LONGEVITY OF HOT-POURED ELASTOMERIC JOINT SEALANTS

Frank D. Gaus, Superior Products Company

•TWENTY years ago, Federal Specification SS-S-164 (AASHO M-173) was issued for a hot-poured joint sealing compound. It stated that the compound should be "a mixture of materials which will form a resilient and adhesive compound capable of effectively sealing joints in concrete against the infiltration of moisture throughout repeated cycles of expansion and contraction and which will not flow from the joints or be picked up by vehicle tires at summer temperatures." According to figures issued by the Federal Highway Administration in September 1970, 42 state highway departments still use a sealing compound that meets the requirements of this specification.

In 1968, an up-dated specification was issued by the United States Air Force as Federal Specification SS-S-1401A. The major changes included in this specification were a resiliency requirement and a requirement for a longer cooking period of material prior to its preparation for testing. It did not include tests for longevity or resistance to weathering.

There has long been a need for an improved hot-poured sealing compound. This topic has been discussed frequently at many national and international symposia (1, 2, 3, 4, 5). In response to this need, we have developed a polyvinyl chloride (PVC) hot-poured elastomeric sealant that will give long-term performance.

THE RESISTANCE OF HOT-POURED SEALANTS TO WEATHERING

During the early stages of PVC sealant development in 1963, tests were conducted on a newly developed PVC elastomeric hot-poured sealant by using a Weather-Ometer. The artificial-weathering test method contained in Interim Federal Specification SS-S-00200c for polysulfide-coal tar extended sealants was used to compare weathering properties. We learned that the PVC sealant was much more resistant to weathering than was the polysulfide-coal tar sealant.

During the past 8 years, our consultants have purchased various types of hot-poured sealants and have tested every hot-poured sealant that conforms to Federal Specifications SS-S-164, SS-S-167b, and SS-S-1401A, AASHO M-173, and the so-called Minnesota up-graded type. The materials were tested for resistance to weathering and flow characteristics by using the artificial-weathering test method. The testing program disclosed that certain hot-poured sealing compounds start to blister and bubble after just 1 hour; the SS-S-00200c specification requires that the full test be run for 160 hours. When it was learned that the 1401A sealing compound used in 1968 had very poor resistance to artificial weathering, we initiated a program to correlate laboratory artificial-weathering test results with field installation results. The 1401A materials and the PVC sealants that were installed in 1963 were compared.

Cook (6) was absolutely correct when he stated, in reference to the new 1401A, "The 164 specification had, for years, been the standard specification. The 1401 specification is a recent amendment. The addition of the resiliency requirement forces the manufacturer to upgrade the rubber content of the material. The materials which meet this newer specification look good, but require long-term field verification."

Sponsored by Committee on Sealants and Fillers for Joints and Cracks.

Artificial-weathering test panels were used at various installations such as the Kansas City International Airport and military air bases and were tested by the highway departments of Minnesota, Louisiana, Texas, and California. All of these participants reported that the materials eventually oxidized, bubbled, blistered, hardened, and flowed or pumped out of the joint, as had been predicted by the laboratory artificial-weathering tests. The findings of the program are reported in detail elsewhere (4).

At the same time, the PVC installations showed no signs of blistering, bubbling, cohesive failure, adhesive failure, or hardening after 9 years in areas subject to all types of weather conditions such as Detroit, Michigan; northern and southern California; Nevada; and Texas.

The positive correlation between the results of the field study and the artificial-weathering research in the laboratory is the basis for the development of a new specification for a hot-poured sealant for highways and airfields. This sealant will satisfactorily seal a joint watertight, resist intrusion of dirt and aggregate by maintaining resiliency, without adhesive or cohesive failure or blistering, bubbling, or hardening, for a period of from 15 to 20 years.

Field surveys of sealants over the past 4 years indicate that long-term performance is being obtained by using preformed neoprene compression seals in new construction, provided a premium adhesive-lubricant is used to place and hold the seal in the joint. A recent report based on 22 years of investigation by the state of Michigan (7) indicates that the neoprene compression seal loses as much as 70 percent of its initial compression in only 2 years, which substantiates that a premium adhesive-lubricant is mandatory for long-term seal performance. PVC hot-poured elastomeric sealants are providing the same long-term performance in new construction as well as in maintenance work.

RESEALING MAINTENANCE OF JOINTS

It is evident that funds for the maintenance of joints are becoming more and more scarce. Because of the increase in traffic volume, more and more of the maintenance dollar is being spent on "traffic control."

The increase in population and traffic makes it mandatory that a long-lasting sealant be used initially, whether it is a premolded neoprene compression seal or a PVC hot-poured elastomeric sealant, in new construction in concrete pavement. This type of sealant should also be used in resealing existing highway joints.

Rissel (8) points out that labor costs are rising faster than any other aspect of maintenance work, and he concludes that the best material should be used in the resealing of joints.

PVC elastomeric hot-poured sealants can be used for resealing highway joints and can provide long-term performance. The cleaning operation is fast: A plow can be used to remove old material; diamond concrete saw blades can be run through the joint to clean and shape it; the joint can be cleaned by a fast, thorough sandblasting; and then the sealant can be applied rapidly to the joint. Traffic may be opened immediately after the sealant has cooled in the joint. The sealant is applied at the low temperature of 250 F to 280 F. This low temperature does not deteriorate the polymer ingredient of the sealant.

For new construction or resealing of joints, the joint shape factor is an accepted and proven fact. The joint should be 1¼ in. in depth with the sealant applied to ¼ in. below the pavement surface.

A nonproprietary performance specification is available for the highway PVC elastomeric polymer hot-poured sealant and for the JFR type for use in critical areas of airfield pavements subject to jet fuel spillage and jet blast[1].

[1] The original manuscript of this paper included an appendix, Specification for Sealing Compound Elastomeric, Polymer-Type, Hot-Applied One Component, for Portland Cement Concrete Pavements. The appendix is available in Xerox form at cost of reproduction and handling from the Highway Research Board. When ordering, refer to Xerox Supplement 40, Highway Research Record 389.

The general requirements of the performance specifications state,

> The sealing compound when in place shall form a resilient and adhesive compound which is highly resistant to weathering, shall effectively seal joints in concrete against the infiltration of moisture throughout repeated cycles of expansion and contraction, and shall not flow from the joint or be picked up by vehicle tires at an ambient temperature of 70 F with full impact of solar radiation. The sealing compound before placement shall be stable at the safe heating temperature for up to three hours. The filled joints shall be free of large internal voids due to placement or voids which develop subsequently in service.

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