

## Evaluating the Water Reactivity of Expired Propellants

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**Background/Objective.** This case concerns the disposal of expired propellants that had been ignited in burn pans with the residual waste ash of each propellant type stored in separate drums awaiting disposal. Ideally, the propellant waste ash would be landfilled, however, the reactivity, if any, of each propellant waste ash when exposed to the environment needed to be assessed prior to disposal to characterize the waste for disposal. The USACE Tulsa District contracted MSE Group, LLC (through a Joint Venture Agreement), who teamed with SiREM, to evaluate the water reactivity of fourteen separate propellant waste ash samples. Analysis of the samples indicated the presence of carbon (C), oxygen (O), and aluminum (Al). Testing was performed to evaluate whether the metallic Al may undergo hydrolysis and release hydrogen gas.

**Approach/Activities.** The potential water reactivity of each propellant waste ash was assessed by placing weighed quantities of each ash sample into calorimeters fitted with thermistors and a gas collection system to monitor temperature and the volume of gas produced, respectively. Each thermistor was graphically interfaced with a laptop using an Arduino Mega 2560 microcontroller board to monitor temperature every 30 or 90 seconds for the duration of the test. After the conclusion of each test, gas samples were collected and sent to a commercial analytical laboratory for analysis.

**Results/Lessons Learned.** All but two of the ash samples were found to be highly water reactive. In addition to expected hydrolysis reactions involving aluminum, another aqueous reaction occurred releasing heat, ammonia gas and hydrogen. Some of the ash samples reacted by releasing gas only without detectible heat generation. Temperatures up to 98.5°C were recorded and translated to a maximum of 251 calories generated per gram of ash with gas production in excess of 150 mL per gram. The data indicated that the ash was hazardous and not suitable for disposal in a municipal landfill.