Memo on Cold Applied Mastic-Type Crack and Joint Filler

L. E. Gregg
Kentucky Highway Materials Research Laboratory
Highway Materials Research Laboratory  
132 Graham Avenue, Lexington 29, Ky.  
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Memo. to:  Dean D. V. Terrell  
Director of Research

On May 6, 1948, I transmitted to you and to the Specification Committee a specification recommended by the Research Laboratory for Cold Applied Plastic-Type Crack and Joint Filler Compound which was later adopted by the Department as Special Specification No. 46. This memorandum contained an account of the brief experimental work done on the paving project on the Lexington-Harrodsburg Road (Proj. F-369 (4) 24 (3)) in the fall of 1947 and the laboratory tests that accompanied it. There were a number of photographic illustrations used to show methods of field installation and the types of failures (or lack of failure) produced by laboratory tests for bond.

In passing the recommended specification on for review we asked that it be considered "...with a view toward including it at least on plans and specifications for projects where there would be a good possibility that it could be tried on a much larger basis than we have been able to apply it heretofore". I don't know whether it has appeared on plans and proposals for new construction, but last fall Mr. W. F. Johnson, Director of Maintenance arranged for the filling of joints on a maintenance project (Fayette County, MP 34-184-A, Lexington-Leestown-Frankfort Road, Ky. 150) in the Sixth District.

According to a memorandum to Mr. Johnson from the Sixth District office, 1080 pounds of 332.8 Enamelite purchased from the Pressite Engineering Company, St. Louis, Missouri, filled 70 joints. The cost was $0.096 per pound, making a total cost of $103.68 or an average cost of about $1.50 per joint for material in a 20-foot pavement. Both expansion and contraction joints were represented, and as noted by Mr. L. A. Whitmer in his memorandum to Mr. Johnson, (copy attached) the joints were cleaned of old material to a depth of 1/8-to 2-inches.

You will recall that the material is furnished in two components-- the powdered asphaltic portion which is composed of ground gilsonite, asbestos fibre, and organic filler; and the liquid which consists of asphalt cement, rubber, and fluxing agents. These two components were combined and mixed in a pug mill type apparatus which was an integral part of the machine for application furnished by the Pressite Company for this experimental work. The material is marketed as a 90 pound unit of which 51 pounds is represented by a bag of powder and 39 pounds is contained in a drum of liquid.

One of the outstanding features of the project was a "ripper" or rough cleaning device which was developed and made
in the Sixth District garage in Lexington. This device, as illustrated in the drawing of Fig. 1, was essentially a tapered prong attached to a "sled" which could be dragged or lifted and carried by a tractor ordinarily used for roadside mowing. The prong projected below the sled and into joints when the equipment was in operation. A man standing on the sled provided weight necessary to force the prong into the joint and hold it there during the ripping process. Also this additional man facilitated the maneuvering of the tractor and sled into position from joint to joint.

Occasionally it was necessary to make two passes with the ripper in order to remove the bulk of old filler, but on the whole the method was remarkably effective and undoubtedly better than anything developed up to that time. Within the past month or two information concerning a so-called "concrete grooving machine" manufactured by the G. H. Tennant Company, Minneapolis, Minnesota has been circulated widely. This machine was demonstrated in Washington during the Highway Research Board meeting last December and I understand that reports on its operation and performance were very favorable. In their literature the Tennant Company claims:

"1. Thorough cleaning of old bituminous material from concrete joints without gumming or heating.

"2. Roughens the joint side wall to prepare a surface to which thermoplastic sealing material will bond even better than on new construction.

"3. Cleans irregular cracks and fissures."

Some consideration of equipment of this type may be desirable in the future if more work along these lines is contemplated or even for requirements for cleaning joints prior to filling with any material on construction projects.

Operation of the sled and prong ripper is illustrated in Fig. 2 which demonstrates very well the ability of this equipment to remove the old asphalt cement filler (and parts of the original premoulded material in expansion joints). After that operation had been completed, the greater part of the debris was swept from the pavement and fine cleaning with a power brush was done with the equipment shown in Fig. 3. This machine was furnished by the Presstite Company and did a good job although there were times when the motor was hardly equal to power requirements. This machine, too, would be eliminated if one piece of equipment such as the Tennant machine were used.

A cleaned joint ready for filling is shown in Fig. 4. Old filler which ran over onto the pavement when joints were poured in the past was ignored, there being no reason to remove it. Fig. 5 illustrates the joint filling machine and the pouring of liquid into the hopper at the start of a mixing operation. Despite indications from this photograph, the liquid is
not highly viscous but rather is more fluid and pours easier than the lightest of asphalt cements. The temperature at this time was in the vicinity of 50° F and, of course, the material was not heated.

