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Reclaimed Asphalt Pavements

WAPA 62nd Annual Conference & Business Meeting
November 30, 2021

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Topics to Cover

- What is RAP?
- Latest RAP data/information
- How do we acquire RAP?
- RAP processing
- Fractionate or not to fractionate
- RAP handling
- How much RAP should I use?
- Other uses for RAP
- In summary

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What is RAP?
Reclaimed Asphalt Pavement

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Reclaimed Asphalt Pavement (RAP)

The term given to removed and/or reprocessed pavement materials containing asphalt and aggregates. These materials are generated when asphalt pavements are removed for reconstruction, resurfacing, or to obtain access to buried utilities. When properly crushed and screened, RAP consists of high-quality, well-graded aggregates coated by asphalt cement.

FHWA User Guidelines for Waste and Byproduct Materials in Pavement Construction

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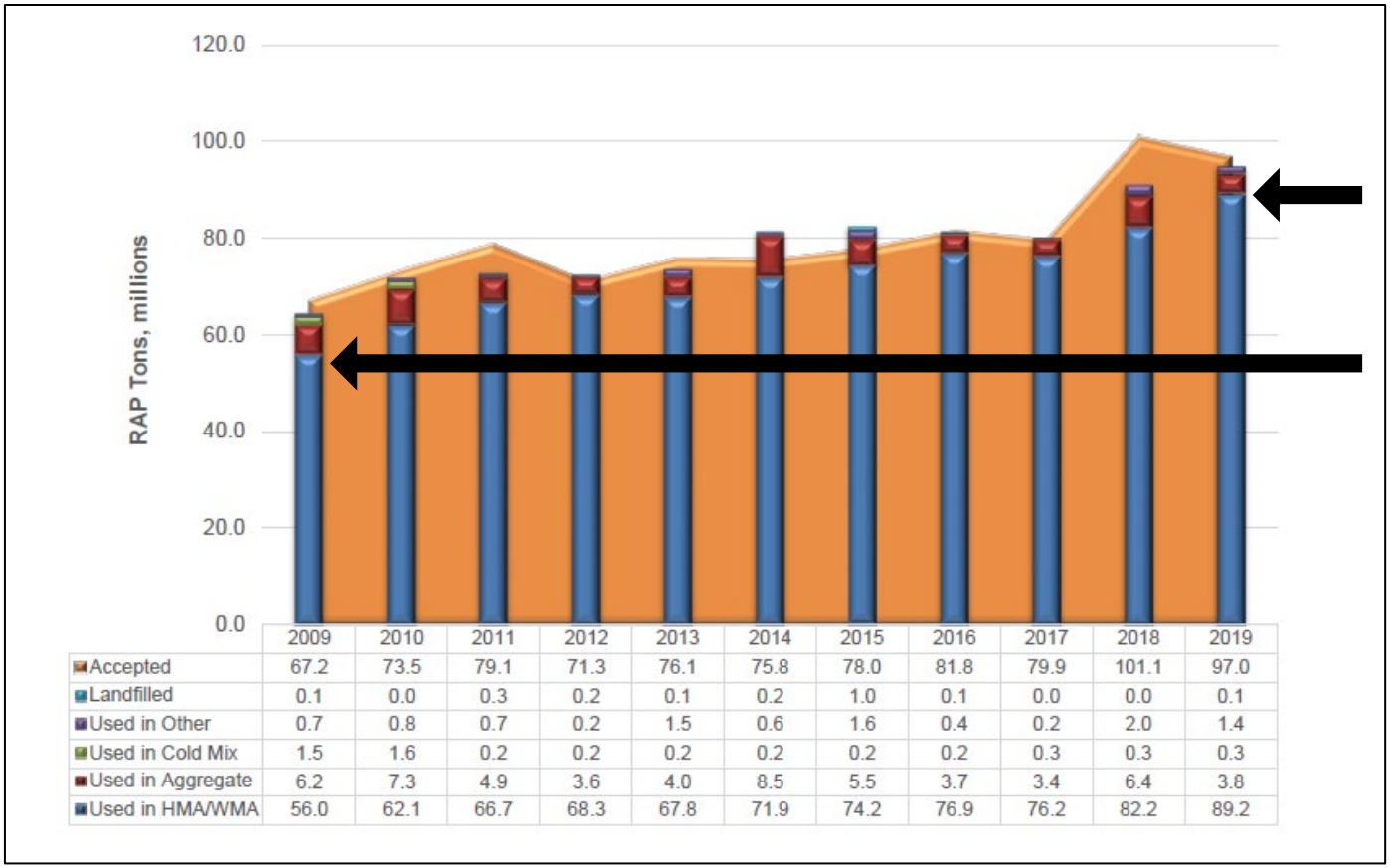
Latest RAP data/information

