## THE MAINTENANCE AND REPAIR OF STREETS WITH BITUMINOUS MATERIALS.

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The causes which tend to destroy the smoothness of a pavement within a city are somewhat different from those outside. In the city, we have in addition to the natural causes of failure, the voluntary action of the public utilities and contractors, wherein they must from necessity excavate in the city pavements in order to give to the people the service which they sell. The regulation of openings and replacements in city pavements is as vital a subject as the city official in charge has to contend with to keep his pavements smooth.

It may not be out of place briefly to describe the methods used in Richmond in this connection. Six years ago we did not have any effective regulation of openings and replacements of pavements. On every street there were trenches which had sunk all the way from two to six inches. From time to time lists were made of these sunken trenches and were referred to the various parties responsible. In most cases it was weeks and months before any real effort was made to fill them. In many instances the responsibility of the trench was denied.

The matter was taken in hand, investigation was made of the practice in other cities and an ordinance was drawn and passed by the city council. At this same time a system of patrol maintenance was inaugurated by the city. The ordinance provided that before a permit was granted to dig in any street, a deposit was necessary to cover the cost of backfilling and the replacement of the pavement over the trench. The city then took over this work of back-filling and pavement replacement and did it at actual cost plus 12 per cent for any future maintenance. This actual cost was deducted from the deposit made and the difference, if any, was refunded.

This placed every trench in charge of the city. If the trench was not kept in repair every one knew that the city itself was not doing its work. This system is still in force and no doubt is responsible for the easy way in which we can control the street maintenance.

Our system of patrol maintenance includes the use of a team which hauls a special wagon containing stone and sand with the necessary tools. Attached to the rear is a tar heating kettle. This wagon was especially constructed for this work, the running gears being from a discarded horse-drawn hook and ladder

fire wagon. The sand compartment holds 30 cubic feet and the stone compartment holds 25 cubic feet. The amount of material carried on the wagon will supply stone and sand enough for pouring two barrels of Tarvia X, which is heated in the kettle at the rear. The kettle has a warming rack which holds an extra barrel covered with a tight hood. The materials thus carried will supply material for the gang for one half day without returning to the store-house.

The program outlined for this repair gang is to start at one end of town, patroling each street and patching all depressions, until the other end of town is reached, then they begin all over again. Only pavements of concrete, water bound and bituminous macadam and surface treated gravel are repaired by this outfit.

In repairing the depressions in these pavements, we first thoroughly clean all dirt and foreign matter from the depression with a shovel and wire broom, giving it a final sweeping with an old house broom. For the shallower holes or ruts, a little hot Tarvia X is poured over the surface, then a heavy coating of coarse sand is spread over the Tarvia while it is still hot. The deeper holes are filled to within ¼ inch of the surface with ¾ inch clean stone chips, smoothed off and tamped. Then hot Tarvia X is poured over and around them. About one and one-half gallons of Tarvia X is used per square yard of patch. Coarse sand is spread over the patch to give it a final finish and make it possible for traffic to go upon it immediately.

The larger cracks and depressions in concrete pavements are repaired in a similar manner to that described above for macadam and gravel pavements while the smaller cracks are repaired by merely pouring them full of the hot Tarvia.

A program is mapped out each year for the surface treating of various macadam and gravel streets in the city. A study of the condition of each city block is made by personal observation. A city map is then procured and the streets which inspection shows to be in greater need of a surface treatment are blocked off. Similar maps are kept each year showing in colors the various streets which have received surface treatments. By this method and record, the amounts of bituminous material per square yard are approximately determined and with the square yards in each city block known, this being kept in a card index, the total amount in gallons for each particular street is determined and set down. Each year the city council appropriates a certain sum of money for the maintenance of these streets and the work contemplated is kept within the budget. In 1923 about 250,000 square yards of pavement were surface treated.

The surface treatment of macadam is very well known although we find that due care should be exercised in getting the

surface thoroughly cleaned, especially near the edge of the gutter where dirt is more liable to lodge and cake. We endeavor to use care in applying the amount of bituminous material that our experience has taught us is proper. Where, in our judgment, one-fifth of a gallon per square yard is sufficient, we endeavor to apply that amount and no more. We have found that it is better practice to apply thin coats instead of trying to build up a heavy mat which is liable to wave under traffic.

The prime purpose of our surface treatments is not, as many imagine, to lay the dust, but to waterproof and seal the surface to prevent dust.

We have, in the past, been able to select the streets which need surface treatments on their merits and not because some resident along the street thought it needed one. As long as this work is left to engineering experience and not political pressure it will function properly and economically, and no longer.

After the bituminous material is applied a covering is immediately spread theron. We use both pea gravel and stone chips for covering. We find, however, that the stone chips ranging from ½ inch to ⅛ inch with no dust, are inclined to hold their place a little more readily after traffic is turned onto the street. The flat sides of the stone present additional surface to adhere to the Tarvia.

The surface treatment of gravel streets which have previously been surface treated is similar in every respect to that of macadam. However the surface treatment of gravel pavements which have never been previously surface treated involves a few features which distinguish it from the other. For successful results with this type it has been our experience that the gravel surface must be firm and comparatively smooth prior to the application of the surface treatment.

The preparation of the surface consists in repairing all depressions by filling the same with ¾ inch clean stone chips tamped to about ¼ inch below the street surface and sealing them with hot Tarvia X. If there is dust on the surface, it can be removed to the gutter with a rotary sweeper. Otherwise good results have been obtained by applying the bituminous material directly to the gravel.

The Tarvia B is applied cold by means of a pressure distributor. For the initial treatment, one-third to one-fourth gallon per square yard is used, with subsequent treatments of one-third to one-fourth gallons per square yard. Better results are obtained by not applying any covering material whatever on the initial treament. This allows the bituminous material to be absorbed by the surfacing gravel to the extent that after traffic has ironed it out for a time, investigation shows that a crust has been

formed of a thickness of from ⅜ to ½ inch. Subsequent treatments are covered with a light sprinkling of either pea gravel or stone chips to the amount of about 5 pounds per square yard.

It has been found that after traffic has used the treated gravel for some months, a few depressions may develop, due either to an excess of dust or a damp clayey spot on the surface at the time of application of the binder. These other places will require looking after. This work is taken care of by the maintenance patrol gang previously described.

We have made it a point to keep the surface treated gravel streets in good repair. This makes the fifth year that we have experimented with Tarvia B on gravel streets and have secured from that experience a good idea of the maintenance required to keep them in repair.

Our five years' experience with surface treated gravel has taught us to observe the following points:

Never apply the bituminous material on a gravel surface which is damp or excessively dusty, as it will not incorporate itself with the pavement and will soon break out.

Be sure to apply the treatment uniformly the full width of the street, otherwise it will ravel at the edges.

Have the surface firm and smooth before applying the binder.

Never apply the binder on any street which has not an adequate foundation, as the binder will not furnish that.

Do not apply the binder on any gravel street unless the treatments will be kept up when they are needed. It has been found that ½ gallon per square yard the first year with ¼ gallon per square yard the second year will keep the surface in such shape that no treatments will be necessary for two years. This applies to a residence street only. To put one treatment on a gravel street and then leave it alone will make it worse than if no treatment had been applied.