

Caltrans HyRAP® Hot Mix Asphalt Pilot Project Demonstrates Superior Performance



July 2022 – HyRAP® after initial placement

Caltrans' mission goal is best summarized by Caltrans District 11 Deputy of Maintenance, Shawn Rizzutto,

“Caltrans continues to look for innovative ways to implement sustainable pavements and to be a steward for the taxpayer and environment.”

Caltrans District 11 Deputy Director of Maintenance, Shawn Rizzutto, stated at the two-year review of the project in June 2024,

“The HyRAP® hot mix asphalt has performed equal to or better than the conventional hot mix asphalt control section, taking into consideration the distress exhibited in the areas it was placed.”



June 2024 – HyRAP® after 2 Years, approximately 24 million vehicle loadings

PROJECT OVERVIEW

Caltrans District 11 placed its first section of HyRAP® hot mix asphalt (HyRAP®) in June of 2022 under an emergency contract for a water main rupture which caused pavement damage to the S/B 163 to the N/B I-5 connector in downtown San Diego. A portion of the Hawthorn St. offramp was also paved, which is the primary exit for San Diego International Airport.

The HyRAP® project consisted of a **0.15 ft. (1.8 in.) cold plane section** with replacement of a **0.15 ft. (1.8 in.) HyRAP® overlay**. The specification for the HyRAP® on this project was specifically designed to reflect the uniqueness of a hot mix asphalt comprised of 100 percent fractionated (crushed) reclaimed asphalt pavement (RAP) grindings with no virgin paving grade asphalt added in the mix. Modifications to the HyRAP® were accomplished solely by the use of a high-end rejuvenating oil (recycling agent).

After two years of heavy traffic use (approximately 12 million vehicles annually, totaling 24 million vehicle loads over this 2- year period) the results are in. Caltrans District 11 Deputy Director of Maintenance, Shawn Rizzutto, stated at the two-year review of the project in June 2024, *“The HyRAP® hot mix asphalt has performed equal to or better than the conventional hot mix asphalt control section, taking into consideration the distress exhibited in the areas it was placed.”*

In addition to the field placement of the HyRAP®, a comprehensive testing evaluation was commissioned by Caltrans to the University of California Pavement Research Center (UCPRC), worldwide renowned for its expertise in pavements, materials, testing, and investigative capabilities. UCPRC results are summarized as follows, comparing HyRAP® to Caltrans’ Statewide Median (HMA test results medium number from all Caltrans conventional hot mix asphalt materials which were tested by Caltrans):

- **Fatigue Performance**
HyRAP® has 6.7 times better fatigue performance as compared to the Caltrans Statewide Median for conventional hot mix asphalt.
- **Repeated Load Test**
HyRAP® performed substantially better than the Caltrans Statewide Median for conventional hot mix asphalt. HyRAP® is less susceptible to deformation as compared to the Statewide Median.
- **Hamburg Wheel Track Test Comparisons**
When HyRAP® was tested with uniform test metrics to other conventional hot mix asphalts including polymer-modified (PM) mixes, HyRAP® demonstrated the highest resistance to rutting, and had the best test results.

A more detailed explanation of the 3 above-referenced tests and results is as follows:

Fatigue Performance

What is this test?

The bending beam fatigue test, as developed during the Strategic Highway Research Program by Professor Carl Monismith (University of California – Berkeley) was used to assess the performance of the material under repeated loading. This test simulates the bending that a pavement experiences when loaded by heavy truck traffic. This test forms the basis for many pavement design systems in use around the world.

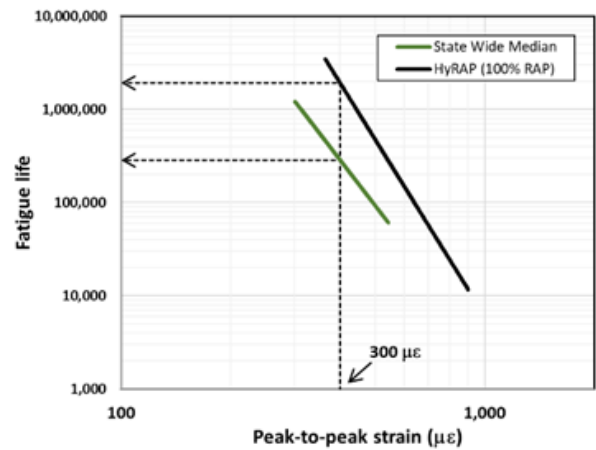
What do the results mean?

If we consider that a truck might cause flexure of the pavement system of say 300 $\mu\epsilon$ (three hundred micro-strain), then the laboratory fatigue life can be estimated from the relationships shown. Typically, a pavement fatigue life will be an order of magnitude different from that obtained in the laboratory with calibration factors observed from field performance.

