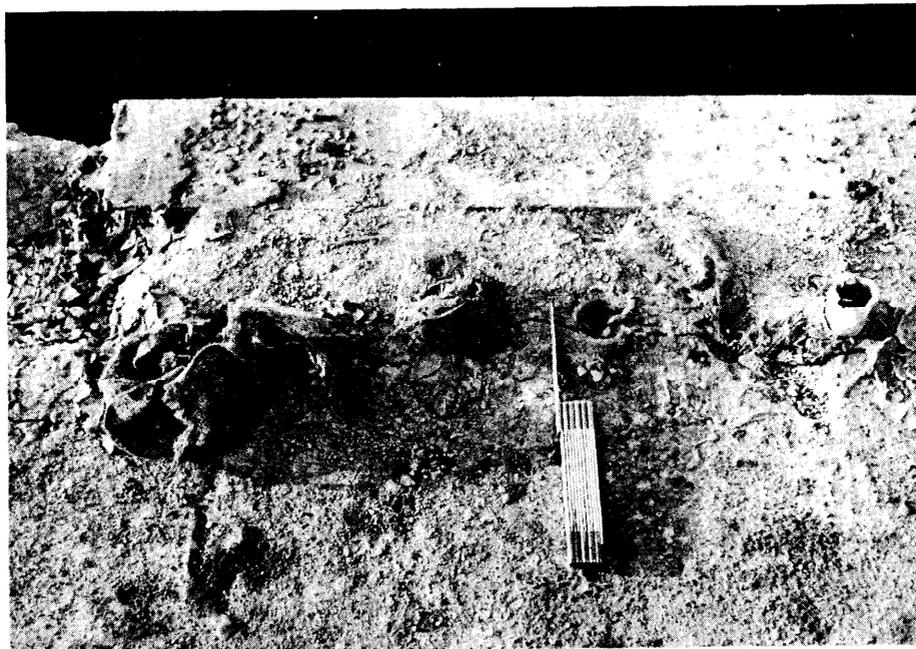




REMR TECHNICAL NOTE CS-MR-1.3

CONCRETE REMOVAL TECHNIQUE: EXPANSIVE
AGENT

An expansive agent as depicted above was used to propagate a crack plane along the removal line for the removal of deteriorated concrete at Emsworth Lock in the Pittsburgh District

PURPOSE: To describe use of expansive agents for concrete removal.

APPLICATION: Expansive agents can be used to fracture concrete to facilitate removal by other means. Used with properly spaced and sized boreholes, this technique can create a controlled crack plane for the removal of a deteriorated outer layer of mass concrete.

ADVANTAGES: Expansive agents increase the rate of concrete removal when used with other removal methods. They can be used to propagate vertical crack planes of significant depth for controlled presplitting in the removal of distressed and deteriorated concrete from mass concrete structures such as locks and dams. No noise, vibration, flyrock, or dust is produced other than that produced by drilling and other removal equipment.

LIMITATIONS: Secondary means are required to complete separation and removal of concrete sections from the structure. In reinforced concrete, a means of cutting the reinforcement must be employed. Several days may be required before presplitting becomes optimum. The agent must be used in sound concrete and must be used within manufacturer-specified temperature ranges to achieve desired crack propagations.

PERSONNEL: Highly skilled personnel of proven ability and experience should be selected to perform the borehole pattern design. Limited skills are required by field personnel.

EQUIPMENT: The following equipment and tools are required:

- a. Drill rig capable of drilling holes (usually 1-1/2 to 2 in. in diameter) to the required depth without significant loss of alignment along the depth of the hole.
- b. Other removal equipment and tools to complete removal.
- c. Equipment for handling and disposing of debris.

STEP-BY-STEP PROCEDURE:

- a. Locate and drill boreholes according to design layout.
- b. Line boreholes with plastic by: (1) tying off bottoms of plastic tubes, (2) filling bottom few inches of liner with sand to give liner weight, and (3) placing by lowering liners into boreholes.
- c. Mix agent according to manufacturer's directions and place resulting slurry into boreholes.
- d. After crack planes have developed (usually 10 to 20 hours after placing slurry) complete removal with necessary equipment.
- e. Remove debris.

