

Patching is done intermittently on macadam streets, at such intervals that we have no satisfactory figures on cost per mile per year. Patching on oiled streets must be done systematically and more frequently, because the public demands a smoother surface on an oiled street. Therefore, until more definite figures are obtainable, we must assume that there will be no decrease in the cost per mile per year for patching as a result of surface oiling, but that the same amount of money, or a small increase, will give better service. The saving will appear in lessened wear and tear on vehicles and greater convenience to the public.

**Oil Macadam: Methods.**—Our method of constructing oil macadam, summarizing briefly from our specifications, is as follows:

After the roadway has been brought to the proper sub-grade . . . , and after the curbs and gutters have been constructed, a layer of broken stone, having a depth varying regularly from 8 ins. at the centre of the roadway to 6 ins. at the gutters, measured before rolling, shall be spread on said sub-grade. . . . The aforesaid layer of broken stone shall then be covered with a layer of screenings of sufficient depth to fill the voids in said layers of broken stone, and then thoroughly rolled with a 10-ton roller until the screenings have worked down into the broken stone and the roadway presents a uniform surface. All depressions occurring in said roadway during the rolling shall be brought to the required grade with broken stone and screenings of the same size and quality as is used in the aforesaid layers.

The aforesaid broken stone and screenings, after being thoroughly rolled and before the rolled surface has been disturbed, shall then be sprayed uniformly with oil at the rate of 1 gal. to the square yard of roadway surface covered, and allowed to remain in this condition for a period of not less than 48 nor more than 72 hours. A light layer of screenings shall then be spread over this oiled surface, after which the roadway shall be sprinkled with water and thoroughly rolled with a 10-ton roller.

The roadway, prepared as hereinbefore specified, shall then be allowed to become thoroughly dry, after which oil is to be sprayed uniformly over the surface at the rate of  $\frac{1}{2}$  gal. to the square yard of street surface covered. Screenings, to the extent of preventing the oil surface from adhering to vehicles shall then be dusted over said oiled surface and thoroughly rolled.

Oil shall be applied to the pavement under pressure of at least 30 lbs. per square inch.

All of the above-mentioned oiling shall be done only while the atmospheric temperature is above 65° Fahr., and even then only during such periods as the sun is shining. No oiling will be permitted when the layer of broken stone or the screenings are in any way wet.

The oil is a residuum of an asphaltic oil and contains 85 per cent. of asphalt, having a penetration of 80. The temperature, volatility and allowable impurities are specified in detail.

Good workmanship and materials are necessary to secure results. In general, it may be said that the same precautions must be observed as for plain macadam, with several that are special to this work. Dirt, and dust in quantities, that are special to this work. Dirt, and dust in quantities, that are special to this work. Dirt, and dust in quantities, that are special to this work. The greatest difficulty, and one that requires experience and judgment to overcome, is in securing that amount of penetration that will use all of the oil (that is, take the surplus from the surface) and yet allow enough near the surface to produce finally an asphaltic appearance. The kind of rock and screenings used, the amount of screenings, the amount of rolling, the moisture present, and the weather are all conditions that must be considered. In general, it may be said that the voids should be well filled and the stone compacted before the first oil is brought on the work, but the surface should be quite porous, even open. After the first oiling should come the greater

part of the rolling. In fact, before the second oiling the street should be as thoroughly compacted as can be done with a roller weighing at least 250 lbs. per lineal inch of tread. In some cases there has been a tendency to reduce the amount of rolling below the requirements of plain macadam. This should not be permitted. Oil macadam requires fully as much rolling as plain macadam.

In some places we have used and are planning to use more extensively in the future, a better class of oil macadam. This is constructed in two courses. The first consists of 4 or 5 ins. of ordinary macadam sized rock, screened, rolled and practically completed as for plain macadam. Then we spread 3 ins. of rock, not exceeding 2 ins. in size, and proceed much as already described in detail. We try to confine the penetration of the oil to the second course.

With neither type of oil macadam, nor in fact, with surface oiling, do we try to secure a uniform asphaltic appearance immediately upon completion. If we should, the material would adhere to passing vehicles and we would find it necessary to spread more screenings. It requires several weeks or months, and in some cases a year, for the surface to assume its final appearance.

**Oil Macadam: Cost.**—We have no figures showing the additional cost of constructing oil macadam over and above the cost of constructing plain or water-bound macadam, except such as can be deduced from our experience in surface oiling and from a comparison of contractors' bids. Roughly we figure that oil macadam, constructed as already described, costs from  $1\frac{1}{2}$  to 2 cts. per square foot more than plain macadam. Perhaps it would be fair to say that comparison of bidding prices shows an average increase of about 15 cts. per square yard. For oil macadam complete, as described, we are paying this season from  $8\frac{1}{4}$  cts. per square foot to  $9\frac{3}{4}$  cts. per square foot, or from  $7\frac{1}{4}$  to 88 cts. per square yard. These prices, of course, include the contractors' profits, cost of collection and all overhead expenses. Where the pavement is constructed in two layers, the cost is increased again about 12 or 15 cts. per square yard. Two-layer work being better in all classes of macadam, this further increase, of course, is not chargeable to the use of oil.

Before closing this paper, it might be well to explain our reason for using oil macadam on new construction and on reconstruction instead of the cheaper process of surface oiling. As already indicated, the results are more permanent. If it be necessary to restore the asphaltic coating of oil macadam after the lapse of several years, it can be done with even less expense than original surface oiling on plain macadam. A mere surface of oil is removed within a period varying from two to five years by the action of traffic and storm water, but these agents seem to have little effect on oil macadam except at the surface. Furthermore, it is claimed, on proof of experience, that surface oiling frequently encourages raveling by preventing the renewal of the moisture that is so necessary to preserve macadam. Theoretically this should be particularly true of streets oiled soon after construction before traffic has secured final compaction. This difficulty should not be observed where the upper half or more is bound with oil. Furthermore, we have found it extremely difficult to secure a surface of oil that will adhere to the macadam and that will not "roll" or "wave." Every precaution must be observed to have the street clean and to adjust the quantity of oil to the requirements of the street. With oil macadam, however, we have more latitude within reasonable limits, for if the street finally shows a deficiency of oil at the surface, the fault can always be corrected by a light third application.

In conclusion, it may be said that it is our policy to permit the use of standard asphalt pavement on light traffic streets, but not to urge such construction excepting near the business district; to use oil macadam on all new construction in the residence districts; to surface oil, as rapidly as