NEWMOA FACT SHEET

Beneficial Use of Non-Hazardous Coal Power Plant Fly Ash as Flowable Fill

April 6, 2001

This fact sheet is intended to provide general information to potential users of non-hazardous coal power plant fly ash as a component of flowable fill. It is the responsibility of the design engineer to determine the appropriateness of using flowable fill containing non-hazardous coal fly ash in a particular application and to select applicable tests and specifications to facilitate construction and environmental protection. Potential users of non-hazardous coal power plant fly ash as flowable fill should contact the appropriate state regulatory program to identify specific use conditions and permit requirements. A listing of state contacts is located at the end of this fact sheet.

MATERIAL DESCRIPTION

Coal fly ash is the fine-grained powdery particulate material collected from the flue gas pollution control equipment at coal-fired boilers. Fly ash has properties that can make it a desirable component of fill material. Fly ash produced from the burning of anthracite or bituminous coal is typically pozzolanic, meaning that it will, in the presence of free lime and water, react to produce cementitious compounds. Fly ash produced from burning lignite or subbituminous coal is also pozzolanic, and in addition has some self-cementing properties, meaning it can harden and gain strength with the addition of water alone.

Flowable fill is a name given to backfill materials which when mixed and deposited are fluid-like and when in place gain sufficient strength at an early age to essentially eliminate later settlement. When set and hardened, flowable fill typically has strength and physical properties similar to a soil. Flowable fill is a slurry mixture typically consisting of water, sand or other fine grain aggregate material, and Portland cement. Fly ash has been used in flowable fill as a supplement to (or replacement of) the fine aggregate and/or the cement. There are various formulations of flowable fill, depending on the desired setting time, final strength, and hardness. For example, if the flowable fill is to be excavated later, it is desirable to select a mix design that will not set too hard. It might be necessary to mix trial batches to determine that a flowable fill mix has the desired properties.

There are a wide variety of mixes as well as names for the product called “flowable fill.” A few of the names include controlled-density fill, low strength backfill material, flowable mortar, flowable fill, soil-cement grout, unshrinkable fill, K-Krete, and lean-mix backfill. The American Concrete Institute (ACI) formed Committee 229 to investigate the properties of what it has designated as controlled low strength materials (CLSM).

BASIC DESCRIPTION OF USE

Flowable fill has been used for many purposes where high strength material is not required. Flowable fill is self-leveling and self-compacting and therefore, is ideal for situations where obtaining compaction is difficult or labor intensive. In addition, construction personnel and equipment are not required in the

trenches so the width of excavations can be decreased, laid back slopes eliminated, and lane closures and flagging operations reduced. Flowable fill has been used as a backfill for trenches, building excavations, bridge abutments and as a structural fill to serve as a foundation, sub-base or a sub-footing. Flowable fill by definition does not have the strength of concrete and should not be considered concrete. Its most important properties are that it is flowable and will fill a cavity completely without excessive labor.

CONCERNS

The chemical composition of the coal fly ash can vary and depend on the type of coal that is burned, the extent to which the coal is prepared before it is burned, and the operating conditions of the boiler. Generally, more than 95 percent of the ash is made up of silicon, aluminum, iron, and calcium in their oxide forms, with magnesium, potassium, sodium, and titanium representing the remaining major constituents. Ash may also contain a wide range of trace constituents in highly variable concentrations. Potential trace constituents include: antimony, arsenic, barium, cadmium, chromium, lead, mercury, selenium, strontium, zinc, and other metals. The concentration of trace constituents in some ash might be sufficient to require evaluation regarding soil and/or groundwater contamination standards in some states.

Controlled Low Strength Material (e.g. flowable fill) containing fly ash should not be placed in contact with cast iron pipes, or aluminum pipes or fittings, unless the aluminum has been coated with an approved primer.[1]

If flowable fill is used as backfill around lightweight pipes, floatation of the pipes could occur and steps to mitigate this should be taken. Arching between anchor points can occur when anchors, straps or gravel bags are used if the spacing interval is too great.

TECHNICAL/SCIENTIFIC STATUS

1) **Standards:** **Controlled Low Strength Materials (CLSM)**, AC 229R-94, ACI, 1994.

Controlled Low Strength Material (CLSM) Guidelines, New York Department of Transportation, Engineering Instruction (EI) 99-039, December 14, 1999.

