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VOLATILIZATION OF ALPHA ACTIVITY DURING HEATING OF RADIOACTIVE ASHES

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ABSTRACT

Thermal treatment of mixed wastes is one option that has the potential to significantly reduce final disposal volume and increase the durability of the waste form in one operation. One potential concern in evaluation and design of such a system, however, is the volatilization of contaminants of concern, which may increase secondary waste generation, cause permitting concerns, and complicate design of engineering containment. To evaluate the potential for significant contaminant losses, ash from mixed waste incineration was stabilized by melting at 1300°C while offgases and evolved particulate were captured for analysis. Losses of gamma emitting radionuclides were up to 20% and dominated by cesium, but losses of plutonium and uranium were less then 0.1%.

INTRODUCTION

Incineration of combustible radioactive waste reduces volume significantly, yielding ash residues containing up to 99 % of the radionuclides. Both bottom and fly ash are unsuitable for long-term storage or final disposal because of their physical form (easily spread and ingested finely divided solids), low chemical stability (both TCLP and ANSI 16.1), and low compressive strength (ASTM C-39).

Several options are available to enhance the physiochemical properties of ash residues resulting in a solid matrix that readily passes compressive strength requirements, and can be made to pass leach criteria for RCRA toxic and radioactive constituents. At various international sites this is achieved by bituminization [1] or by grouting [2]. Some methods are also being developed for the fixation of ash residues in stable ceramic matrices based on natural clays [3–6]. However, these processes generally increase the final disposal volume, which typically causes an increase in overall cost.

One promising option leading to a significant volume reduction of ash residues is melting using only sufficient additives to result in an acceptable waste form. One such technology to immobilize ash residues by partial melting in the presence of fluxing additives uses induction melting in a water–cooled crucible. This process is in practice on an industrial scale at the SIA "Radon" (Moscow) [7,8].

One design issue to be evaluated prior to implementation of any high–temperature process for radioactive waste treatment is transfer of radionuclides in the vapor phase due to aerosol carry–over and volatility of some compounds. The distribution of radionuclides between the final product and the gaseous phase is a decisive parameter in designing the offgas system, evaluating the quantity of secondary waste, and determining a safe range of operating conditions.