National Summary of RAP Usage



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Accepted	67.2	73.5	79.1	71.3	76.1	75.8	78.0	81.8	79.9	101.1	97.0
Landfilled	0.1	0.0	0.3	0.2	0.1	0.2	1.0	0.1	0.0	0.0	0.1
Used in Other	0.7	0.8	0.7	0.2	1.5	0.6	1.6	0.4	0.2	2.0	1.4
Used in Cold Mix	1.5	1.6	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3
Used in Aggregate	6.2	7.3	4.9	3.6	4.0	8.5	5.5	3.7	3.4	6.4	3.8
Used in HMA/WMA	56.0	62.1	66.7	68.3	67.8	71.9	74.2	76.9	76.2	82.2	89.2

In 11 years we have seen over a 33% increase in RAP usage

Data from the NAPA Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage 2019

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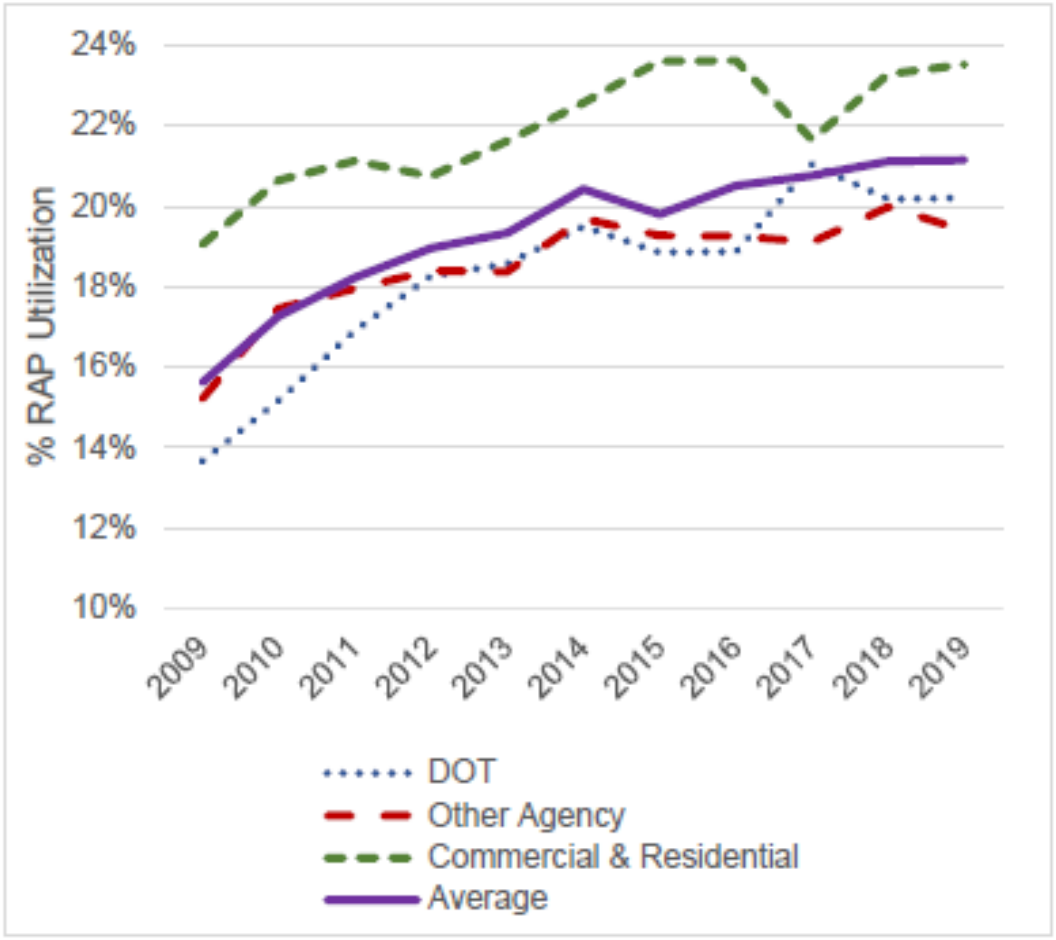
National RAP Usage by Sector



