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**FIELD STUDY OF DISPOSED WASTES
FROM ADVANCED COAL PROCESSES
DE-AC21-86MC22118
DOE Quarterly Technical
Progress Report**

April, 1994 to June, 1994

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TABLE OF CONTENTS

	Page
1.0 OBJECTIVES	1
2.0 SUMMARY OF PREVIOUS WORK	1
2.1 Colorado	2
2.2 Ohio	2
2.3 Illinois	3
3.0 OBJECTIVES FOR THE CURRENT REPORTING PERIOD	5
4.0 ACTIVITIES FOR THE REPORTING PERIOD	5
4.1 Colorado Ute Site	5
4.2 Ohio Site	5
4.3 Illinois Site	6
5.0 MANAGEMENT	6
6.0 ACTIVITIES PLANNED FOR THE NEXT QUARTER	6

1.0

OBJECTIVES

The Department of Energy/Morgantown Energy Technology Center (DOE/METC) has initiated research on the disposal of solid wastes from advanced coal processes. The objective of this research is to develop information to be used by private industry and government agencies for planning waste disposal practices associated with advanced coal processes. To accomplish this objective, DOE has contracted Radian Corporation and the North Dakota Energy & Environmental Research Center (EERC) to design, construct, and monitor a limited number of field disposal tests with advanced coal process wastes. These field tests will be monitored over a three year period with the emphasis on collecting data on the field disposal of these wastes.

There has been considerable research on the characteristics and laboratory leaching behavior of coal wastes -- a lesser amount on wastes from advanced coal processes. However, very little information exists on the field disposal behavior of these wastes. Information on field disposal behavior is needed (a) as input to predictive models being developed, b) as input to the development of rule of thumb design guidelines for the disposal of these wastes, and c) as evidence of the behavior of these wastes in the natural environment.

2.0

SUMMARY OF PREVIOUS WORK

This study is organized into four major Tasks. Tasks 1 and 2 were devoted to planning the Task 3 field study. Task 4 uses the results of the field testing to produce an Engineering Design Manual for the utilities and industrial users who manage wastes from advanced coal combustion technologies.

Task 1 identified and rated test design options. A Test Design Manual was prepared and submitted to METC in 1988. Specific test procedures suitable for each design option were identified under Task 2. These test methods were documented in a

Test Procedures Manual, submitted to METC in 1988. Also under Task 2, test sites were selected and site access was negotiated. Sites in Illinois and North Dakota were delayed at this stage, and the North Dakota site was dropped from consideration. Task 2 was completed and Final Test Plans were submitted to METC for three sites in 1988.

Task 3 progress for each of the test sites is summarized below:

2.1 Colorado

The test cell was constructed in June, 1989 with CFBC ash from a low sulfur western coal. The ash has low lime and sulfate content. Core samples were collected in June and December 1989, in March, June and December of 1990, in June 1991, and June 1992. No groundwater or porewater samples have been recovered; two surface runoff samples were collected. A year five sampling at the Colorado site is planned for July, 1994. A draft site assessment report, based on the initial three years of monitoring, was completed in December, 1992. Comments on the report were received in early 1994, and a final draft of the report is in preparation.

The strength of core samples from the Colorado site is low to moderate (200 psi to 900 psi), with permeabilities of 2×10^{-3} to 3×10^{-4} . Laboratory leachates show moderate concentrations of calcium, sulfate, and other common ions. Trace element concentrations in test leachates are low compared to regulatory limits. No leachate has been generated from the test cell at this site.

2.2 Ohio

Two test cells were constructed, in February and April of 1989, using LIMB ash from an Ohio coal with 2.4% sulfur. The ash has a high lime and sulfate content. Test Case 1 (North Cell) was constructed with 25% moisture; Test Case 2 (South Cell) was constructed with 38% moisture to optimize compaction. The wastes

expanded, heaved, and fractured during the first year, particularly in the South Cell. Mineralogical changes in the wastes with hydration and weathering are the primary cause. Core strength is low to moderate (<100 psi to 2000 psi) and highly variable because of fracturing. Field measurements of permeability vary from 3×10^{-3} to 5×10^{-5} cm/sec. Permeabilities are lowest in the North Cell.

Large amounts of water were bound in the wastes in the first year as the waste saturated and hydrated. Starting in the second year, leachate appears to have migrated out of the South Cell into one downgradient well. The leachate at the bottom of the test cell contains up to several thousand mg/L of sulfate, chloride, potassium, and sodium, with somewhat lower concentrations of calcium and silicon. Trace metal concentrations are generally low compared to regulatory limits, but a few samples contain arsenic at concentrations of up to 0.35 mg/L.

