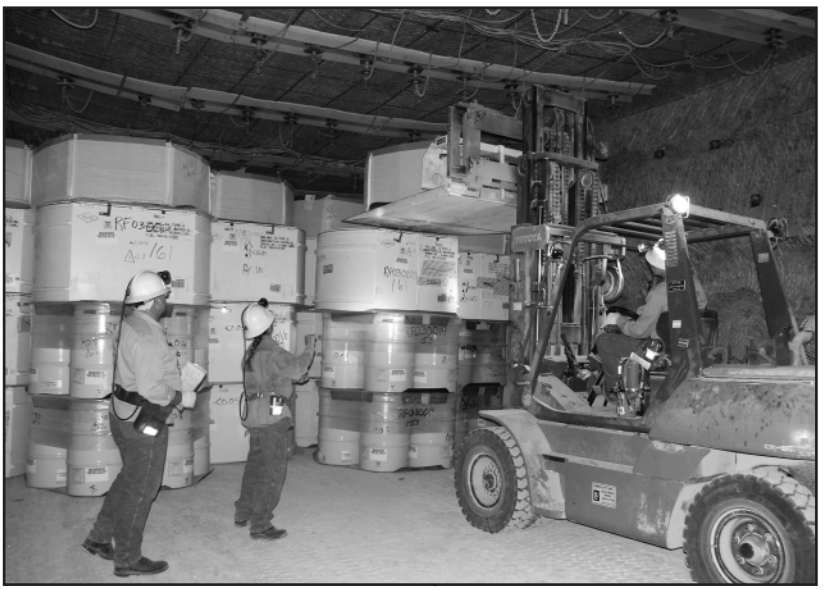
WIPP Technical Fact Sheet:

Planned Change Request for Magnesium Oxide

Summary

The U. S. Department of Energy (DOE) has submitted a planned change request to emplace 1.2 moles of magnesium oxide (MgO) for every mole of organic carbon contained in the waste materials at the Waste Isolation Pilot Plant (WIPP). This amount of MgO represents a reduction from the 1.67 moles of MgO per mole of organic carbon that the EPA currently requires.



Magnesium Oxide being placed on top of a stack of contact-handled transuranic waste at WIPP.

The WIPP repository uses MgO as an engineered barrier. By reacting with carbon dioxide, MgO ensures that consistent chemical conditions favoring lower actinide solubilities are maintained in WIPP brines, resulting in lower predicted releases from the repository. A detailed uncertainty analysis has verified that 1.2 moles of MgO per mole of organic carbon (called the MgO loading) ensures that there is always enough (and usually an excess of) MgO available to maintain favorable chemical conditions. Operational procedures ensure that an MgO loading of 1.2 or greater is maintained. The reduction in the MgO loading is desirable to DOE because it can reduce operational risks without adversely impacting repository performance.

Background/History

The U. S. Environmental Protection Agency (EPA) required the WIPP disposal system to include both natural and engineered barriers in order to provide confidence that repository releases will be well below EPA's long-term containment requirements (40 CFR § 191.13). DOE selected MgO as an engineered barrier during the Compliance Certification Application (DOE 1996, Section 3.3). The presence of adequate amounts of MgO ensures that favorable and consistent conditions are maintained in WIPP brines by reacting with any carbon dioxide produced by microbial consumption of organic carbon in the waste materials. If carbon dioxide is not removed by reaction with MgO, its presence will cause brine in the waste rooms to go acidic, resulting in increased actinide solubilities. MgO also helps to reduce predicted releases by reducing repository pressure. Performance assessment calculations assume there is enough MgO to react with all carbon dioxide, an MgO loading of 1.0.

EPA agreed with DOE's position on MgO as an engineered barrier:

> *The EPA determined that MgO will be an effective barrier, based on DOE's scientific evaluation of the proposed barrier's ability to prevent or substantially delay the movement of radionuclides toward the accessible environment.* (EPA 1998a, Section VIII.D.4).

Proposed Change and Rationale

On April 10, 2006, DOE submitted a planned change request to EPA to reduce the MgO loading to 1.2 moles of MgO for every mole of organic carbon contained in the WIPP.

DOE is currently required to emplace a minimum of 1.67 moles of MgO backfill for every mole of organic carbon in the waste materials. The value of 1.67 represents a 67% excess over the amount of MgO that is required to react with a conservatively estimated maximum amount of carbon dioxide that could be generated by microbial processes. EPA has stated that this "*relatively high excess amount*" is required because "*the extra MgO would overwhelm any perceived uncertainties that the chemical reactions would take place as expected*" (Gitlin 2006). When DOE requested that the MgO loading be lowered from 1.67 to 1.2, the EPA requested that the DOE address "*the uncertainties related to MgO effectiveness, the size of the uncertainties, and the potential impact of the uncertainties on long-term performance*".

In response to the EPA's request, DOE evaluated three types of uncertainties related to MgO:

- Uncertainties in the quantities of carbon dioxide produced by microbial processes
- Uncertainties in the amount of emplaced MgO that is available to react
- Uncertainties in the quantity of carbon dioxide with which a single mole of MgO can react

The uncertainty analysis is based on a number of conservative assumptions, including: (i) microbes will remain active long enough to consume all of the organic carbon in the waste, (ii) microbial reactions always produce the maximum amount of carbon dioxide; that is, every mole of carbon in the waste materials will produce a mole of carbon dioxide, and (iii) other materials in the waste, such as lime and the corrosion products of iron-based materials, do not react with carbon dioxide. The uncertainty analysis predicts that, under expected conditions, an MgO loading of 1.2 will be more than sufficient to react with the maximum amount of carbon dioxide.

WIPP's current operational procedures require DOE to emplace a 4,200 pound supersack of MgO on top of each stack of waste containers in the repository and to track the emplaced masses of MgO and organic carbon on a room-by-room basis, at the end of each waste emplacement shift, to ensure that the amount of MgO always meets the EPA requirement in each room of the repository. In general these operational procedures result in many areas in the repository having MgO in excess of the current requirement. DOE presently has no plans to alter current operational procedures.

Impact on WIPP Performance

Emplacement of 1.2 moles of MgO for every mole of organic carbon contained in the WIPP has no impact on repository performance. The current models for repository performance do not depend on the amount of MgO in the repository, provided that it is great enough to react with all carbon dioxide produced by microbial processes. Since the uncertainty analysis demonstrates that an MgO loading of 1.2 can react with the maximum amount of carbon dioxide that could be produced by microbial consumption of all organic carbon in the repository, it follows that the DOE's planned change request for MgO has no impact on repository performance.

The proposed reduction in the MgO loading also produces reductions in transportation risk to the public and in operational risks to workers emplacing the MgO.

References

DOE. 1996. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot. DOE/CAO-1996-2184, U.S. Department of Energy Waste Isolation Pilot Plant, Carlsbad Area Office, Carlsbad, NM.

Gitlin, B. C. 2006. Letter to D. C. Moody concerning the DOE's request to reduce the MgO excess factor from 1.67 to 1.2, dated April 28, 2006.

For more information

WIPP Information Center
U.S. Department of Energy
Carlsbad Field Office
P.O. Box 2078
Carlsbad, NM 88221

1-800-336-WIPP (9477)
E-mail: infocntr@wipp.ws
Web address: www.wipp.energy.gov

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