

MAINTENANCE OF GRAVEL AND STONE ROADS,
ESPECIALLY SURFACE TREATMENTS

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During the past four or five years the maintenance of gravel and stone roads has been developed in many highway organizations to a rather high degree of efficiency. This has been forced upon the highway departments because of the enormous increase in traffic and the large mileage of these types of road, coupled with the limited funds for highway purposes which would not permit the paving of the highways at such a rate as demanded by the sudden increase in traffic.

The maintenance of these types of surface by the application of fine gravel and stone to the surface and systematically dragging with long base drags has been so well standardized and developed that in many parts of the country perhaps little further advancement can be made in this work.

The increased traffic, together with the increased speed invited on the smooth stone or gravel surface, not only rapidly disintegrates the surface on this type of road so that the loose material, during the dry season of the year, is a great handicap to traffic, but also the dust nuisance has become so greatly accelerated that there is an extreme demand for a dustless surface on these lower types of road. As a result, several different and distinct methods of treating the stone and gravel surface with bituminous material have been developed. These different methods have special advantages with reference to economy and satisfactorily carrying the traffic in different places because of different climatic conditions and different kinds and distribution of traffic. The different methods which have been quite well standardized are briefly described below:

I THE SKIN METHOD OF SURFACE TREATMENT

The state of Maine was one of the first states to use bituminous material on its gravel roads. The method used in this state consists of applying surface treatment of a light grade of tar with a view to laying the dust and preserving the surface, generally only for one season. It is expected that the tarred gravel surface will break up during the spring thaws and it is customary to scarify the surface each spring, relevel it, and after it is again compacted by rolling

or traffic, the surface is again treated with $\frac{1}{4}$ to $\frac{1}{3}$ gallon per square yard of a light grade of tar and a suitable covering material, which carries the traffic during that summer

In places, particularly Ohio and Minnesota, the old gravel surface has been treated more extensively than in Maine with a view to carrying the surface through the spring season without breaking. The second coat of tar is covered with a suitable grade of fine aggregate. In Ohio this treatment has been followed later in the season and before going into the winter, with a treatment of heavy asphalt road oil covered with a heavy coat of $\frac{3}{4}$ -inch crushed stone. This method differs from the Maine method in that heavier treatments and the final treatment of heavy asphalt oil are intended to hold the road surface intact during the winter and spring season

For many years the skin method of bituminous surface treatment on well-built waterbound macadam roads as well as bituminous macadam roads has been standard practice for maintenance and contemplates, with occasional treatments at from one to three years, the permanent maintenance of the road surface. The details of the variations of such treatments will not be described here, as they are such standard practice in many parts of the country that the methods in common use are well known.

II THE MULCH METHOD

This method has been used quite extensively in a number of states, especially in Wisconsin, California, Indiana, and Michigan. While the methods in these different states have slightly differed in general, the principle has been somewhat the same. In Wisconsin and Indiana this system consisted in leveling up an old gravel road by proper dragging and scraping and applying to the surface about 1 inch of clean road maintenance gravel. This gravel is treated with a light grade of tar, after which the treated gravel is scraped to one side of the road and the bare road surface given another coat of tar, after which the mixture of gravel and tar previously scraped from the surface is spread back upon the treated surface and, by successive dragging and scraping, the tar and gravel is left as a uniform mixture over the entire road surface.

Better results are secured when the loose metal on the surface is comparatively coarse gravel or crushed stone. Also, the coarser the metal in the compacted portion of the road surface, the better the results will be. The sand and fine gravel with the very slight excess

of tar is inclined to cause shoving and pushing of the surface under heavy traffic. With the ordinary gravel it is difficult to keep the coarse and fine materials uniformly mixed, and with this unevenness in the mixture, the same amount of bituminous material will be the source of trouble—either too much in one place, causing the shoving and pushing, or a deficiency in another place, which will cause the surface to ravel. While many surfaces have given very good results with this method of treatment, there is a tendency to use the coarser aggregate and approach more nearly the third method, as described below.

The oil mix method used in California consists in mixing a fuel oil with several inches of loose gravel in the old road surface which has been previously prepared by scarifying and properly leveling. The amount of oil used is about $\frac{1}{2}$ gallon per square yard per inch of depth of loose material. The oil is put on in two or three applications and thoroughly mixed with the loose material after each application by means of harrows and graders, care being taken to finish the process with only sufficient amount of oil. This grade of asphalt and method are reported as giving good results in warm semi-arid climates. The method is described in a bulletin issued by the California Department of Public Works, called "Light Asphaltic Oil Road Surfaces."

The object in all of the mix methods is to secure a mixture of a suitable grade of asphaltic oil or tar with the top layer of stone or gravel, such that there will be sufficient bituminous material to properly bind the aggregate and prevent raveling and yet not an excess, which is certain to be the source of shoving and pushing.

III. RETREAD METHOD

The retread method, which is being used extensively in Indiana and some other states, consists in treating a layer of 2 or 3 inches of 1-inch to 2-inch size loose stone or gravel with suitable grades of tar or liquid asphalt, and differs from the two preceding methods in that it more nearly approaches a standard penetration macadam road. It might be briefly stated that it is a third method in four different and distinct classes, wherein the fourth method is the standard penetration macadam. This so-called retread method builds up a crust of several inches and consists of coarser stone or gravel than used in the preceding methods, makes a surface which is less susceptible to breaking up during the spring season under heavy trucking, and, hence, is a more appropriate method than the two preceding ones where there

is a deep frost action and heavy traffic during the spring season. It differs from the standard penetration macadam, in that the coarse aggregate is leveled and moved around on the surface before treatment with the road grader or drag, and, if necessary, after the first treatment it is again so leveled and smoothed. After the first treatments and rolling, the surface is completed by two or more successive applications of bituminous material, followed by rolling and the use of about $\frac{3}{4}$ -inch stone or gravel for covering material. In other words, the finished process in this type is almost the same as the finishing steps of the penetration macadam. The covering material, after treatment, is dragged and leveled off with a road maintainer in such a way as to make a smooth surface after completion.

Any of the above surfaces will break up or become rough and irregular under heavy traffic during the thawing period unless they have a fairly well compacted and stable base of gravel or stone. Hence, these types are not so well fitted for heavy trucking routes, especially where heavy traffic comes on the surface at all seasons of the year. They are proving very economical and satisfactory where an old road has a sufficient crust of metal to carry heavy loads, where the heavy traffic occurs during the warm, dry season of the year, or in semi-arid climates where excess moisture or heavy frost action are not present.

Details and specifications for these different methods described above can be secured by writing to the State Highway Departments of the states mentioned with the description given above.

Light oil treatment of gravel roads is practiced by some states purely as a dust-laying proposition. Either a light asphalt or tar is used. Care must be taken not to apply too much oil. If too much oil is applied, the surface of the road tends to bind, resulting in an uneven and rough road.

Under certain conditions calcium chloride is an effective agent in the maintenance of gravel roads. It is cheaper than methods two and three described above. It costs about the same as method one where subgrade and climatic conditions are such that number one treatments can be shipped every third year. Calcium chloride does not entirely eliminate the dust problem.