



South Carolina
Department of Transportation



PROJECT SUMMARY

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South Carolina
Department of Transportation
P.O. Box 191
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Evaluation of Cost Benefits to the SCDOT with Increased RAP-RAS Usage

Overview

The 1970s marked the beginning of the widespread use of reclaimed asphalt pavement (RAP) in asphalt pavements in the United States. In addition, in the 1980s, some field trials with high RAP contents were constructed and evaluated. However, in early years, many state Department of Transportations (DOTs) used only a low percentage of RAP materials in their hot mix asphalt (HMA) mixtures. One major reason for this was that the mixtures containing high RAP contents could result in increased “blue smoke” emissions from plants since the RAP materials were fed directly into the path of hot gasses. It is important to note that with the modern design of new plants, this is no longer a major concern. In addition, the use of recycled asphalt shingles (RAS) has increased dramatically by many states around the country.

There were three main objectives for this research project. The first was to analyze the cost benefits to the Department from the past utilization of RAP, RAS, and RAP/RAS in various mixtures around the state. The second objective was to develop a proposed pay schedule for aged binder versus virgin binder in the form of a draft specification. The third was to predict the potential cost savings to SCDOT from the use of the proposed alternate pay schedule.

Literature Review

One of the most recognized national industry surveys on RAP usage is conducted annually by the National Asphalt Pavement Association. Information Series 138, *Annual Asphalt Pavement Industry Survey on Recycled Materials and Warm Mix Asphalt Usage 2009-2012* stated that the number of states averaging more than 20 percent RAP in HMA/WMA mixes increased steadily from nine states in 2009 to 20 in 2012. In addition, the national average percentage of RAP used in mixes has increased from about 19% in 2011 to about 20% in 2012. It is important to note that the survey does not consider the effects of different grades and sources of binders on the performance of various mixes (PG 58-34 vs PG 64-22). Brown stated that since 2007, about half the states have increased the allowable percentages of RAP in their asphalt pavements saving states significant dollars. To mill, haul and process RAP costs only a fraction of the cost of virgin mixtures. He indicated that RAP allows contractors to produce a lower cost hot mix and pass along the savings to owner agencies. The Florida DOT estimates \$224 million in savings from the use of RAP since 1979, the equivalent to two-thirds of their annual resurfacing budget. A Minnesota study estimated 18% savings if 40% RAP were used in HMA production. The Indiana DOT conducted a cost-benefit

analysis of a research project as part of an independent review of the cost-effectiveness of the DOT's research program. According to the conservative estimate of the review, Indiana DOT's savings were nearly \$330,000 per year when adding only 5% RAP to more than 5 million tons of base and intermediate mixes, although RAP contents of 15 to 20% are more typical.

Results

The researchers conducted a national survey addressing several related topics including the following: tons of hot mix asphalt (HMA) and/or warm mix asphalt (WMA) used in 2012; tons of RAP and RAS used in HMA mixtures; tons of RAP and RAS in WMA mixtures; % of RAP based on total weight of mix; % of RAP based on aged binder based on total binder weight; higher percentages of RAP in WMA mixtures; utilizing a methodology to calculate the cost savings by using RAP and or RAS; intermediate and base mixes containing RAP and RAS; traffic information; additives used in the mixes; and many other questions. Nineteen states responded to the survey. The results of data gathered from SC DOT indicated that the average percentage of RAP per mix for all 7 Districts, in SC, in 2008 was 15.96 and this steadily increased almost 2% per year between 2008 and 2011. In some districts, the RAP utilization is much more than others for many reasons (e.g., more projects, more contractors, etc.). Asphalt pavement unit cost data points from SCDOT's database for the years 2008 through 2013 were used. It should be noted that unit mix costs can be affected by a wide variety of factors including project size, project location (urban vs. rural, night vs. day), transportation costs, mix application rate, time period placed, and overall market conditions. Based on the data, in 2013 there was an average savings of \$12.50/ton by using RAP. It is estimated that about \$25,000,000 savings were observed using RAP since there were approximately 2,000,000 tons of mix placed around the state. If the estimated percent savings to SCDOT is expressed as a percent of the total mix cost paid, the percent savings appeared to increase steadily from 9% in 2008 to 16% in 2013. The total estimated savings to SCDOT by utilizing RAP mixtures between 2008 and 2013 was approximately \$90.7 million, which is equivalent to a savings of 11% during this time period.

Summary & Conclusions

In this research project, many issues with the utilization of RAP and RAS in South Carolina was investigated. In addition, a national survey was conducted to obtain information regarding this issue throughout the country. The conclusions are as follows:

- SCDOT specifications and contractors' willingness to use RAP in SCDOT mixes has produced very high percentages of SCDOT mixes that use RAP, and most Districts are near 100% usage.
- Most mix types increased in unit cost over the course of the study (2008-2013). These increases seemed incremental in nature and attributable to inflationary reasons.
- The estimated percent savings to SCDOT (expressed as a percent of the total mix cost paid) increased steadily from 9% in 2008 to 16% in 2013. The total savings to SCDOT by utilizing RAP mixtures between 2008 and 2013 was estimated to be \$90.7 million.
- It was recommended that no changes be made to the current SCDOT payment method for mixes containing aged binder (RAP and/or RAS).
- It was recommended that SCDOT begin collecting the following mix information in the Site Manager Database: Job Mix Formula (JMF) number, % RAP, % Binder Content in RAP, Optimal Binder Content and Asphalt Binder Index.

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