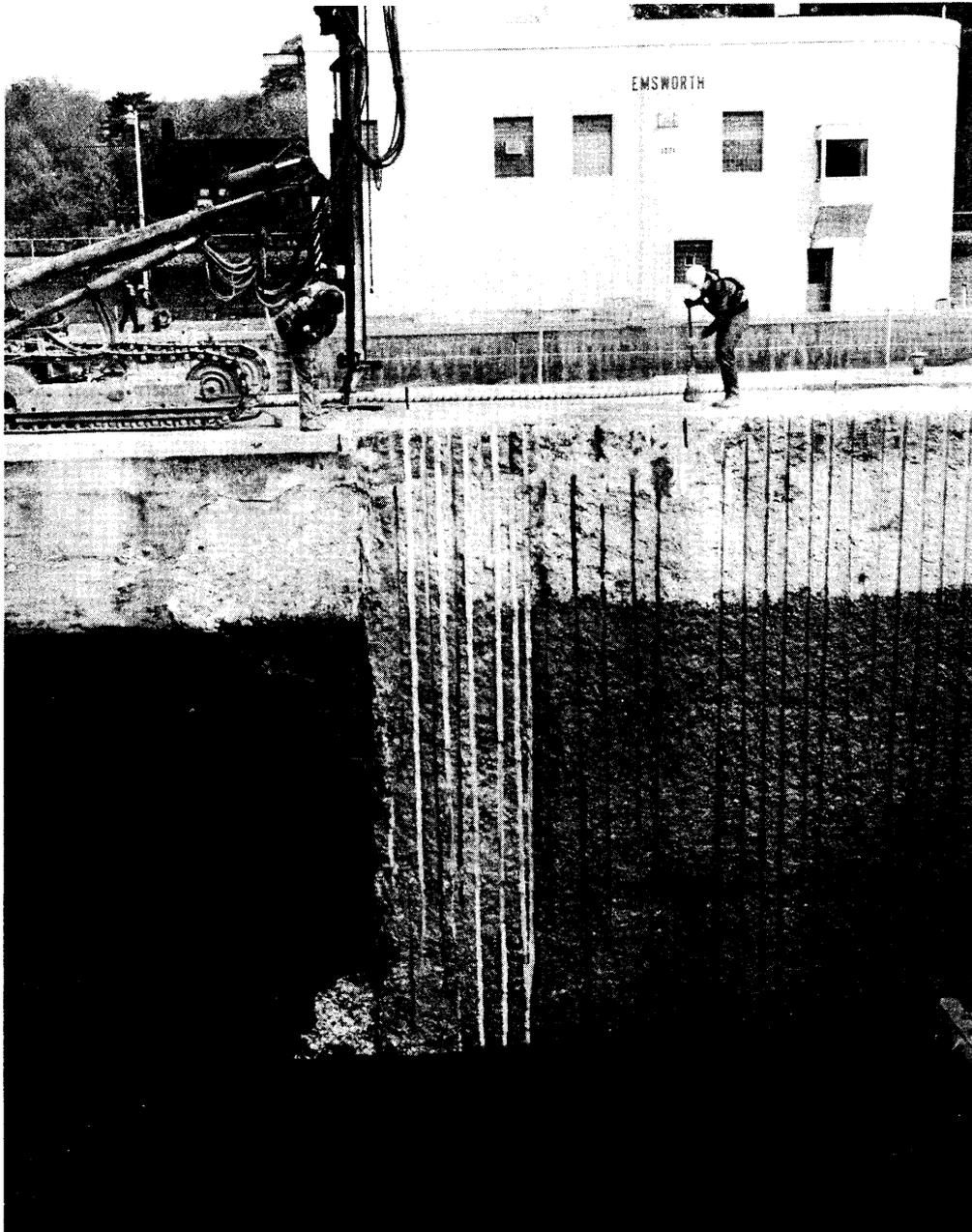
US DISTRIBUTORS:

- a. Product: Bristar

Construction and Industrial Supply Co.
189 Cobb Parkway North
Building B - Suite 3
Marietta, GA 30062
Phone: 404-429-0008
- b. Product: S-MITE

Con-Rok (International)
505 NW 76th St.
Vancouver, WA 98665
Phone: 206-694-8690

BACKGROUND: The expansive agent method is a presplitting technique that employs forces developed from restraint of the agent's expansion by the concrete surrounding a pattern of boreholes to propagate controlled crack planes in concrete. The boreholes must be in sound concrete and of a designed pattern to control direction of cracking. Actual removal of the concrete is accomplished by a mechanical removal method such as the use of an impacting tool. The combination of these methods significantly increases the ease and rate of removal from that of mechanical methods alone.



Depicted above is the surface that resulted when an impacting method was used to complete the concrete removal at Emsworth Lock

The agent comes in powder form and is mixed with water to form a slurry. As the agent will irritate the skin and eyes, rubber gloves, goggles, and surgical masks should be worn to protect the worker. Boreholes that contain water are lined with plastic to prevent dilution of slurry. Boreholes that are suspected of containing large voids or that intersect crack planes should also be lined to prevent slurry from entering other areas of the structure and producing unwanted cracking. When the slurry is poured into the holes, it solidifies and expands producing tensile stress concentrations on the inner surface of the hole. The tensile stress that develops will generally exceed the tensile strength of the concrete within 10 to 20 hours (Ref a) after pouring. A crack will begin to propagate out from the hole due to the resulting overstress and may continue for a couple of days before reaching optimum. Secondary means of breakage are employed to complete separation and removal of concrete. For reinforced concrete, a means of cutting the reinforcement must also be employed.

In November 1980 at Emsworth Lock in the Pittsburgh District, a pilot test program was implemented to evaluate removal techniques for future work on the lock. One portion of the program involved evaluating the use of an expansive agent called Bristar for presplitting the concrete to allow for easier removal. This effort involved removing 1 ft of deteriorated concrete from a 6-ft-wide and 26-ft-high area of lock face. For such, 2-in.-diameter boreholes were located 1 ft behind the lock face on 6-in. centers and vertically drilled to a depth of 26 ft. The first photo in this technical note shows the presplitting crack that propagated between boreholes approximately 20 hours after the slurry was placed. The second photo shows the resulting surface after removal of the presplit section of the lock face. The removal was completed by using a crane to drop a large I-beam with a fabricated chisel point into the presplit crack.

REFERENCES: a. Bristar, non-explosive demolition agent. Old Cement Co., Ltd., Technical Note, Tokyo, Japan, undated.