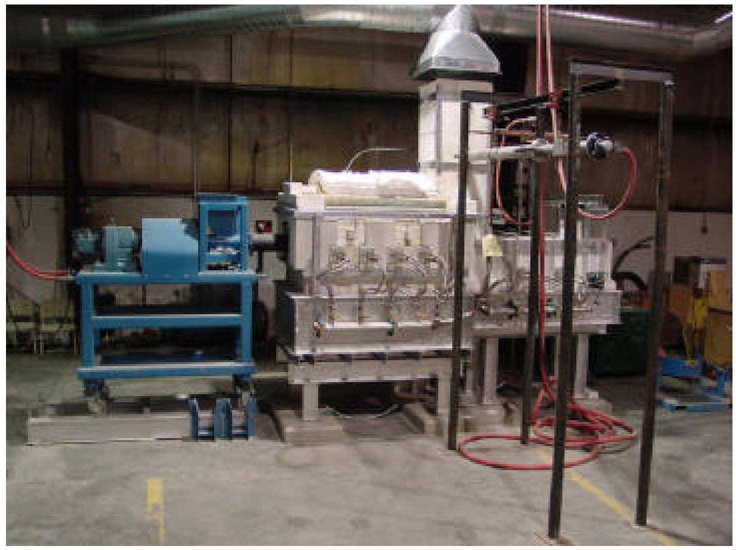
Glass Furnace Technology (GFT) Project Fact Sheet
Phase III: Pilot-Scale Melter

Following the release of the draft Lower Fox River Remedial Investigation/Feasibility Study (RI/FS) in February 1999, WDNR received a set of comments from Minergy Corp. (Minergy). Minergy's comments suggested that a vitrification (melting) technology might be more effective and appropriate for dealing with contaminated sediments than some of the options in the RI/FS. WDNR contacted Minergy as a follow-up to their RI/FS comments. Minergy prepared a proposal for a multi-phased study to determine the cost effectiveness of this technology and the effectiveness of this technology to destroy organic contaminants (primarily PCB) and immobilize inorganic contaminants (primarily heavy metals). Minergy proposed a four phased feasibility study for the testing of a glass furnace technology including a cost-sharing proposal. With the assistance of a grant from US EPA's Great Lakes National Program Office (GLNPO), WDNR accepted Minergy's proposal to conduct the Glass Furnace Technology feasibility study. Also, recognizing the extreme scrutiny PCBs have been under and the need for a thorough <u>independent</u> evaluation of the contaminants' fate, WDNR requested assistance from US EPA's Superfund Innovative Technology Evaluation (SITE) Program. US EPA's SITE Program has accepted the challenge of conducting the cost and treatment effectiveness evaluations for this project.



The four phases of the study are:

- Phase I: Mineralogy and sediment characterization
- Phase II: Crucible melt and preliminary design engineering
- Phase III: Pilot-scale sediment melt of dewatered dredge material
- Phase IV: Full-scale facility construction.

Phases I and II have been successfully completed. Phase I was to characterize the mineral composition of river sediments to estimate the glass quality, durability and melting point. Phase I conclusions include that river sediment characteristics are very consistent throughout the river and are very favorable for producing a quality glass product. Further, vitrification technology is more appropriate for river sediments than incineration as demonstrated by the low Loss on Ignition analyses (a.k.a. sediment does not burn!).

Phase II of the project, crucible melts of actual Lower Fox River sediment, were conducted to determine the actual melting conditions and glass characteristics/qualities of the sediment alone and when augmented with other materials (flux mixtures). Four different test "recipes" were included in the crucible melts and the sediment successfully melted into glass in all four tests. Phase II results include a proposed recipe for melting river sediment into glass aggregate and preliminary engineering designs for the pilot test facility proposed for Phase III. This preliminary engineering recommended not to use an existing glass furnace for Phase III testing. Results of Phase II testing indicate that the cost to retrofit an existing facility to the specification needed to melt the sediment would be as much as building a pilot melter to those same specifications. Also, most existing facilities are too large to accommodate a limited duration test.

Results of Phase I and II testing indicate that the glass furnace capital and operating costs could allow the processing and melting of the river sediments to be considered an economically viable option.

Phase III is the actual construction and operation of a pilot scale glass furnace, specially designed based on the results of Phase II, to generate operational data and determine the cost and treatment effectiveness of this technology for the potential construction of a full-scale facility (Phase IV). The entire treatment process consists of two basic steps: a sediment-drying step followed by the vitrification (melting) step. A full-scale unit, if built, would have these two process steps linked into a single unit to accomplish the entire treatment of dewatered dredged sediment from projects like Deposit N or SMU 56/57. However, for the purposes of this pilot-scale evaluation, it was necessary to evaluate these two steps independently. Because there is potential to lose sediment contaminants during the drying step and the potential for incomplete (<100%) contaminant treatment during the vitrification step, both processes will be evaluated by US EPA SITE. The evaluation of the drying step has already been completed using a bench scale Holoflite® dryer at Hazen Research Inc.'s Golden Colorado facility.

The pilot-scale glass furnace is a refractory-lined, rectangular melter. The refractory is brick or concrete that has been specially treated to resist chemical and physical abrasion, has a high melting point, and provides a high degree of insulating value to the process. Natural gas is fired in the furnace, raising the internal temperatures to about 3000^{o} F. Exhaust treatment is further simplified and energy efficiency improved by the melter's use of purified oxygen rather than atmospheric air as the oxygen source. At these temperatures, the sediment melts and flows out of the furnace as molten glass. Due to low gas volumes produced by the oxy-fuel melter and the large volume of gas space above the molten line, gases remain resident in the melter for a significant period of time (10 to15 seconds). Other vitrification technologies have demonstrated > 99.9999% destruction of PCBs at lower temperatures and shorter residence times. It is anticipated that this technology should produce similar destruction efficiencies. In addition, any trace metals in the molten glass will be stabilized when it is quenched and the glass matrix is formed.

This pilot-scale melter will be operated 24 hours a day for approximately two weeks. Over the two-week period, the melter will process approximately 70 tons of dewatered dredged sediment while producing about 2 tons of glass aggregate per day.

The two primary objectives of Phase III testing are:

- To determine the treatment efficiency (TE) of PCBs in dredged-and-dewatered river sediment when processed in the Minergy GFT.

- To determine whether the GFT glass aggregate product meets the criteria for beneficial reuse under relevant federal and state regulations.

In addition there are three secondary objectives:

- Determine the unit cost of operating the GFT on dewatered dredged river sediment.

- Quantify the organic and inorganic contaminant losses resulting from the existing or alternative drying process used for the dredged-and-dewatered river sediment.

- Characterize organic and inorganic constituents in all GFT process input and output streams. Of principal concern is the formation of dioxin and furan during the vitrification step.

MINERGY
A WISCONSIN ENERGY CORPORATION

GLNPO
GREAT LAKES NATIONAL PROGRAM OFFICE

WISCONSIN
DEPT. OF NATURAL RESOURCES