Cold Weather Reinstatement

In northern climates, most of the roadwork involving pavement repair and reinstatement has been limited to the period between April and November when the ambient temperature is above 40º F and there is no likelihood of frost. At the request of several of our clients, we have been working on a process that will allow us to extend that season by at least a month on each end and maybe even throughout the year.

Water-soluble mixtures freeze

It is a fact of nature that no water-soluble cementitious product will set up and gain strength at temperatures below freezing. That applies to bonding compounds like Utilibond and every other cement based grout. What happens is that ice crystals form at the surface and prevent a bond from forming between the two surfaces that are to be joined. Cold temperatures above freezing also tend to slow down the curing and strength gain time of cementitious products. In our case, Utilibond instead of setting up and gaining strength in 20 to 30 minutes, as it does at 70º F, may take 30-40 minutes at 50º F.

Heat of Hydration

Concrete generates heat during hardening as a result of the chemical process by which cement reacts with water to form a hard, stable paste. The heat generated is called heat of hydration; it varies in amount and rate for different Portland cements. Heat generation and buildup are affected by dimensions of the concrete, ambient air temperature, initial concrete temperature, water-cement materials ratio, cement composition and fineness, amount of cementing materials, and admixtures.

Temperature affects the rate at which hydration of cement occurs—low temperatures retard hydration and consequently retard the hardening and strength gain of concrete. At 50º F, the rate of hydration and strength gain is approximately half the rate of the same mixture at 73º F. If concrete is frozen and kept frozen above about minus 10° C, it will gain strength slowly. Below that temperature, cement hydration and concrete strength gain cease.

Cement slabs are different

When you are pouring cement slabs, there are several methods like adding soluble salts that react with the water causing it to freeze at a lower temperature, or employing heated forms or tenting or air-entrainment, that can be used to minimize the cold weather effect without affecting the *compressive* strength of the concrete, but you cannot use them when the end result is to bond one surface to another. In our application, tenting is impractical and chemical based additives and air-entrainment will weaken the bond. When bonding two surfaces together, as in the reinstatement application, you need to at least maintain a surface temperature at the point of bonding well above freezing until the bond sets and begins to gain strength. After that, freezing temperatures will not affect the bond.

Core reinstatement in cold-weather

In order to use the core reinstatement process at low temperatures we need to ensure that the surfaces to be bonded are not frozen and are warm enough for long enough to allow the cementitious bond to set and gain strength before the frost returns. We are aided in this process by the fact that the hydration process

© 2005 Utilicor Technologies Inc.

in Utilibond is exothermic – it gives off heat -- and this heat makes it possible for the hydration process to continue until the Utilibond has reached a strength that is able to resist freezing temperatures.

Because of its super-fast strength gain, Utilibond only needs about 10-15 minutes for that reaction to develop. During this initial 10 to 15 minutes period an external heat source is required to allow the internal exothermic hydration reaction to develop sufficient internal heat of its own to permit the bond to gain strength. The Utilicor Core Heater, which can generate 35,000 BTU's per hour, simultaneously delivers dry heat to both the hole and the core raising the temperature of both to 70º F in minutes, allowing core reinstatement to take place in cold or freezing temperatures. Other products with slower strength gain times, such as those that take more than half an hour to gain strength at normal operating temperatures of 70º F, will take longer and may not perform in cold weather.

Utilicor Core Heater
The Utilicor Core Heater consists of three parts: (1) a surface mounted core hole heat baffle; (2) a core heater drum or hood; and (3) a 35,000 BTU, portable, forced air propane heater.

The core heater is fabricated from 11-22 gauge-galvanized steel. The octagonal surface mounted core-hole baffle, by which the heated air is directed down into the hole, is 23" in diameter and stands approximately 7" above the surface. It has a 4" square perforated internal baffle that projects 3" below the surface and directs the hot air down into the hole. Once this surface unit is positioned over the hole, the core is lifted on to the top of the unit, where it is supported by four steel cross members.

The cylindrical (12 sided) dome or heater hood, approximately 18" high and 21" in diameter with handles and a mechanical vent in the top, is then placed on top of the base, completely enclosing the core. The output port of the forced air heater is then connected to the intake collar of the core-hole baffle and switched on. This allows super-heated air to be blown directly downward into the hole through the 4" square aperture or baffle. (Note: if desired, the propane-heater can be removed up to 10 - 12 feet away and connected remotely to the core heater by means of a high-temperature hose.)

The super-heated air circulates in the hole and reflects off the bottom traveling up the sides of the hole and into the upper chamber formed by the dome, where it circulates around the core and through the pilot hole, heating the bottom and sides of the extracted core. Temperature and air flow in the upper chamber are regulated by opening or closing the mechanical vent at the top. Temperature readings are taken from time to time using a hand held infra-red temperature sensor, and when the appropriate reinstatement temperature is achieved, the core heater is removed and the core reinstated, following normal procedures.

For more information:
E. Marshall Pollock,
President & CEO,
Utilicor Technologies Inc.
1090 Don Mills Road,
Toronto, ON, Canada

Tel: 416-391-3901
Fax: 416-444-7352
Toll Free: 1-888-572-6666
Email: mpollock@utilicor.ca

© 2005 Utilicor Technologies Inc.