RAP ETG Meeting

Phoenix, AZ

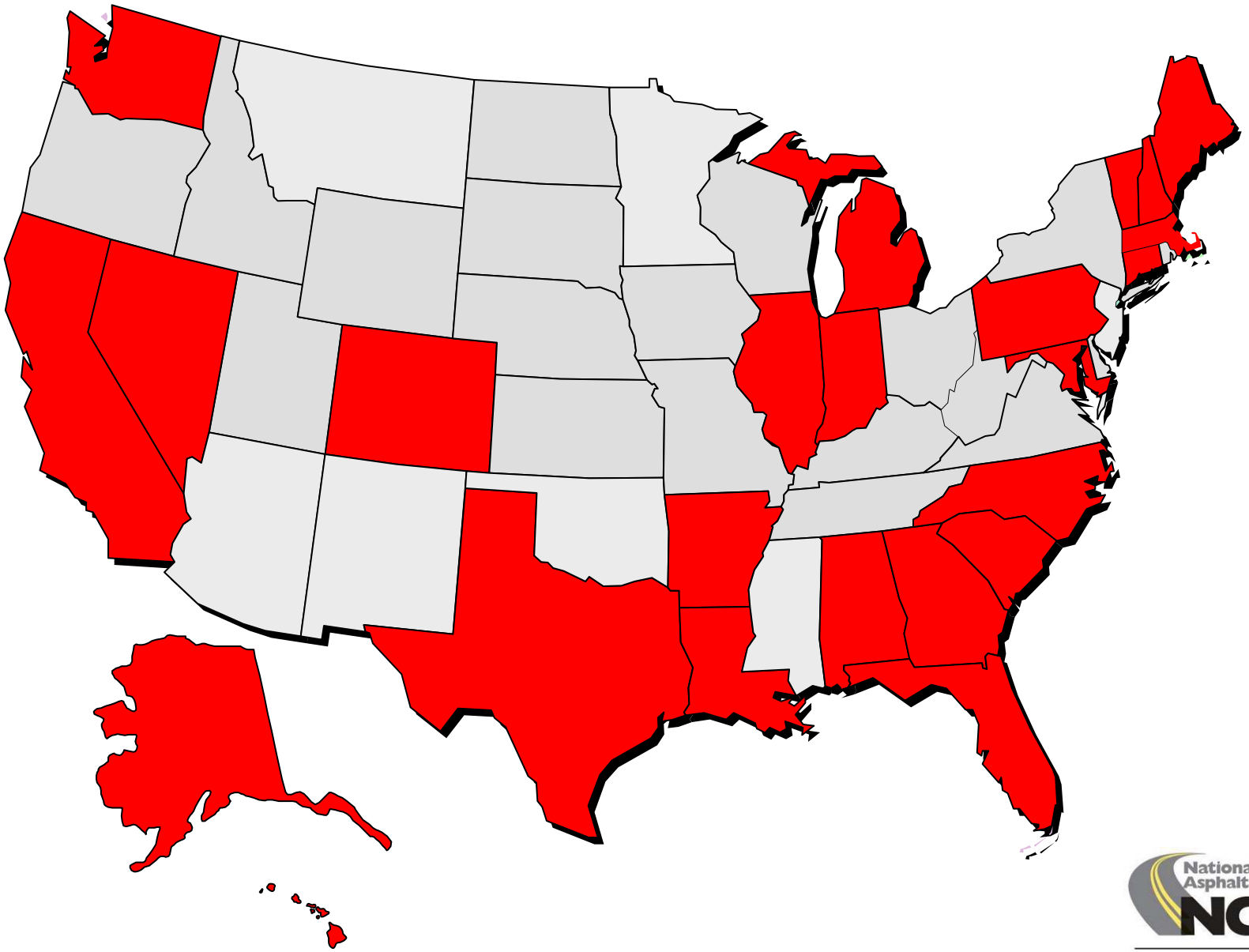
Summary of NCAT's Survey on RAP Management Practices and RAP Variability

