

Case Study: Caltrans Innovates a Sustainable, Low-cost Wearing Course Using RAP & PASS[®] Emulsion

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Stretched between Los Angeles and Jacksonville FL, Interstate 10 is one of the most heavily used routes (known as the Sunset Route) facilitating the movement of goods from the ports of Long Beach and Los Angeles by truck to the rest of the southern United States. In California, I-10 has seen dramatic increases in vehicle traffic during the past three decades, yet the state for the last several years has experienced funding shortfalls that have created major challenges for the professionals at Caltrans.



Worsening road conditions also result in mounting costs to drivers using the roads from vehicle damage. A 2010 report on urban highway and road conditions by TRIP, a national transportation research group, listed the Indio-Palm Springs area of Riverside County ninth in a survey of the worst quality roadways in the US, with these conditions contributing to increased vehicle costs of \$609 annually per driver.

Poor road conditions aren't just bad for your car, they can be bad for your health. A May 2009 study by the Pacific Institute for Research and Evaluation (PIRE) examined the role and consequences of the physical condition of our roadways in the number, severity and economic costs of motor vehicle crashes. The study found that roadway condition was a contributing factor in more than half (52.7%) of the nearly 42,000 American deaths resulting from motor vehicle crashes each year and



Caltrans Innovates Using RAP & PASS® Emulsion (cont.)

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38 percent of the non-fatal injuries. In terms of crash outcome severity, it is the single most lethal contributing factor—greater than speeding, alcohol or non-use of seat belts. That same study also estimated the cost of bad roads to the US economy at approximately \$217 billion annually.

Worsening road conditions and dramatic increases in vehicle miles traveled set the stage for a significant professional challenge for the staff at Caltrans. District 8, where John Hubbs is the Area Maintenance Superintendent. The District is the largest geographically of the 12 statewide Caltrans districts, with four interstates and 32 state routes totaling over 7,000 lane miles within its boundaries.

Maintenance History

Historically, the approach to treating the deteriorating pavement is to crackseal, and fill potholes using cold-mix asphalt. However, the treatments are labor intensive and the sections of road requiring attention have increased exponentially at the same time the agency's budget for staff has decreased. This combination of factors has made it nearly impossible to catch up with the backlog of maintenance needs using traditional methods.

Material costs also factor heavily in roadway maintenance. Costs of new hot-mix and cold-mix asphalt, while still far more economical and practical

than concrete, have risen dramatically in the past five years and challenged the traditional approach even further. Asphalt prices have climbed to over \$100 per ton, twice what they were just five years ago. Most often pothole repairs last for less than a year, and require ongoing maintenance or replacement because of moisture and expansion/contraction.

Over the past several years, Mr. Hubbs chose to address these challenges by developing a rapid crack-fill solution that would seal not only the severe and most visible pavement cracks, but the entire roadway surface to prevent moisture from compromising the road base. In the interest of preserving the value of the network, he began employing newer innovative products such as PASS® engineered emulsions that possess rejuvenating qualities to restore as well as seal the pavement.

PASS® emulsion was developed in the 1980's and first patented in 1992. It was the first engineered emulsion to successfully combine a liquid polymer-modified asphalt with a rejuvenating agent. The combination of the high-performance polymer and rejuvenator yields a material that is tough yet highly ductile, forgiving when used with a variety of aggregates and effective at penetrating and restoring the existing asphalt. Given its properties, the PASS® emulsion has been used in maintenance



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John Hubbs
Area Maintenance
Superintendent

applications for crack sealing, tack coating, and in a diluted formulation as a rejuvenating fog seal.

For several years, Mr. Hubbs' rapid crack-fill solution involved employing a PASS® "scrub seal" treatment on pavements exhibiting moderate distress and cracking. PASS® emulsion was used as the binder material for an application of 3/8" black volcanic cinders, a popular treatment since volcanic cinders are black and remain black for their lifetime providing excellent delineation, plus they are lightweight, absorbent, and provided an effective and safe wearing course for the highway. The PASS® binder is also highly resistant to reflective cracking, which made for a successful long-lasting application.

