An Examination of the Research, Development, Design, and Implementation Issues Related to Solution Cavern Disposal of Toxic Industrial Wastes

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Abstract

A safe, practical and economically feasible alternative to current waste management practices for low-level radioactive and toxic solid civil wastes is required in today's environmentally conscious society. Solution Cavern Disposal (SCD) in caverns either purpose created or dissolved for a previous use, represents a positive engineering approach to disposal which addresses the issue of environmental security over geologic time. Because SCD is intended to be permanent, ensuring long-term isolation of waste slurry mixtures from the biosphere is the most important aspect of this technology. Waste isolation can be achieved, in part, by properly engineering a waste slurry which will compact over time when subjected to the stresses of a closing cavern. Furthermore, designing engineered waste slurries with granular salt as the base material and with additives such as fly ash, shales, and clays has numerous advantageous because:

1. These materials are geochemically stable;
2. Clay particles act as sites for cation exchange;
3. Salt has a high co-efficient of thermal conductivity and as a result any heat generated in a cavern will be quickly dissipated and redistributed; and,
4. Granular salt densifies through creep processes.

Laboratory studies have shown that at very long times and high stresses, the behaviour of an engineered waste slurry is dominated by the salt, which exhibits fluid-phase diffusional transport even at low moisture contents (0.5-2%). The net effect being continued densification of the engineered waste as time goes on, until the pore throats become so small as to block or seriously retard transport mechanisms. At some point during densification the porosity becomes non-connected, and the permeability of the system thereafter is the result of slow diffusive mass transfer along crystal and grain boundaries. The end result is the permanent entombment of the solid waste in a low permeability salt skeleton which is continuous, and surrounded by intact salt.

The article will discuss in detail our approach to SCD using engineered waste slurries designed to address the toxicity level of candidate waste materials. As well, issues related to site selection criteria, site investigation techniques, and decommissioning strategies will also be discussed.