

Department of Resources Recycling and Recovery

SCOPE OF WORK

Update of Life Cycle Cost Analysis of Asphalt Rubber and Cost Effectiveness for Terminal Blends

I. INTRODUCTION/OBJECTIVES

Recycled tire rubber, referred to as crumb rubber modifier (CRM), is used in various pavement applications. One of these applications is Asphalt-Rubber (AR), which has been studied since the 1950s and has been used in highway applications since the 1960s. Asphalt-Rubber is a field-blended wet process, asphalt binder that is formulated and reacted at elevated temperatures and under high agitation to promote the physical interaction of the asphalt cement and CRM constituents. Extender oil may be added to enhance the asphalt/rubber interaction, reduce viscosity, facilitate spray applications, and promote workability. Terminal blend (TB) is another form of the wet process asphalt binder where CRM is blended with hot liquid asphalt at the refinery or at an asphalt binder storage and distribution terminal and transported to the hot-mix asphalt (HMA) mixing plant or job site for use. The particle size of CRM used in the terminal blends is finer than that of the asphalt-rubber blends. The HMA materials that incorporate these binders are referred to rubberized asphalt concrete (RAC) by the Department of Resources Recycling and Recovery (CalRecycle).

RAC HMA and spray applied binder applications (i.e., chip seals) can be used wherever conventional asphalt concrete (AC) or surface treatments would be used and provide better resistance to reflective and fatigue cracking than conventional materials. RAC is typically most effective in thin overlays over distressed flexible or rigid pavements. The initial cost of the RAC HMA and chip seals may be higher than that of the conventional asphalt mixes, but the better performance and lower maintenance costs can offset the higher initial cost.

Life Cycle Cost Analysis (LCCA) is an effective way to determine whether a RAC project is cost effective. The current LCCA that CalRecycle uses in its RAC outreach effort is over ten years old. Since the original study, there have been significant changes in RAC costs and technology as well as improvements in LCCA programs. Hicks and Epps (1999) developed a comprehensive LCCA report on asphalt-rubber paving materials for the Rubber Pavements Association (RPA). Ten years later, the older projects have experienced more traffic and numerous new projects have been constructed and evaluated. In addition, the Federal Highway Administration (FHWA) and some state DOTs have improved their LCCA programs using both deterministic and statistical models. The RPA LCCA report needs to be update based on the latest information on RAC project lifespan and costs, and utilizing new LCCA software. Also the new LCCA will include RAC chip seals which were not considered in the existing RPA study.

II. WORK TO BE PERFORMED

The objective of this research is to update and expand the LCCA performed for the RPA including both field blend (asphalt-rubber) and terminal blend HMA and chip seals under various roadway, traffic and weather conditions and compare them with similar applications of conventional materials. The results of this study will assist CalRecycle in promoting the use of RAC products (asphalt rubber and TB) by validating their long term economic benefits over using conventional materials. This will ultimately result in more public works agencies using RAC products in their future projects.

III. TASKS IDENTIFIED

Task 1 - Survey Caltrans and 10-20 local agencies in California for updated lifespan data for chip seals and thin HMA overlays for various materials types, including conventional, asphalt rubber, terminal blend, and polymer modified asphalt HMA. This will include a survey of Caltrans and local agencies as well as a review of Heavy Vehicle Simulator (HVS) reports by UC Davis and Accelerated Loading Facility (ALF) reports by FHWA on the relative performance between asphalt rubber and conventional HMA and other modifiers.

Task 2 - Develop new scenarios for comparing alternate pavement treatment strategies using LCCA. Work with agencies and industry to obtain typical alternative strategies for conventional and asphalt rubber pavements.

Task 3 - Update the in-place costs for AR, conventional, and polymer modified asphalt. Work with agencies and industry to obtain updated cost data for thin HMA overlays and chip seals.

Task 4 - Collect cost and performance information for terminal blend HMA overlays and terminal blend chip seals. Investigate their cost effectiveness and conduct life cycle cost analysis on terminal blend overlays and chip seals.

Task 5 - Determine user costs for LCCA. Determine the agency costs for delaying repair of roadways. This could be agency and location dependent. Check with the various agencies to verify how to (or how they) include these costs in the LCCA.

Task 6 - Run FHWA's Realcost software at various discount rates using both deterministic and probabilistic models. Confirm with Caltrans and the agencies what they would like to see in this effort.

Task 7 - Prepare a final report in Transportation Research Board (TRB) format for a possible paper.

IV. CONTRACT/TASK TIME FRAME

The proposed project period will be from May 2010 to May 2012.

(Some tasks will overlap in time)

Task #	Time requirements
1. Survey Caltrans and local agencies for updated lifespan data for chip seals and thin HMA overlays	3 months
2. Develop new scenarios for comparing alternate pavement treatment strategies using LCCA	3 month
3. Update the in-place costs for AR, conventional, and polymer modified asphalt	12 months
4. Collect cost and performance information for terminal blend HMA overlays and terminal blend chip seals	12 months
5. Determine user costs for LCCA	3 months
6. Final report	3 months
TOTAL	24 months

The following provisions will be included in the Terms and Conditions or Special Terms and Conditions of the Contract:

V. COPYRIGHT PROVISION

The Contractor shall assign to the Department of Resources Recycling and Recovery (CalRecycle) any and all rights, title and interests to any copyrightable material or trademarkable material created or developed in whole or in any part as a result of this Agreement, including the right to register for copyright or trademark of such materials. The Contractor shall require that its subcontractors agree that all such materials shall be the property of the CalRecycle. Such title will include exclusive copyrights and trademarks in the name of the CalRecycle.

VI. WASTE REDUCTION AND RECYCLED-CONTENT PRODUCT PROCUREMENT

In the performance of this Agreement, Contractor shall use recycled content, used or reusable products, and practice other waste reduction measures where feasible and appropriate.

Recycled Content Products: All products purchased and charged/billed to CalRecycle to fulfill the requirements of this contract shall be Recycled Content Products (RCPs), or

used (reused, remanufactured, refurbished) products. All RCPs purchased or charged/billed to CalRecycle to fulfill the requirements of the contract shall have both the total recycled-content (TRC) and the postconsumer content (PC) clearly identified on the products. Specific requirements for the aforementioned purchases and identification are discussed in the Terms and Conditions of the Contractual Agreement under Recycled-Content Product Purchasing and Certification.

The Contractor should, at a minimum, ensure that the following issues are addressed, as applicable to the services provided:

A. WRITTEN DOCUMENT PROVISION

All documents and/or reports drafted for publication by or for CalRecycle in accordance with this contract shall adhere to CalRecycle's *Guidelines For Preparing CalRecycle Reports (available upon request)* and shall be reviewed by CalRecycle's Contract Manager in consultation with one of the CalRecycle's editors.

In addition, these documents and/or reports shall be printed double-sided on one hundred percent (100%) recycled-content paper. Specific pages containing full-color photographs or other ink-intensive graphics may be printed on photographic paper. The paper should identify the postconsumer recycled content of the paper (i.e., "printed on 100% postconsumer paper"). When applicable, the contractor shall provide the contract manager with an electronic copy of the document and/or report for the CalRecycle's uses.

To the greatest extent possible, soy ink instead of petroleum-based inks should be used to print all documents.