCUR.

DO NOT HANDLE NEAR HEAT, SPARKS, OR OPEN FLAME.

AVOID CONTACT WITH EYES.

AVOID PROLONGED OR REPEATED CONTACT WITH SKIN.

WASH THOROUGHLY AFTER HANDLING.

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3 - SUPPLEMENT

NPCA HMIS RATING

HEALTH	2	*
FLAMMABILITY	1	
REACTIVITY	2	
PERSONAL PROTECTION**	D	

**RESPIRATORY PROTECTION MAY BE NECESSARY DEPENDING ON CONDITIONS OF USE --
WHERE EXPOSURE THROUGH INHALATION MAY OCCUR, NIOSH/MSHA APPROVED RESPIRATORY
PROTECTION IS RECOMMENDED.

CHRONIC HEALTH EFFECTS

RESULTS FROM A MOUSE LYMPHOMA TEST WERE POSITIVE, INDICATING THAT THIS
MATERIAL MAY HAVE MUTAGENIC POTENTIAL. HOWEVER, AN 18 MONTH
CARCINOGENICITY STUDY IN MICE WAS NEGATIVE FOR ALL TYPES OF CANCERS,
INCLUDING THE SKIN WHICH IS A MAJOR ROUTE OF EXPOSURE. AN AMES ASSAY FOR
MUTAGENICITY WAS NEGATIVE. THEREFORE, THERE IS REASON TO BELIEVE THAT
THIS MOUSE LYMPHOMA ASSAY WAS A FALSE POSITIVE FINDING. IT SHOULD BE
NOTED THAT THIS ASSAY SYSTEM PRODUCES A HIGH INCIDENCE OF FALSE RESPONSES.

THIS MATERIAL CONTAINS AN INHIBITOR (HQ, MEHQ, ETC.) AT <1%. THE TYPE
AND AMOUNT MEET PRODUCT SPECIFICATIONS. CONTACT A SARTOMER CO., INC.
REPRESENTATIVE FOR EXACT CONCENTRATIONS AND DETAILS ON INHIBITOR LEVEL
MAINTENANCE.

NOTE -- QUALIFIERS AND CODES USED IN THIS MSDS

EQ = EQUAL	AP = APPROXIMATELY
LT = LESS THAN	GT = GREATER THAN
TR = TRACE	UK = UNKNOWN
N/AP = NOT APPLICABLE	N/P = NO APPLICABLE INFORMATION FOUND
N/DA = NO DATA AVAILABLE	

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4 - DISCLAIMERS

SOME OF THE INFORMATION PRESENTED AND CONCLUSIONS DRAWN HEREIN ARE FROM
SOURCES OTHER THAN DIRECT TEST DATA ON THE PRODUCT ITSELF.

THE INFORMATION IN THIS MSDS WAS OBTAINED FROM SOURCES WHICH WE BELIEVE
ARE RELIABLE. HOWEVER, THE INFORMATION IS PROVIDED WITHOUT ANY WARRANTY,
EXPRESS OR IMPLIED, REGARDING ITS CORRECTNESS.

THE CONDITIONS OR METHODS OF HANDLING, STORAGE, USE AND DISPOSAL OF THE
PRODUCT ARE BEYOND OUR CONTROL AND MAY BE BEYOND OUR KNOWLEDGE. FOR THIS
AND OTHER REASONS, WE DO NOT ASSUME RESPONSIBILITY AND EXPRESSLY DISCLAIM
LIABILITY FOR LOSS, DAMAGE OR EXPENSE ARISING OUT OF OR IN ANY WAY
CONNECTED WITH THE HANDLING, STORAGE, USE OR DISPOSAL OF THE PRODUCT.

THIS MSDS WAS PREPARED AND IS TO BE USED ONLY FOR THIS PRODUCT. IF THE
PRODUCT IS USED AS A COMPONENT IN ANOTHER PRODUCT, THIS MSDS INFORMATION
MAY NOT BE APPLICABLE.

THIS MSDS HAS BEEN PREPARED IN ACCORDANCE WITH THE REQUIREMENTS OF THE
OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200).