

Innovations in Recycled Asphalt Pavement (RAP)

“The Roads to the Future are Paved with Recycled Materials”

Rocky Mountain West Pavement Preservation Partnership

October 21st, 2015

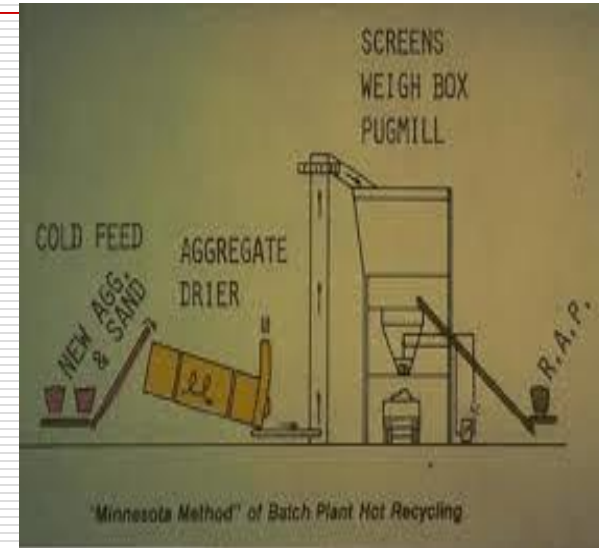


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Pavement Recycling Systems, Inc.

What We Know

- ❑ Asphalt has always been Recyclable. # 2 in world after Water
- ❑ Valuable material in Hot Mix Asphalt
- ❑ Used when and where feasible
 - How do we expand on the value?



Reclaimed Asphalt Pavement

□ The Need

- Some of the best aggregates are in our roads.
- Increasingly difficult to open new pits.





Expanding Recycled Asphalt

□ **Cost Effect**

- Shrinking budgets equal fewer asphalt overlay projects
- Useable in asphalt paving projects “remove and replace”
- Useable in Pavement Preservation
 - Central Plant Recycling
 - Slurry Seal
 - Chip Seals

□ **High Quality/Perform Excellent**

- Many cases out performs native aggregates
- Neutral charge, works great with all emulsions/binders
- Natural “black aggregate”
- Quality “legacy” asphalt binders



RAP Management

- Products
 - Typical uses
 - Innovative uses
 - Methods of Management
 - On Site Methods
 - Contract Methods
 - Best Practices
-

Products

Typical Uses

- RAP Base
- Shoulder Backing
- Trucking yards
- Dust Control
- Crushed Miscellaneous Base

Is this the only use of
such a valuable asset?

Valuable RAP Products



- RAP CCPR Asphalt Pavement
- RAP Terminal Blend Rubber Chip seals
- RAP chip, Scrub Seals
- RAP Slurry, RAP Micro Surfacing
- RAP Crack Fill Aggregates
- RAP Base
- RAP Shoulder Backing
- Crushed Miscellaneous Base
- RAP Haul Roads
- RAP Dust Control



Products

Cold Central Plant Recycling (CCPR)

Clean Rap = New Pavement:

- Stockpiled and kept clean
- Crushed RAP to specific gradation
- Mixed with engineered emulsion or foamed asphalt per mix design in a central plant close to project
- Transported to lay down area
- Paved as a recycled mix
- Compacted to specified density
- Readied for surface treatment
- Reduced carbon footprint
- Reduced truck traffic
- Reuse agency asphalt assets

From RAP



to Pavement

Recycle Your Asphalt on Site!

Urban Quarry!



