

# **Reclaimed Asphalt Pavement (RAP) Used in Pavement Preservation Applications**

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**National Pavement Preservation Conference 2016**

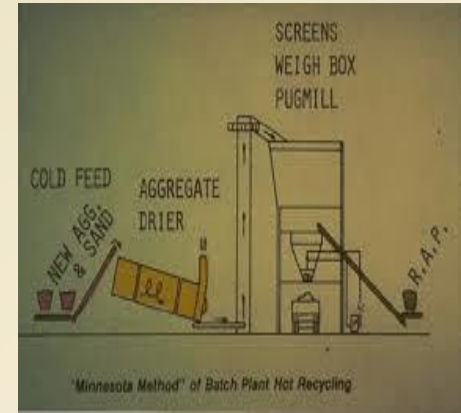
**Nashville, TN  
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Pavement Recycling Systems, Inc.**



# What We Know

- Asphalt has always been recyclable.  
# 2 in world after recycled water
- Valuable Material in Hot Mix Asphalt
  - Provided Feasible and Cost Effective
  - Nearby to HMA Plant
  - More Going Out Than Into the Facility
    - No Inventory Build Up



# Other Historical Low Value RAP Uses

- Shoulder Backing
- Trucking & Equipment Yards
- Haul Roads
- Dust Control
- Crushed Miscellaneous Base

These Are Poor Uses for Such a Valuable Asset

# No Need to Squander Virgin Aggregate

- RAP In Many Cases Out Performs Native Aggregates
- Neutral Charge, Works Well With Binders
- Cost Effective
- Environmentally Smart
- Tends to Stay Black Longer



# Alternative Uses in Pavement Preservation

- Cold Central Plant Recycling (CCPR)
- RAP Chip Seals
- RAP Slurry Seals/Micro Surfacing
- RAP Cape Seals



# Cold Central Plant Recycling (CCPR)

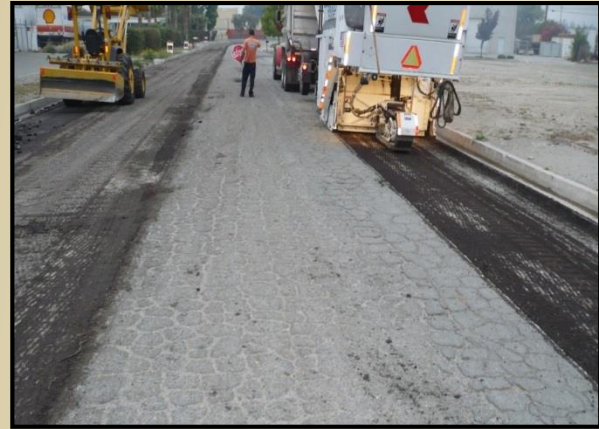


**Clean RAP**



**= New Pavement**





# 1) Mill and Stockpile RAP

- **Onsite CCPR** - Cold Milled from Roadway and Recycled Back to Same Roadway
- **Imported CCPR** – RAP is Brought from One Project and Recycled to Another
- **Central Facility CCPR** – RAP Stockpiled from Various Projects for Future Use

