IN-DRUM SYSTEM OVERVIEW

In-drum systems have the capability to convert reactive chemicals into stable compounds without removing, handling, or sorting wastes from the source container. Systems are designed for the treatment of radioactive waste-containing drums that are unacceptable for shipping, long-term storage, and/or traditional methods of disposal. The resultant product is a dry, chemically stable, inorganic waste material. The in-drum system can generically be split into four stages (Fig. 3):

1. Drum Characterization
2. Drum Treatment
3. Off-Gas Treatment
4. Waste Disposal

Prior to treating, the drums are characterized to confirm and/or determine their contents. Real-time radiography (RTR) may be used to look for prohibited items such as compressed gas bottles. RTR can determine general physical composition (e.g., the presence of cans, bottles, drums, liners, absorbent, free liquids) of drum contents. Nondestructive assay (NDA) may be used to determine radionuclide content. Acceptable knowledge (AK)[c] may additionally be used to determine composition of drum contents.

Primary treatment of the drums is performed in a heated chamber. The vessel wall is fabricated of a high-temperature-resistant alloy with electric heaters located outside the vessel walls. Intact drums of waste are then placed in the vessel. Once placed, nitrogen is injected into the chamber to provide an inert blanketing gas which allows contents to be thermally decomposed without combustion. The drum is then remotely vented to allow the drum contents to off-gas as they are generated. The contents of the vessel are then heated to a suitable temperature for the wastes, typically 550°C to 650°C. At this temperature, water and organics with low-boiling points are evaporated from the waste. Organics with high-boiling points (e.g., plastics and other organic polymers) are broken down into volatile organics that are gasified and converted to carbon char that remains in the solid wastes. Nitrate compounds within the waste decompose to metal oxides and NOx. Following treatment, steam may be injected into the chamber to gasify the carbon char into CO and CO_2 for further removal.

During processing, generated off-gas is vented for downstream treatment. In one configuration of off-gas treatment, gases would pass through a primary filter, be thermally decomposed in a thermal oxidizer, then quenched and scrubbed prior to passing through a final stage of off-gas filtration and exhausted through the flue-gas stack.

The heat-up rate is controlled in a manner to limit the carry-over of any solids through the off-gas; the primary filter captures any particulates that may have been carried over during venting. In the thermal oxidizer, any volatile organic compounds (VOCs) will be thermally decomposed to carbon dioxide and water. Halogens that may be present in the gas will be converted to acid gases. The off-gas is then quenched and scrubbed downstream to remove any acid gas from the exhaust and absorb them into the caustic scrubber solution generating salt in the solution.

[c] Acceptable knowledge (AK) is a term used by the U.S. Environmental Protection Agency (EPA) to describe process knowledge that is used to characterize hazardous waste. In the context of WIPP, AK is specifically defined as "… any information about the process used to generate waste, material inputs to the process, and the time period during which the waste was generated, as well as data resulting from the analysis of waste…" [5].