Data from the NAPA Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage 2019

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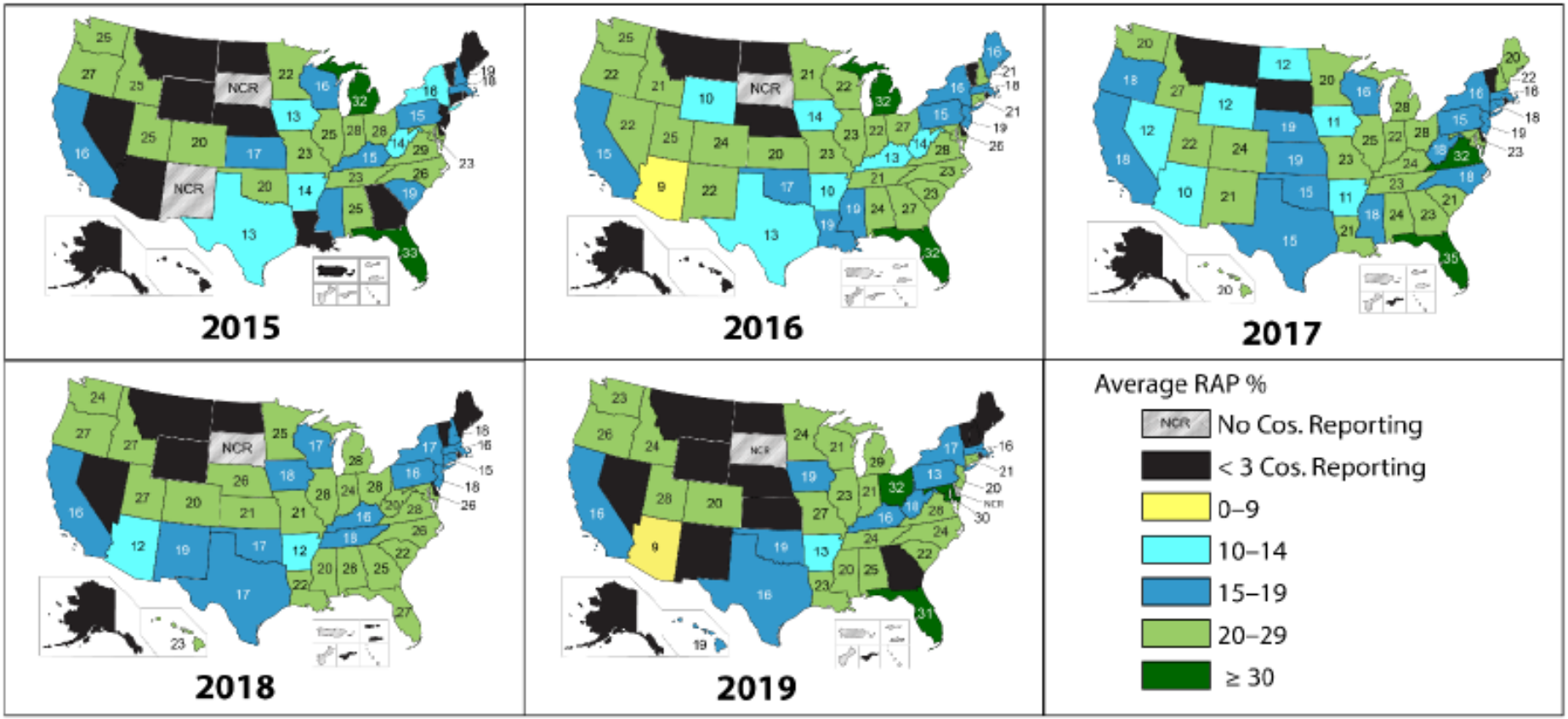
RAP Usage by State



Data from the NAPA Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage 2019

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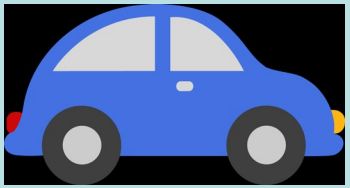
RAP Data Summary for 2019

- The total estimated tons of RAP used in asphalt mixtures was 89.2 million tons
- Reclaiming 97 million tons of RAP for future use saved about 58.9 million cubic yards of landfill space, and more than $5.3 billion in gate fees for disposal in landfills

GHG's



520,000

2.4 Million Metric Tons of CO_2

24 Million

$916 Million

4.5 Million Tons of Asphalt Binder

84 Million Tons

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How do we acquire RAP?

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RAP Acquisition

- RAP may be obtained from several sources:
  - The most common method is pavement milling operations (cold planning)
  - Full-depth pavement demolition
  - Wasted asphalt plant mix

Types of Reclaimed Asphalt Pavement

Millings

Demolition

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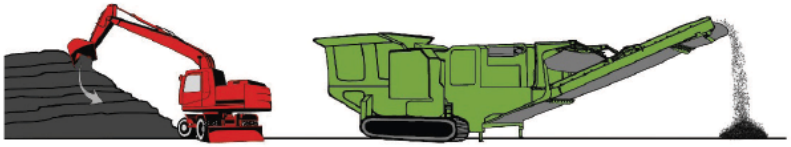
RAP Processing

RAP Best Practices

Build in layers.

