FINAL REPORT

EVALUATION OF CHEM-CRETE

by

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Research Scientist

(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

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ABSTRACT

Two test sections, one on new construction and the other on a maintenance resurfacing project, were installed in the fall of 1980 to evaluate the proprietary product Chem-Crete. Laboratory tests and dynaflect and density measurements were performed on the experimental and control mixes and the performance was evaluated over a two-year period.

Raveling was noticed in all sections, especially in the Chem-Crete mix, approximately two months after paving; however, the deterioration appeared to stabilize in all sections shortly thereafter, and traffic healed the surface of the control sections but not that of the Chem-Crete sections. Significant additional cracking and raveling appeared in both Chem-Crete sections after the second winter, whereas the control sections continued to perform satisfactorily.

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Several years ago the proprietary asphalt product Chem-Crete was promoted as a potentially superior binder for use in flexible pavement mixtures. The developer claimed that it increased strength, reduced creep, improved temperature susceptibility, improved adhesion, and improved fatigue life.

In October and November of 1980, test sections were constructed at two locations to compare the performance of mixes containing Chem-Crete at a 1:9 weight ratio with AC-20 asphalt to that of regular plant mix using the AC-20 material. Details of the installation, testing, and observations of the initial performance were given in the interim report on the investigation.* Each test installation contained plant mix with and without Chem-Crete. Each mix was placed at 100 lb./yd.^{2} (54.3 kg/m^2) as the surface course in 1.7 mi. (2.7 km) of 24 ft. (7.3 m) pavement on a construction project in Roanoke City and Roanoke County. The other installation was made in a maintenance resurfacing placed at 165 lb./yd.^{2} (89.5 kg/m^2) on a 1.3 mi. (2.1 km) section of 24 ft. (7.3 m) pavement in Franklin County.

RESULTS REPORTED PREVIOUSLY

Dynaflect tests performed on all of the pavements before and after paving indicated no significant reduction in deflections attributed to the surface courses. The Roanoke project, which was on new construction, had lower deflections than the Franklin County resurfacing project; therefore, distress was expected to be less severe on the Roanoke project.

Lab specimens were fabricated from the Chem-Crete and control mixes, cured at 140°F (60°C), and tested. As anticipated, the Chem-Crete specimens attained a higher strength than the control specimens after one month. Cores obtained from the Franklin Co. project, however, indicated no significant difference in strengths

*Maupin, G. W., Jr., "Interim Report - Evaluation of Chem-Crete," Virginia Highway and Transportation Research Council, January 1982, VHTRC 82-R30.

between the Chem-Crete and control mixes. No cores were removed from the Roanoke project because the results of tensile tests would have been suspect because of the extremely thin surface course. Failure of the Chem-Crete mix to gain significantly more strength than the control mix during the first month after paving possibly resulted from cool fall temperatures.

Stripping tests on the specimens prepared in the lab indicated that both mixes for the Roanoke project were slightly susceptible to stripping. Similar tests on cores from the Franklin Co. project showed the Chem-Crete mix to be more susceptible to stripping than the control mix; however, there was not a significant difference at a 95% confidence limit.

Constant stress fatigue tests simulate the fatigue failure mechanism of thick asphalt layers (greater than 3 in. [80 mm]), and constant strain fatigue tests simulate the fatigue failure mechanism of thin layers. Since the thicknesses of the surface courses were 0.87 in. (22 mm) and 1.4 in. (36 mm) on the two test installations, the constant strain test would be the best simulation of fatigue failure of the mixes. Usually, stiff mixes yield a longer fatigue life than flexible mixes under constant stress testing, and flexible mixes yield a longer fatigue life than stiff mixes under constant strain testing. The Chem-Crete mix was stiffer than the control mix and, as expected, it behaved worse than the control mix under constant strain fatigue tests and better than the control mix under constant stress tests. Therefore, it was concluded that the Chem-Crete test sections would develop fatigue cracks before the control test sections.

PERFORMANCE

As stated in the interim report, raveling was observed in the test sections with and without Chem-Crete several months after paving. The loss of fines was the primary problem; however, the full depth of the Chem-Crete layer was eroded from the wheel paths at several locations on the Roanoke project. Traffic appeared to heal the control sections and the initial deterioration did not appear to be detrimental. Although the deterioration stabilized in the Chem-Crete sections, the surface remained quite open and rough because of the loss of fines.