# Onsite CCPR

**Same Road - RAP Milled from Roadway to be Reconstructed**

**Prior to Milling**



**Cold Milled**



**Stockpiled Nearby**





# Imported CCPR

**RAP Imported from One Roadway and Processed and Returned to Different Application**



# Central Facility CCPR

**RAP Imported from Various Projects and Stockpiled for Future Use**



## 2) RAP is Sized (Typically 1" to 1.5" Max)

Using a Scalping  
Screen on the Feed  
Hopper of  
Processing Plant



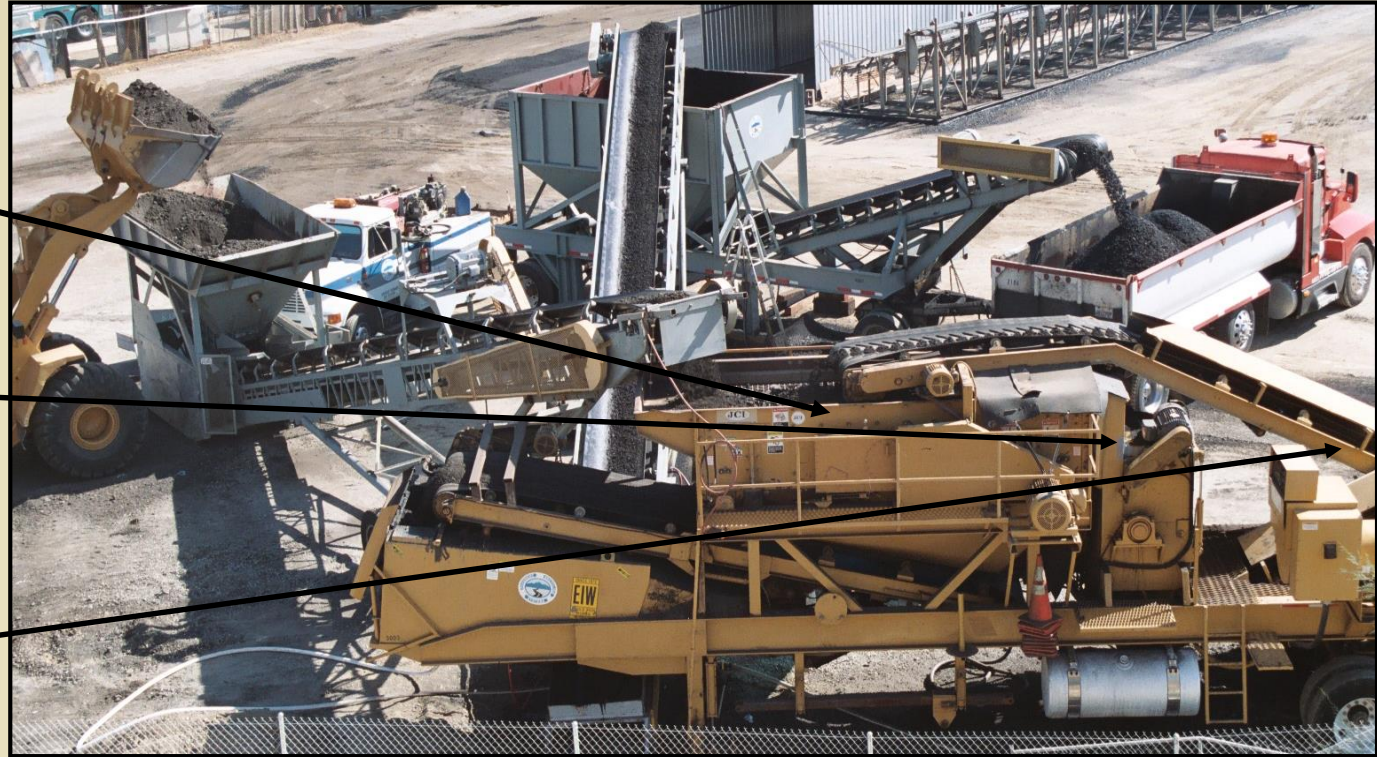


# 100% RAP Crushed and Screened Closed Loop System

Screen

Crusher

Return



# RAP Fractionization





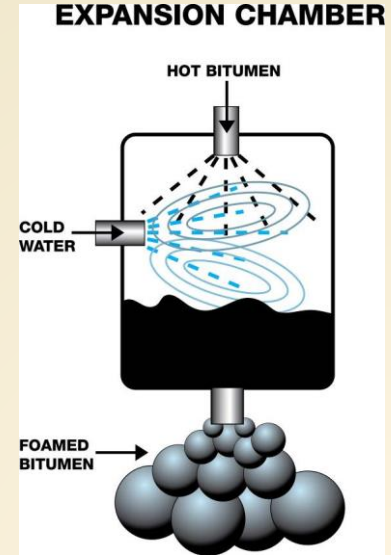
### 3) Can Supplement with New Aggregate



