100% RAP for Repair Purposes

RowanUniversity
CENTER FOR RESEARCH & EDUCATION IN ADVANCED TRANSPORTATION ENGINEERING SYSTEMS

Mahmoud Samara, Kayleigh McDevitt, Sk Faisal Kabir Ph.D., Ayman Ali Ph.D., Mohamed Elshaer Ph.D., Yusuf Mehta Ph.D., P.E.

Center for Research and Education in Advanced Transportation Engineering Systems (CREATES), Rowan University

CRREL ERDC

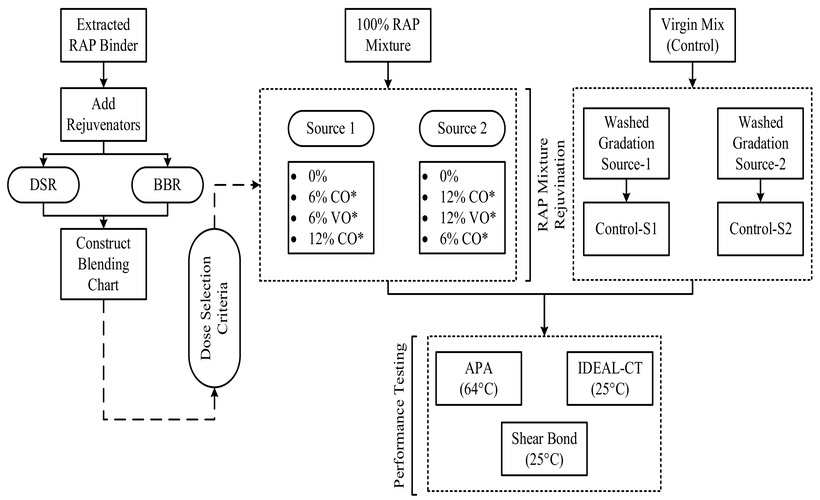
Background

Using high RAP (30% or more) in hot mix asphalt (HMA) has been a challenge due to increased crack potential and workability issues. An alternative use can be the application of RAP for repair purposes. Therefore, the current study was undertaken to evaluate the laboratory performance of 100% RAP with and without rejuvenators for repair purposes.

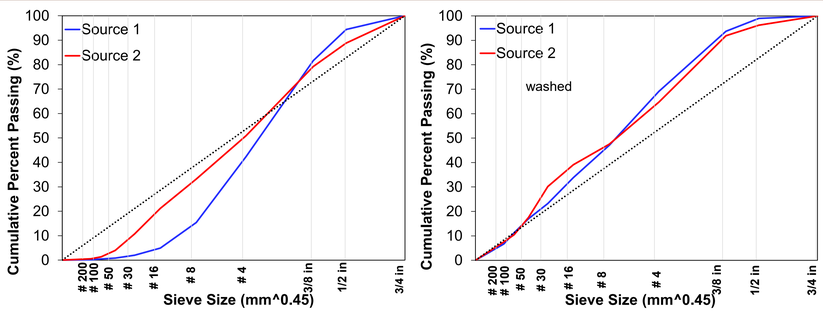
Goal and Objectives

- Evaluate the impact of different rejuvenators (two; Corn Oil (CO) and Vegetable Oil (VO)) and RAP sources (two; S1 and S2) on the performance of 100% RAP mixtures (or rejuvenated RAP mixtures);
- Assess the performance of rejuvenated RAP mixtures in terms of rutting, cracking, and shear bond strength;
- Recommend the best-performing rejuvenator and doses for producing rejuvenated RAP mixtures for short-term and medium-term patching.

Materials and Methodology

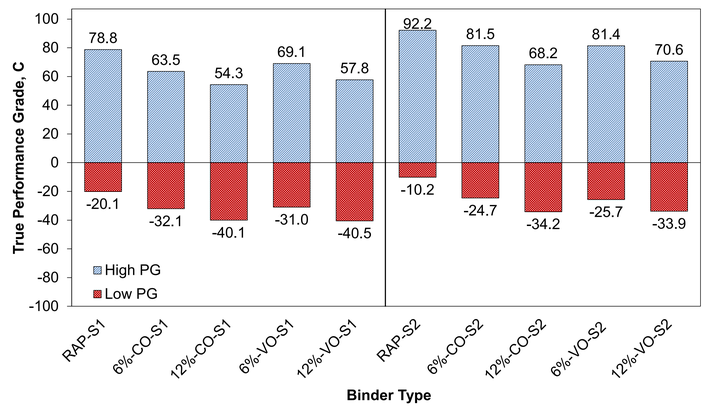


Material Gradation



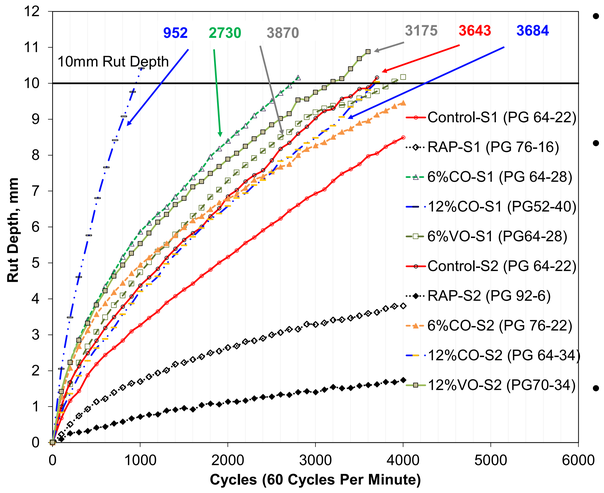
RAP binder content source 1: 5.3%, source 2: 5.4%

