Ice Control*

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In 1938 a survey was conducted by the ARBA Committee on Ice Control on the different methods used in the treatment of icy pavements by the several states in the snow belt. Considerable information was obtained, and the findings were reported to the Association.

During the past year a follow-up study has been made with the idea of presenting treating methods which could be called standard practice.

The necessity for safe driving conditions during the winter months is generally acknowledged. The question of what constitutes safe driving conditions also should be well established. However, the lack of uniform methods and variations in the extent of treatment, not only in the different states but even within a state, constitutes a real hazard to the highway user.

If it were possible for this committee to set up a specification, defining in general the extent and methods of operation, and have the several states follow through, the public would know just what to expect in driving from one area to another. The pavements cannot be made foolproof, but driving conditions should be such that the user, with a reasonable amount of caution, can travel safely, knowing what to expect under existing conditions.

VARIATION IN METHODS

The 1945 survey in twenty-four states shows that there were nearly as many different methods used as there were states reporting. A great variation in ideas also exists as to what constitutes safe driving conditions. A few of the states are endeavoring to provide a dry pavement. Others are depending upon the use of abrasives alone to furnish the necessary protection, while some states depend upon mechanical means to remove the ice rather than upon abrasives or chemicals. Some of the states attempt to provide protection throughout the entire length of the pavement, while others depend upon sanding of the hills, curves, and

* This report of the ARBA Committee on Ice Control was presented by Mr. Overesch as a distinct contribution to the subject.

intersections. Climatic conditions necessarily govern, to a certain extent, the methods and success of any operation. The prevailing temperature, drifting, and the length of storms all have their influence. The constant sifting of snow across pavements between storms creates a special hazard to cope with and requires constant attention.

The use of abrasives and chemicals is the most common method, although ten states report partial use of the bare pavement maintenance with straight chemicals. The amount of chemical used varies from twenty-five pounds per cubic yard of abrasives to two hundred pounds per cubic yard. It is difficult to understand the reason for this difference, particularly in view of the complaints of the damage done to certain pavements by the use of chemicals. In view of this wide variation, we can safely say that most of the damage is caused by abuse of these materials rather than by a rational use of them.

For abrasives, cinders, with the larger or oversized material screened out, are still the most commonly used. Sand, however, is gaining in popularity. In some instances washed sand, all to pass a ⅜-inch screen, is used. Dustless stone screenings, passing a ⅜-inch screen, are used in some localities. The color of the abrasive is being considered by some states, the dark material being favored because of its absorption of heat rays from the sun. When cinders are used, the question of sulphur content should be investigated thoroughly. In some instances, the chemical reaction of the sulphur contained in the cinders is quite detrimental to the pavement.

Storage of Materials

The question of storage of materials is getting more attention, although the greater percentage of abrasives is still placed in unprotected stock piles. The use of covered bins is gaining rapidly, as indicated by reports from five states and plans for post-war bins in other states. Many stock piles are covered with either temporary or permanent covers. Paper bags, tar paper, and wooden panels are frequently used. A new type of cover is constructed of semicircular corrugated light steel. It has the advantage of requiring little space for storage and can be used year after year. The covering of storage bins or stock piles is desirable and economical if chemicals are used to prevent freezing of the abrasives.

The chemicals are used with the abrasives first to prevent their freezing and second to anchor the cinders or sand on the packed snow or ice. The quantity of salt or flake calcium chloride used should be kept at a minimum and is mainly dependent upon the moisture content of the

abrasive at the time of treatment and the anticipated temperature range. Moisture is necessary for the chemicals to pass into solution.

If there is insufficient moisture present to dissolve the chemical, then the abrasives should be treated with a solution of known strength rather than the dry chemical. In either case, it is highly important that the chemical content of the abrasive be maintained at a known level. Because of dilution by snow and rain falling upon the stock pile, the practice of open storage does not permit the control of chemicals. It then becomes necessary to add more chemical from time to time by a hit-or-miss method.

Control Methods

Much of the damage occurring on concrete surface is due to improper control of the use of chemicals. In many cases those who prescribe the quantity of chemical to be used and the method of use would be surprised to find out what is actually being done in the field. In one case we were told by the district office that not more than thirty-five pounds of chemical per cubic yard was being used. Yet, on the same day and less than ten miles from this district office, the engineer was shown straight chemical being spread at the rate of about two pounds per square yard on a concrete pavement less than two years old. Repeated applications of this amount cannot help being detrimental to present-day plain concrete surfaces; and if sodium chloride is used to such an extent, it may be injurious to the more or less open types of bituminous surfaces. This is due to the recrystallization of this material when the moisture is drawn from the pavement by the drying-out process of nature. In the 1938 report of this committee, the use of chemicals mixed with abrasives was recommended. A rational use is still recommended for the purposes mentioned previously but not for snow removal.