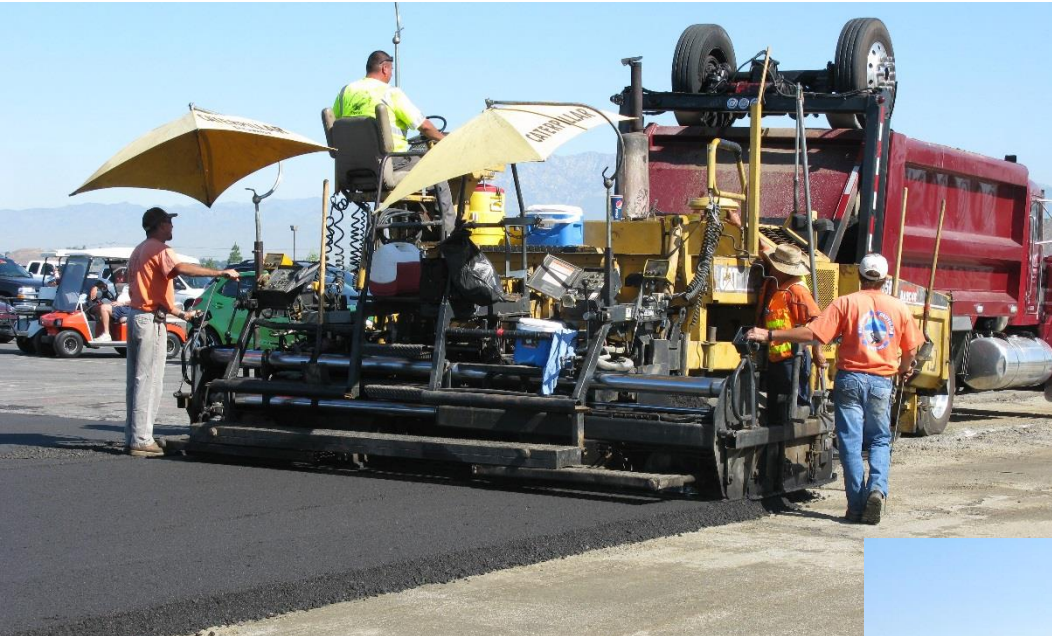
Value Engineered



City Of Menifee Newport Road 3" CCPR over 10" FDR Cement



Manheim Auto Auction 1-Million Square Feet 100% Recycled Asphalt



Modesto Shopping Mall 800,000 Square Feet 100% Recycled Asphalt



Value Engineered



RAP Products

Chip Seals



RAP Chip Gradation

TABLE 200-1.2.1 (A)

Sieve Size	Percent Passing ¹	
	Medium 3/8"	Medium Fine 5/16"
1/2" (12.5 mm)	100	
3/8" (9.5 mm)	85-100	100
No. 4 (4.75mm)	0-15	0-50
No. 8 (2.36 mm)	0-5	0-15
No. 16 (1.18 mm)	-	0-5
No. 200 (75 um)	0-2	0-2
Residual Asphalt Content ²	3.5% Min. (Based on dry weight of aggregate)	3.5% Min. (Based on dry weight of aggregate)



