

venting, or at least reducing, the ravelling of the road-bed. The best results are produced if a heavy road oil is used after the road has been partially rolled and previous to the laying of the binder course of fine rock or coarse sand. In this way the asphaltum in the oil gets thoroughly incorporated with the component parts of the road-bed which are bound together and interlocked. Successful results have also been achieved in mixing the rock and asphaltic oil together in an ordinary concrete mixture before laying it down. The application of from one-third to one-half gallon of road oil per square yard to the wearing surface of an old macadam road tends to preserve it from wearing action and renders the surface more even and waterproof and incidentally lays the dust. But such measures are merely palliatives and dust preventives, comparatively cheap to adopt (2 cents per square yard or \$150 per mile for a width of 12 feet) and, moreover, a decided relief to the travelling public and householders during the summer months. With the approach of the wet seasons, however, the roads thus oiled are rendered muddier than ever, and the mud, being of a heavy, plastic nature, is more difficult and costly to remove. The results from surface road oiling are subsequently disappointing and there appears to be something in the contention that the oiling of roads, while preserving the surface in summer, tends to loosen and disintegrate the particles of the roadbed in winter when they are subjected to the trying alternating influences of rain, frost and thaw. Hence, after several seasons of experimenting with surface oiling with different conditions, such as sweeping the roadbed free of all dust and dirt, applying the oil by means of spraying machines under pressure, and in adopting every conceivable device to arrive at the most satisfactory results, the practice of road oiling has been abandoned by many authorities as being too costly.

In their determined efforts to preserve and lengthen the life of macadam roads and to combat the dust, nuisance engineers and authorities have been experimenting for several years back with coal tar in the building of tar-macadam roads. Refined coal tar from gas works, specially treated to remove the injurious constituents and yet to preserve the ductile and bituminous properties of the tar, has been generally employed in the construction of such roads. The methods adopted have varied considerably, but the general principles of construction involve the heating of the stone to drive out the moisture and the mixing by hand or mixer of the stone, and tar heated to a specific temperature. The chief drawbacks to the use of tar on construction of macadam roads are:—

- (1) It is difficult to procure commercial tar of uniform quality.
- (2) Great care is necessary in the heating of tar, for if heated too much it becomes brittle and loses its ductile properties upon which its virtue depends.
- (3) The tar must be uniformly refined—if refined too little the light volatile oils and ammonia will disintegrate it, if refined over much it will be too brittle.
- (4) The weather must be warm and dry to successfully use tar macadam.
- (5) The roadbed must be perfectly clean and dry. Hence the use of tar-macadam is confined to the summer months.
- (6) It is too susceptible to extremes of temperature, being soft and mushy in midsummer heat and too brittle and slippery in cold, frosty weather.
- (7) It is not sufficiently dense and durable.

Better results appear to have been procured from tar-macadam roads in the Old Country, probably because of the more uniform and better quality of commercial tars which are there procurable, and also owing to more careful and scientific construction. In this country their adoption has been confined chiefly to eastern cities, where it has been found that, at an average cost of about 50% over the cost of ordinary water-bound macadam roads, fairly satisfactory and serviceable results have been procured for the first two or three years, but that after that period the wearing surface began to develop a mottled appearance and to disintegrate. Tar painting of such broken surfaces to seal the pores and preserve the surface has been tried but without the desired results, and consequently recourse has been had to covering such tar-macadam roads, on which the foundation is good, with a sheet asphalt or some other asphaltic mixture preparation. Hence, owing to the variability of the results produced, and the shortness of the life of even the best tar-macadam roads, their further adoption has been generally abandoned in favor of some more durable bituminous pavement of greater first cost. The general failure of the use of commercial coal tar led to much experimenting and the result has been the production of a specially distilled coal tar preparation known as "Tarvia." But while its use, when confined to park roads and boulevards, has met with a measure of success, it cannot be maintained that the results produced on its adoption to much-travelled highways has justified its additional cost. As applied to the road surface as a dust preventive, its average cost is 10 cents per square yard, or about \$825 per mile for a 14-foot roadbed, and while further treatment can be applied at a correspondingly less cost, taking the cost of periodical treatments into account, it cannot be said to be economical in the long run. Briefly, the process consists in applying to the ordinary macadam formation, under a pressure of about 50 lbs., heavy asphaltic oil containing about 85% of pure asphalt and heated to a temperature of about 220°. The macadam is laid and rolled in two courses; the first course consisting of about 6 inches of 3-inch sized rock, and the second course varying in size from 1-inch to 2-inch rock. To this latter course is applied the heated asphaltic oil, which penetrates throughout the whole of the macadam. On top of this oil is spread a layer of granite screenings varying from $\frac{1}{4}$ inch to $\frac{3}{4}$ inch, from which the dust and dirt have been eliminated and the whole mass is then thoroughly consolidated by rolling. Another treatment of oil is then applied, and further granite screenings about $\frac{3}{16}$ inch spread and rolled. Judging from results, such an asphaltic treatment appears to produce a compact, elastic roadbed, with a smooth surface of beautiful appearance. While the experiment has only been of comparatively short duration and it remains to be seen whether or no its durability will be proved, the additional cost of about 25% over the ordinary water-bound macadam road fully justifies its more general adoption. It is estimated that such an "oilcrete" road would wear well for about five years, and as it eliminates the need for yearly oiling of an ordinary macadam road, whose life at the most is three years, there is much to be said in its favor.

It will serve no purpose to discuss further any of the other oils, bitumens and special preparations which the ingenuity of engineer and manufacturer have devised in their endeavor to meet the special requirements of this automobile age. Although each manufacturer or inventor claims his particular preparation to be the panacea of road construction, their compositions are all very similar and the methods of use and application vary only slightly.