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WASTE SOLIDIFICATION AND STABILIZATION USING SLAG CEMENT

Portland cement has been used since the 1950's to stabilize potentially hazardous materials in sludges and sediments. Portland cement works by solidification, stabilization, and encapsulation of the waste material.

Research has been conducted on the use of slag cement alone and in combination with portland cement to stabilize waste materials.¹ Based on this research, slag cement has been specified and used on several successful waste stabilization projects.

SOLIDIFICATION

Solidification is the process of reducing the excess water in a waste sludge. Waste management laws generally prohibit waste sludge containing free water to be deposited in landfills. Slag/portland cement mixtures react and chemically bind excess water in a process called hydration.

STABILIZATION

Stabilization is the process of chemically changing a hazardous waste material into a less soluble or less toxic form. Slag/portland cement combinations accomplish this by raising the pH of the waste material. Many toxic metals found in waste sludge have their lowest solubility at higher pH levels and are therefore less likely to leach out. The presence of ferrous iron and sulfur compounds make slag cement an excellent reducing agent that can change toxic metals into less toxic forms.

ENCAPSULATION

Encapsulation is the process of surrounding waste particles with a layer of material that is very low in permeability. This layer of material inhibits the leaching of the hazardous material. Slag/portland cement combinations lower permeability, providing significant reductions in the mobility of toxic material.

RADIOACTIVE WASTE

Technetium is an isotope that is a fission product of uranium. It is a major concern in the disposal of radioactive sludge due to its long half life (213,000 years) and its mobility as soluble pertechnetate. The reduction potential of slag cement has been found to change technetium to a less soluble valence state. When slag cement is used, the leachability of technetium can be decreased by several orders of magnitude.²

WASTE SOLIDIFICATION/STABILIZATION USING SLAG CEMENT

BROWNFIELD REMEDIATION

Slag has been successfully used for brownfield remediation. Brownfields are sites where their development is complicated by the presence of hazardous contaminants. The Environmental Protection Agency (EPA) places a high priority on brownfield redevelopment as “cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment.”³



Figure 1 - Brownfield Remediation at WE Energies site in Appleton, WI

In Appleton, Wisconsin, a combination of 70 percent slag and 30 percent portland cement was used to remediate coal tar contaminated soil at a WE Energies' former manufactured gas plant which operated from 1867 to 1954. The remediated site (Figure 1) has been converted into a public park and is targeted for potential future development.³

OPTIMUM SLAG / PORTLAND CEMENT MIXTURES

Slag cement has been used in the stabilization and solidification of a variety of waste materials. However, due to the many complex waste forms and compositions, mixtures for waste stabilization must be developed using actual job materials, with test methods and performance criteria specified by an engineer experienced in stabilization/solidification technologies. Any use of slag cement in waste stabilization/solidification must be tested and monitored by a qualified professional and laboratory. Guidance in stabilization/solidification technologies for some wastes can be found in the EPA's guidebook, “Stabilization/Solidification of CERCLA and RCRA Wastes.”⁴

As with all stabilization/solidification mixtures, trial batches should be performed to verify concrete properties. Results may vary due to a variety of circumstances, including temperature and mixture components, among other things. You should consult your slag cement professional for assistance. Nothing contained herein shall be considered or construed as a warranty or guarantee, either expressed or implied, including any warranty of fitness for a particular purpose.

References

1. Blue Circle Research
2. Blue Circle Research
3. “Brownfields Cleanup and Redevelopment,” <http://www.epa.gov/swerosps/bf/index.html>, U. S. Environmental Protection Agency, 2005
4. Waste Treatment, (e-newsletter) February 16, 2005, Portland Cement Association, Skokie, IL
5. “Stabilization/Solidification of CERCLA and RCRA Wastes,” EPA/624/6-89/022, Center for Environmental Research Information and Risk Reduction Engineering Laboratory, U. S. Environmental Protection Agency, Cincinnati, 1989

Due to the many complex waste forms and compositions, mixtures for waste stabilization must be developed using actual job materials. Performance criteria, test methods, mixture design, testing and quality control must be performed by qualified professionals and laboratories.



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About the Slag Cement Association...

The Slag Cement Association is the leading source of knowledge on blast-furnace slag-based cementitious products. We promote the increased use and acceptance of these products by coordinating the resources of member companies. We educate customers, specifiers and other end-users on the varied attributes, benefits and uses of these products.