1. On unextracted RAP. 2. On extracted RAP. Determined by CT362, CT379 or CT382.

RAP Chip Material

Residual Asphalt



Chips

Single stones and conglomerations

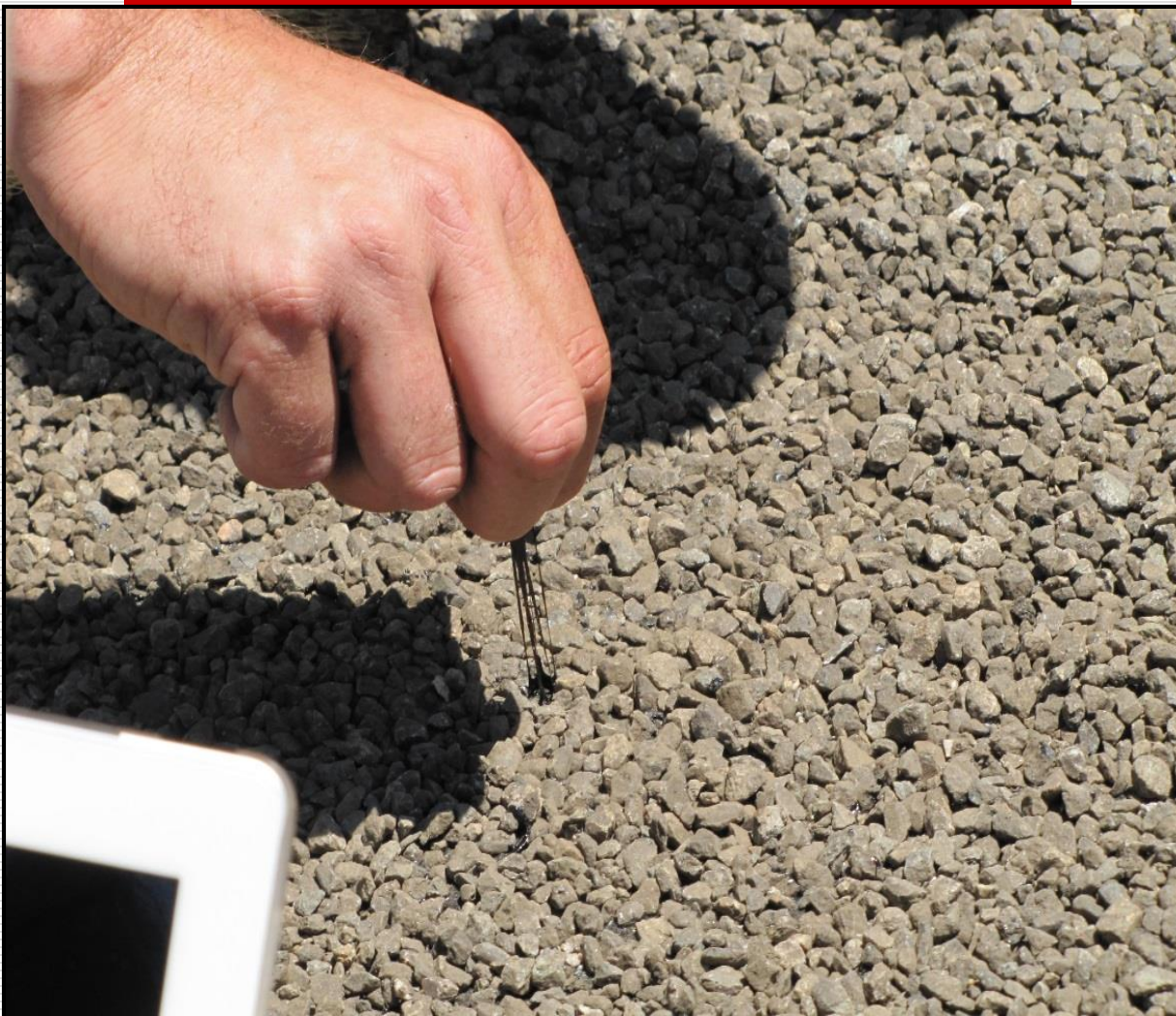
Residual asphalt content will vary by sample

Laboratory Tests on Chip

- Los Angeles Abrasion (ASTM C 131)
 - 5% Loss -100 Revolutions
 - 23% Loss – 500 Revolutions
- Cleanness Value: 58 (Cal 227)
 - Spec is 75 minimum
 - But not an issue

							Extracted
Sieve Analysis:		1	2	3		Ave.	3
(ASTM C136 & C117)							
3/8"		100	100	100		100	100
No. 4		37	42	38		39	51
No. 8		5	8	7		7	18
No. 16		3	5	4		4	14
No. 30		3	5	3		4	12
No. 200		2	3	3		3	6
Asphalt Cont.							3.9
(%):							

RAP Chips 3/8", 5/16"



Appearance is dirty but the dust is actually asphalt dust. Bonding capability is outstanding.