While this represented a highly cost-effective alternative to new hot-mix asphalt, budget constraints and the rising cost of the volcanic cinders (reaching \$54/ton this year) required Mr. Hubbs to seek out a more affordable aggregate product. Through this process, he validated the idea of using Recycled Asphalt Pavement (RAP) millings that were generated by pavement rehabilitation work nearby. Mr. Hubbs estimates that this process will save Caltrans enough money to do 10 times the number of lane miles that could be afforded previously with the district's materials budget.

Exploring the use of PASS with RAP

A recently mill and A/C overlay project in the Riverside/Indo area of the highway had produced a stockpile of approximately 300,000 tons of RAP millings. Rather than pay for this material to be hauled off and recycled as a low-cost base material, Caltrans' Hubbs discovered that the RAP could be converted on-site to a high-value product that met the State's chip specification. Hubbs' innovation resulted in the agency saving the cost of purchasing new aggregate as part of the process, but also allowed Caltrans to realize a significant hidden value of the stockpiled material.



Caltrans Innovates Using RAP & PASS® Emulsion (cont.)

The scrub seal worked as single-pass application followed by sweeping, and the RAP proved to be very compatible with PASS; it adhered and set up quickly allowing traffic to return to the highway within four hours.

The project produced a stockpile of RAP stones and fines that are ready to use for future projects.

"The RAP stockpile, which some would classify as waste, actually contained about 5% residual asphalt content, which means that we were sitting on approximately \$7,500,000 worth of asphalt liquid at today's rack prices," said Hubbs. "The relatively high residual asphalt content in turn allowed us to reduce the amount of emulsion needed in our mix design - another savings that made our dollars go farther." By partnering on these solutions with industry, Caltrans is using newer technology such as PASS® to maximize the value of its materials and keep the valuable asphalt liquid (as high as \$500/ton in 2010) on the road where it belongs.

The PASS® Scrub Seal process was a proven success for the agency, so the team developed an appropriate gameplan to utilize the RAP chips generated from the existing stockpile. Working with Main Street Materials, Pavement Recycling Systems, and Western Emulsions, Caltrans utilized the stockpile to develop two products a 5/16 - 3/8" RAP aggregate chip that met state specifications, and a RAP slurry product utilizing the smaller fine material generated through the crushing and screening operation.

Caltrans retained several thousand tons of RAP chips for use on future projects, in addition to a large quantity of leftover fine material planned for use in a RAP slurry

system. By recycling the fines, Caltrans will not need to purchase new sand at \$17/ton for its slurry system, and the residual asphalt content of the RAP fines enable them to reduce the slurry emulsion in the mix by 20% for even further cost savings.

Pavement Recycling Systems brought a portable crushing and screening unit to the project site, engineered the project design, and conducted materials processing and testing. Caltrans operations crews, run by Supervisor Cliff Eastin, applied the aggregate to the highway following Main Street Materials' application of the PASS® CR emulsion product. The team's first trial used a 3/8" aggregate, but had the best performance and success with a 5/16" stone. The keys to maintaining production workability of the RAP chip were keeping the stockpiled material moist and cool using water.



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Postive Project Results

The team was pleasantly surprised by the success of the project. The project covered 35 miles along I-10, one of the most heavily traveled roadways in the nation. The scrub seal worked as single pass application followed by sweeping, and the RAP proved to be very compatible with PASS®; it adhered and set up quickly allowing traffic to return to the highway within four hours. No sanding or blotter material was needed.

The economics of the project were favorable the aggregate material was processed and applied at total cost of \$500,000 over the 35 miles of application. This cost included processing of a significant portion of the RAP stockpile, of which some is now ready for use on future scrub seal (using the 3/8" material) and slurry seal (using the fines) projects. Hotmix asphalt alone for a 35 mile project would have cost over \$1.3 million, well beyond the district's available materials budget. In fact, Hubbs reported that the agency budget for pothole patching on the I-10 exceeded the per-lane mile costs of using the scrub seal treatment.

Recycling the RAP aggregate offered Caltrans a variety of benefits:

- Aggregate was pre-coated with quality asphalt binder, lowering the amount of emulsion required
- The stones worked well with a cool emulsion system containing an asphalt Rejuvenator
- The RAP was highly workable and remained so several weeks during the production phase
- The existing asphalt covering the rock resulted in exceptional delineation, much preferred by agencies.
- The project team observed remarkable adhesion of the stone to the PASS® CR emulsion following the roadway sweeping.
- The project produced a stockpile of RAP stones and fines that are ready to use for future projects.