MAGNESIUM OXIDE – AN ENGINEERED BARRIER

Why is MgO Used At WIPP?

The U.S. Department of Energy (DOE) proposed the use of magnesium oxide (MgO) as an engineered barrier in the Compliance Certification Application. The purpose of the MgO is to ensure that consistent and favorable chemical conditions are maintained in WIPP brines by reacting with any carbon dioxide produced by the decay of organic carbon in the waste and waste emplacement materials. Organic carbon is present in these materials in the form of plastic, rubber, and cellulosic materials, such as wood and cloth. The MgO used at WIPP is a bulk granular material in supersacks that are co-emplaced with the waste in the repository.

MgO meets the requirement for an engineered barrier because it limits the amount of radioactive elements dissolved in WIPP brine, thereby delaying their movement toward the accessible environment and satisfying an assurance requirement under 40 CFR §191.14. The presence of MgO also helps to reduce predicted releases during a future borehole intrusion because it reacts with carbon dioxide, thereby reducing repository pressure. EPA agreed with DOE's position that MgO functions as an engineered barrier in the Agency's certification decision for WIPP on May 18, 1998.

How Much MgO Is Emplaced in the WIPP?

During waste emplacement operations, the required amount of MgO is determined by a formula that conservatively uses the maximum amount of carbon dioxide that can be produced by the decay of all the organic carbon in the waste. The calculation also includes an "excess factor" greater than 1, which provides additional assurance that extra MgO is always available to react with carbon dioxide.

EPA mandated a conservative approach for calculating the required amount of emplaced MgO because of the potential uncertainties in long-term chemical and microbial processes in WIPP brine.

What Has Changed Since CRA-2004?

On April 10, 2006, DOE submitted a planned change request to EPA to reduce the excess factor used to calculate the required amount of emplaced MgO from 1.67 to 1.2. Since the first WIPP recertification decision in 2006, DOE has been using a factor of 1.67, which represents a 67 percent excess over the amount of MgO required to react with the maximum amount of carbon dioxide that could be produced in the repository. The proposed excess factor of 1.2 still represents a 20 percent excess over the maximum amount of carbon dioxide that could be produced in the repository.

As part of the review of the planned change request, DOE evaluated the uncertainties related to:
(1) The amount of organic carbon that is consumed
(2) The amount of carbon dioxide that is produced
(3) The efficacy of MgO reactions with carbon dioxide

The uncertainty analysis concluded that, under expected

What is MgO?

Magnesium Oxide, or MgO, is a compound of magnesium and oxygen. MgO is used in a granular form in WIPP's disposal rooms to provide added assurance that radioactive contamination will not escape the facility in the unlikely event of water entering the repository or human intrusion.

MgO provides this assurance by:

- Limiting the amount of radioactive elements dissolved in brine (salt water)
- Reacting with carbon dioxide to reduce pressure of the sealed repository

Each column of contact-handled transuranic waste has a supersack of MgO on top. Each supersack weighs approximately 4,000 pounds. Additional supersacks may be placed in a disposal room to ensure that the emplaced MgO can react with the maximum amount of carbon dioxide expected to be produced by the waste .

repository conditions, an MgO excess factor of 1.2 will be more than sufficient to react with the maximum amount of carbon dioxide that could be generated.

EPA approved the reduction of the MgO excess factor to 1.2 in February 2008. In doing so, the EPA required DOE to continue to track the organic carbon and emplaced MgO on a room-by-room basis. In other words, each room of the WIPP repository must have at least 20% more MgO than organic carbon on an atom-by-atom basis. The Agency also required DOE to verify, on an annual basis, that the reactivity of MgO meets or exceeds 96% ± 2%, consistent with an assumption in DOE's uncertainty analysis. At the time CRA-2009 was being prepared, DOE has not yet implemented the EPA-approved reduction of the excess factor from 1.67 to 1.2.

Does This Change Impact Long-Term Performance?

Implementation of the MgO excess factor of 1.2 will have no impact on long-term performance of the WIPP. DOE's uncertainty analysis demonstrated that an MgO excess factor of 1.2 provides enough MgO to react with the maximum amount of carbon dioxide, so this change has no impact on long-term performance.

For Further Information

Appendix MgO-2009 of CRA-2009 provides additional information on all aspects of MgO as an engineered barrier for the WIPP.