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CLEMSON UNIVERSITY

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SUMMARY REPORT

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SUMMARY

LABORATAORY MIX DESIGN AND FIELD EVALUATION OF MODIFIED ASPHALT BINDERS

Researchers have been investigating the incorporation of various synthetic polymers in asphalt binders for many years. Most of the results of this research indicate that the utilization of modified asphalt binders in flexible pavements has many benefits. Mostly because of the implementation of the Strategic Highway Research Program (SHRP) program, the use of polymers in asphalt mixtures has been increasing over the last ten to fifteen years. One of the final products of the SHRP asphalt research program was a new system called Superpave (Superior Performing Asphalt Pavements), which aids engineers in the selection of proper paving materials and the design of the paving mixtures. Since the development of Superpave, the utilization of modified asphalt binders in flexible pavements has increased dramatically, creating a need for evaluating these materials.

Experimentation with improving the material properties of traditional asphalt binders through the addition of natural or synthetic polymers dates back to the early 1960's. These efforts to modify traditional asphalt binders were an attempt to achieve at least some of the properties of an "ideal" binder, such as a low thermal sensitivity in its utilization temperature range, a high thermal sensitivity in its working temperature range, a low sensitivity to loading time, a high resistance to permanent deformation, a high tensile strength, a high fatigue strength, as much adhesiveness as traditional binders, and a high resistance to aging. Polymer modifiers have been used most often to improve the temperature susceptibility of asphalt binders to reduce permanent deformation, thermal cracking, and fatigue cracking in asphalt mixtures made with these binders.

This study consisted of two phases. In the first phase of the project, the Superpave mix design method was used to determine optimum binder contents for several 12.5 mm Surface Course mixtures using one aggregate source and three polymer-modified binder sources. Next, rut-resistance samples were made with the Superpave Gyratory Compactor (SGC) using the optimum binder contents for each of these mixtures. These samples were then temperature-conditioned and tested for resistance to rutting using the Asphalt Pavement Analyzer (APA). Finally, statistical analysis of the rutting data was used to determine if the various binders had any effect on rutting.

In the second phase of the project, SCDOT procedures were used to determine optimum binder contents for Open-Graded Friction Course (OGFC) mixtures using two aggregate sources, three polymer-modified binder sources, and two fiber sources. Draindown samples were then made and tested using the optimum binder contents for these mixtures. Statistical analysis was also performed on the draindown data to determine if either the various binders or different fiber types had any effect on draindown. Although the construction of field test sections was also initially part of the scope for this study, problems in locating a suitable project for the Surface Course and OGFC test sections prevented the completion of this step

The aggregates used in this study were obtained from the Martin Marietta Materials quarries in Cayce, SC and Rock Hill, SC. Due to several changes in the potential locations of the field test sections during the laboratory phase, only the aggregates from Cayce quarry were used in the rut-resistance portion of the study, while both aggregate sources were used in the Open-Graded Friction Course (OGFC) portion. Several different aggregate types were obtained, including 7M, 89M, 789, Regular Screenings (RS), and Washed Screenings (WS).

Three different polymer-modified binders with a PG 76-22 grading were used in the study. The control binder was a PG 76-22 binder from Citgo called Citgoflex, which contains a styrene-butadiene-styrene (SBS) polymer modifier. The other two binders were Evaloy, which is a reactive elastomeric terpolymer (RET) polymer-modified PG 76-22 binder from Dupont, and a PG 76-22 binder from Citgo that contained modifiers in the form of both crumb rubber from Rouse Rubber and an SBS polymer.

Two different types of stabilizing fibers were used in the OGFC mixtures. Because mineral fibers were one of the two allowable types of stabilizing fibers specified by SC DOT for OGFC at the time of this study (the other allowable type being cellulose), Fiberand mineral fibers were chosen to be the control fiber type. A polyester fiber manufactured by Martin Color-Fi was selected as the other fiber type to be tested. High Calcium Hydrated Lime (HCHL) from Global Stone of Luttrell, Tennessee was used for all mixtures.

The Statistical Analysis System (SAS) computer program was used to perform the statistical analysis on the data obtained from both phases of the project. The results of this investigation indicate that there is insufficient evidence to conclude that any of the Surface Course mixtures exhibited significant differences in rutting resistance. In addition, the results show that there is insufficient evidence to conclude that any of the OGFC mixtures exhibited significant differences in draindown characteristics.

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