How do the results for HyRAP® (100% RAP) compare to other materials?

The results obtained for the HyRAP® mix are compared to Caltrans' Statewide Median result in the figure below. This figure shows the fatigue life for a flexure expressed in peak-to-peak strain. In this case, the data shows estimate lives of 290,100 and 1,986,900 for Caltrans' Statewide Median and HyRAP® materials respectively. This is an increase of approximately 6.7 times compared to Caltrans' Statewide Median, demonstrating that HyRAP® performs superior to other conventional hot mix asphalts used on a statewide basis

Bending Beam Fatigue Test – HyRAP® versus Statewide Median



Repeated Load Test

What is this test?

In the repeated load test, a cylindrical specimen is loaded either with or without confinement at two temperatures (45°C and 55°C). The unconfined test is the most severe version of this test and of all the materials evaluated, HyRAP® reached a terminal condition in the test, defined at 5% strain, at the highest temperature—outperforming the other materials.

What do the results mean?

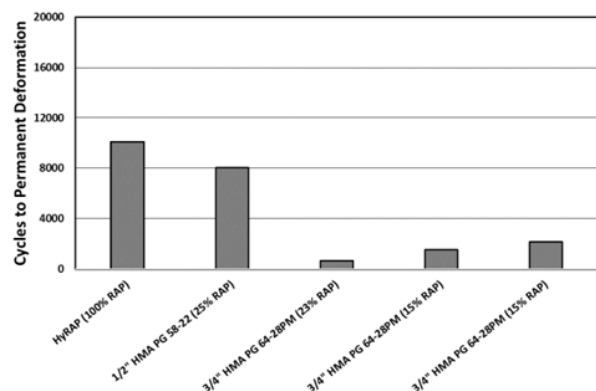
In a high-temperature climate such as that found in Southern California, it is vital for paving materials to have excellent properties with respect to permanent deformation. The test provides a means to test materials, typically in the design phase, to determine suitability for a project in a particular climate and traffic-loading environment.

How do the results for HyRAP® (100% RAP) compare to other materials?

Out of the five mixes evaluated at 55°C with no confinement, the HyRAP® material performed best reaching 10,000 cycles before the limiting strain of 5% was attained.

This indicates HyRAP® materials will have excellent performance with respect to permanent deformation propensity and should not deform excessively under traffic loading.

AMPT Repeated Load Test (Unconfined) at 55°C for Several Mixes and HyRAP®



Hamburg Wheel Tracking

What is this test?

The Hamburg wheel tracking test evaluates an asphalt mixture for both rutting (permanent deformation) sensitivity as well as the ability of the mixture to resist water damage.

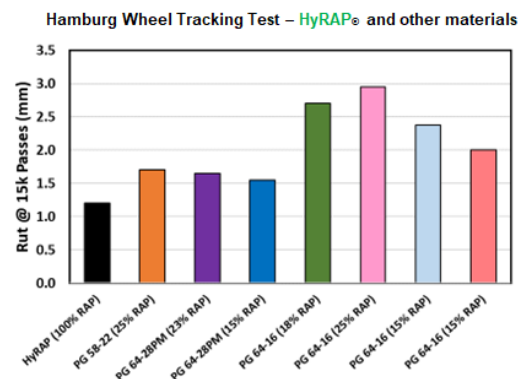
What do the results mean?

In the study, two samples were tested for the HyRAP® mix and a series of other materials that included both conventional and polymer-modified binders. The average result for each of the mixes is presented in the figure below. The HyRAP® material was the best performer at the conditions tested, with no sensitivity to water damage and a very low rut at 15,000-wheel passes.

How do the results for HyRAP® (100% RAP) compare to other materials?

In the case of these test results, the amount of deformation experienced by the HyRAP® mix was the lowest, indicating that this mix was the best performer, even compared to the polymer-modified binders included in the study.

The amount of rut developed is about two-thirds of that obtained with the average of the polymer-modified binders and less than half that obtained with the average of the conventional mixes.



SUMMARY

HyRAP® outperformed conventional hot mix asphalt in Caltrans' Statewide Median that it was compared to, including polymer-modified hot mix asphalts. Not only is the performance of HyRAP® demonstrated in this study, but additionally, HyRAP® serves to significantly reduce Greenhouse Gas Emissions (GHG) and lower Caltrans' Carbon Footprint (results will be reported in a future newsletter).

Caltrans' mission goal is best summarized by Caltrans District 11 Deputy of Maintenance, Shawn Rizzutto, "Caltrans continues to look for innovative ways to implement sustainable pavements and to be a steward for the taxpayer and environment."

Government policymakers should be asking their staff to implement HyRAP® into their pavement strategies and designs, to not only provide benefits to the taxpayer, but to do their part in GHG and carbon footprint reductions.