Randy West, Director

National Center for Asphalt Technology

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

Responses to RAP Survey



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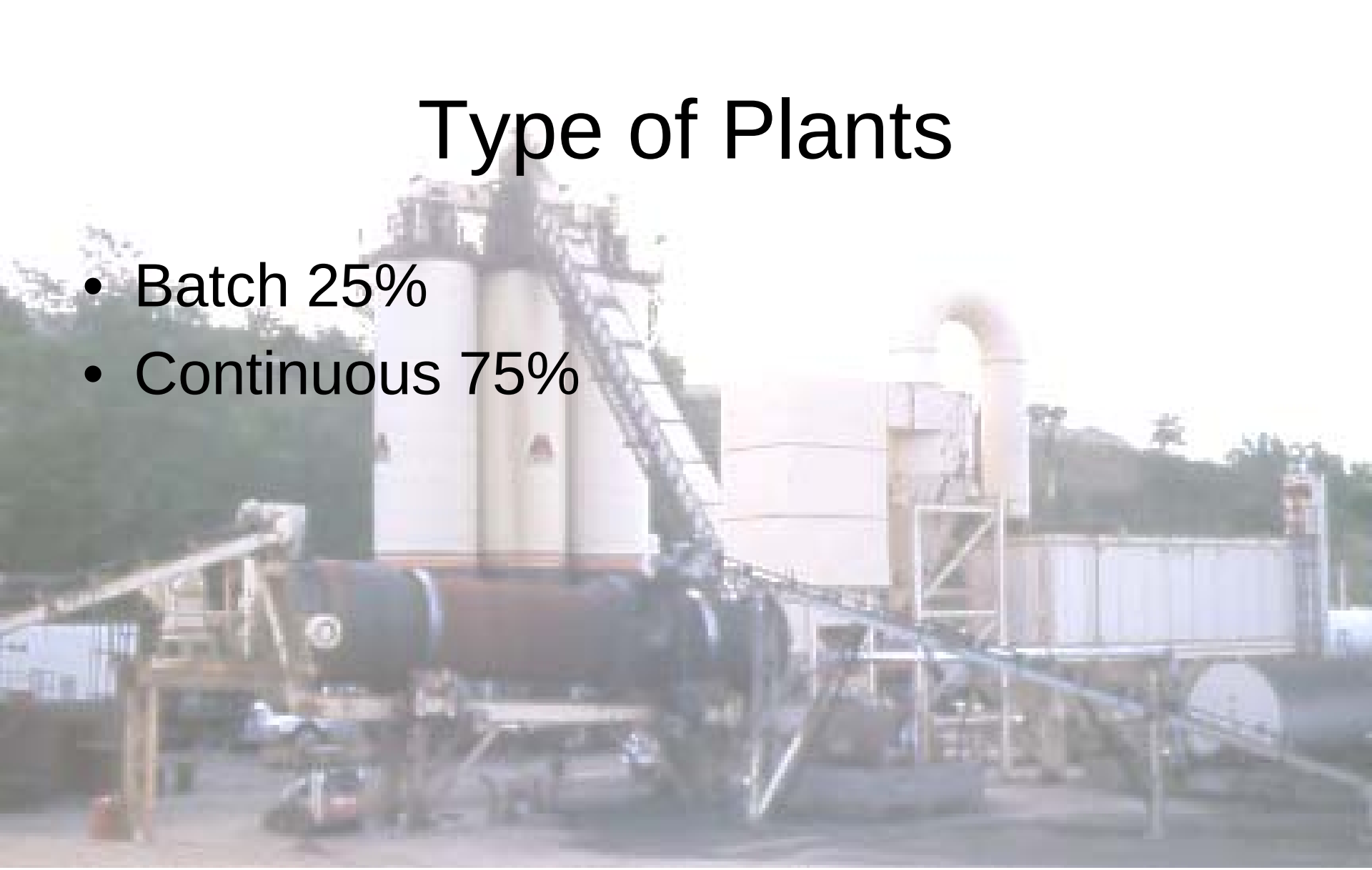
Type of Plants