PG Grading



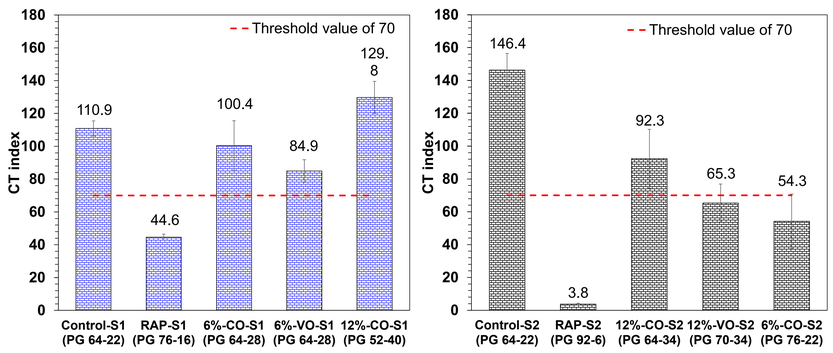
- Addition of rejuvenators decreased the values of LPG for the rejuvenated binders.
- 6% dose rate for source-1 showed reduction in the LPG by two grades for both rejuvenators (i.e., CO and VO).
- 12% dose rate reduced the LPG of the extracted RAP binder (source 1) by four grades for both CO and VO rejuvenators.

Rutting Performance

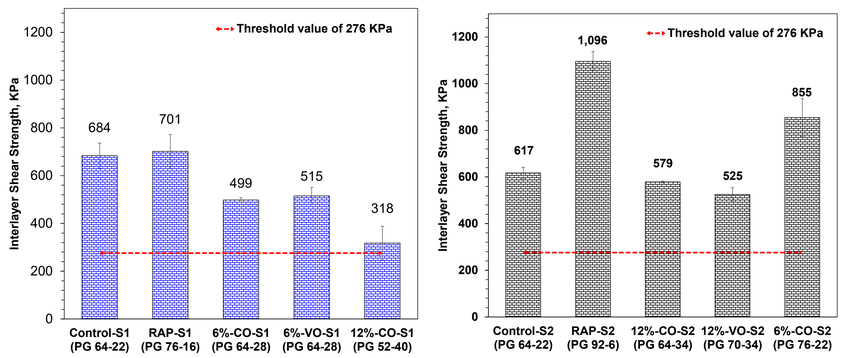


- Rut depth criteria: Max. 10 mm rut depth after 4000 cycles
- The RAP mixtures w/o rejuvenators showed the highest rutting resistance with rut depth values of 3.8 mm and 1.7 mm.
- 6%CO-S2 had 9 mm rut after 4000 cycles.

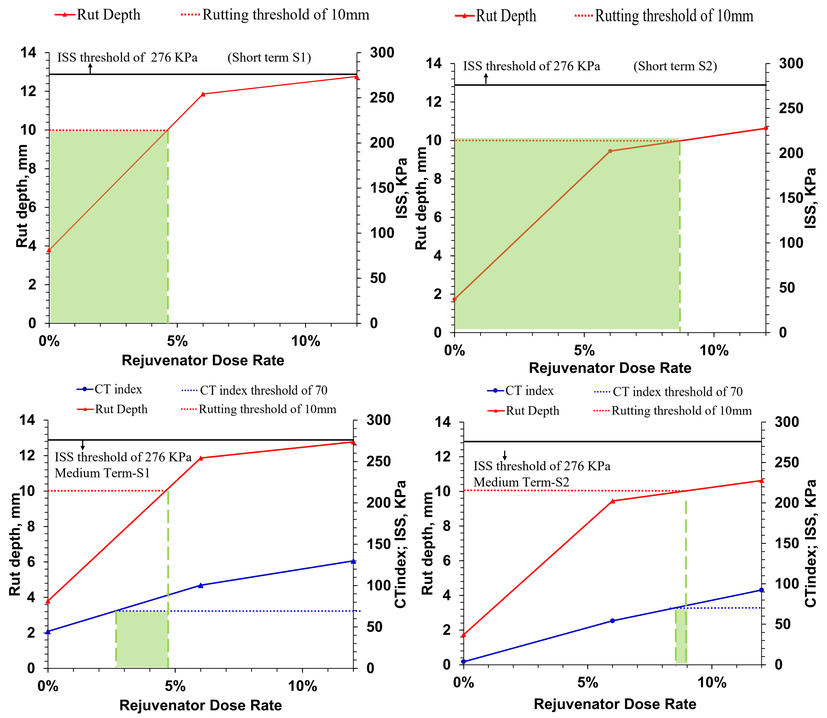
Cracking Performance (CT_{index})



Interlayer Shear Strength (ISS) Test



Performance Based Chart



Conclusion & Recommendation

- If extracted RAP PG grading is between PG76-16 to PG92-6 then RAP can be used directly as patching materials without any rutting issues for short-term contingency applications.
- Additional cracking performance testing is highly recommended for a medium-term repair of 6 to 12 months. As none of the RAP sources without rejuvenators pass the CT_{index} threshold set by some state DOTs, adding 6% CO and 12% CO help to pass the criteria for source 1 and source 2 respectively.
- For overall patching repair purposes 2.5%-4.5% and 8.5%-9% corn oil for sources 1 and 2 are recommended, respectively.

Acknowledgment

The tests described and the resulting data presented herein, unless otherwise noted, are based upon work supported by the US Army ERDC under PE 62784, Project T12 "Innovative Technologies and Materials to Protect National Security Interests in the Arctic Region.", Task 08 under Contract W81EWF01291720