200
11/18/91
M. L. R.
(2)

MLM--3712

DE92 002943

Process Development Accomplishments: Waste and Hazard Minimization, FY 1991

Don A. Homan

November 4, 1991

MOUND

operated by
EG&G MOUND APPLIED TECHNOLOGIES
P.O. Box 3000, Miamisburg, Ohio 45343-3000

for the
U. S. DEPARTMENT OF ENERGY
Contract No. DE-AC04-88DP43495

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This report has been reproduced directly from the best available copy.

Available to DOE and DOE contractors from:

Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831

Prices available from (615)576-8401, FTS 626-8401

Available to the public from:

National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Rd.
Springfield, VA 22161

MLM-3712
UC-702,707

Process Development Accomplishments: Waste and Hazard Minimization, FY 1991

Don A. Homan

Issued: November 4, 1991

MOUND

operated by
EG&G MOUND APPLIED TECHNOLOGIES
P.O. Box 3000, Miamisburg, Ohio 45343-3000

for the
U. S. DEPARTMENT OF ENERGY
Contract No. DE-AC04-88DP43495

MASTER

3

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

Foreword

This report summarizes significant technical accomplishments of the Mound Waste and Hazard Minimization Program for FY 1991. The accomplishments are grouped by endeavor as defined in FY 1991/FY 1993 Process Development Program Plans and Budgets Waste and Hazard Minimization Activity Data Sheets, MLM-MU-90-69-0001 (September 4, 1990).

Your comments and requests for additional information should be directed to D. A. Homan, FTS 774-3116.

Contents

	<u>Page</u>
EXECUTIVE SUMMARY	6
MD314 WASTE AND HAZARD MINIMIZATION	7
MD314-01 Environmentally Responsive Cleaning Program	7
Nonhalogenated Solvent Trials	7
Substitutes for Volatile Organic Compounds	8
MD314-02 Hazardous Material Exposure Minimization	9
MD314-03 Nonhazardous Plating Development	10
MD314-04 Explosive Processing Waste Reduction	11
MD314-06 Tritium Capture Without Conversion to Water	12
MD314-09 Robotic Assembly	13
WASTE AND HAZARD WASTE MINIMIZATION COST SUMMARY	14
DISTRIBUTION	15

Executive Summary

- Bioact EC-7 has proven to be a suitable replacement for methylene chloride in W89 production processes. To incorporate Bioact EC-7 into W89 production, documentation such as product WR certification and manual revisions have been completed.
- Development efforts are in progress to find volatile organic compound substitutes. Processes showing promise include supercritical carbon dioxide, dry gas plasma, high pressure aqueous spray, and laser ablation. None of these processes contribute to the waste stream.
- All MDA-based materials have been replaced at Mound.
- Industrial Hygiene monitoring of operations involving use of TDI based materials showed exposure levels to be less than 10% of the allowable limit.
- Mound is an active member of the DOE Hazardous Material Exposure Minimization working group.
- A non-cyanide copper plating solution has been identified. A commercial sealer with half the nickel has been identified as a possible replacement for the present nickel acetate sealer.
- Flash point testing was conducted on mixed/solvent systems which constitute explosive process waste. "Chemical Oxygen Demand" and "Biological Oxygen Demand" tests were conducted on selected explosive processing waste streams to determine suitability for treatment by microbes in Mound's sewage treatment plant.
- Considerable progress has been made toward selecting a getter material for tritium capture without conversion to water.

- A robot was successfully integrated with the prototype pyrotechnic loading station. A powder weighing device and self stripping dies have been developed. The loading dies were so successful that all future development dies will be of this design.

MD314 Waste and Hazard Minimization

MD314-01 Environmentally Responsive Cleaning Program

NONHALOGENATED SOLVENT TRIALS

A survey of hazardous halogenated solvent use was completed at EG&G Mound, Unidynamics of Phoenix, Arizona, and Thiokol of Elkton, Maryland. EG&G Mound usage was 21,530 lb. for FY 1991. Unidynamics and Thiokol usage was approximately 660 lb. A database, listing types of hazardous halogenated solvents, user, and quantities used was created to track usage reductions at EG&G Mound and contractors. Major reduction of hazardous halogenated solvent usage at EG&G Mound and contractors is expected in late FY 1992, pending successful compatibility results review.

Ten candidate nonhazardous, nonhalogenated solvent substitutes for halogenated solvents were evaluated for their cleaning efficiency in removing production contaminants and machine coolants from component parts and aluminum and stainless steel coupons. All ten candidate solvent cleaning efficiencies exceeded the halogenated solvents presently used in production. W89 component production cleaning trials were conducted employing one of the candidates, Bioact EC-7 (terpene-surfactant mixture). The results of the production cleaning trials showed that Bioact EC-7 cleaning efficiency was greater than the methylene chloride presently in use. As a result of the successful production cleaning trials, Bioact EC-7 has been recommended as a replacement for methylene chloride in W89 production processes. To implement Bioact EC-7 into W89 production, documentation such as product WR certification and manual revisions have been completed. Production implementation

of Bioact EC-7 will occur in late FY 1992 pending successful W89 component compatibility results.