RAP Chip Seal San Bernardino County El Rivino Road 2006 5/15" Chips

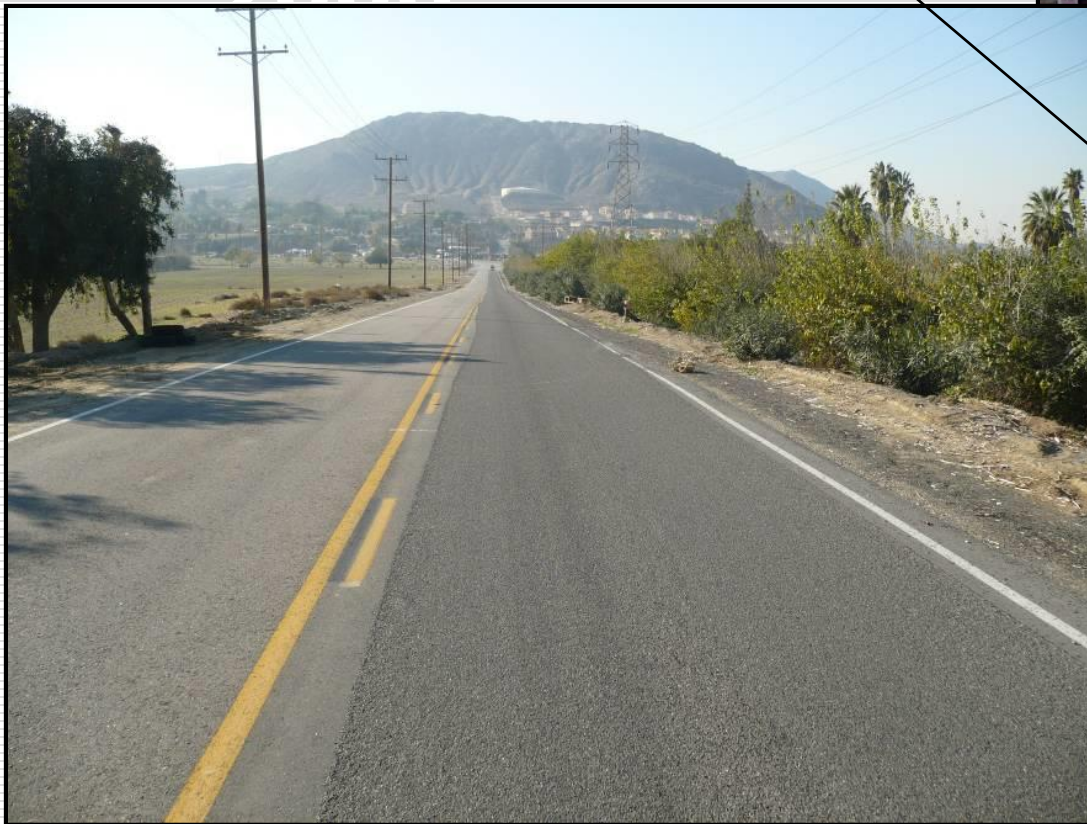
Before



RAP Chip Seal November 2014

After 8 years later

2006



RAP Chip Scrub Seal Los Angeles County 2009 Avenue J

Scrub seal with polymer modified rejuvenating emulsion

Extensive block cracking and alligator cracking