Don't push over edge of slope.

Excavate through layers to feed crusher.



Feed loader from side of stockpile, working up through layers.

RAP Crushing/Sizing

RAP Processing

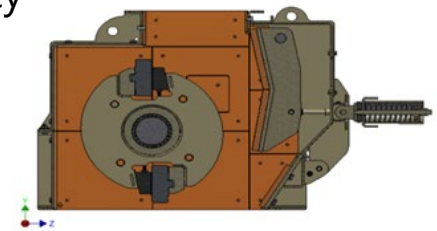
- RAP Screening
  - Coarse material requires more amplitude and less frequency
  - Fine material requires less amplitude and more frequency
  - Efficient screens will minimize the amount of recirculation
  - RAP is sticky and builds up quickly in screenboxes
  - Understand desired products

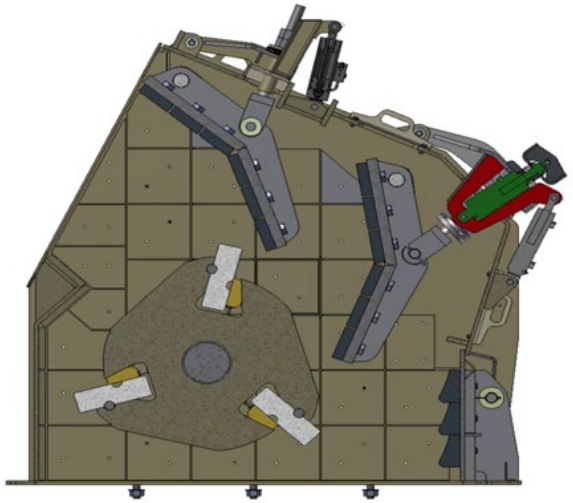
RAP Processing

- RAP Crushing
  - Impactor designs meant to break apart the bond but not over-crush
  - Quick adjust aprons and hydraulic variable speed drive to adjust to conditions
  - Size crushers according to what is needed based on feed product and desired products

RAP Processing

- Horizontal Shaft Impact (HSI) Crusher
  - Designed to break up pavement or agglomerations of RAP rather than downsize the aggregate gradation
  - Typically use a three-stage impact bar arrangement that can be set to size material according to the desired top-size aggregate
  - High reduction ratio and capacity





RAP Processing

- Conveyor designs intended to handle slabby material
- Machines that are easy to move
- Machines that are easy to run
- Look for shelves and flat spots that will hold material
- Look for designs that will help keep components clean
- Clean equipment daily

Processing Concerns

Moisture and temperature can affect the crushing and screening of RAP

- **When the RAP is wet and/or hot temperatures**
  - RAP will be stickier and tend to build up in feeders and crushers
  - Blind screens
  - Stick to belts
  - Accumulate under conveyors
- **Require more maintenance of RAP processing units and feeder systems**
- **Affect the gradation and asphalt content of the RAP**

Processing Concerns

With the cradle to gate concept of hot mix asphalt, you never know what you'll find in a truckload of material brought in for recycling

- **Crack fill material can be an issue when processing**
  - Impedes efficiency
  - Needs to be cleaned out 3-4 times each day

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Fractionate or Not to Fractionate

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To Fractionate or Not to Fractionate

- Single Size Stockpile

- Fractionated stockpiles

To Fractionate or Not to Fractionate

- Case for Single Sizing
  - Simplicity of one stockpile
  - Smaller plant footprint/storage
  - Cost effective
  - Less generation of P200
  - One set of equipment
    - Cold Feed Bin
    - Weigh scale
    - Conveyor

To Fractionate or Not to Fractionate

- Concerns with Single Sizing
  - Difficult controlling gradation in mixes containing greater than 20% RAP
  - Stockpiled RAP can segregate and also join back together
  - Tougher to achieve uniform distribution
  - Tougher to control percent binder of recycled material

To Fractionate or Not to Fractionate

- Case for Fractionating
  - Crushing and screening
  - Breaking apart the bond
  - Treating RAP gradation same as virgin mix
  - Takes advantage of higher asphalt content in the “fine” RAP
  - Allows more flexibility in designing mixtures

To Fractionate or Not to Fractionate

- Concerns with Fractionating
  - More room needed at plant
  - Additional stockpile testing
  - Additional bins/feeders/ conveyors/scales/etc…
  - Keeping up with plant capacity
  - Potential for imbalance of fractionized RAP usage
  - Fine RAP holds moisture and hardens quickly

