

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 Mastic-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. M. 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 Presstite 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 1½-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 Presstite 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 viscuous 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 (similiar 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

LG:mbm

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.

Commonwealth of Kentucky  
Department of Highways

AN EXAMINATION OF EQUIPMENT FOR PREVENTING  
SEGREGATION IN STORAGE OF COARSE AGGREGATES

by  
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Introduction

This is a report of an investigation of a device developed for the purpose of reducing to a minimum the segregation of coarse aggregates during delivery from chutes or conveyors to bins and other storage or transportation facilities.

Producers and consumers are always confronted, more or less, with segregation of materials, but methods toward its elimination have been moderately successful at best. As a matter of fact, the most successful of these methods have been those that required placement and distribution of loads in bins, stockpiles, barges, and the like, rather than the use of mechanical devices for prevention of segregation within the loads themselves.

It is the purpose of this report to present results of experimental work with a mechanical device for that purpose. The experiment was necessarily confined to miniature apparatus representing equipment that could reasonably be devised for actual application to aggregate production plants.

### Equipment

The device provided for this experimentation was installed on a small scale model of a typical two-bin screening plant with a gyrating type two-surface shaker screen. This model plant was scaled down to one inch equalling one foot full scale. In lieu of the usual conveyor system a hopper, with an adjustable trap door for controlling feed, was provided for the introduction of the aggregate to the screens. This complete assembly is picture in Figure 1.

Fig. 1. Photograph of small scale model of  
Anti-Segregation Materials Plant

The anti-segregation device was installed directly beneath the chute openings to the bins and over the midpoint of bins. The aprons or spreaders were of fan-like construction provided with fins on both faces, curving outward for distributing the aggregate laterally and powered to oscillate longitudinally to effect uniform distribution in that direction. The aprons were caused to oscillate (to approximately  $40^\circ$  each side of the vertical) by means of a motor driven gear mechanism driving an eccentric at low speed which in turn operated the aprons at a low period of oscillation. This device was relatively simple in design and operation. The sketch in Figure 2 illustrates design and location of the aprons. Similar but smaller aprons were placed beneath bin outlets for uniform distribution of material in trucks.

#### Materials and Methods

After preliminary trial runs it was decided that due to the small scale size of the "plant" it would be more practical to remove from the aggregate (a coarse river sand) all material larger than the No. 4 sieve to obtain a grading more in proportion to a normal coarse aggregate. Also, to more effectively test the device for minimizing segregation, the upper screen of the shaker was blanked for tests in Series I-IV in order to convey all of the aggregate to one bin, thus providing a material with a wider gradation range. Procedure in Series V differed in that the shaker screen was employed to separate the aggregate into coarse and fine grades. A more detailed description is given on a subsequent page.

The actual gradation of the aggregate and the relative sieve sizes for full scale enlargement appear in Table I.

TABLE I

Sieve Sizes Square Openings		Percent Passing
Actual Size	Relative Size*	
No. 4	2.22 in.	100.0
No. 8	1.12 in.	78.0
No. 16	0.55 in.	45.0
No. 30	0.25 in.	12.0

\*This gradation does not conform to a standard size, but is somewhat comparable with size No. 47 with an excess of fines.

Laboratory assistants were assigned to conduct test operations and collect samples with no especial instructions other than recommended variation in methods to follow for collecting samples. This eliminated the possibility of selective sampling by someone who knew the end point of the experiment. Five series of operations were made, distinguished as follows:

Series I. With the anti-segregation device in operation samples were collected in a tray divided into nine separate compartments and covering the total area of the bin. A tenth sample was drawn from the partially filled bin.

Series II. With the anti-segregation device in operation the bin was partially filled. Ten samples were drawn from the bin at the same time the remaining material was being added. Each sample of 500 grams was taken during the passage of each 1500 to 2000 grams. Thus, samples were not taken, one immediately following the other.



Series III. With the anti-segregation device removed, the bin was filled. Ten samples of 500 grams each were drawn from the bin during the passage of each 1500 to 2000 grams.

Series IV. With the anti-segregation device in operation the bin was filled and ten samples were collected as in Series III, the last sample emptying the bin.

Series V-A and V-B. The method employed in collecting this series of samples deviated somewhat from the above in that sizes larger than the No. 4 sieve were included in the total aggregate, and the shaker screen was employed to divide the aggregate into coarse and fine gradations and convey them to separate bins with the anti-segregation device in operation. Six samples were collected in each bin, five in open cups distributed in the bins (one at center, two near corners, and two at intermediate points), and the sixth drawn from the bins.

The actual gradations of materials from the two bins appear in Table II, together with the relative sieve sizes for full scale enlargement.

TABLE II

Sieve Sizes Square Openings		Percent Passing	
Actual Size	Relative Size*	V-A	V-B
3/8 in.	4.50 in.	100.0	-
No. 4	2.22 "	83.0	-
No. 8	1.12 "	38.0	100.0
No. 16	0.55 "	7.0	75.0
No. 30	0.28 "	-	23.0
No. 50	0.14 "	-	2.0

\*V-A is comparable with Size No. 36 with an excess of coarse materials.

V-B compares somewhat with No. 610

Sieve analyses were made for each of the samples, a total of fifty two being made for the five series.

### Results

The results of sieve analyses are presented graphically in Figure 5. Grain size curves representing the average gradation for each Series and showing the spread for each appear in Figures 3 and 4.

A study of the results plotted in Figures 3, 4 and 5 reveals that there was definitely more uniformity of material with the use of the anti-segregation device than without. This is especially true in Series I, II and V. In Series IV there is marked deviation from the average for samples 9 and 10, but not so much as is evidenced in Series III, in which case the anti-segregation device was not employed.

### Conclusions

It is reasonable to conclude that the principle of this device has merit. Should it seem worth consideration, the study of the performance of a full scale model operating under actual conditions would prove more conclusively its value.