Gamma Irradiation Testing of Montan Wax for Use In Waste Management Systems

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Abstract

A field demonstration was funded by the U.S. Department of Energy (DOE) to quantify the potential use of montan wax as a subsurface barrier material for nuclear waste management applications. As part of that demonstration, a study was completed to address some of the characteristics of the wax. Of particular interest is its resistance to chemical and structural changes that would influence its integrity as a barrier to minimize the migration of contaminants from their storage or disposal locations. Properties that were evaluated included hardness, melting point, molecular weight, and biodegradation as a function of gamma radiation dose. Based on the data obtained to date the wax is extremely resistant to radiation-induced change. Coupled with low permeability, the material shows promise as a subsurface barrier material.

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Introduction

The U.S. Department of Energy is sponsoring the development of low-permeability materials that may be used for low-level waste binders and also barriers that can be emplaced in-situ around waste storage and disposal facilities. One promising technology involves the use of a wax extracted from lignite coal (montan wax) that is inexpensive (about 75 cents/lb) and does not require sophisticated techniques for processing.

As polymeric materials, waxes are known to be susceptible to damage from radiation. Gamma ionizing radiation is considered to be the more important type of radiation because of its presence in many radioactive waste streams and its ability to penetrate large thicknesses of matter. Therefore, if wax-based materials are to be qualified as barriers for wastes containing radioactive constituents, information on the effects of radiation on the durability and mechanical properties of montan wax over extended periods of time needs to be obtained.

The important gamma-induced damage mechanisms that could affect barrier life include:

a) Crosslinking of the polymer chains that would increase the molecular weight, increase strength, and reduce plasticity,

b) Chain scission that would decrease the molecular weight and strength, and

c) Gas generation (mainly hydrogen, methane, carbon monoxide, and carbon dioxide), that could conceivably cause grout swelling and cracking.

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