HAZCON ADVANCED SOLIDIFICATION TECHNOLOGY

A SOLIDIFICATION/STABILIZATION TREATMENT OF SOIL/SLUDGE WASTE CONTAMINATED WITH WOOD PRESERVING CHEMICALS

By T.H. Mitchell

The following contains excerpts from a presentation given by Thomas H. Mitchell, General Sales Manager of KMG Services, Houston, Texas, at the eleventh annual meeting of the Canadian Wood Preservation Association in Toronto, Ontario, November 7, 1990.

The presentation is intended to be an informational review of the solidification process. Further detailed technical data is available upon request.

The HAZCON solidification/stabilization process is a chemical technology which incorporates the use of a proprietary and patented polymer additive, Chloranan, to encapsulate toxic chemicals and to minimize mobility in treated material. HAZCON was developed in the chemical industry to detoxify material contaminated with a wide variety of both organic and inorganic compounds to minimize environmental hazard.

The basic concept involved with the HAZCON process is the blending of soil/sludge waste with portland cement, the polymer additive Chloranan, and water to form a cement-like mass which may be developed with compressive strength suitable for construction and load-bearing application.

It is well-known that cement can be mixed with "clean" soil to obtain satisfactory compressive strengths for construction purposes. Such has been traditionally used in actual projects with five to fifteen percent cement by weight in the cement to soil mixture. Greater cement ratios provide higher compressive strengths, and aggregate is used to gain even higher strength. The majority of strength, however, is provided by the cement, and the aggregate is used to extend the costly cement.

The use of cement with sand/soil/aggregate/water containing organics, especially oils and greases, is not effective, as normal cement hydration reactions are inhibited in presence of organics which results in a significant loss of compressive strength and/or failure of the material to cure or solidify.

Complete hydration reactions of cement are prevented when exposed to organic contaminants. The HAZCON process with its Chloranan additive enables these reactions to continue even with organics present.

Normal cement has a fibrous crystal structure which provides the strength of the solidified material. These fibers bind to each other and to the aggregate substrate. The addition of Chloranan in the solidification process changes the structure to a more platelet-like one and interfering organics are fixed so as not to prevent the normal hydration reactions of the cement. This is a molecular-level binding and is an integral aspect of the process in preventing contaminant leaching.

Blending the additive Chloranan with cement, contaminated material, and water results in microencapsulation and consequent immobilization of waste constituents even in the presence of high levels of organics, oils, and greases. Cement alone is not effective in immobilizing either organic or inorganic compounds. Many factors influence the set, cure, and permanence (strength) of solidified material. Salts such as arsenates, borates, phosphates, and sulfides interfere with cement hydration. Metal salts of magnesium, copper, lead, and others affect curing. The HAZCON process binds specific anions, cations, and organics to reduce this interference.

Depending on application requirement, the strength of HAZCON-treated material may be developed for landfilling (approx. 500 psi) or for load-bearing application (3,500 psi). Mentioned previously was the change of crystal structure from fibrous to platelet-like with HAZCON treatment. This not only aids in stabilizing contaminated material but also results in lower hydraulic permeability than that of normal concrete and a much denser product with the ability to withstand wet/dry and freeze/thaw without degradation.

The HAZCON process has been tested and recognized as effective by the United States Environmental Protection Agency. HAZCON has been demonstrated by the EPA in its Superfund Innovative Technology Evaluation program to successfully encapsulate and immobilize organics and metals in soil. The location selected for this demonstration was near Douglassville, Pennsylvania, and was #102 on the EPA's National Priority List. The site is a former oil recovering facility with two lagoons, one filled with oily sludge and the other a former landfarming area. According to the EPA, over 250,000 cubic yards were present and contaminated with up to 25% oils and greases, PCB's, volatiles, semi-volatiles, and heavy metals.

Excavation began in 1987, and contaminated material was HAZCON processed and poured into plywood forms for curing. Material was returned to its point of excavation after curing and buried for continual long-term testing. In addition, two holes were excavated and filled with HAZCON treated material to

simulate in situ closure. According to the EPA, the test was an unqualified success in stabilization. Organics and metals were immobilized. Material permeability was reduced and high compressive strength was developed. Three years after the solidification, the EPA reports no evidence of degradation of the treated material.

