The State of California has been using asphalt-rubber on State highways on and off since the early '70s. It was felt that the asphalt-rubber would be better than other cheaper maintenance treatments on highways that were in the last stages of failure and really needed reconstruction.

In these older projects there were some problems. These included chip loss, excessive flushing or bleeding, and resulting pickup by vehicle tires on hot days. But it was found that maintenance costs were reduced, cracks were not reflected through, and further pavement deterioration was arrested.

Recently California obtained legislative approval to initiate a pavement preventive maintenance program. Maintenance funding amounting to 20 million dollars per year was provided in addition to other regular maintenance funds. The idea was that pavements that were still in relatively good shape would be sealed to further the life. Primary treatment consisted of chip seals and slurries. However, there were problems. In urban areas, work had to be done at night; in cold areas, neither chip seals or slurries lasted very long; and in areas where there was excessive snow plowing and pack blading, both the slurries and chip seals were bladed off or worn away by tire chain wear.

Chip seals and slurries have been used also on roads that had too many cracks to qualify for preventive maintenance funds but, here, often cracks came through in two or three years.

In efforts to solve the above problems California has started again to use more asphalt-rubber chip seals. Even though costs were higher (two to three times what a standard chip seal would cost), cracks did not come through and seal coat life was above ten years.
There have been some problems with asphalt-rubber chip seals though. Our standard 3/8" x #6 chip specification allowed too many fines which prevented proper seating and adherence of the chips in the asphalt-rubber binder, with resultant loss of chips and flushing or bleeding. The early solution to this problem was to cut back asphalt-rubber spread rates, which just made the problem worse.

Another problem that has not been totally eliminated has been the blackening, slickening up and bleeding of newly laid asphalt-rubber seal coats. This sometimes occurs in early hot weather (above 100° ), heavy truck traffic, and lots of stopping, starting and turning movements. Some projects have had to be sanded or overlaid to stop this. The answer appears to be to go to a coarser aggregate gradation and just assume that in the first year some sanding may be required until the seal coat cures out. Coarser mixes also cause problems too, in that if traffic speeds are not controlled initially, broken windshields can result.

Precoating of chips with paving asphalt at a rate of 0.5 -1% seems to help the retention problem and appears to be cost-effective. California is using this technique often lately.

California is now using asphalt-rubber seal coats where cheaper chip seals and slurries can't be used because of temperature and traffic problems; also, where the amount of cracking is excessive and yet rehabilitation is not warranted or fundable. We have seen evidence that double layers of asphalt-rubber chips can cover excessive alligator cracking and provide long life with no evidence of cracks coming through. In the past, thin asphalt concrete blankets were used in these situations but cracks quickly come back and costs are high.

It is noticed that when cracks or pickup "divots" occur, with time, traffic and hot weather, the asphalt-rubber seal tends to flow and heal up the flaws. Thus, it has self-healing qualities.
The following is a summary of actual or authorized Contract Major Maintenance expenditures on California State Highways.

<table>
<thead>
<tr>
<th>Year</th>
<th>Lane mile</th>
<th>Chip Seal</th>
<th>Cost</th>
<th>Lane Mile</th>
<th>Slurry Seal</th>
<th>Cost/Lane mile</th>
<th>Cost</th>
<th>Lane Mile</th>
<th>Asph-Rub Chip Seal</th>
<th>Cost/Lane Mile</th>
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<td>0</td>
<td>45000</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>1983/84</td>
<td>1922</td>
<td>9398764</td>
<td>4890</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>1984/85</td>
<td>2175</td>
<td>1292764</td>
<td>5944</td>
<td>3.8</td>
<td>28000</td>
<td>7368</td>
<td>0</td>
<td>0</td>
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<tr>
<td>1985/86</td>
<td>1934</td>
<td>13404923</td>
<td>6931</td>
<td>21.2</td>
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<td>12170</td>
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<td>1986/87</td>
<td>3437</td>
<td>34654845</td>
<td>7899</td>
<td>525.3</td>
<td>6773438</td>
<td>12894</td>
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<td>1987/88</td>
<td>3117</td>
<td>23148377</td>
<td>7426</td>
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<td>1988/89</td>
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<td>8422675</td>
<td>7084</td>
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<td>14171</td>
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<td>1989/90</td>
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</tr>
</tbody>
</table>

The following are highlights of completed Caltrans Asphalt-Rubber Chip Seals: (3) (5)

1. Interstate Route 5 at Stadium Way in Los Angeles, six ramps to be treated with Asphalt-Rubber Chip Seal Coat - 3.06 lane miles. Contract No. 07-108204.

