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Evaluation of New Patching Material for Open-Graded Asphalt Concrete (OGAC) Wearing Courses

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Strategic Plan Element (SPE) 3.2.6:

Development of Improved Patching Procedures for OGAC Overlays

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EXECUTIVE SUMMARY

A free-draining, easy-to-use patch material was evaluated through limited testing to determine if it could be successfully used to patch holes and pop-outs in open-graded asphalt pavements. FloMix, an off-the-shelf patching product from Roklin Systems Inc., was modified to produce a free-draining, fast-setting matrix of aggregate and polymer. This modified patch product was then placed at two test sites where its workability and durability were assessed. The product was found not durable in the more severe field trial.

PURPOSE OF THE RESEARCH

Open Graded Asphalt Concrete (OGAC) is quickly gaining popularity in wetter regions of the state as a surface or “riding” course. The appeal of OGAC in wetter regions is that it quickly drains water from the pavement below the riding surface rather than across it. This is highly desirable for safety considerations. OGAC is designed to be highly permeable and is placed over a relatively impermeable pavement layer. During a rain event, the water quickly seeps into the OGAC layer and, as it hits the impermeable interface at the bottom, drains laterally through the OGAC layer and off the roadway. This drainage characteristic greatly reduces or eliminates pooling of surface water and the associated risk of hydroplaning on the roadway during a rainstorm. The quick removal of surface water also results in improved driver visibility as tire splash and spray from big rigs and other vehicles on the roadway is greatly reduced. Additionally, OGAC is now being considered for broad use across the state because it tends to reduce vehicle tire noise.

Unfortunately, OGAC also has some drawbacks. One of the drawbacks is that Caltrans Maintenance doesn't have products and procedures necessary to properly maintain the OGAC and its drainage characteristics when localized distress necessitates patching.

Improving OGAC patching procedures was identified as a Department need by the Pavement Standards Team (PST). This need is documented in the PST-approved Strategic Plan for Partnered Pavement Research Program for 2003/2004 as Strategic Plan Element (SPE) 3.2.6, Development of Improved Patching Procedures for OGAC Overlays.

DESCRIPTION OF THE TEST

A literature review was conducted to determine how other state agencies were handling the problem of OGAC maintenance. The goal of the literature review was to identify alternative patching procedures used by other agencies which could maintain the permeability of the OGAC layer and be durable enough to last until the end of the expected remaining life of the existing pavement. Unfortunately, the literature review revealed no such patching alternatives.

The next step was to identify and evaluate new products that might be used or modified in a manner that would provide adequate drainage and durability. FloMix, a proprietary patching product made by Roklin Systems Inc., was selected for evaluation and potential modification.

Conventional FloMix is a combination of rapid-setting two-part urethane polymer and a blend of hydrophobic polymer-coated aggregate. Mixing is performed in the field with the use of a five-gallon bucket and a pail mixer. The patch material is blended and placed at ambient temperature to the distressed surface. No compaction is required, and the material hardens sufficiently in two hours to open to traffic. FloMix is relatively easy to apply and requires

minimal equipment and training. However, conventional FloMix is densely graded and therefore is not suitable for maintaining drainage continuity after patching.

Roklin Systems Inc. agreed to modify the grading of their conventional aggregate blend. The gradation was "opened up" by adding a large quantity of polymer-coated pea gravel. Loss of stability due to the inclusion of rounded aggregates was not considered to be a major concern because the two-part polymer does not have the viscoelastic qualities of asphalt binder and does not lose its capacity to bind aggregate together at higher temperatures. As such, the material doesn't need to rely primarily on the internal friction of the aggregate to resist shear deformation at higher temperatures. This modified patching material was then evaluated under limited testing at two trial test sites.

The first test site was at the Pavement Research Center, located at the University of California Berkeley Richmond Field Station in Richmond, CA. The primary objectives of the first test were to assess workability and ease of application, and to get a qualitative indication of drainage characteristics. Two potholes were filled with the material, and the material proved to be workable and easy to use. Additionally, a "lift" approximately 40 mm thick and 0.2 m^2 was placed over non-distressed dense-graded asphalt concrete (DGAC) with a 2-percent cross slope. To create this lift, the patch material was placed in a small wooden frame on top of the DGAC (Figure 1). After the patch material set up, the wooden frame was removed and water was poured over it (Figure 2). Twenty ounces of water was poured over the patch material over a period of approximately 60 seconds. The water seeped in relatively quickly with none of the water running off the surface of the patch material. Within a couple of minutes the water began draining from the downslope side of the patch along the interface between the patch material and the

underlying DGAC (Figure 3). This trial suggested that the porosity of the modified FloMix material was high enough to provide adequate drainage characteristics.

The second trial site was on Highway 20 in District 1, where a large proportion of Caltrans-maintained roads are surfaced with OGAC and patching OGAC is problematic for maintenance crews. District Maintenance Engineer Terry Davis worked with us to identify a suitable trial location in the eastbound lane of Highway 20 at milepost 19.5, about 10 miles west

Figure 1. Patch material being placed in wooden frame on top of DGAC pavement.

Figure 2. Water on surface of patch material.

Figure 3. Water draining from downslope side of patch material.

of Willits, California. The selected test site had been paved with OGAC a couple of years prior. It is suspected that the eastbound lane at the distressed location may have been paved before the underlying DGAC had dried completely from rain the day before. The OGAC at the test site had started coming up over an area of a few hundred square feet. Eventually, maintenance crews ground out the distressed OGAC down to the underlying DGAC. The objective of the test was to patch the ground out area with the modified FloMix and assess the durability and drainage characteristics of the patch.

Modified FloMix was spread full lane over a length of several meters at the Highway 20 test site by a District 1 maintenance crew (Figure 4). The patch was about 1.5 cm thick and was tapered at the ends and edges. This was considered to be a severe test condition for the patch material for a couple of reasons. First, the thickness was less than desired for optimal drainage characteristics. Secondly, the patch was large in addition to being thin, and it had no confinement at the edges.

A water truck was brought in before the lane was opened to traffic. The truck made two passes, giving the patch a thorough soaking both times (Figure 5). The majority of the water drained through the patch, as anticipated, and drained out the downhill edge of the patch

(Figure 6). The test site was then opened to traffic and the patch was monitored for durability. Unfortunately the patch was not durable and began chipping off of the underlying DGAC within a few months. Figure 7 shows the rough patch area after a year. Note the areas where the patch material has raveled completely away.

RECOMMENDATIONS

Based upon the results of limited testing in this research, the use of modified FloMix for OGAC patching is not recommended. The workability and drainage characteristics of the material were good, but the material did not meet the field durability criteria. The material may have acceptable durability if applied in a less severe condition, such as filling medium-sized potholes, however this has not yet been evaluated.

Figure 4. Placement of patch material on Highway 20 field site.

Figure 5. Application of water to patched area.

Figure 6. Water draining from downslope side of patched area.

Figure 7. Deteriorated patch site showing significant raveling and roughness after one year.