SUBSTITUTES FOR VOLATILE ORGANIC COMPOUNDS

Development efforts were initiated to evaluate supercritical carbon dioxide (SCCO₂) and dry gas plasma nonhazardous, nonwaste stream contributing cleaning processes for substitutes for volatile organic compounds (VOCs) presently used in production operations. Initial results revealed that SCCO₂ has the potential of removing contaminants such as bulk cutting fluids from component parts and aluminum and stainless steel coupons to acceptable residue levels. Process optimization studies are in progress and will be completed in late FY 1992. Dry gas plasma cleaning evaluations are in progress; results are expected in early FY 1992. In addition to the above cleaning process evaluations, high pressure aqueous spray (HPAS) and laser ablation are being evaluated for VOC substitution in production. HPAS evaluated at vendor's location at no cost revealed that production contaminants could be removed to acceptable levels at water pressures above 2000 psi. Additional evaluations will be required to optimize operational parameters. Laser ablation studies are in progress, with completion expected in late FY 1992.

Revision of all development and production cleaning manuals to include new cleaning processes and materials is in progress.

EG&G Mound compatibility studies for W89 and spark gap device materials are in planning and fabrication stages. Assembly and testing are scheduled for late November. Results will be evaluated quarterly through FY92.

Specifications for the purchase of a nonhazardous SCCO₂ system and a high pressure aqueous spray system are complete. Equipment safety and engineering documentation are scheduled for completion by the end of September. Equipment delivery is expected late in FY 1992. When implemented into production these systems are expected to significantly reduce the hazardous waste stream at EG&G Mound.

EG&G Mound's process development fund priorities were reevaluated to allow additional funding for this program.

MD314-02 Hazardous Material Exposure Minimization

The FY 1991 milestones with respect to elimination of 4, 4"-methylenedianiline (MDA) based materials have been accomplished. Evaluation of the physical, chemical, and processing properties of Halthane 88-3, the replacement for the MDA containing Halthane 88-2, was completed and showed no problems with respect to its use in Mound operations. It is being used successfully in the W89 development program, thus demonstrating a successful transfer to production. Additional property evaluations requested late in FY 1991 will be conducted in FY 1992.

Curing Agent Z (an MDA-based epoxy curing agent) was successfully replaced in PXD production and in solenoid production at a vendor location with an Ethacure-100-based system. Property evaluation demonstrated acceptable performance in both applications; Sandia approval was received for the change. An unexpected potential serious health problem with Ethacure 100 that became known late in FY 1991 has resulted in a coordinated DOE MDA Users Group program to address replacement of Ethacure 100. Mound will continue to be an active member of this interagency working group in FY 1992 and beyond.

The program to minimize potential employee exposure to toluene diisocyanate (TDI) is on schedule. Two of the five subtasks have been accomplished. Industrial hygiene monitoring of operations involving use of TDI-based materials showed exposure levels less than 10% of the allowable limit, thus demonstrating outstanding worker compliance with operating procedures. The goal of another subtask is to evaluate a short-term solution to reduce potential TDI exposure by processing TDI-based materials on automated equipment. A thorough evaluation of equipment from fourteen manufacturers has resulted in the purchase of a system to allow laboratory evaluation of

this approach. In addition, evaluation of potential candidates to replace TDI-based materials is under way, working in concert with the DOE working group.

MD314-03 Nonhazardous Plating Development

SUBTASK A) Waste Identification/Material Substitution

MILESTONE: Identify high volume wastes

Two classes of materials were identified as contributing to the most waste: a carbon removal solution containing sodium hydroxide and potassium permanganate, and a cleaning solvent containing mostly acetone. These two classes of compounds made up approximately 80-90% of the waste leaving the plating area in M108 in the past two years.

SUBTASK B) Identify/Substitute Non-Nickel/Cyanide Processes

MILESTONE: Identify cyanide/nickel substitutes

A commercial alkaline non-cyanide copper plating solution was identified as a possible substitute for the cyanide plating solution currently used in the plating shop.

A commercial nickel acetate sealer for dyed anodized aluminum was identified as a possible candidate replacement for the nickel acetate sealer now used in the plating shop. The commercial sealer contains half the nickel concentration of the product presently used.

SUBTASK C) Revise Procedures/Controls

MILESTONE: Review process procedures and equipment controls

A review was made of the process procedures and equipment in the plating shop. A preliminary assessment was that the implementation of a final spray water rinse of the plating rack into the last drag-out rinse tank would reduce waste water contamination. Also, a simple neutralization of the carbon removal solution (see Subtask A) would allow the solution to be processed through the existing waste water effluent stream.

SUBTASK D) Develop Spillage Containment Hardware

MILESTONE: Identify containment alternatives

Spillage containment alternatives are still being investigated. A preliminary idea is to use a flexible liner underneath each existing plating console.