To Fractionate or Not to Fractionate

Level 1 Fractionating

- Ideal for fractionating millings
- Self contained
- Easily transported
- Low operating cost
- Low entry price for fractionating

To Fractionate or Not to Fractionate

Level 2 Fractionating

- Ideal for fractionating millings
- Self contained
- On-board HSI crusher
  - Liberate bond
- Easily transported
- Two products
- Closed circuit

To Fractionate or Not to Fractionate

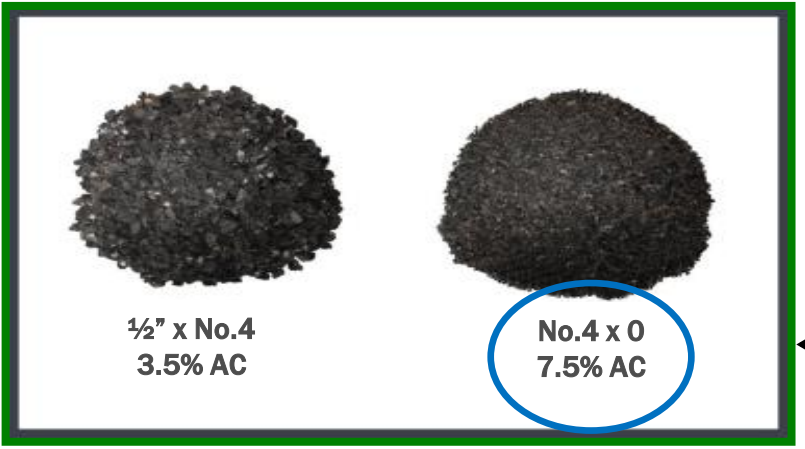
Level 3 Fractionating

- **Will handle any material size**
- **Multiple configurations**
  - Fractionating
  - One-size Recycling
  - Closed Circuit
  - Open Circuit
- **High tonnages**
- **Ideal for mobile sites**
- **Has uses in other materials**
  - Concrete
  - Aggregate

To Fractionate or Not to Fractionate

Level 4 Fractionating

- **Great for One-Site Operations**
- **Customized to Fit Your Needs**
  - Self Contained or Line Power
  - Portable/Electric
  - Various Tonnage and Feed Size Configurations
- **On-demand Sizing**
- **Easy Access and Serviceability**
- **Produces up to five sizes**
- **Offers similar control as virgin product**



← How much of a difference?

20% RAP Mix:

0.2 x 7.5% AC = 1.5% AC

0.2 x 3.5% AC = 0.7% AC

0.8% Potential AC swing

40% RAP MIX, 1.6% AC SWING

Fractionation Doesn't Correlate to Utilization

RAP Fractionation

Texas

- Reports 50% RAP being fractionated but averaging 16% RAP in mixtures

RAP Fractionation

Maryland

- Reports 0% RAP being fractionated but averaging 30% percent RAP in mixtures

Producers from 30 states reported fractionating RAP

Nationally, a reported 21% of RAP is fractionated

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RAP Handling

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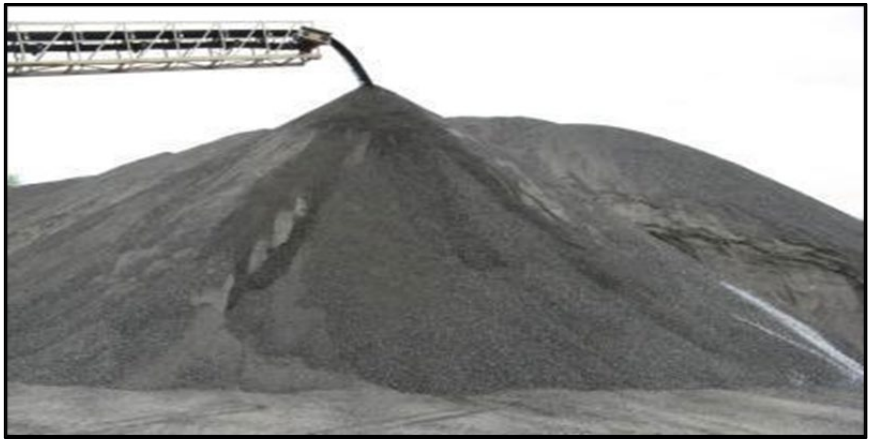
RAP Handling

- RAP Stockpile Considerations
  - Majority of locations have no special RAP stockpiling
  - Very few RAP stockpiles are placed on a sloped surface to aid in draining
  - Very few are placed on a paved surface to minimize contamination
  - Rarely are they placed under cover to minimize moisture and sunlight exposure
  - Consider amount of material needed on-hand



