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Shaw Environmental, Inc.

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To: Mr. Jim Walsh

From: Charles Schaefer, Ph.D. Shaw Environmental, Inc.

Subject: **DRAFT - Laboratory Testing to Evaluate Potential Suppression Agents**
Countywide Landfill, Stark County, OH

Introduction

Described herein is a brief description of a proposed laboratory treatability test to evaluate the application of various suppression agents for mitigating the reaction between aluminum dross and leachate water present in the Countywide Landfill. The testing will be performed by Shaw Environmental, Inc. (Shaw) at their laboratory in Lawrenceville, NJ.

Previously performed studies have suggested that addition of certain salts can hinder the reaction between aluminum metals and water via passivation of the metal surface.^{1,2} The objective of the currently proposed laboratory study is to evaluate the potential effectiveness of various suppression amendments by estimating the amendment dosage required for treatment, determining how quickly the reaction suppression will occur, verifying that the suppression mechanisms are irreversible, and quantifying the overall impacts of amendment addition on gas production and composition. Summaries of the overall approach, laboratory methodologies, data evaluation, schedule, and preliminary cost estimate are provided in the following sections.

Approach

The general approach for evaluating the effectiveness of various suppression agents is to perform small-scale batch tests in the laboratory using “representative” dross and landfill materials. In air-tight laboratory bottles, the hydrolysis reaction will be initiated by adding leachate water to the samples, and the subsequent gas generation rate and composition will be monitored as a function of time. Parallel samples using the selected suppression agents also will be prepared, and gas generation rates and composition will be compared among the treatments to evaluate potential treatment effectiveness of the amendments.

¹ Krnel, K.; Kosmac-breve, T., 2000. “Reactivity of aluminum nitride powder in dilute inorganic acids”, J. American Ceramic Soc., 83, 1375-1378.

² Cornerstone Environmental Group, LLC, 2006. Report – Gas system operating review at the Countywide Landfill.

Methodology

Materials and Sample Collection

Aluminum dross and non-dross landfill solids will be collected by others from a representative location adjacent to the apparent reaction zone. Alternately, reactive aluminum dross material similar to that disposed of within the Countywide Landfill will be utilized. A minimum of 2 kg of aluminum dross and 2 kg of landfill solids will be needed. In addition, a minimum of 3L of leachate water will be needed.

It is recommended that solid and aqueous samples collected from the landfill will be collected under nitrogen blanket to limit air contact, and potential changes in geochemical conditions, with the samples. Samples also will be collected in sealed containers to limit contact with air during shipping.

Selected suppression agents include magnesium chloride, phosphate salts, silicate salts, and possibly a surfactant or foam suppression agent.

Sample Preparation

All sample preparation will be performed in an anaerobic chamber to limit the introduction of air to the sample bottles. Samples will be prepared in 160-mL glass serum bottles. A total of 18 bottles will be prepared. 50 mL of leachate water will also be added to each bottle. A total of six treatments will be prepared as follows:³

Aluminum Dross Control: This control will be amended with 25g of dross, and will receive no additional amendments.

Aluminum Dross + Landfill Solids Control: This control will be amended with 25g of dross and 25g of landfill solids, and will receive no additional amendments.

Suppression Treatment 1: Treatment 1 will be amended with 25g of dross, 25g of landfill solids, and magnesium chloride at an aqueous (i.e., leachate) concentration of 0.1 wt%.

Suppression Treatment 2: Treatment 2 will be amended with 25g of dross, 25g of landfill solids, and magnesium chloride at an aqueous concentration of 10 wt%.

Suppression Treatment 3: Treatment 3 will be amended with 25g of dross, 25g of landfill solids, and a phosphate salt at an aqueous concentration of 0.1 wt%.

Suppression Treatment 4: Treatment 4 will be amended with 25g of dross, 25g of landfill solids, and a phosphate salt at an aqueous concentration of 10 wt%.

Suppression Treatment 5: Treatment 5 will be amended with 25g of dross, 25g of landfill solids, and a silicate salt at an aqueous concentration of 0.1 wt%.

Suppression Treatment 6: Treatment 6 will be amended with 25g of dross, 25g of landfill solids, and a silicate salt at an aqueous concentration of 10 wt%.

Suppression Treatment 7 (optional): Treatment 7 will be amended with 25g of dross, 25g of landfill solids, and a surfactant/foam formulation at an aqueous concentration of 1 wt%.

³ Preliminary testing will be performed to verify that the selected sample amounts are sufficient for measuring gas generation.

Privileged and Confidential

All treatments will be prepared in duplicate. Bottle headspace will be purged with a gas formulated to approximate the landfill gas composition. Serum bottles will be capped with a Teflon septum and aluminum crimp seal. After capping the bottles, the bottles will be removed from the anaerobic chamber and placed in a constant temperature bath to maintain the temperature at approximately 170 degrees F. A syringe, connected to a sampling valve, will be inserted through the septa of each bottle to facilitate gas collection and monitoring.

Monitoring and Analyses

The rate of gas production will be measured by collecting the generated gas volume in Tedlar bags that are connected to the syringes. Gas composition also will be monitored by sampling through the syringe. Generated gas volume will be monitored daily, and gas composition monitoring will be performed at least twice per week. Headspace gases will be analyzed for the following:

- methane
- ammonia
- hydrogen
- carbon monoxide
- carbon dioxide
- oxygen
- nitrogen

Analyses will be performed using a thermal conductivity detector, a hydrogen ionization detector, and/or a flame ionization detector.

It is anticipated that testing will be performed for a 3-week duration; this time period is expected to provide sufficient information regarding the reaction and suppression kinetics, including the extent of irreversibility of any passivation reactions. The pH of the slurry will be measured for all samples at the end of the testing, and (if possible) microscopic observations of the dross surface will be made to provide insight and confirmation regarding potential suppression mechanisms.

Schedule

Upon receipt of the required materials, the preparation of the experiments is expected to occur within one week. The anticipated duration of the test is three weeks, and approximately one week is needed to perform the final analyses, tabulate and evaluate the data, and prepare a brief letter report. The letter report will contain a summary of the test procedure, tabulated results, and conclusions regarding the potential applicability of the suppression agents.

Preliminary Cost Estimate

The preliminary cost estimate for the proposed laboratory testing is \$28,000. This estimate does not include costs associated with collection of dross and landfill solids.