Although the liquid and powdered components were somewhat segregated during the early stages of mixing, as shown in Fig. 6, they soon became dispersed and combined so that mixing could be completed easily in 5 minutes. The disadvantages of a mixing chamber as a fixed part of the applicator device are obvious, since the machine could not serve both purposes simultaneously. However, it is doubtful that much, if anything, could be gained by mixing in a separate chamber, because the difficulties of transferring material from the mixer to the applicator would be too great. One solution to this-- and I think the Presstite Company is advocating it for installations with their material and equipment-- is the use of two machines which could alternate from mixing to filling, thus keeping the crews busy at all times and avoiding delays in any of the operations.

Undoubtedly a number of changes can and will be made in the machine as time goes on, particularly if it is produced by some concern experienced in mechanical equipment. These should improve its operation, although this model equipment probably includes all the features essential to the work. During the mixing process a clutch on the feeding mechanism is disengaged so that material is not extruded. Then, when the clutch is thrown in, a worm screw (similar to that on some stoker feeds) forces material from the opening at the bottom of the hopper along the barrel and out through the nozzle in the lower foreground of Fig. 7. The speed of the motor and hence the speed of extrusion is controlled at the handle bar in the upper part of the photograph-- an arrangement much the same as that on a motorcycle.

Filling of a joint was started about 3 feet from the edge of the pavement (Fig. 8) because of the lip curb. In order to guide and control the nozzle properly, the operator worked backward, so after the joint had been filled through the curb on the opposite side, it was necessary to cross the road, turn the machine around, and fill the portion which had been omitted at the start. Even with all these handicaps, joints could be filled at an average rate of 2 to 3 minutes each.

As rapidly as a joint was filled it was covered with a strip of light wrapping paper (see Fig. 9) in order to prevent tracking of the filler by traffic. Although this appears time consuming and unsightly, there was actually no appreciable time required for this and the paper was hardly noticeable after it was in place. There is no doubt that the material would track badly in the beginning and for a period of several days if it did not have this protection. However, on this job the paper stayed essentially intact for more than two months.
except for the portions extending onto the pavement surface which wore away quickly under the action of traffic. A joint after more than a month of service is pictured in Fig. 10 where the paper can be detected even at a distance.

The joints on this project were inspected for the second time on February 8, and after more than two months of service the material was considerably more pliable than hot-poured filler would be under similar circumstances. Even so, this mastic cold filler was not soft at about 50° F temperature and there was no evidence of rocks or other hard objects having been forced into the joints.* There were a few places where the filler was low, which apparently were caused by settlement of the material after the joint had been filled.

I understand that several states, including Minnesota, Colorado, Michigan, Indiana, and Ohio are going forward with plans to set aside a construction project where the mastic-type filler will be used on a trial basis during the coming year, and that their requirements will be based on the Kentucky Specification for this material. Although we have not had enough field exposure to definitely prove or disprove the cold materials as a solution to joint filling problems, we now have enough installed to make any evaluation more conclusive. A larger installation on construction projects would be desirable, particularly if a part of it was applied in green concrete. It would be best if this was advertised as an alternate for contract bidding, rather than as a non-competitive investigational feature, however, for that would be the best way to determine how contractors regard such materials from their standpoint.

L. E. Gregg
Associate Director of Research

Copies to:
Research Committee Members

*As a matter of comparison, inspections on the Harrodsburg-Lexington Road made last summer during high temperatures showed the mastic filler more firm than the hot-poured rubber-asphalt type. Whether this indicates a hardening process that increases with time is not known, however there is no evidence of this at present--its second winter of exposure.
Fig. 2. Joints were given initial cleaning by the ripper shown in operation here, and a final cleaning by a wire-brush mechanism that can be seen off the pavement on the extreme right. In some cases it was necessary to run the ripper through twice with different blades in order to remove the bulk of material prior to fine cleaning.
Fig. 3. Wire-brush mechanism in operation for fine cleaning after the ripper had removed the bulk of old filler. This device and the machine for mixing and applying the mastic filler were supplied by the Prestite Engineering Company.
Fig. 4. Joint cleaned in preparation for filling. Old filler which had flown over onto the pavement in the past was ignored. Depth to which old filler was removed probably averaged 1\(\frac{1}{2}\) to 2 inches.
Fig. 5. Pouring liquid component of batch into hopper of mixing and extruding equipment. First the liquid was poured into the hopper, then the powder was added and mixing carried on for about 5 minutes. During this period a clutch on the drive shaft was disengaged to prevent extrusion of the material through the tube and nozzle in the lower foreground. The hopper was made to accommodate a 90 lb. unit consisting of 39 lb. of liquid and 51 lb. of powder.
Fig. 6. Batch in the early stages of mixing. Separation of components at this stage is prominent, but complete mixing was accomplished easily in 5 minutes.
Fig. 7. Near view of the machine showing the relation between nozzle, pavement surface, and joint. An average of 2 to 3 minutes was required for filling a joint. This varied with the depth to which the joint had been cleaned and with the type of joint—expansion or contraction. The machine was operated by a 3/4 h.p. gasoline motor but was not self propelled.
Fig. 8. Machine in place ready for installation. Because of the lip curb, it was necessary for the operator to begin a joint about 3 ft. from the pavement edge and work to the opposite side, cross the road, then turn the machine around, and fill that portion which was omitted at the start.
Fig. 9. As rapidly as a joint was filled it was covered with a strip of light wrapping paper in order to prevent tracking of the filler by traffic. This paper, as shown in Fig. 10, remained essentially intact over the filler for at least two months although that portion of the paper extending onto the concrete surface was worn away in a short time. Note that the operator worked backwards in order to control the nozzle by properly guiding the machine.
Fig. 10. Second joint east of Pole No. 436 before and after filling. In the lower photo the joint is pictured after more than a month of service through December and early January. The paper had not worn away, but the material had set up to the point where it deflected only a slight amount under pressure even though the temperature was about 50° F. Material on the pavement is old filler of the type that was removed when the joint was cleaned.
Fig. 11. Panoramic view showing the entire operation of cleaning and filling the joints. Note cleaning operations in the distance at the top of the vertical curve, and filling operations in the middle foreground. This is near the end of the job where the two operations became widely separated. Some traffic has passed over the joints in the near foreground which were filled 10 to 15 minutes prior to the taking of the photograph, but it is obvious that no tracking has occurred.
154 Market Street
Lexington, Kentucky
December 17, 1948