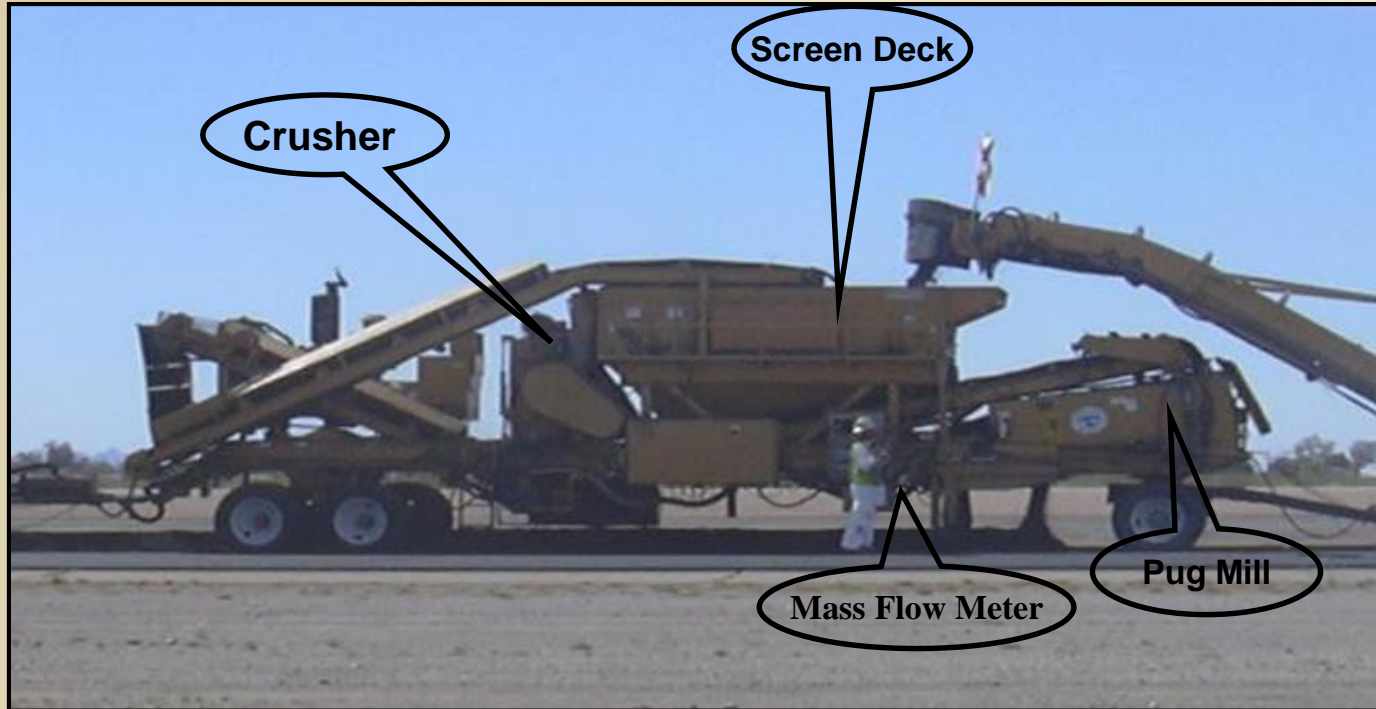
# 4) Mix with Water and Recycling Agent

## Adding Recycling Additives if Necessary

- Recycling Agents
  - Emulsified Asphalt
    - Engineered Emulsions
    - Polymer Modified Emulsions
    - Solvent Based Emulsions (CMS2s)
  - Expanded Asphalt (Foam)
- Recycling Additives (added in small quantities)
  - Cement Dry
  - Lime Slurry