RAP Handling

- RAP Stockpile Considerations Minimize Segregation
  - Building windrows in layers is the most effective way to minimize segregation
  - Use indexing-type conveyors that extend and raise the end of the conveyor as the size of the stockpile increases
  - Keep in mind that a front-end loader is a great way to remix and/or relocate the stockpile

RAP Storage

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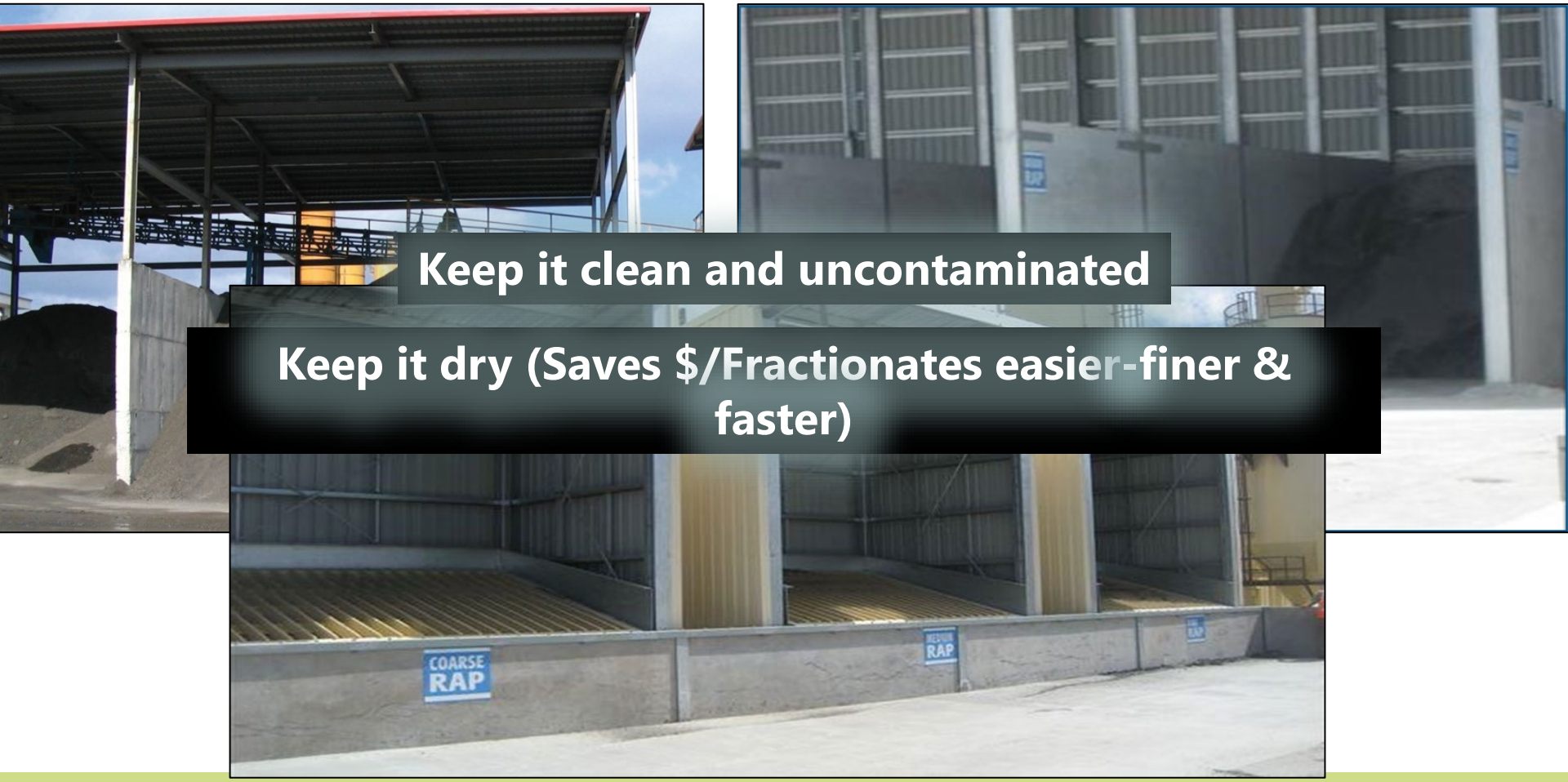
RAP Storage



Keep it clean and uncontaminated

Keep it dry (Saves $/Fractionates easier-finer & faster)