TO:                         Mr. H. F. Johnson
                              Director of Maintenance

SUBJECT: Fayette County
        MP 34-184-A
        Lexington-Leestown-Frankfort Road
        KY 150

On November 29th and 30th, 1948, 70 expansion joints were poured using 332.8 Enamelite or equal meeting specific specifications No. 46 which was used as an experiment.

This material was furnished by the Prestite Engineering Company, St. Louis, Missouri, at the price of 0.096 per pound and the material that was used in the 70 joints was 12 - 51 pound bags of dry asphalt and 12 - 39 pound drums of liquid asphalt. This material was mixed cold in a Pug Mill type mixer and one bag of material and one drum of liquid asphalt was mixed at one time. This proportion would pour approximately six joints of 22' pavement and it would take approximately 10 minutes to mix a batch. When this material was poured a strip of 2-inch paper was placed over the entire joint to protect the fresh material from traffic. This paper was left on joint and traffic wore it out in a week or ten days. The material used in pouring these joints has the appearance of a rubber composition joint. The equipment used was a small tractor and a shop made joint cleaner. After they were cleaned with this machine the Prestite Engineering Company furnished a small machine powered with a small gasoline motor and it operated a steel brush six inches in diameter that cleaned all the old crack and joint filler down to the expansion material that was placed in the concrete during construction. This was to a depth of from 1 ½ to 2 inches. Then the machine that mixed the material was used to lay the cold mix in the joint. The total weight of a batch of this material when mixed would weigh approximately 90 pounds. From observation when these joints were being poured, it was noted that it would not be necessary to cut these joints out to a depth of 2 inches as it is obvious that the deeper the joints are cut out the more material it will take for replacement.

An inspection was made of these joints on December 16th and they are level with the pavement and have a very easy riding surface and the material is very pliable.

The location where these joints were poured with this experimental material began 7.00 miles from the West City Limits of Lexington on KY 50 and ended 0.20 miles East of the Fayette-Scott County Line in Fayette County and a more definite location is beginning opposite telephone pole No. 269 near a large white oak tree on the right and ending the second joint back of telephone pole No. 288.
The 1,080 pounds of Enamelite that were purchased on HCT 11050 for $103.68 from the number of joints poured would be approximately $1.50 per joint on 20'-wide pavement. This of course would depend on the depth the joints are cut. The equipment necessary for pouring these joints would be a small tractor to pull the shop made joint cutter for cutting out the old cold patch material and a Joint Cleaning Machine which would cost approximately $250.00 and the mixer which is operated by a small gasoline engine would cost approximately $1,000.00 and would take an organization of one Foreman and eight men to carry on this operation and the above equipment and crew could place approximately 1,000 pounds of this material per day. This material is not suitable for pouring any other cracks or longitudinal joints.

When these joints were being poured an inspection was made by Mr. F. C. Spurrier of the Frankfort Maintenance Office and Mr. L. E. Gregg of the Research Laboratory and the weather was very favorable for this type of work. The Company who furnished this material had several representatives on the job supervising the mixing and placing of material.

\[S\]  
L. A. WHITMER  
Sr. Hwy. Engr.

FOR: B. T. MOWNAHAN  
District Engineer

LAW: its  
cc: L. E. Gregg  
Research Laboratory