- Batch 25%
- Continuous 75%



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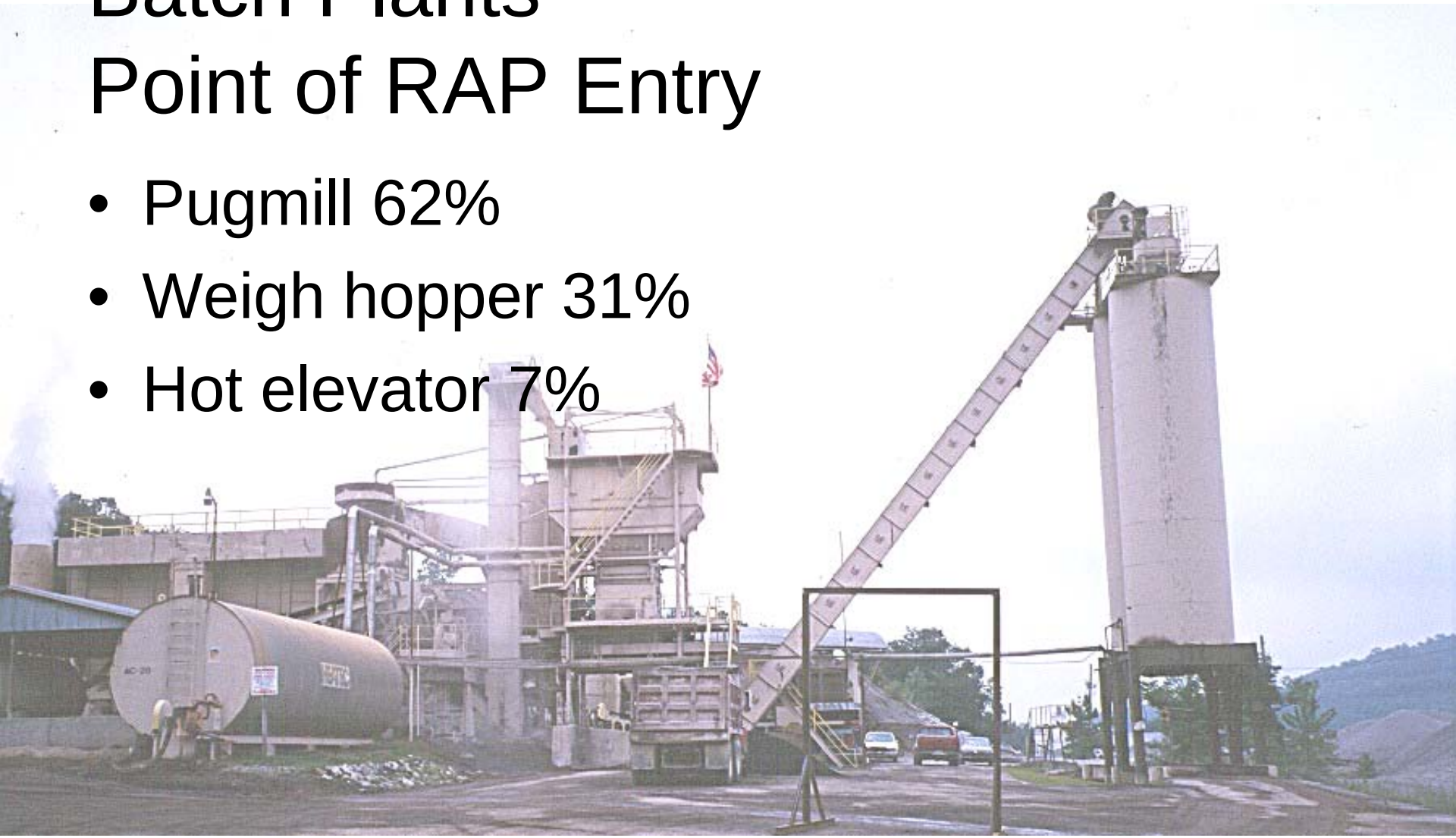
Batch Plants – Point of RAP Entry