Core samples were first collected in June, 1989, and quarterly and annual core sampling events have taken place according to schedule since that time. Water samples have been collected on a quarterly basis since October, 1989. Final core sampling for the initial three year monitoring period took place in August, 1992. A year five sampling event at the Ohio site is planned for July, 1994.

A draft final report on the Ohio site has been prepared and submitted to DOE/METC. Following receipt of comments from the DOE, the report will be finalized.

2.3 Illinois

The first Illinois test cell was completed in April, 1991, with BFBC ash from a Illinois coal with 3.1% sulfur. A large excess of limestone is used in the combustor; the ash is high in lime relative to most FBC wastes, containing up to 30% CaO. The ash also contains abundant sulfate, but has relatively low concentrations of typical

coal ash constituents compared to other wastes included in this study. The two test cells planned for the second Illinois test case will evaluate the effects of added coal ash on cementitious reactions in the waste. Laboratory studies to define the optimum mix of FBC waste and coal fly ash were conducted and two mixes were selected. Both mixes contain equal amounts of pulverized coal fly ash and FBC ash by weight; the mix for Cell 2 was placed at optimum moisture for compaction with a smooth roller, and the mix for Cell 3 was placed as a pumpable slurry at a moisture content 10% over OMC. Cell construction, planned for late fall, 1992, was completed in June, 1993 because of permit complications.

The initial cell was instrumented and sampled in June 1991. Water samples and additional cores were collected in August and November, 1991, and February and May, 1992. No expansion has been noted at the site. The wastes are solidified with unconfined compressive strength between approximately 150 and 550 psi, although some fracture zones may be present in the waste and may reduce overall strength. The permeability measured on cores recovered from the test cell ranges from 1×10^{-6} to 2×10^{-4} ; field permeability measurements range from a high of 3×10^{-3} near the surface to a low of 2×10^{-5} at depth in the test cell. The initial three years of sampling was completed at Cell 1 in May, 1994.

Core samples from Cells 2 and 3 have been collected on two occasion since construction, and porewater samples have been sampled three times. The field monitoring program under this contract will terminate October 1, 1994. The DOE plans to contract for follow-on monitoring through 1996.

Task 4 work on the Disposal Facility Design Manual is under way. An internal review draft of the design manual has been prepared. A draft of the Design Manual will be submitted to the DOE August 1, 1994.

3.0 OBJECTIVES FOR THE CURRENT REPORTING PERIOD

The specific objectives for the reporting period of April, 1994 to June, 1994 were as follows:

- Collect and analyze third annual samples from Illinois Cell 1;
- Collect and analyze first annual samples from Illinois Cells 2 and 3;
- Complete a draft of the Design Manual;
- Present project results at the AWMA conference;
- Finalize the Colorado Site report; and
- Prepare for sampling at Ohio and Colorado sites.

4.0 ACTIVITIES FOR THE REPORTING PERIOD

4.1 Colorado Ute Site

The final draft of the Colorado Site report is in preparation. Year 5 sampling at the Colorado site was scheduled for the week of July 11, 1994.

4.2 Ohio Site

The final draft of the Ohio Site Report will be issued pending receipt of comments from the DOE. Year 5 sampling at the Ohio site was scheduled for the week of July 18, 1994.

4.3 Illinois Site

The twelfth set of quarterly water samples was collected in May, 1994. Core samples were also collected at this time from all three test cells at the site. The analytical results for these samples have not yet been received from the labs.

5.0 MANAGEMENT

Results from field testing program were highlighted in a paper prepared for the Air and Waste Management Association annual conference in Cincinnati on June 23, 1994.

Radian received technical directions to substitute the Year 5 sampling at the Colorado and Ohio sites for the Year 2 and 3 monitoring at the Illinois site. Radian prepared addenda to the Colorado and Ohio Test Plans to cover the additional monitoring, and obtained DOE approval for these plans before scheduling the additional work. The current contract is now set to expire October 1, 1994.

6.0 ACTIVITIES PLANNED FOR THE NEXT QUARTER

The following activities are planned for the period of July, 1994 through October, 1994:

- Finalize the Colorado site report;
- Finalize the Ohio site report;
- Finalize the Design Manual;
- Complete Year 5 sampling and analysis; and
- Complete a draft of the Illinois Cell 1 site report.

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