In mid-1990, the U.S. EPA issued a final rule on the test procedure to determine toxicity of waste material in the U. S. Designated as the Toxicity Characteristic Leaching Procedure or TCLP, it is an extraction process designed to measure and simulate leaching of toxic material to contaminate ground and groundwater. The EPA has set regulatory limits on the TCLP leachate for forty chemicals and compounds. As an example, the regulatory limit for pentachlorophenol in the TCLP is 100 ppm. Material containing that level or more is considered toxic and hazardous.

The HAZCON process is capable of immobilizing contaminants so that the TCLP leachate of treated material reflects less than the limits imposed by the EPA. The material is thus stabilized for disposition or use in construction application.

The following schedules provide results of wood treating waste material processed with HAZCON solidification/stabilization technology.

HAZCON technology involves complex chemistry, ion exchange, nucleation, and a variety of reactions with a resulting micro-encapsulation of toxic contaminants - and importantly, providing a cost effective alternative to incineration, with the feature of utilizing waste on site for construction projects such as the building of drip pads, loading pads, concrete storage areas.

Field execution of the HAZCON process is not complicated. Waste soil/sludge is excavated, and pre-treated by screening, milling, or shredding as appropriate and requires only the use of common construction machinery such as backhoes, front end loaders, and pull shovels. The solidification process utilizes equipment similar to that used for cement mixing and handling. Pumps can be used for transfering light sludge wastes to mixers and moving slurry to curing sites.

The critical aspects of job design in using the HAZCON process are the selection of stabilizing agents and additives, the waste to additive ratios, and determining mixing and curing requirements. Physical/chemical characteristics of waste are site specific and have direct impact and bearing on job design. An essential feature of the HAZCON process is a bench scale treatability study to select additives, ratios, and performance measurement with leach tests (TCLP), volumetric expansion determination, compressive strength analysis, permeability tests, and freeze/thaw cycles to determine

integrity of the treated material.

The treatability study includes characterization of the original, untreated waste to optimize encapsulation of contaminants, strength of treated material, and stability. An important consideration is the compressive strength requirement of the treated material. How will it be disposed? How will it be used? Will it be buried or landfilled? Will it have load-bearing construction application?

There are several important findings in the characterization:

Contaminant Type	PH
Concentration	Moisture/Oil
Appearance	Particle Size
Density	

A solidification formula is developed taking these factors into consideration and bench solidification is completed using that formula. Treated material is then subjected to post-solidification analysis testing which reports stabilization of contaminants and immobilization, permeability, freeze/thaw stability, volume expansion, and project cost estimates.

Further detail and technical information concerning the HAZCON solidification process is available upon request by contacting KMG Services, Inc., 10611 Harwin, Suite 402, Houston, TX 77036 (713) 988-9252.

HAZCON
SOLIDIFICATION/STABILIZATION
PROJECTS

CONTAMINANT	BEFORE TREATMENT (PPM)	AFTER HAZCON TREATMENT (PPM)	DETECTION LIMIT (PPM)
Material - Loading Pad Dirt			
Acenaphthene	464	.012	-----
Fluorene	387	.206	-----
Phenanthrene	1360	ND	.0001
Fluoranthene	880	.04	-----
Pyrene	719	.02	-----
Material - Dry Soil			
Barium	.96	.672	-----
Lead	260	.19	-----
Mercury	3.06	ND	.002
Selenium	.46	ND	.004
Material - Storage Yard Dirt			
Penta	1859	1.59	-----
Fluorene	156	ND	.001
Phenanthrene	809	.01	-----
Fluoranthene	2799	.02	-----
Pyrene	1644	.01	-----
Chrysene	588	ND	.001
Benzo Pyrene	586	ND	.001

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CONTAMINANT	BEFORE TREATMENT (PPM)	AFTER HAZCON TREATMENT (PPM)	DETECTION LIMIT (PPM)
MATERIAL - LOADING PAD GRAVEL			
PENTA	6.02	.007	-----
NAPHTHALENE	1.93	ND	.0004
FLUORENE	4.15	ND	.0003
PHENANTHRENE	44.36	ND	.0002
FLUORANTHENE	30.92	ND	.0002
PYRENE	23.74	ND	.0002
MATERIAL - TRANSFER PIT SLUDGE			
PENTA	805	.016	-----
PHENANTHRENE	417	.004	-----
FLUORANTHENE	5768	.004	-----
PYRENE	4187	.001	-----
BENZO FLUOR.	213	ND	.0003
ARSENIC	4100	.242	-----
CHROMIUM	7700	.138	-----
COPPER	1700	.074	-----
LEAD	112	ND	.01
ZINC	106	.028	-----