- Pugmill 62%
- Weigh hopper 31%
- Hot elevator 7%



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Continuous Plants – Point of RAP Entry

- Mid drum (parallel flow) 24%
- Behind burner (counter flow) 32%
- Outer drum (Double barrel) 38%
- Second drum 6%

Number of RAP Cold Feed Bins

- One 61%
- Two 36%
- Three 3%

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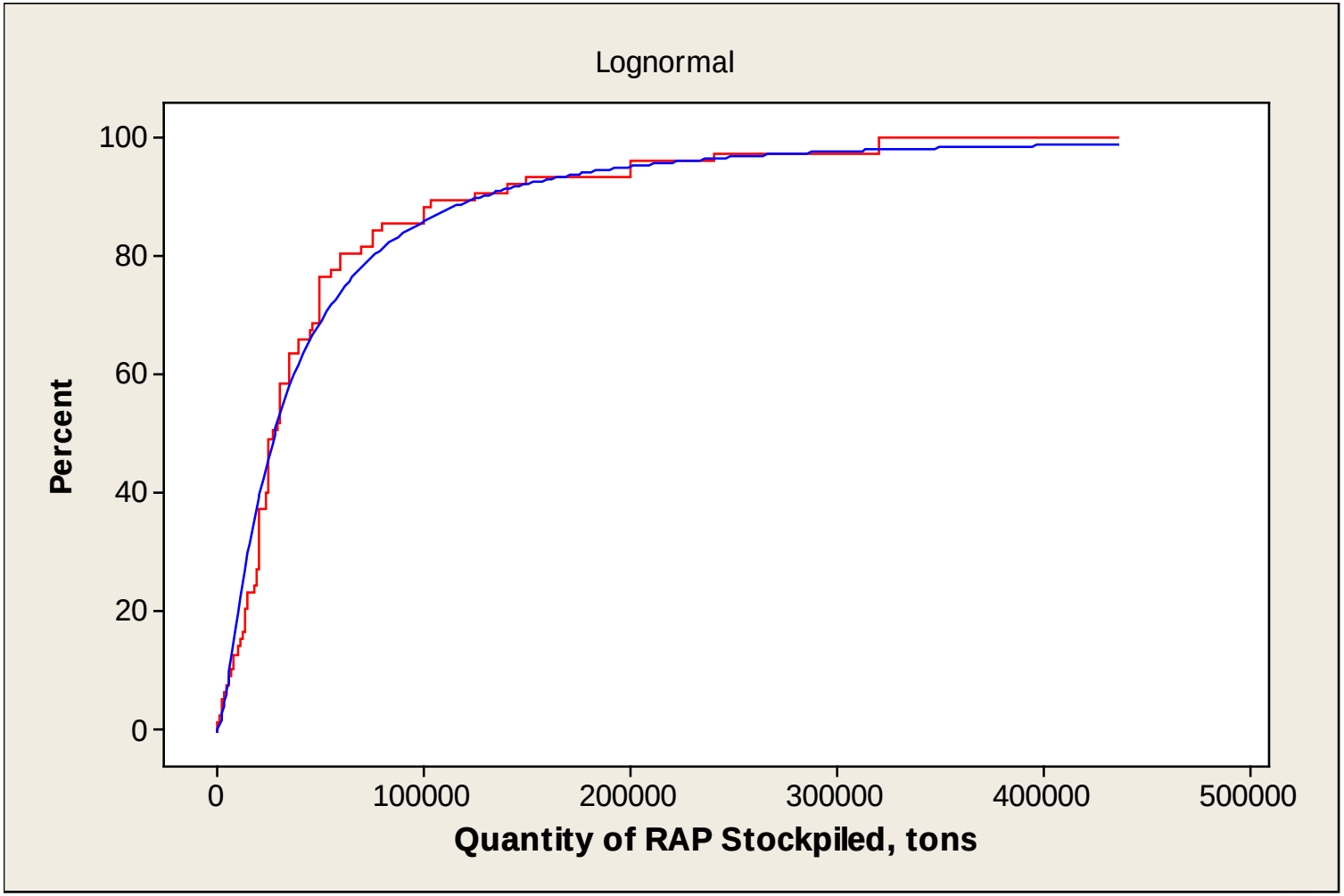
Supply of RAP