RAP Chip Scrub Seal

Hand applied additional
RAP chips to low
areas

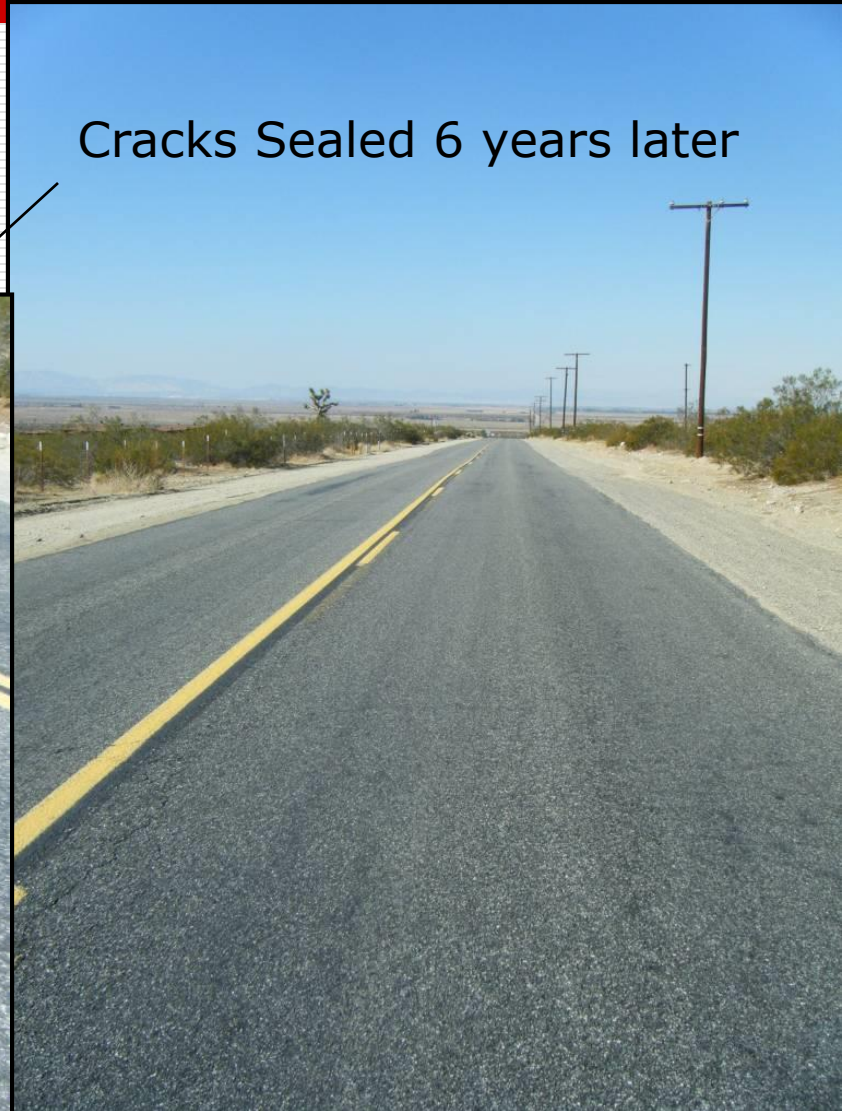
Rain fell that night



RAP Chip Seal 2014 After

Los Angeles County

Cracks Sealed 6 years later



RAP Products

Slurry Seal and Micro Surfacing



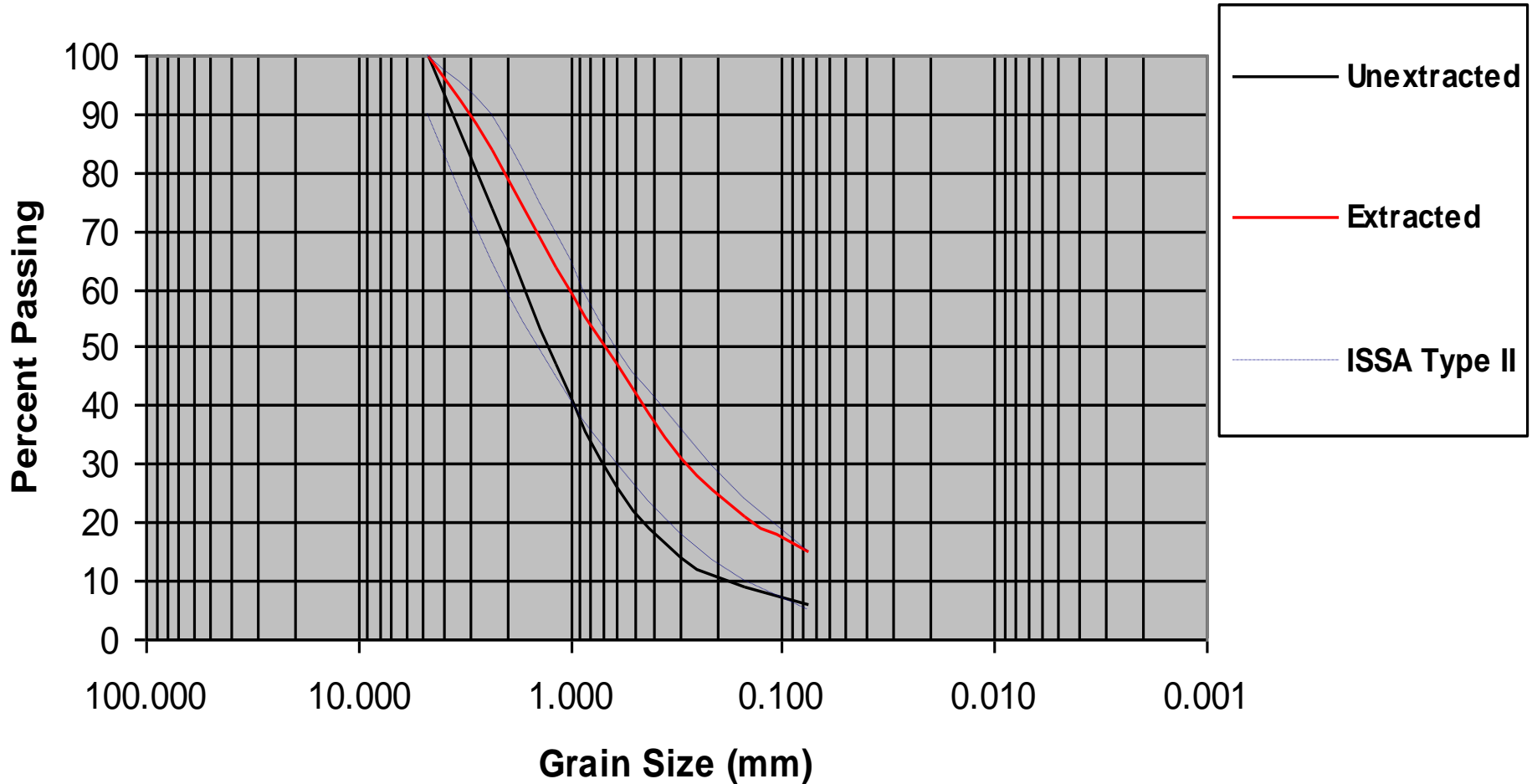
RAP Slurry Gradation

RAP Slurry Dust

Sieve Size	Percent Passing UN-extracted	Percent Passing Extracted	ISSA Specification
3/8"	100	100	100
No. 4	95-100	95-100	90-100
No. 8	65-85	70-90	65-90
No. 16	35-60	50-75	45-70
No. 30	18-38	35-55	30-50
No. 50	8-25	22-40	18-30
No. 100	5-20	13-38	10-21
No. 200	2-12	10-20	5-15
Residual AC		6.5% Min.	