2) **R&D:** "**The Effect of Freeze-Thaw and Frost-Heave on Flowable Fill,"** David Gress, Ph.D.,P.E., UNH-Civil Engineering #1096-1, University of New Hampshire, October 1, 1996.

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[1] *Controlled Low Strength Material (CLSM) Guidelines*, New York State Department of Transportation, Engineering Instruction (EI) 99-039, December 14, 1999.

"**Fly Ash Facts for Highway Engineers**," Federal Highway Administration and American Coal Ash Association available by calling (703) 317-2400.

APPLICATIONS

Approximately 30 states have some experience with the use of flowable fill, with Minnesota, Maryland, Michigan, Iowa and Indiana having the most frequent use.[2]

1) **Full Scale:** Massachusetts Highway Department/Massachusetts Turnpike Authority, Central Artery/Tunnel Project - used as backfill in trenches and slurry-wall guide walls on various contracts.

REGULATORY STATUS

1) **Connecticut:** Requires a General Permit pursuant to Section 22a-209f of the Connecticut General Statutes and adherence to technical guidance (document available from DEP).

2) **Maine:** Permit-by-Rule notification for the production of flowable fill using non-hazardous fly ash (Waste Management Rules Chapter 409). The use of flowable fill containing non-hazardous fly ash is subject to Reduced Procedures for Select Beneficial Use Activities (Waste Management Rules Chapter 418) and requires a permit.

3) **Massachusetts:** If coal ash is used beneficially as identified in the solid waste statute (M.G.L. Ch. 111 Sec. 150A) then the use of coal ash is exempt. Not withstanding this exemption, DEP discourages the use of coal ash as fill material due to the potential that oil and /or hazardous materials within the coal may cause toxic or otherwise harmful exposures to humans, leach into groundwater or cause contaminated runoff.

4) **New Hampshire:** Certified Waste (re: Certificate of Direct Reuse- DES-SW-CR-97-001) PSNH Schiller Power Station, Portsmouth, NH, 1997.

5) **New York:** The use of coal fly ash to produce low-strength backfill material is a predetermined beneficial use (6 NYCRR Part 360-1.15(b) (15)).

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[2] *User Guidelines for Waste and By-Product Materials in Pavement Construction*, Federal Highway Administration, FHWA-RD-97-148, April 1998.

6) **Rhode Island:** Marketer/potential user of material must obtain DEM approval through the beneficial use determination process in order to obtain an exemption from solid waste regulations (chapter 23-18.9).

7) **Vermont:** Must submit a written request to the DEC Solid Waste Management Program in accordance with their July 2000 *Procedure Addressing Acceptable Uses of Solid Waste.*

For More Information Please Contact:

In Connecticut: Oswald Inglese Department of Environmental Protection 79 Elm Street Hartford, CT 06106 (860) 424-3725	**In Maine:** James Glasgow Department of Environmental Protection 17 State House Station Augusta, ME 04333 (207) 287-7719
In Massachusetts: Sean Griffin Department of Environmental Protection One Winter Street Boston, MA 02108 (617) 292-5967	**In New Hampshire:** Mike Sills Department of Environmental Services 6 Hazen Drive Concord, NH 03301 (603) 271-2907
In New York: Jeff Schmitt Department of Environmental Conservation 50 Wolf Road Albany, NY 12233 (518) 457-6072	**In Rhode Island:** Chris Shafer Department of Environmental Management 235 Promenade Street Providence, RI 02908 (401) 222-2797
In Vermont: Bryan Harrington Department of Environmental Conservation 103 South Main Street Waterbury, VT 05671 (802) 241-3473	**At NEWMOA:** Jennifer Griffith NEWMOA 129 Portland Street, 6th Floor Boston, MA 02114 (617) 367-8558, ext. 303

The Northeast Waste Management Officials' Association (NEWMOA) is a nonprofit, nonpartisan interstates organization that addresses regional waste and pollution prevention issues. The membership is composed of state environmental agency directors of the hazardous waste, solid waste, waste site cleanup, pollution prevention and underground storage tank programs in Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. New Jersey recently rejoined NEWMOA (March 23, 2001) and therefore, did not participate in the development or review of this fact sheet. NEWMOA provides a forum for increased communication and cooperation among the member states, a vehicle for the development of unified position on various issues and programs, and a source for research and training.