One or two states prohibit the use of chemicals on concrete pavements less than three years old, and another prohibits their use on any concrete regardless of its age because of the scaling effect, so called. Scaling of concrete pavements was not uncommon before the use of chemicals and will continue until the concrete pavements are made immune to the effect of thawing and freezing. The use of air-entrained cements or a combination of portland and natural cement has helped a great deal to eliminate this effect. Studies are being conducted by a number of agencies to eliminate this fault. A committee report to the Highway Research Board in 1944 on the "Influence of Various Curing Methods on Strength and Abrasives Wear Resistance of a Portland Cement Concrete" is interesting. It shows that the use of calcium chloride as a surface curing agent actually increased the abrasives

resistance of the surface. It might be called a casehardened effect. Several roads are available on which surface curing with calcium chloride was tried. These roads were built more than twelve years ago and show very little surface scaling after ten years of ice control by the use of abrasives and chemicals. The increase in surface density naturally decreased the absorption and its resistance to wear due to the use of chemicals.

A few states are using the strip method of application of chemicals. This consists of applying material in strips about three to four feet wide on the length of the pavement center line or where necessary. The amount used varies from three hundred pounds per mile upward, depending upon the amount of snow or ice and the temperature. The purpose of this method is to bare at least part of the pavement lanes, thus increasing the security of the driver. The method is effective within certain limits. However, if any amount of slush is created by the melting action, it should be removed mechanically when a drop in temperature is anticipated. As the snow or ice is melted, a dilution of the brine occurs, and this dilution may create a driving hazard with a sudden drop in temperature if there is not sufficient crown to the pavement for the water and slush to drain from the surface.

The use of some type of spreader is reported in all except three states, the majority being of the disc type. There are many commercial spreaders on the market, but a large number have been made in highway department shops. West Virginia and Ohio have developed several models that work very well. Some of those manufactured by the companies are large and designed for high-speed work. Many of them have agitators in the truck bodies and worms or screws to deliver the aggregate to the tail gate and thence to the discs or rollers. These types prevent caking or bridging of the material and insure an even flow of abrasives to the spreader. Their use, because of their size, necessarily requires fast loading facilities either by bins, shovels, or cranes, and they are used extensively with centralized storage depots.

Conclusions

1. The lack of uniform ice control practices handicaps the establishment of safe driving conditions. Standardization of these practices would be very desirable.

2. Better supervision on the part of many maintenance engineers is needed as well as education of the patrolmen in the importance of following prescribed methods.

3. Efficient snow removal is a necessary step toward effective ice control, and the two should be properly coordinated. Prompt removal of snow, leaving as little as possible on the pavement, is desirable especially when snow is wet and heavy.

4. Abrasives for ice control should be treated with calcium chloride or sodium chloride to prevent freezing in the stockpiles and to anchor the abrasives on the ice.

5. Properly treated abrasives should not require additional treatment before spreading. Sufficient chemical to prevent freezing in the stockpiles should provide adequate treatment for anchoring the abrasives. In unprotected piles where leaching by rain or melted snow has reduced the concentration of chemical, additional chemical should be added on the surface of the pile, preferably in the form of solution.

6. Covered storage bins or sheds at central locations with mechanical loading speed up the handling of the abrasives and insure adequately treated abrasives at all times.

7. Abrasive stockpiles preferably should be protected by covers or otherwise, to retain the original chemical treatment.

8. Machine spreading is more effective and economical than hand spreading.

9. The best practice for safe driving requires that main arteries be covered throughout the entire length with treated abrasives.

10. The proper control of chemicals used for ice control should not cause serious detriment to pavements. It is recommended that chemicals should not be made available to patrol units to be dumped on storage piles in a haphazard manner when the handling of this material becomes somewhat tough.

11. The use of straight chemical for ice or snow removal is effective within its limits. It is especially adaptable during sleet or light snowstorms which occur when the temperature is just below freezing and continues thus for some time. If any amount of slush is created by the melting action, it should be removed mechanically if a drop in temperature is anticipated.

12. Local availability and unit cost usually determine the type of abrasive to be used. However, the cost of labor and equipment for storing and applying abrasives is several times that of the material itself and of chemical for treatment. Thus a small saving in material cost may be more than offset by the necessity for larger quantities of abrasives per square yard or more frequent application.