This project was initially intended to be a conventional chip seal project (using asphalt emulsion as binder) but was changed to asphalt-rubber due to traffic and work window restrictions. Significant quantities were:

   a. $49,500.00 per lane mile cost.
   b. Aggregate rate of 38 pounds per sq. yd.
   c. Binder rate of 0.59 gals./sq. yds.
   d. There were NO damage claims.

2. Interstate Route 5 at Alameda/Western in Burbank, 35 Ramps to be treated with conventional Asphaltic Emulsion Chip Seal Coat. Contract No. 07-111374.

The contractor processed a Contract Change Order to do the Western Avenue, U.C. ramps with asphalt-rubber binder since the Interchange was an exact duplicate of the
Alameda Street, U.C. Interchange. This would give a good comparison of the two processes. Significant quantities were:

Alameda Avenue (Conventional Asphalt Emulsion) 1.36 lane miles.

- $25,100.00 per lane mile cost.
- Aggregate rate of 34 pounds per sq. yd.
- Binder rate of 0.32 gals./sq. yd.
- There were NO damage claims.

Western Avenue (Asphalt-Rubber) 2.69 lane miles.

- $24,300.00 per lane mile cost.
- Aggregate rate of 42 pounds per sq. yd.
- Binder rate of 0.62 gals./sq. yd.

In less than one year, aggregate loss at Alameda Street is down to the existing pavement, while Western Avenue shows no appreciable loss.


This contract had severe problems with commuter violations of the contractor's traffic controls. Media preparation was nonexistent and local motorists had just completed two years of inconvenience due to construction on an adjacent unrelated Caltrans project. Media, political, and traveling public resentment ran very high. A good portion of the traffic damage was "self-inflicted" by violations of traffic controls. Significant quantities were:

- $22,900.00 per lane mile cost.
- Aggregate rate of 30 pounds per sq. yd.
- Binder rate of 0.57 gals./sq. yd.
- Damage claims consisted of 714 claims.

4. State Route 89 near Truckee, two-lane highway to be treated with Asphalt-Rubber Seal Coat - 27.6 lane miles. Contract No. 03-338304.
This contractor processed a Contract Change Order to increase the aggregate size and the rate of application of the asphalt-rubber binder.

Working conditions during placement of the seal coat saw morning temperatures of 28° - 32° F and afternoon highs of 90° - 95° F. Temperature, in the winter months, has been known to drop to -40° F. This surfacing is holding up exceptionally well and has been classified by Caltrans District Maintenance forces as, "The only thing that has worked up here". Significant quantities were:

a. $13,500.00 per lane mile cost.
b. Aggregate rate of 32 pounds per sq. yd.
c. Binder rate of 0.62 gals./sq. yd.
d. Damage claims consisted of six claims.

This road is subject to heavy snow-plowing and tire-chain use.

5. State Route 138 at 25th Street East in Palmdale - 0.68 lane miles.

Demonstration project placed at the contractor’s expense to demonstrate product viability. A construction project immediately adjacent to the test site was constructed with an asphalt-rubber binder at a contract cost of approximately $25,000.00/lane mile. The pavement surface showed almost immediate distress. This project was done by an inexperienced asphalt-rubber chip seal contractor. The gradation of the aggregate was too high on the fine side, the chip spreader and roller did not keep up with the asphalt-rubber distributor and the weather was cool. Globs of asphalt-rubber appeared on the surface and was picked up by traffic leaving "divots" and rough spots. There was also a loss of chips. Caltrans Maintenance was forced to make corrections by milling and overlaying with 2” of hot open-graded asphalt concrete mix. The cost to repair this section with the AC overlay reached nearly $32,000/lane mile. Exclusive of the cost of related work and less than one year later, the overlay shows signs of block-cracking in the finished surface.