Considerable additional distress was evident in the Chem-Crete sections of both projects in the spring of 1982. The additional cracking and raveling was quite severe on both projects

(Figures 1-4). The surface on the Roanoke project was placed on a very stiff base; therefore, the cracks probably are limited to the surface course. The north end of the Franklin County project, which had no cracking after the first winter, now has numerous transverse and longitudinal cracks, and some alligator cracking, in the traffic lane. At least some of these cracks are probably reflection cracks, since the old surface was patched and cracked. The control mixes on both projects are now performing well (Figures 5-6). There is no distress, except for several edge cracks where it appears that the edge support is weak. The surface has a good macrotexture provided by the initial loss of fines.

DISCUSSION

Factors that could be related to the poor performance of the Chem-Crete test sections, and which are discussed subsequently, are as follows:

1. Excess Chem-Crete and hard asphalt
2. High absorption sand
3. Cold paving temperature and thin lift construction (Roanoke project only)
4. Failure to develop early strength

Excess Chem-Crete and Hard Asphalt

The manufacturer's representative claims that if the dosage of Chem-Crete had been reduced by 50%, a more flexible mix would have been produced.

He also recommended the use of a soft asphalt, such as an AC-5 or AC-10, to improve the low temperature characteristics of the mix. Although he advanced this suggestion, he permitted the use of the AC-20 material.

Test results indicate that the Chem-Crete mix was quite stiff and, therefore, would not perform well when in a thin surface layer. A reduction in the dosage of Chem-Crete and the use of a soft asphalt as suggested by the manufacturer possibly would have made the mix more flexible during cold weather and more durable. These changes were made in recent test installations in other states, and observation of the performance of those pavements should indicate whether Chem-Crete is a cost-effective additive.

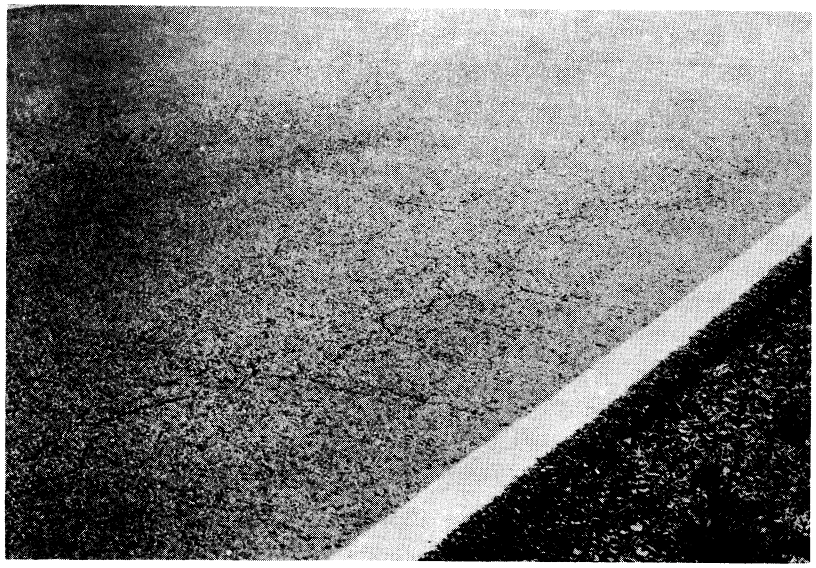

Figure 1. Cracking in Chem-Crete section on Roanoke-City Co. project.

Figure 2. Raveling in Chem-Crete section on Roanoke City-Co. project.

