Protecting Concrete Structures

Linseed Oil Easily Applied During Spring Maintenance

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The problem of protecting bridge decks, parking ramps, curbs, sidewalks, and other concrete surfaces from the ravages of winter is as old as the use of concrete itself. In spite of its smooth, rock-hard appearance, small, almost microscopic pores exist in the concrete surface. During the warmer months, moisture evaporates rapidly from these pores with no harm to the surface. In the winter, however, freezing water can cause measurable surface damage. At lower temperatures, water in the pores freezes and remains solid until the temperature rises enough to permit thawing. Several freeze-thaw cycles may occur during an average winter day. Since water expands when frozen, the effect of repeated freeze-thaw cycles is to initiate scaling and later spalling of the top surface. This is particularly true for concrete less than four years old.

The problem is aggravated by the use of most de-icing agents. These agents react with concrete and markedly accelerate the deterioration process. In particular, chlorides will penetrate concrete and cause corrosion of reinforcing steel. As the level of chlorides in concrete becomes excessive, the rate of corrosion increases. Reducing the case with which chlorides penetrate concrete surfaces is an effective means of preventing corrosion of rebar and subsequent concrete deterioration.

The scaling and pitting which beset concrete surfaces, often after a single winter, point up a problem which urgently demands a solution. Two possible approaches to this problem are the use of air-entrained concrete and protective coatings, such as linseed oil.

Prominent among the corrective measures suggested is the use of air-entrained concrete. This material contains myriads of tiny air bubbles distributed more or less evenly throughout the mass. The air bubbles help to inhibit scaling and spalling due to freeze-thaw cycles and the use of de-icing chemicals. Today nearly all new concrete highway construction uses air-entrained concrete.

Air-entrained concrete failures occur frequently enough to be a source of serious concern to highway maintenance engineers. Plausible explanations, such as incorrect quantity of entrained air, improper formulation, inferior quality of aggregate, excessive trowelling of the top surface, etc. are often offered when air-entrained concrete fails in service. The fact remains that failures continue to occur and while more vigilant and costly inspection at the time of placing the concrete may obviate some of these difficulties, it could not entirely eliminate the possibility, of human error.

Protective coatings are harmless, easily applied, low-cost materials, which can be applied in thin coats to seal the pores of the concrete and thus prevent the entrance of water and corrosive solutions. These are a practical means of correcting the trouble at its source. Although we will primarily review linseed oil as a protective coating, various other substances, such as synthetic resins, silicates, and silicones have also been suggested as protective coatings for concrete. One major manufacturer of synthetic resins has advertised in national magazines to call public attention to the problem and to highlight the need for winter roadway protection.

The water-repellency characteristics of linseed oil films suggested, many years ago, its application for this purpose. The Portland Cement Association and the Salt Institute have pointed out the value of linseed oil as a protective coating for non-air-entrained concrete. Others have even suggested the use of boiled linseed oil for additional protection with non-air-entrained concrete. A number of state, county, and municipal highway departments have used and are still using linseed oil for both types of concrete.

To apply a protective coating of linseed oil costs around $.10 per square yard for materials. While application costs can vary, estimates indicate that this will not exceed an additional $.10 per square yard when readily-available, efficient spreading equipment is used.

Double-boiled linseed oil is preferred to raw oil because of its more rapid drying and film-forming characteristics. To decrease the viscosity and facilitate spreading, it is common practice to mix the oil with an equal volume of mineral spirits,

When the mixture is used, it is customary to apply two coats, the first at .025 gal. per square yard. When this has thoroughly dried, it is followed by a second coat applied at the rate of .015 gallons per square yard.

This article, and its supplement on page 3, appeared in a 1987 issue of *Road Business*. We have reprinted it to remind people responsible for bridge maintenance of Mr. Goodwin's important recommendations.

Mr. Goodwin, other NHDOT managers, and Steve White, a highly regarded structural engineer, have organized a workshop for local road managers.

Maintenance and Repair of Municipal Bridges

April 13 in Peterborough
April 20 in Newmarket
May 4 in Plymouth