- Stable 51%
- Declining 24%
- Increasing 25%

Quantity of RAP Stockpiled



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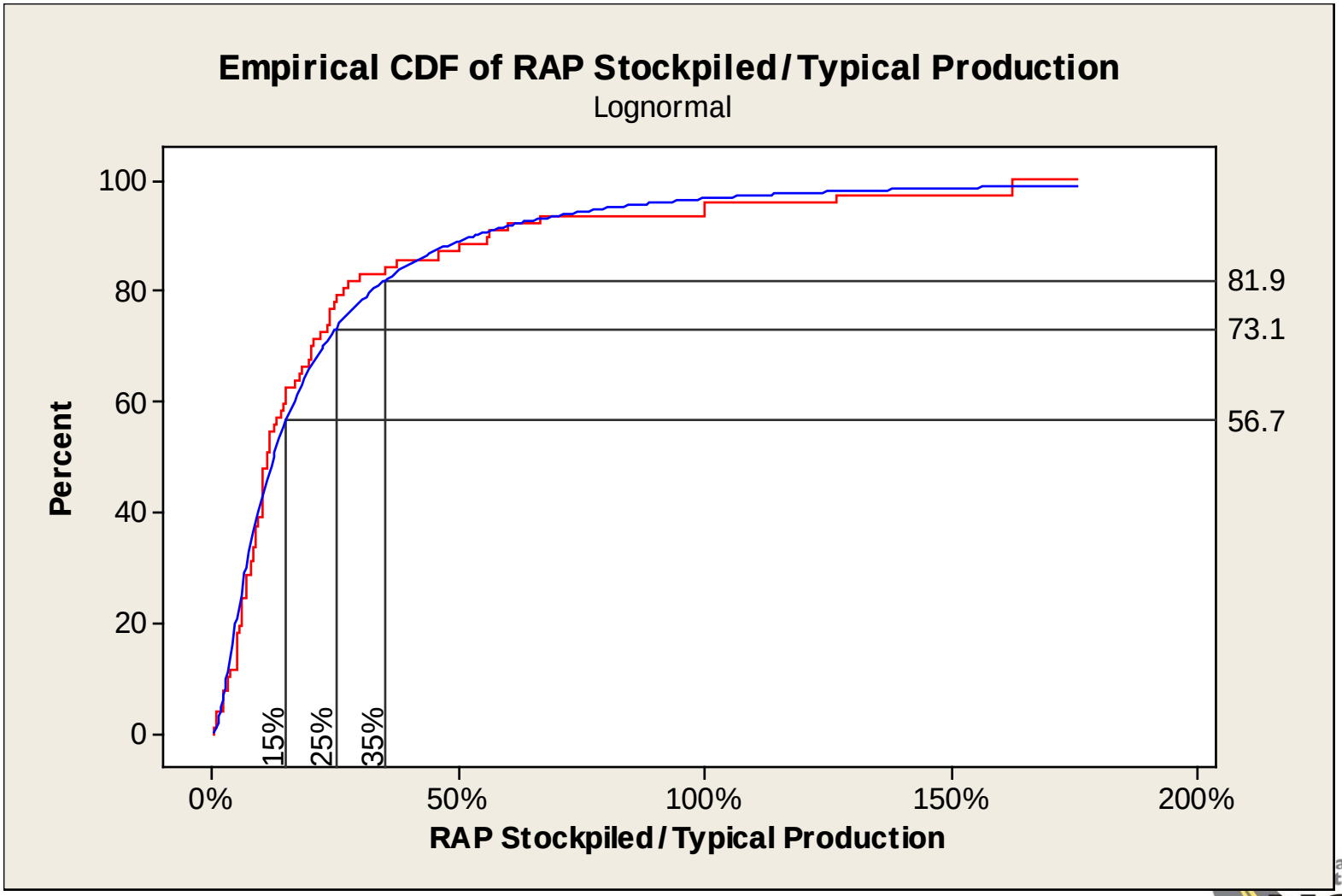
How Much RAP Could Be Used