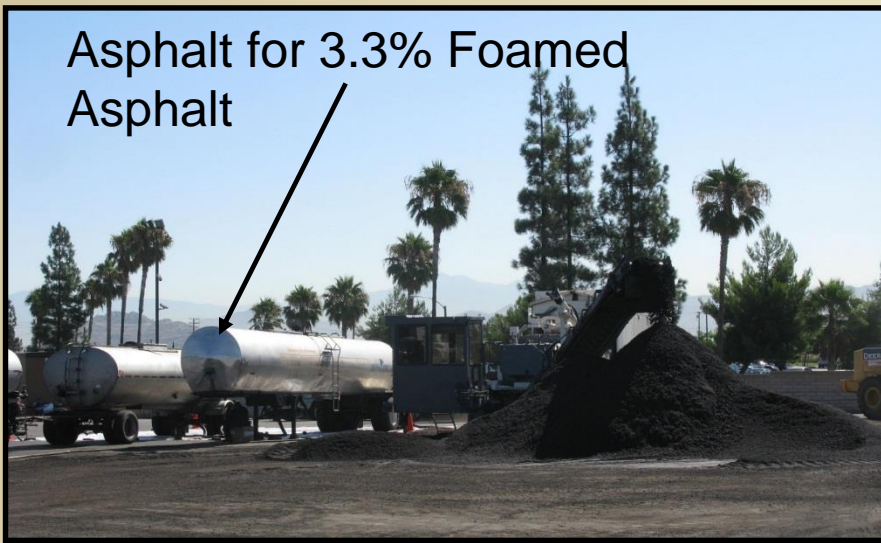


# Combination Processing Plant





Asphalt for 3.3% Foamed Asphalt



# After Sizing Standard Pugmill

1.0% Cement Added



# 5) Loaded into Trucks and Transported To Laydown Area



Swept and Tacked Prior to Paving



## 6) Pave Recycled Mix



## 7) Compact to Specified Density



Pneumatic-tired roller at least 22 to 25 tons

Double drum vibratory steel-wheeled roller at least 10 tons





# Surface Before Sealing





## 8) Protect for Temporary Traffic

Apply fog-seal  
Apply sand blotter  
Release to traffic





## 9) Cure and Reroll if Necessary



Typically 2 to 10 days

Reroll (supplemental compaction) if required (typically for emulsified asphalt)





Slurry or Micro Surfacing –  
Low Volume Shoulders and Lots



Chip Seal – Low  
Volume Highways

# 10) Final Surfacing

**Because of Higher Void Ratio Must  
Be Sealed**

HMA Overlay – Higher Volume Highways  
High Shear Areas



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





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



# RAP Chip Aggregates



Single stones and conglomerations  
Residual asphalt content will vary by sample



# RAP Chip Gradations

Sieve Size	Percent Passing <sup>1</sup>	
	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 <sup>2</sup>	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



# RAP Chips



Appearance may be dusty but the dust is actually asphalt

No need to wash. Wet with an emulsion and keep dry for asphalt rubber

Bonding is excellent



# RAP 3/8" Terminal Blend Asphalt Rubber Chip Seal





# RAP 5/16" PME Chip Seal



# RAP Chip Seal San Bernardino County

## El Rivino Road 2006 5/16" Chips

Before





# RAP Chip Seal

10 years later





# RAP Chip Scrub Seal Los Angeles County 2009 Avenue J

Scrub Seal with Polymer  
Modified Rejuvenating  
Emulsion Broomed into  
Cracks



# RAP Chip Seal 2015 After

Los Angeles County



Cracks Sealed 6  
years later



# RAP Aggregates - Type II Slurry and Micro Surfacing





# RAP Slurry and Micro Surfacing Aggregates



Very Few Conglomerations  
Residual Asphalt Remains Consistent

# Type II RAP Slurry Aggregate



# RAP vs Conv. Agg. Differences

- RAP Slurry Light on Fines for Type II
  - Coating of Asphalt Limits Crushed Fines
- Need to Prevent Clumping
  - Limit Amount of Material Stockpiled
  - Rescreen if Necessary
- Needs to Be Rubber Tire Rolled
- 3% Latex Modified Minimum
  - Adds Early Retention Until Asphalts Meld





# RAP Slurry Seal

<b>RAP</b>		<b>ISSA Type II</b>
<b>Component</b>	<b>Amount</b>	<b>Amount</b>
Emulsion	10% - 14%	12% - 18%
Residual AC	12.5% Min.	7.5% - 13.5%