Rap Slurry Gradations

Gradation Curves



RAP Slurry Material

Consistent Residual Asphalt



Slurry Dust

Very few conglomerations

Residual asphalt remains very consistent

Type II RAP Slurry Aggregate



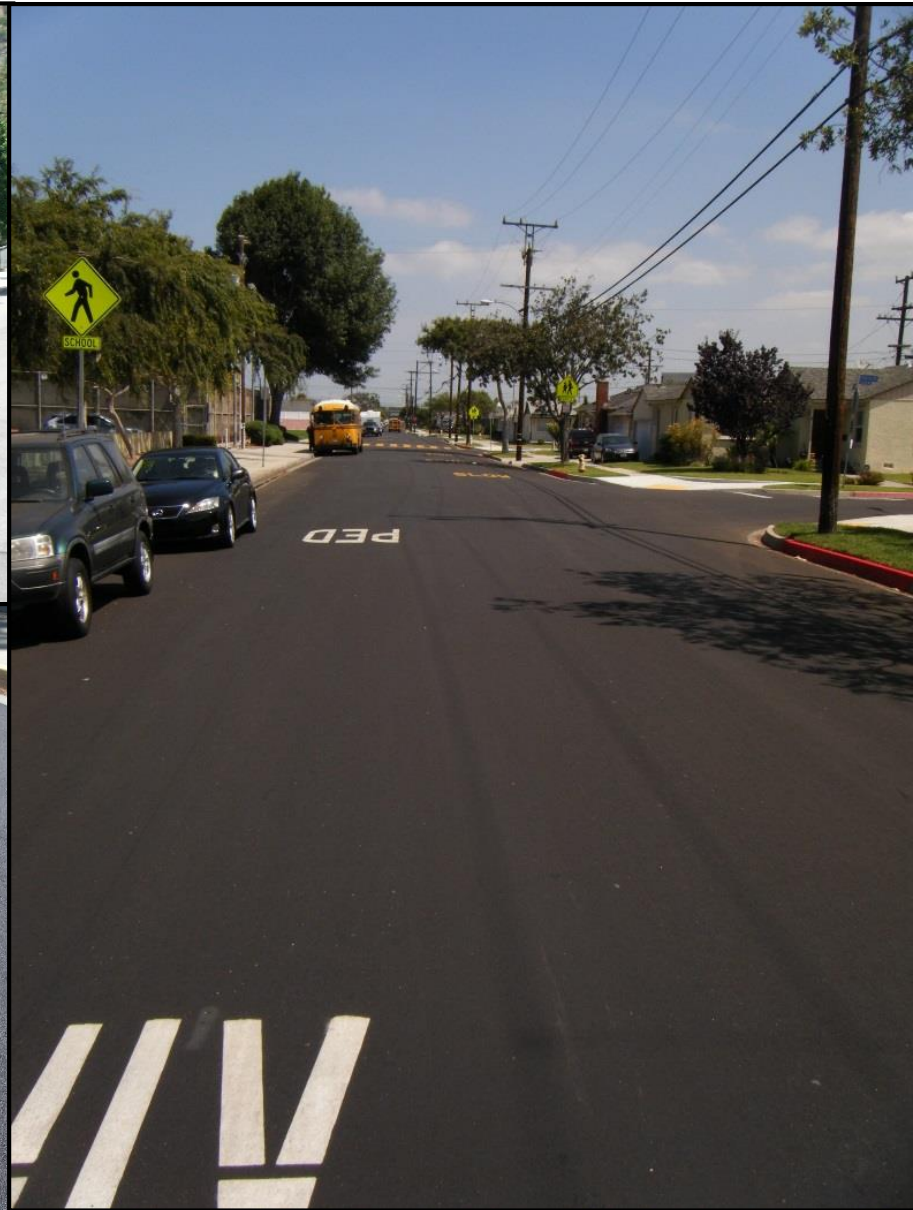
RAP Slurry Seal

RAP Slurry Seal

ISSA Type II

Component	Amount	Amount
Emulsion	10% - 14%	*12% - 18%
Residual AC	12.5% Min.	7.5% - 13.5%

Conventional Equipment Super Results



RAP Slurry Black Aggregate



RAP Slurry compared to Conventional, City of La Mirada, California. Side by Side – One Year later, RAP is still black!



RAP Slurry



Conventional Slurry

Methods of Management

- Use of RAP materials in conventional bids
(SPECIFICATIONS AVAILABLE)
- Utilization of In House RAP
 - On Site Method

Existing RAP Stock Pile or
New RAP Stock Pile
Being Developed



Crush and Screen On-Site

The need can be for a specific product or products. A qualified operator can be contracted by time or quantity.

1. Contracted By Time
 1. Set Mobilization Cost
 2. Set Crushing Cost
 3. Set Screening Cost (Based on product, there may be more screening than crushing)
2. Contracted By Quantity
 1. Set quantity of product with unit price or lump sum contract.
 1. Small quantities can be expensive
 2. Understand that it is not unusual to have multiple products produced simultaneously.

Caltrans Maintenance

- In house crews
 - Chip Seal
 - Crack Seal
 - Shoulder Backing
- Contract Work
 - Slurry Seal



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Utilized four RAP piles separated by over 150 miles from each other.

This process allowed Caltrans to make multiple products from their own material.

The trucking cost can exceed \$38 per ton to some locations.

Superior products used for two years with little to no additional cost.



RAP Chip Seals Caltrans Ramps



Complete RAP Management

RAP Management Program allows the owner to contract:

- Import
 - Stockpile Management
 - Crushing, Screening and fractionation
 - Export
-

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RAP Management Program allows the owner to contract:

- Import
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 - Crushing and Screening
 - Export
 - Trucking
 - Cost tracking
-

Best Practices

- Clean RAP for Slurry
 - Contaminated material should be segregated for use on other products
 - Sand Equivalent (SE)
- Utilization of multiple products at one time
 - Chips and slurry dust – Slurry and AC Base
- Minimum of two screenings for chips.
- Moisture content
 - Wet for chips on Emulsion Binders
 - Dry for chips on Hot Asphalt Binders
 - Understand quantities to achieve best pricing
- RAP Slurry Seal can not sit more than two weeks to four week without being re-screened.

RAP Aggregate Products Production

- Rap Chips (5/16" and 3/8")
- Rap Type II Slurry Dust
- Crushed Miscellaneous Base
- AC Base
- RAP Base
- Mixing Aggregates for CCPR



5/16" Chips Made from RAP



Caltrans On-Site Management



RAP Chip and RAP Slurry (RAP Cape) Aggregates Produced Simultaneously



Finished Environmentally Friendly Product



Questions?



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