RAP Management Practices

- Combine all RAP into a single stockpile

50%

- Maintain separate stockpiles for different sources of RAP

50%

Reasons Given for Separate RAP Stockpiles

- Required by state
- To keep millings separate from multiple source RAP
- To improve consistency with RAP stockpiles

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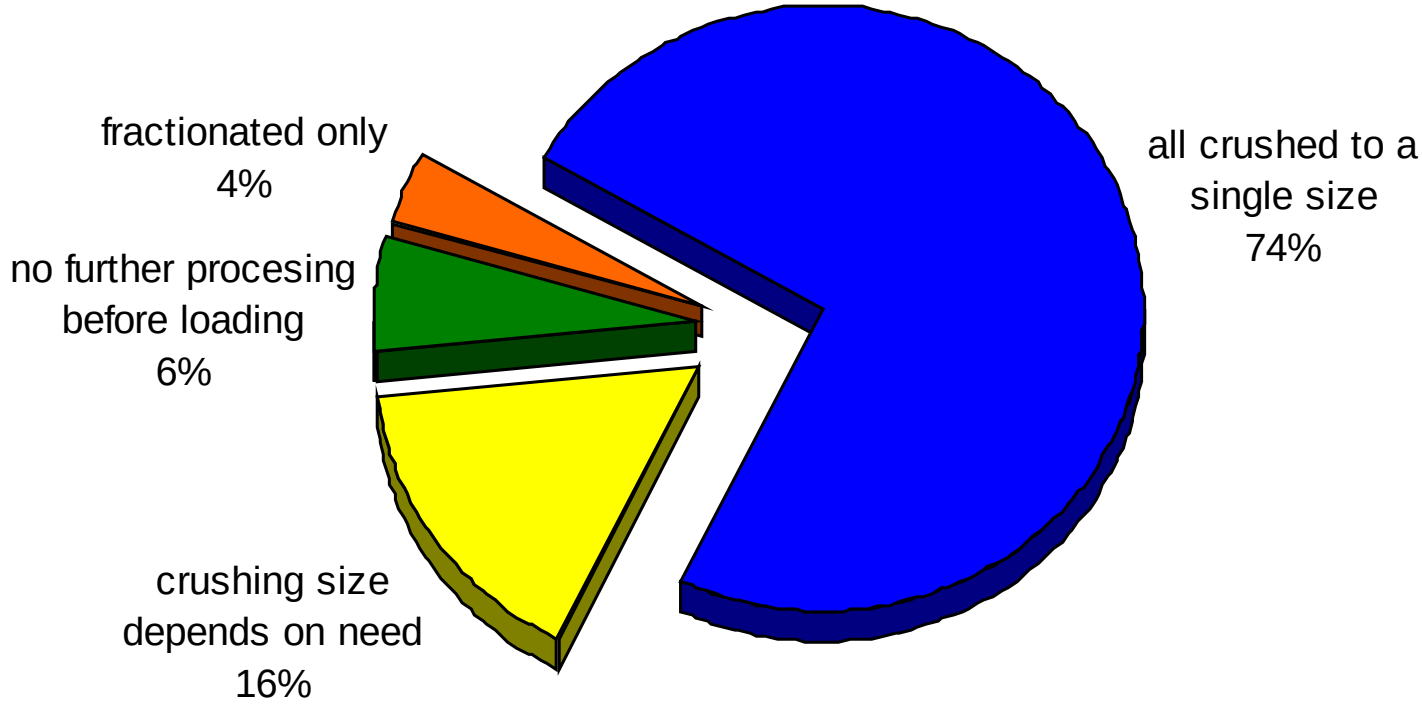
RAP Crushing & Processing