MD314-04 Explosive Processing Waste Reduction

Training was purchased, installed, and taken on a supercritical extractor/-chromatograph which will be used to test solubilities of explosives in supercritical CO₂ (SCCO₂).

Plumbing was rerouted in the explosives processing facility so that waste streams containing toxics can be isolated from those that do not.

Flash point testing was conducted on mixed water/solvent systems which constitute process waste. Thus, the ratios of water to solvent which constitute flammability hazards were determined as defined by statute.

A medium-scale device was designed for measuring explosive solubilities in SCCO₂, and the components were purchased.

A variety of regulatory interpretations were obtained from our Environmental Section, including the hazard classification of processing solvents, the significance of acetone's "F-listing," and precedents regarding the disposal of these materials. An agreement was obtained from the EPA to prepare a request-for-ruling on a proposal for discharging selected non-flammable waste streams containing no EPA-listed toxics to monitored in-house sewage treatment.

Selected explosive waste streams were analyzed to determine the exact amount of residual explosive content.

"Chemical Oxygen Demand" and "Biological Oxygen Demand" tests were conducted on selected explosive processing waste streams to determine their suitability for treatment by the microbes in Mound's sewage treatment plant.

A survey of water-separation technologies was conducted to determine the feasibility of separating explosive process waste streams into their aqueous and organic components.

MD314-06 Tritium Capture Without Conversion to Water

Considerable progress has been made toward the FY 1991 milestone of selecting a getter material. Meetings have been held with project participants, with a metal hydride consultant, and with suppliers of getter materials. Several getter materials have been chosen as likely candidates. Samples of such materials have been purchased and pressure-composition-temperature analyses have been contracted. Results from these tests have not yet been received. Thermodynamic studies have been begun with protium and deuterium to evaluate the thermodynamic and kinetic properties of several of the getters. An informal procedural plan has been generated for cycling getter materials in tritium. Containers for the cycling experiments have been ordered.

MD314-09 Robotic Assembly

In FY 1991 a robot was successfully integrated with the prototype loading station. This loading station will be installed in the development area and used in the manual (nonrobotic) mode. Work is underway on the next loading station. A powder weighing device was designed and constructed by Sandia National Laboratories (Albuquerque) and is planned to be incorporated into the system. Self stripping dies similar to the ones planned for the system were constructed for two development components, the XMC4218 and the XMC4282. In the manual mode these loading dies proved successful in loading these components. All future loading tools for development work will use this design. In FY 1992 the weighing station and the loading station will be incorporated to form a system.

WASTE AND HAZARD WASTE MINIMIZATION COST SUMMARY

	FY 1991 Planned		FY 1991 Actual	
	<u>FTE</u>	<u>DSK</u>	<u>FTE</u>	<u>DSK</u>
MD314 Waste and Hazard Minimization Activities	7.0	479	8.4	581.8

Distribution

External

OSTI, UC-702, 707 (200)
F. A. Baca, Director, BRMD, AL
R. B. Burditt, MMES, Y-12
K. A. Carlson, WMOSD, AL
D. C. Christensen, MS 5-500, NMT-DO, LANL
R. E. Clough, L-125, LLNL
N. S. Dienes, Director, WMOSD, AL
Director, Office of Development, Testing and Acquisition, MA, HQ
Director, Office of Research and Advanced Technology, MA, HQ
Director, Office of Policy and Program Planning, MA, HQ
D. L. Feucht, EG&G, RFP
C. Frank, EM-50, HQ
M. C. Garcia, HPD, AL
B. Granoff, Org. 6611, SNL
K. E. Hain, EM-50, HQ
R. F. Hatfield, LLNL (5)
G. S. Hearron, WQD, AL (2)
D. Jacobs, GEND
J. R. Knight, Westinghouse, SR
J. W. Koger, MS-8097, MMES, Y-12
J. Marchetti, DP22.1, HQ
J. A. Morley, DAO/DOE
G. R. Otey, Org. 5160, SNLA (5)
M. D. Querry, Allied-Signal, Inc., KCD
P. A. Saxman, TTCS, AL
H. T. Season, Jr., Director, WPD, AL
G. E. Seay, WX-DO, LANL, (5)
A. C. Skinrood, Org. 8133, SNLL (5)
R. J. Slape, M&H-SM Co., PX
D. L. Stoltz, D/920/OB28, AS-KCD
R. E. Stoltz, Org. 8316, SNL
W. E. Swartz, MS-048, GEND
A. E. Whiteman, Director, WQD, AL

Internal

D. D. Back	D. A. Homan (5)
G. L. Ball	T. L. Koeller
T. L. Buxton	D. E. Michel
D. P. Cornwell	R. F. Salerno
R. J. DeSando	W. H. Smith
J. V. Dichiaro	R. E. Vallee
E. E. Egleston	H. A. Woltermann
D. W. Firsich	C. M. Woods
R. A. Fischbein	Library (3)
D. G. Glasgow	Publications
L. D. Haws	

Mary J. Pacinda, Editor
Technical Manuals and Publications

END

**DATE
FILMED**

12126191