The demonstration section, however, has performed well through a complete climate cycle which is known to be extreme in this area. The test element proves that, when properly installed, an asphalt-rubber binder seal coat will give exceptional service life.
This section will continue to be monitored for performance. Significant quantities were:

a. $20,000.00 per lane mile cost (projected).
b. Aggregate rate of 39 pounds/sq. yd.
c. Binder rate of 0.69 gals./sq. yd.
d. To date, there have been NO damage claims within the test section, as opposed to almost continuing claims associated with the original contract construction.


Because of high ADT, this project required nighttime construction. It would have been impossible to complete this work during daytime or at night with conventional asphaltic emulsion seal coat. Shortly after completion, the Los Angeles area experienced an unusual hot spell. Daytime temperatures exceeded all records and nighttime lows set new highs. Pavement temperatures exceeded 165° F and vehicle-tire temperatures would not permit touching. Major intersections are signalized with three- and four-phase signals. Vehicles stopped at crosswalks and in turn pockets would have tires fused to the asphalt-rubber chip binder. Then, when the vehicle moved, a tire footprint "divot" would be pulled from the surface. A check with the City of Phoenix indicated that they routinely sand at the intersections during periods of high temperatures. This was done by contractor forces even though the project had been given Relief of Maintenance. This is a requirement that should be considered in Caltrans contracts even though a repeat of the same climatic conditions would be remote. Significant quantities were:

a. $20,100.00 per lane mile cost.
b. Aggregate rate of 35 pounds/sq. yd.
c. Binder rate of 0.61 gals./sq. yd.
d. There were three windshield damage claims. With time, the "divots" healed up fairly well and the project now looks good.

This project was completed at about the same time as the above portion and had the same problems, but not nearly as severe. There is still evidence of "divots" at the crosswalks and left-turn pockets but some of the smaller areas are showing signs of healing themselves under continued traffic loads. Sanding during the hot weather could possibly have prevented the small losses.

Significant quantities were:

a. $20,200.00 per lane mile cost.
b. Aggregate rate of 34 pound/sq. yd.
c. Binder rate of 0.62 gals./sq. yd.
d. There were two windshield damage claims.

Summary:

a. Asphalt-rubber chip seal coats can provide a strong, flexible, impermeable, crack-resistant, wearing surface that will give years of excellent service.

b. The process can be employed over a greater span of construction months.

c. Early opening to traffic reduces hazards and construction time.

d. Asphalt-rubber can be placed in narrow working windows almost independently of weather conditions.

e. A service-record history is now showing good life cycle costs and maintenance-free performance.

f. Public and private decision makers now have another viable alternative to pavement rehabilitation.

g. As an added benefit, separate from the engineering merits of asphalt rubber, the system utilizes discarded tires as a raw material, answering a major environmental concern.
8. State Route 1 in San Mateo and Santa Cruz County.

A. Job Description

1. 04-SCR, SM-1, 129-27.7/37.5, 0.0/2.0, 3.5/5.2
   Contract #04-120464
   Apply Asphalt Rubber Chip Seal 13' Wide on both lanes of:

   **Location 1:** Highway 1 PM 27.7, SCR to PM 2.0 SM.

   **Location 2:** Route 129, PM 3.5 to PM 5.2

2. Date of Completion: 9/15/87

3. Contractor: Granite Construction Co.

4. Bid Units

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Units</th>
<th>Price</th>
<th>Quantity</th>
<th>Amount</th>
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<tbody>
<tr>
<td>1.</td>
<td>Signs</td>
<td>LS</td>
<td>23,000</td>
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<td>$23,000.00</td>
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<td>2.</td>
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<td>3.</td>
<td>Shld Backing</td>
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<td>5.</td>
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<td>3,694.55</td>
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<td>6.</td>
<td>Screening</td>
<td>TON</td>
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<td>100,637.44</td>
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<td>7.</td>
<td>Thermo Stripe</td>
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<td>8.</td>
<td>8&quot;Thermo Stripe</td>
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<td>9.</td>
<td>12&quot;Thermo Stripe</td>
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<td>437.45</td>
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<td>10.</td>
<td>Thermo Pavement Marking</td>
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<td>3,588.00</td>
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<td>11.</td>
<td>Paint Traffic Stripe</td>
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<td>12.</td>
<td>Paint Pavement Marking</td>
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<td>13.</td>
<td>Pavement Marker</td>
<td></td>
<td></td>
<td></td>
<td>17,760.60</td>
</tr>
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</table>

**TOTAL CONTRACT ITEMS** $462,304.92

**EXTRA WORK** $4,030.67

**TOTAL PROJECT COST** $466,335.59
4. **Lane Mile Costs [12']**

Based on asphalt rubber finally pay quantity and an estimated average spray rate of 0.57 G/SY. The project consisted of 29.04 lane miles to be seal-coated.

Based on miles indicated on the plans (each lane 13' wide), the project consisted of 28.97 lane miles.

Cost per Lane Mile: \( $466,335.59 = $16,081 \) (in 1987 dollars)

B. **Job Specifications**

1. Spray Rate 0.54 ± 0.03 Gal/SY.
2. Screenings Spread Rate - 30 to 35 Lbs./SY
3. Screening Gradation Medium 3/8" x #6
4. Asphalt Rubber Type 1 - AR 1000 or 2000 Type 2 - AR 4000
5. Equipment
   - Self-Propelled Distributor Truck
   - Self-Propelled Chip Spreader
   - Three Pneumatic Rollers

C. **Climatic Conditions**

Cool

D. **Current Conditions**

A recent inspection of this project disclosed a significant loss of chips in the Northbound lane and centerline of the work done in Location 1 on Highway 1.

The work done on the southbound lane in Location 1 and that done in Location 2 is in good to excellent condition.
E. Comments

ISI subcontracted the placing of the asphalt-rubber membrane. In a conversation with Jeff Smith of ISI, he stated they started out on the Northbound lane using 0.3% precoated chips. He indicated they had a continuous problem of "dirty" screenings with gradations of plus 35% passing the #4 mesh and 2% passing the #200 mesh.

ISI stopped the job when they had finished the Northbound lane and negotiated with Granite to obtain the following:

1. Increase the pre-coating to 0.75%.
2. "Clean" up the screenings.
3. Increase spray rate.

Comments in the resident engineer's diary indicated they had a problem with excess fine material in the screenings.

The project specs provided for a spray rate of $0.54 \pm 0.03$ Gal/SY. As indicated above, because of the problems encountered in placing the Northbound lane, ISI negotiated some changes with Granite, including an increase in the spray rate. Jeff Smith of ISI said this rate was increased to approximately 0.60 Gal/SY, which was above spec limits.

I could not confirm this change in the resident engineer's diary comments.

F. Comments

The only questionable portion of this project, consisting of two locations, was the loss of chips on the Northbound lane. After the completion of this lane changes were made.

After the changes were made, the remainder of the project is currently in good
to excellent condition. It is only logical to assume this is the case because of either one or a combination of the changes which were:

1. Increase in precoating percentage.
2. Reduction of the % passing #4 mesh in the screenings.
3. Increase in spray rate.

9. State Route 99 near Bakersfield

A. Job Description

1. 06-KER-99-2.7/R29.9
   Contract #06-180704
   Apply asphalt rubber chip seal to off- and on-ramps to Highway 99 at the following locations:

   **Location 1.** Mettler and Route 166
   One on-ramp - One off-ramp

   **Location 2.** McKittrick Road and Route 223
   All four on- and off-ramps

   **Location 3.** 99 and Houghton Road
   All four on- and off-ramps

   **Location 4.** Taft Road - Route 119
   All five on- and off-ramps
   Frontage Road, S.E. Quadrant

   **Location 5.** Panama Lane
   All four on- and off-ramps

   **Location 6.** White Lane
   All four on- and off-ramps

   **Location 7.** Highway 65
   Southbound on ramp to 99
2. **Date of Completion** -- September 24, 1979

3. **Contractor** - Unknown

4. **Bid Units**

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Price</th>
<th>Final Pay Quant.</th>
<th>Final Cost</th>
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<td>97.465 T</td>
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<td>002</td>
<td>Type III Barricade Idea</td>
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<td>003</td>
<td>Asphalt Rubber 315T</td>
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<td>004</td>
<td>Screenings 2300 T</td>
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<td>2,265.880 T</td>
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<td>005</td>
<td>Paint Binder 26 T</td>
<td>200.00</td>
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<td>Paint Marker 175 ea.</td>
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<td>007</td>
<td>Paint Marker 140 ea.</td>
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<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>$193,224.40</strong></td>
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</table>

After Deductions **$189,336.96**

4. **Lane Mile Costs (12')**

Based on asphalt-rubber final pay units, and an estimated spray rate of 0.55 G/SY, project consisted of 18.24 lane miles to be seal coated.

Cost per lane mile: \[
\frac{193,224.40}{18.24} = 10,594 \text{ (in 1979 dollars)}
\]

B. **Job Specifications**

1. Spray Rate 0.55 ± 0.03 G/SY.
2. Screenings Spread Rate 35 to 39 LBS/SY.
5. Equipment.
   - 3-axle Semi Spray Truck (difficult to operate on short radius ramp curves).
   - Chip Spreader.
   - Pneumatic Rollers
5. Equipment.
   3-axle Semi Spray Truck (difficult to operate on short radius ramp curves).
   Chip Spreader.
   Pneumatic Rollers
6. Sand Cover - 5 to 10 lbs./SY

C. Climatic Conditions
   Assumed hot and dry.

D. Current Conditions
   Note!

Acceptable means that after ten years' service, surface is visually intact (minor chip loss if any) and cracks in adjacent unsealed areas have not shown up in sealed areas to any great extent.

Generally -- no immediate maintenance required.

1. Location 1  Acceptable
2. Location 2  All ramps overlaid
3. Location 3  All ramps overlaid
4. Location 4  All ramps overlaid except Southbound on-ramp (NW Quad)
5. Location 5  Northbound on ramp overlaid - all other ramps acceptable
6. Location 6  All ramps acceptable except Northbound off-ramps, which has lost chips in outer wheel path on approach to boulevard stop at White Lane
7. Location 7  Numerous cracks in outer truck lane - inside lane acceptable. Last section after overpass has been overlaid.

Summary

Original Project: 23 off- and on-ramps
12 1/2 have been overlaid
Overlays were necessary primarily due to surface distortion and wheel rutting.

E. Comments

1. According to Jerry Fay, District 6 South Region Maintenance Manager, the areas I had referred to as "overlays" were not overlays. These areas had been ground out to a depth of 7" - 8" and replaced with asphalt concrete. This work was done in 1988.

2. A sample of AR binder and chips was removed from the Panama Lane Northbound off-ramp in the area just before the boulevard stop sign at Panama Lane.

After ten years, this sample is still very flexible and resilient.

10. State Route I-10 east of Indio.

A. Job Description

1. ± 1-mile test section of a SAM placed approximately 1/2 mile west of Chirioco Summit on #2 lane westbound on I-10 in Riverside County.


3. Contractor: Unknown

4. The following are comments made by Mr. John Wade, Materials Department, District 11, in a telephone conversation:

(a) Reacted Asphalt
    Sahuaro formulation with an estimated spray rate of 0.57 to 0.60 GAL/SY.

(b) The test section was divided into two approximately equal sections. The easterly portion received a "flush coat" of a light oil at a rate of ± 0.04 GAL/SY. The purpose of the flush coat was to "liven up the cracks and provide a better bond" for the SAM.
(c) The existing pavement is 6" - 8" thick, with low deflections if water is kept out of the subgrade. He feels the SAM does a good job of sealing.

(d) He believes the section with the "flush coat" did a better job restraining transfer of cracks.

