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Electro Osmotic Pulse Technology for Prevention of Water Intrusion in Concrete Structure

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EMERGING CONSTRUCTION TECHNOLOGIES

Other Technologies – Water Detection / Resistance

ELECTRO OSMOTIC PULSE TECHNOLOGY FOR PREVENTION OF WATER INTRUSION IN CONCRETE STRUCTURE

THE NEED

Groundwater intrusion into a building can cause serious structural degradation, corrosion of expensive mechanical equipment, e.g., Heating Ventilation, and Air Conditioning (HVAC) equipment, which is often located in basement spaces. Thus it increases maintenance requirements (frequent repairing or cleaning to combat mold growth), and can make areas uninhabitable or even unusable (see Figure 1).

FIGURE 1 SEVERE MOLD PROBLEM

Humid environments are known to promote growth of molds and bacteria that have an adverse effect on human health and worker productivity. As the molds and microorganisms proliferate, indoor air quality decreases and health problems increase. To improve air quality it is necessary to decrease relative humidity and lower the moisture level of the surfaces on which the molds and microorganisms grow.

In older buildings, severe damp-basement problems call for immediate action to mitigate water damage. In selective problem areas, the usual approach is to 'trench and drain', in other words, to excavate and expose the wall area and the base of the foundation, to replace dampproofing on the wall surface, and to install a drain tile system around the building or affected area. This expensive process is further

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complicated by the fact that most contractors limit their warrantees against future seepage in areas with high water tables.

THE TECHNOLOGY

Traditional methods for correcting water seepage involve the application of sealants or costly excavation to place tiles around the facility exterior.

FIGURE 2 SEVERE WATER INTRUSION

In 1994, a team of researchers from the U.S. Army Engineer Research and Development Center (ERDC), DryTronic, Inc., and APS Materials began development of an innovative technology for the prevention of water intrusion in below-grade concrete structures (see Figure 2).

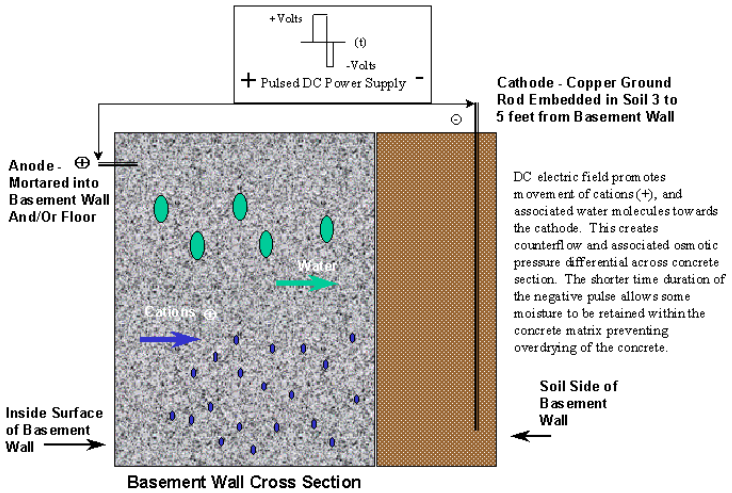

FIGURE 3 ELECTRO OSMOTIC PULSE TECHNOLOGY FOR PREVENTION OF WATER INTRUSION IN CONCRETE BASEMENTS

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ElectroOsmotic Pulse (EOP) technology is based on the concept of electroosmosis; the movement of an electrically charged ion in a liquid under the influence of an external electric field. EOP not only eliminates water-seepage problems from the interior of the structure without excavation, but it further mitigates corrosion damage to mechanical equipment and reduces the interior relative humidity of the basements. The reduction in relative humidity or moisture content of the concrete interior surface also eliminates one of the primary sources of disease carrying molds and bacteria, which require a high moisture content to grow. The system uses two sets of electrodes; one set is embedded into the interior concrete walls and the other set is embedded in the surrounding backfill/soil. A pulsing DC voltage is applied between the electrodes to produce an electric field across the walls/floors, which moves water from the dry side (interior) toward the wet side (exterior), preventing moisture from reaching the interior surface of the concrete. A representative pulsating electroosmotic sequence consists of a pulse of positive voltage (time "t-pos") (as seen from the dry side of the concrete wall), a pulse of negative voltage (time "t-neg"), and a period of rest when no voltage is applied. Laboratory and field tests were conducted at ERDC laboratories in conjunction with demonstrations and evaluations at selected Army installations to assess the feasibility and cost effectiveness of EOP technology in comparison with conventional dampness mitigation techniques.

The Benefits

The following benefits are expected from the EOP System:

- The prevention of structural damage by reducing rebar corrosion and concrete cracking.
- The prevention of corrosion damage to interior mechanical and electrical equipment by reducing relative humidity.
- Prolong the life of standard concrete repair technologies.
- The improvement of interior air quality for the safety for occupants and workers.
- Ease of EOP installation which causes less disruption to operations.

Status

Technology demonstration and validation was conducted under the Facilities Engineering Applications Program (FEAP) which was administered by the Corps of Engineers Center for Public Works (CECPW-EB). At the Fort Jackson demonstration site, the EOP power supply output current varied from 0.75 amps for a high exterior water level to less than 0.2 amps for a low water level; the concrete surface humidity dropped from an initial 95% to 50% in 5 months, and; the EOP system installation saved more than 40% over the installation cost of a conventional "trench and drain" method. Unlike other methods, EOP is a permanent solution and does not have to be redone every five years or so. These benefits have been recognized in the

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numerous EOP installations by the U.S. Army ERDC Construction Engineering Research Laboratories (CERL).

FIGURE 4 BASEMENT BEFORE EOP INSTALLED

CERL has performed two technology demonstrations and has installed and monitored systems in several wet basements with great success and cost savings (see Figure 5).

FIGURE 5 SIX MONTHS AFTER EOP INSTALLED

BARRIERS

- EOP system is not available in the market. It is not commercialized yet.
- Appropriate assessment should be preceded before the application of EOP system application was decided. For example, if the reason of water intrusion into the basement is due to certain degree of the damage of concrete structure, it could be recommended to repair the structure first.

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Nova Award Nomination List http://www.cif.org

Reviewers

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