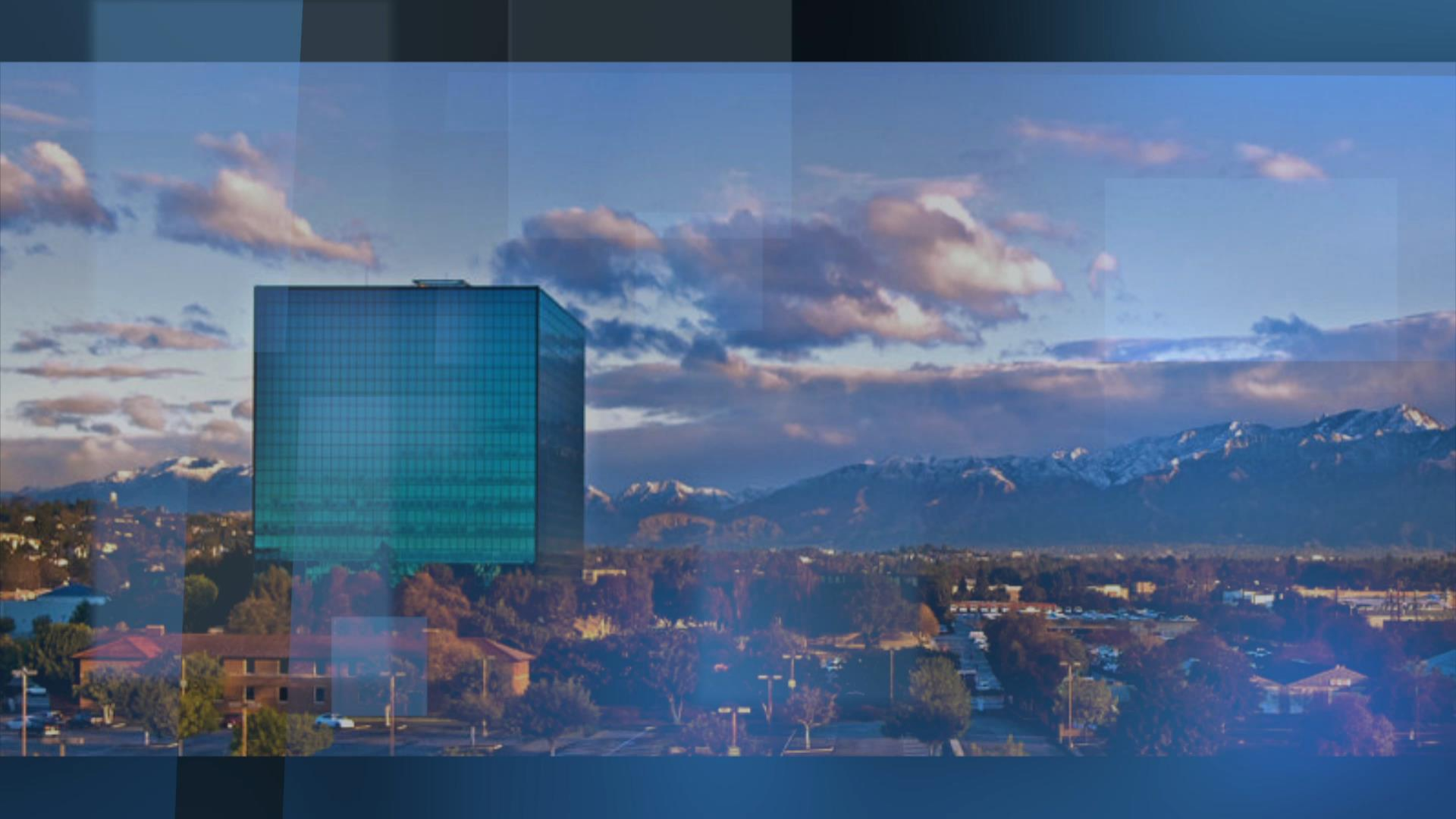
# Conventional Equipment Can Be Used



# RAP Slurry compared to Conventional, City of La Mirada, California. Side by Side – One Year later, RAP is Blacker







# Methods of RAP Management

- Require RAP Materials in Conventional Bids
- Utilization of In-house RAP
  - On Site Method

Existing RAP Stockpile  
or New RAP Stockpile  
Developed



# RAP Aggregate Central Production Facility





# 5/16" Chips Made from RAP



# Recycle Your RAP on Site

## Urban Quarry





# Caltrans On-Site Management





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



# Some of the Best Aggregates Are in Our Roads Increasingly Difficult to Open New Pits



**Solution  
Use RAP!**

# Questions?

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