

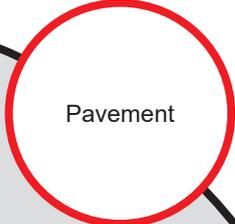


Caltrans Division of Research,
Innovation and System Information

Research



Results



Pavement

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Project Title:

Increasing Crumb Rubber Usage in HMA

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Increasing Crumb Rubber Usage in HMA

Reduce landfill disposal of scrap tires by requiring that all hot mix asphalt contain a small amount of CRM.

WHAT IS THE NEED?

California is faced with the challenge of annually diverting more than 40 million scrap tires from its landfills. In 2010 California Department of Resource Recycling and Recovery (CalRecycle) estimated that of the approximately 41.1 million reusable waste tires generated annually in California, 33 million (81 percent) were diverted through various alternatives including reuse, retreading and combustion.

In 2005, the Legislature passed and the governor signed AB 338, which requires Caltrans to use a specific percentage of crumb rubber modifier (CRM) per metric ton of the total amount of asphalt paving materials it uses each year. Specifically, as of 2013, Caltrans is required to use, on an annual average, 11.58 pounds of CRM per metric ton of the total amount of asphalt paving materials.

WHAT WAS OUR GOAL?

Caltrans proposes to reduce landfill disposal of scrap tires by requiring that all hot mix asphalt contain a small amount of CRM. As noted above, this small amount of CRM is defined as either 5-10 percent by weight of asphalt binder or 0.25-0.50 percent by weight of aggregate in hot mix asphalt.

WHAT DID WE DO?

A comprehensive review of the literature covering more than 100 published journal articles, conference proceedings, and reports



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found that although considerable research has been undertaken to understand the advantages and disadvantages of using recycled tire rubber to modify asphalt binders, no published information on PG+X-type initiatives (i.e., focused more on using additional waste tires in asphalt mixes rather than on improving performance of the binder and mix) was found. A number of states have specifications that allow tire rubber as a substitution for styrene-butadiene-styrene (SBS) modification (e.g., California [PG-M], Florida [PG-ARB], and Louisiana [PG-CRM]). No published research on adding very small quantities (i.e., less than 0.5 percent by total weight of the mix) in a dry process was located.

Meetings were held with Caltrans and industry to develop a workplan to test the alternatives that the group agreed upon.

WHAT WAS THE OUTCOME?

The Caltrans, industry and academia meetings decided to evaluate the following alternatives:

Approach 1: Wet Process with No Agitation, Complete Digestion

Caltrans PG+X for unmodified binders and meeting all current PG specifications, with addition of the CRM not resulting in a change to the PG grading of the base binder. It is anticipated that binders that already meet the current Caltrans PG-M specification would fall into this category.

Approach 2: Wet Process with Agitation, Incomplete Digestion

Caltrans PG+X for asphalt rubber binders and meeting anticipated PG specifications for asphalt rubber binders with changes to some components of the specification (e.g., solubility). Addition of the rubber should not result in a change to the PG grading of the base binder. It

is anticipated that binders prepared using the same approach currently followed to prepare the asphalt rubber binders used in gap- and open-graded mixes (i.e., rubber particles smaller than 2.36 mm [passing the #8 sieve]) and in chip seals (i.e., rubber particles smaller than 1.4 mm [passing the #14 sieve]), but with lower CRM contents, will fall into this category.

Approach3: Dry Process

Addition of between 0.25 and 0.5 percent CRM per ton of asphalt concrete mix (~ 5 to 10 lb/ton [2.3 to 4.5 kg/ton]) using a dry process. Mixes containing this rubber must still meet all Caltrans specifications. The PG grading of the binder should not be affected if this approach is followed.

Approach-4: Wet Process with Agitation, Complete Digestion

Same as Approach-2, but using other recycled tire rubber formulations typically with a finer rubber particle size, such as devulcanized tire rubber, which can be field-blended to achieve a binder containing between five and ten percent CRM (by weight of the binder) that still meets PG specifications, with potentially some relaxation for solubility. Addition of the CRM should not result in a change to the PG grading of the base binder.

WHAT IS THE BENEFIT?

The evaluation will consider advantages/disadvantages of the various alternatives in terms of several factors: technical, environmental, economic and performance. The expected outcome is a variety of alternatives that will accommodate the addition of a small amount of CRM in hot mix asphalt to meet the legislative mandate.