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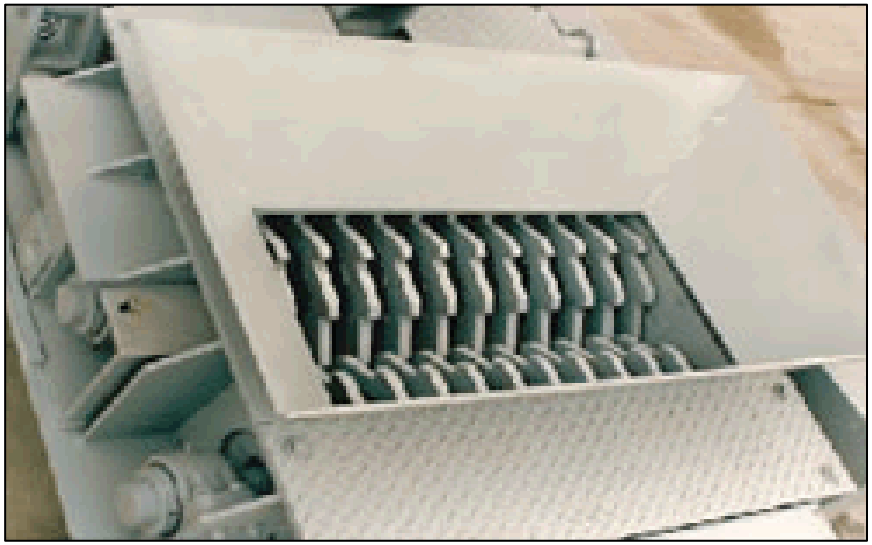
RAP Feeding/Scalping Screens