5. Ted Giles, Maintenance Superintendent in this area for the past 11 years, stated that very little maintenance had been done on this test section.

My own comments after inspecting the project are:

1. The SAM is in an acceptable condition after 12 years of service with no need of any immediate maintenance.

2. The SAM is still restraining the cracks in the shoulder areas penetrating the driving lanes. Cracks that do appear in the driving lanes are "ghost" cracks.

3. This is desert "high" country. Pavement temperatures often reach 170°F and surface oxidation is a real problem. After 12 years the asphalt rubber is still flexible and stretches like a rubber band.

11. State Route 1, 129, 152 in Santa Cruz County north and east of Santa Cruz.

A. Job Description

1. 04-SCR-1, 129, 152-VAR.
   
   Location 1
   Route 1 PM 24.6 to PM 27.7

   Location 2
   Route 152 PM T0.3 to T1.0

   Location 3
   Route 129 PM 6.7 to PM 10.0

2. Date of Completion: October 17, 1988

3. Contractor: Bartz Construction Co.
4. **Bid Units**

<table>
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<tr>
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<th>Description</th>
<th>Bid Price</th>
<th>Unit</th>
<th>Quantity</th>
<th>Cost</th>
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<td>Pavement Marker</td>
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**Final Pay**

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<tr>
<th>Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Cost</th>
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<tr>
<td>TOTAL CONTRACT ITEMS</td>
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<td>EXTRA WORK</td>
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<td>TOTAL PROJECT COST</td>
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5. **Lane Mile Cost (12')**

Based on asphalt rubber final pay quantity and an estimated average spray rate of 0.55 GAL/SY, the project consisted of 15.4 lane miles.

Based on centerline miles indicated on the plans, the project consisted of 15.3 lane miles.

Cost per Lane Mile $265,352.10 / 15.4 = $17,231 (in 1988 dollars)

B. **Job Specifications**

1. Spray Rate 0.55 to 0.65 GAL/SY
2. Screenings Spread Rate 30 to 35 LBL/SY
3. Screenings Gradation Med. Fine 5/16" x #8
4. Asphalt Cement Type 1 AR-1000 or AR-2,000, Type 2 AR-4000
5. Precoated % 0.30 to 0.50
6. Equipment
   Self-Propelled Distributor Truck and Bootman
   Self-Propelled Chip Spreader
   Three Pneumatic Rollers

C. Climatic Conditions

Assumed cool and damp

D. Current Conditions

Location 1  Highway 1 south of Davenport
There has been a significant loss of chips on the northbound lane and on the centerline. The southbound lane has a much better appearance and chip retention.

Location 2  Route 152
Some blackened area at signalized areas and a few divots in this area; however, in general, the job is acceptable.

Location 3  Route 129
Excellent job - insignificant amount of stripping on centerline and under Railroad Bridge.

E. Comments

The following comments are based on my conversation with Jeff Smith of ISI.

Location 1 - The project was started on Highway 1 on the northbound lane and continued to completion on the southbound lane. The specs called for a medium fine screening 5/16" x #8, (30% to 60% passing #4). The spray rate used was approximately 0.55 GAL/SY at the low end of the spec.
Upon completing the work at Location 1, ISI convinced the resident engineer to coarsen up the screening gradation to that approaching the 3/8" x #6 gradation, and increase the spray rate to approximately ± 0.63 GAL/SY.

Locations 2 and 3 were completed under these conditions.

The following are my comments:

1. The work performed at Locations 2 and 3 is acceptable and ranging from good to excellent.

2. Jeff Smith could not come up with a positive reason why the work on the southbound lane at Location 1 is so much better than the northbound lane. He speculates they may have "lucked out" by having better climatic conditions when placing the southbound lane.

Based on the above, it is logical to assume that in order to obtain an acceptable asphalt-rubber seal coat, the following items must be controlled:

1. Control the amount of material passing the #4 mesh - perhaps 0-15% passing. It appears the amount of fines was excessive.