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RAP Crushing: Max Size

Screen Size	% of Responses
< 1/2 inch	6%
1/2 inch	52%
5/8 inch	16%
3/4 inch	11%
1 inch	5%
> 1 inch	11%

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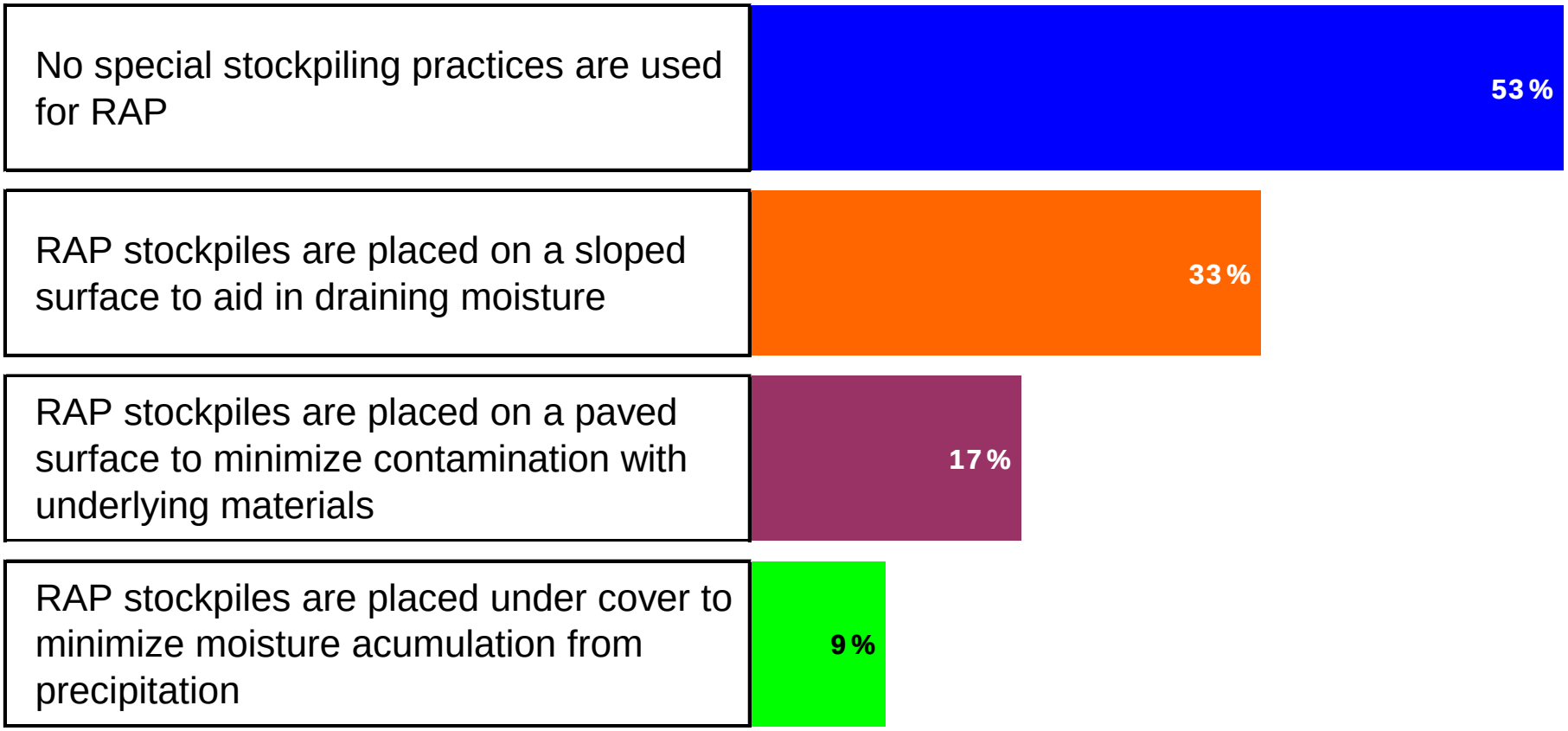
RAP Stockpiling Practices