Oversize can be scalped off and placed back on RAP pile for future

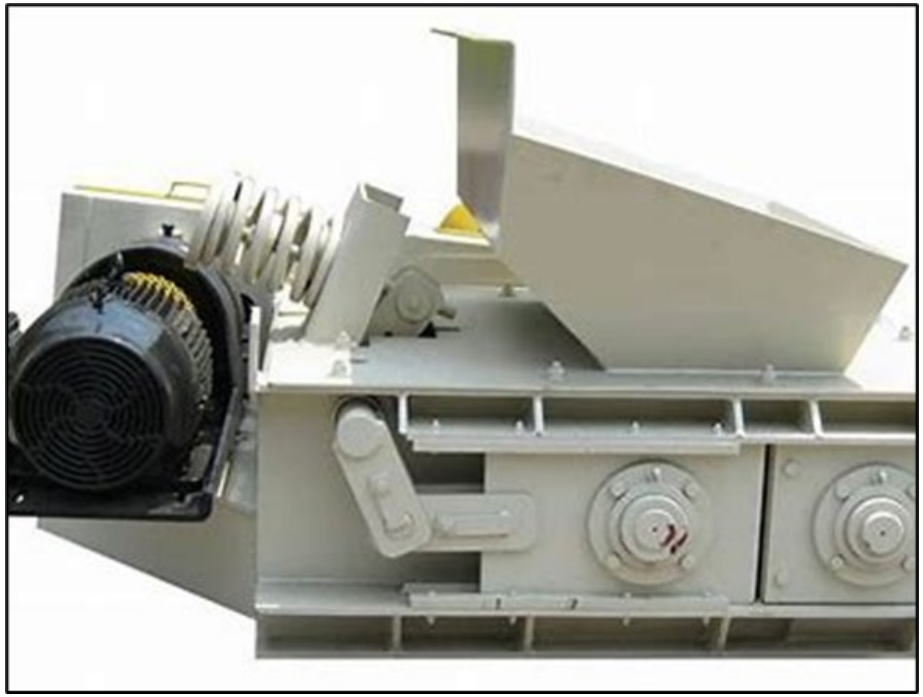
RAP Feeding

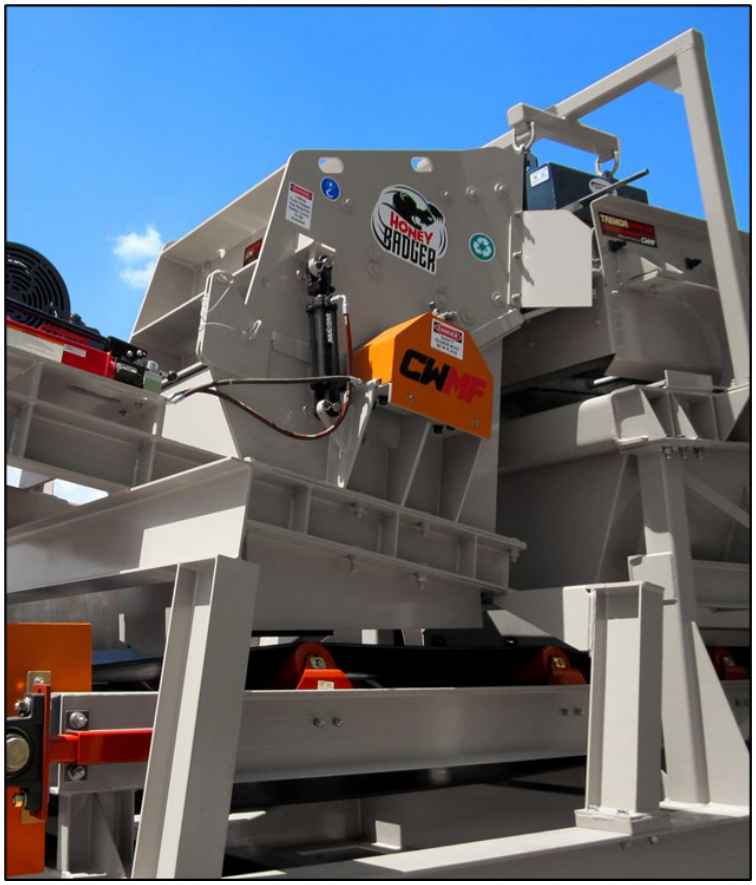
- In-line roller crushers (also known as lump-breakers) and reduced-speed impact crushers are designed to break up agglomerations rather than change the gradation



RAP Feeding

- In-line RAP crushers or crusher circuits which will re-crush any oversize material





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How Much RAP Should I Use?

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How much RAP should I use?

- RAP usage can be limited by several different factors
  - Size of the RAP collar itself
  - Size of combustion unit
    - Inefficient drying of aggregate/ overfiring the burner
  - Design of the drum
    - Flight design/pattern
    - Length of the mixing chamber
  - Use of Warm Mix
    - Less drying time needed
    - Less wear and tear on plant

How much RAP should I use?

It’s all about performance-those tests may limit RAP use

Data from the NAPA Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage 2019

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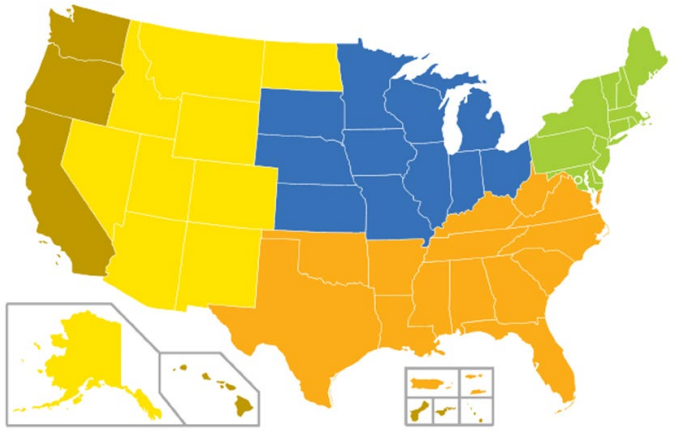
Other Uses

Reclaimed Asphalt Pavements

- Asphalt mixture producers remain the country's most diligent recyclers
  - More than 94% of asphalt mixture reclaimed from old asphalt pavements are put back to use in new pavements
  - Remaining 6 percent being used in other civil engineering applications
    - Unbound aggregate bases
    - Hot-in-place recycling (HIR)
    - Cold-in-place recycling (CIR)
    - Cold Central Plant Recycling (CCPR)
    - Full Depth Reclamation (FDR)

		(tons)			
	Companies	HIR	CCPR	CIR	FDR
NCAUPG	20	213,200	8,400	2,074,072	1,767,980
SEAUPG	5	106,400	0	0	19,431
RMAUPG/PCCAS	3	0	0	26,880	43,005
NEAUPG	NCR	NCR	NCR	NCR	NCR
2019 Totals	**28**	**319,600**	**8,400**	**2,100,952**	**1,830,416**



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In Summary

RAP is worth it's value

- The use of RAP reduces the need for virgin materials, conserves valuable asphalt binder and aggregates, conserves green house gases and is the most sustainable pavement choice
- Beyond the environmental benefits of resource preservation, the use of RAP can help lower initial material costs for road construction, allowing road owners to achieve more roadway maintenance and construction activities within limited budgets

Material	Material Quantity, Million Tons		% Agg.	% AC	Aggregate Cost Savings, $ Billion		Asphalt Binder Cost Savings, $ Billion		Total Cost Savings, $ Billion	
	2018	2019			2018	2019	2018	2019	2018	2019
RAP	82.2	89.2	95	5	$0.822	$0.916	$1.981	$2.375	$2.803	$3.291

Data from the NAPA Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage 2019

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Reclaimed Asphalt Pavements

https://www.youtube.com/watch?v=feiYRSaWB24

National Asphalt Pavement Association Video
America's Most Recycled Product

Questions

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