2. Have an adequate amount of precoating - perhaps 0.75 to 1.00 percent.

3. Have an adequate spray rate to properly embed the screenings -- perhaps 0.60 to 0.70 GAL/SY.

4. These areas are immediately next to the ocean for the most part and are subject to foggy, damp weather.

The next project is not on a State Highway, but Caltrans was so impressed with the effectiveness of the SAM over totally failed AC pavement that we reviewed it. The garbage truck traffic on this road is bumper to bumper from 6 a.m. to 6 p.m. The asphalt-rubber treatment is by far cheaper than any other form of rehabilitation and looks to have long life.
LOS ANGELES COUNTY SANITATION DISTRICT
PUENTE HILLS LANDFILL

TEST SECTION CONSISTING OF A DOUBLE STRESS-ABSORBING MEMBRANE (SAM)

This landfill is located southeasterly of the intersection of the 60 and 605 Freeways in Los Angeles County.

The haul road to the landfill dumping area is subjected to extremely heavy truck traffic consisting of approximately 2,500 trucks daily, each carrying maximum legal loads (or over).

The haul road where the test section was placed was constructed in 1983 and the structural section included 10" of Untreated Rock Base (URB) and 6" of Asphalt Concrete (AC).

By 1988 and due to the extremely heavy truck traffic, this haul road became severely distressed, evidenced by alligator cracking over the entire surface.

During April of 1988, a double or two-tier Stress Absorbing Membrane (SAM) was placed on approximately 400' of this roadway.

The bottom tier consisted of an AR-4000 Asphalt Cement containing 20% crum rubber and spread at a rate of 0.70 gal/sy. A nominal 3/4" chip was then rolled into this membrane at an approximate rate of 32 lbs/sy.

The top tier consisted of the same binder and spread at a rate of 0.60 gal/sy. A nominal 1/2" chip was rolled into this membrane.

The aggregate gradation was coarse and did not have many fines.

Currently, there is no indication of any distress or transfer of cracks in this double test section.
This paper has not really addressed SAMs in detail but the Caltrans concept is that in maintenance work all SAMs eventually become SAMIs. After a period of time, the roads will be distorted and wheel-rutted even if the sealed surfaces contain no cracks or oxidized material. It will then have to be overlaid with a thin asphalt concrete overlay, thus the asphalt-rubber SAM becomes a SAMI.

Caltrans is definitely adding asphalt-rubber to its list of maintenance surface treatments. It appears that their flexible treatments may be better and more cost-effective than thicker, rigid rehabilitation concepts.
REFERENCES


"Performance of Asphalt-Rubber SAMs and SAMIs in California", by Ed Delano, P.E., Pavement Maintenance Program Advisor, Headquarters Maintenance, CalTrans, Sacramento, CA.

Question/Dean Maurer from Pennsylvania DOT:

When you precoat chips do you use Asphalt-Rubber as a precoating material or do you use just the standard grade AC?

Ed Delano:

Normally we use a standard paving grade asphalt, 1% by weight or slightly less depending on conditions. The concept was new to us but with suggestions from contractors and the ARPG, we decided to do it, even though it adds a little to the overall cost.

Dean Maurer:

One other thing also, I assume that these slides you are showing indicate fairly good success. You didn’t try this process on roads where you saw major base failures. In other words if you have rutting, etc., you do not attempt to do that.

Ed Delano:

Yes, we have used Asphalt-Rubber chip seals on roads with major base failures with good results. Some of the slides I did not get a chance to show today depict this situation. On badly alligatored roads if we use coarser graded chips with a heavy spread rate (up to 0.7 gal./SY) of Asphalt-Rubber, performance has been phenomenal. The only problem we have to be concerned with is the potential for bleeding and flushing with the heavy spread rates. It has been our experience that Asphalt-Rubber chip seals are the way to go for maintenance of badly alligatored roads.

Dean Maurer:

You would recommend that you take care of base failures in general in a different manner.

Ed Delano:

Bad base failures should be dug out and replaced with good material prior to the seal coat. If the failures are not too bad (small alligator cracks) Asphalt-Rubber chip seal SAMS (stress absorbing membranes) have proved to be the maintenance solution to this problem for us.