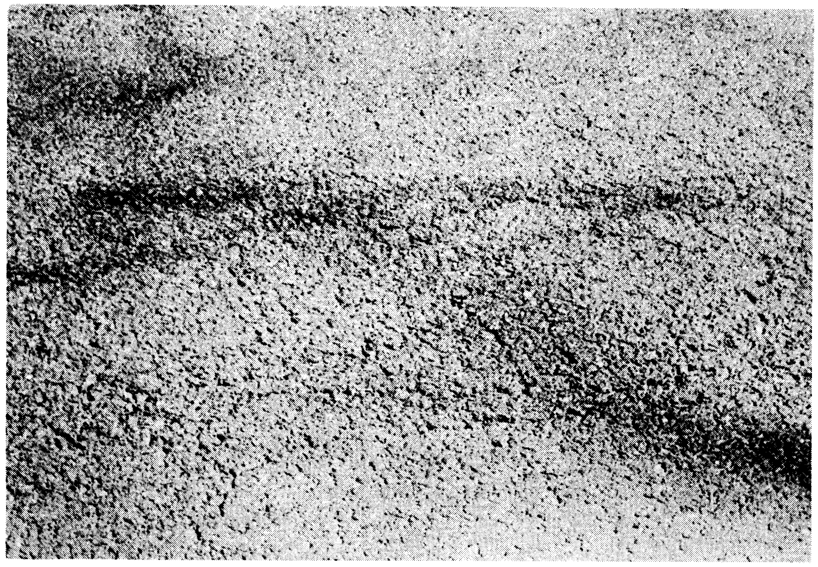

Figure 3. Cracking in Chem-Crete section on Franklin Co. project.

Figure 4. Cracking and raveling in Chem-Crete section on Franklin Co. project.

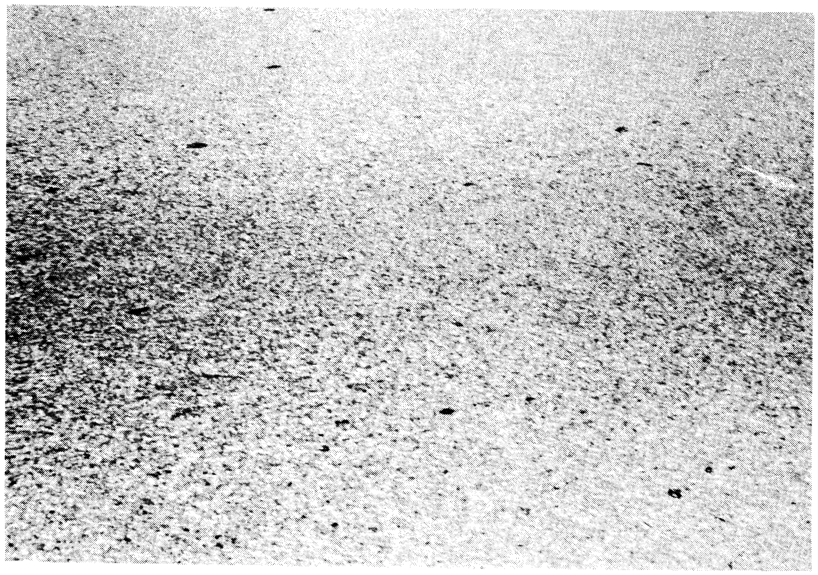

Figure 5. Control section Roanoke City-Co. project.

Figure 6. Control section Franklin Co. project.

High Absorption Sand

As discussed in the interim report, the absorptive sand was possibly responsible for the early loss of fines. This problem might have been magnified in the Chem-Crete sections because the Chem-Crete treated asphalt is less viscous than regular asphalt during the pugmill mixing process, and the sand would tend to absorb more asphalt. Although the absorptive sand might shorten the service life of the control mixes, they are performing well.

Cold Paving Temperature With Thin Lift Thickness

The combination of low temperatures and a thin application could have caused problems on the Roanoke project. Laying the 0.87 in. (22 mm) pavement surface during cool temperatures could have caused low densities. This was not confirmed, since no attempt was made to obtain cores for density determinations because of the inaccuracy in results associated with thin layers. There was no problem in this regard on the Franklin County project.

Lack of Early Strength Development

The results of indirect tensile tests indicated that lab specimens cured at room temperature gained strength faster than the pavement. The slow strength gain for the pavement could be attributed to cool fall temperatures, and this lack of early strength development could have contributed to the raveling problems experienced soon after paving.

CONCLUSION

Based on a two-year evaluation, the control mixes are performing satisfactorily, but the Chem-Crete mixes are not.

RECOMMENDATION

It is recommended that no additional experimental work with Chem-Crete mixes be undertaken in Virginia. However, the performance of pavements placed in other states using a smaller dosage of Chem-Crete and a softer asphalt should be followed.