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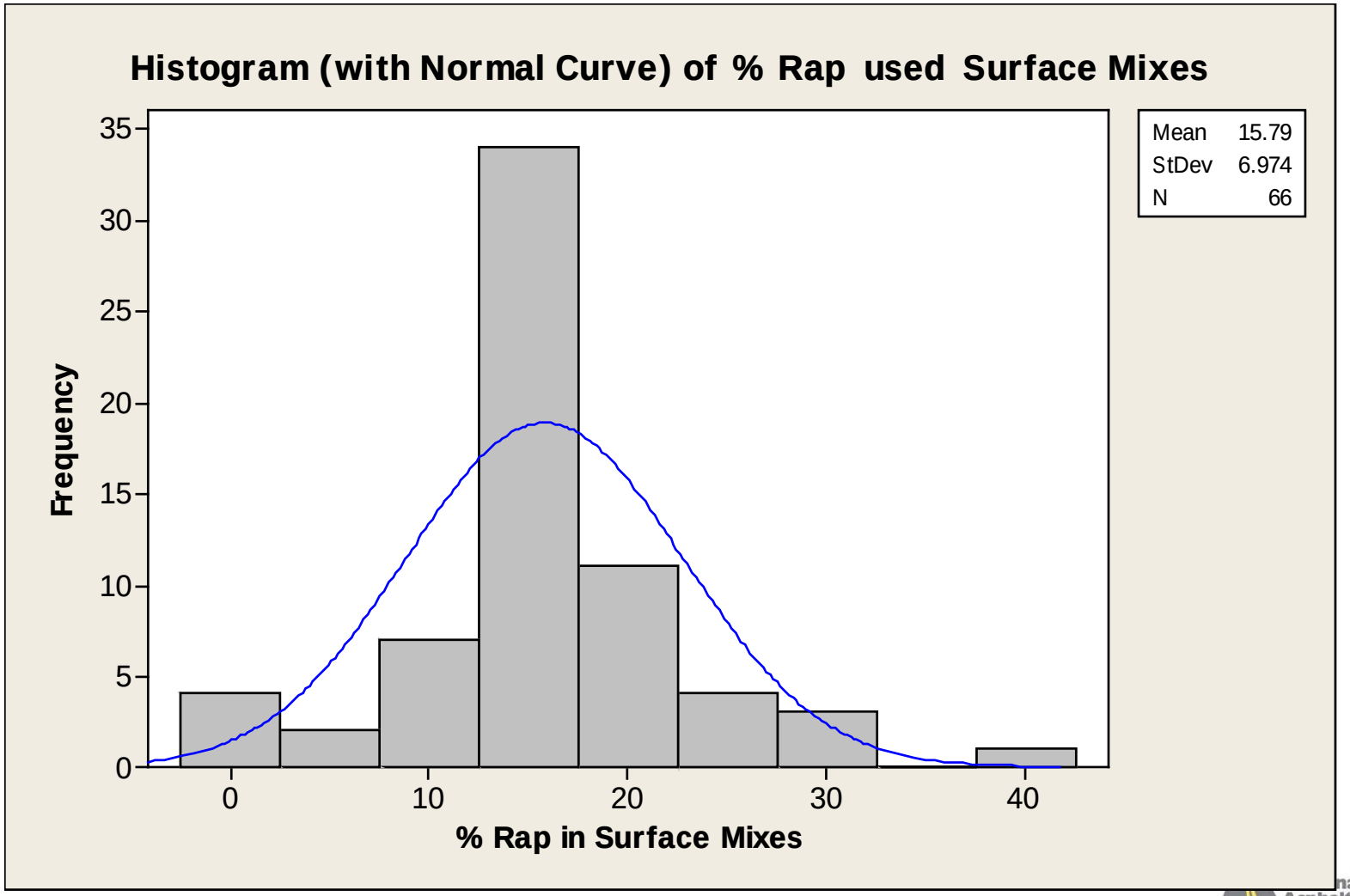
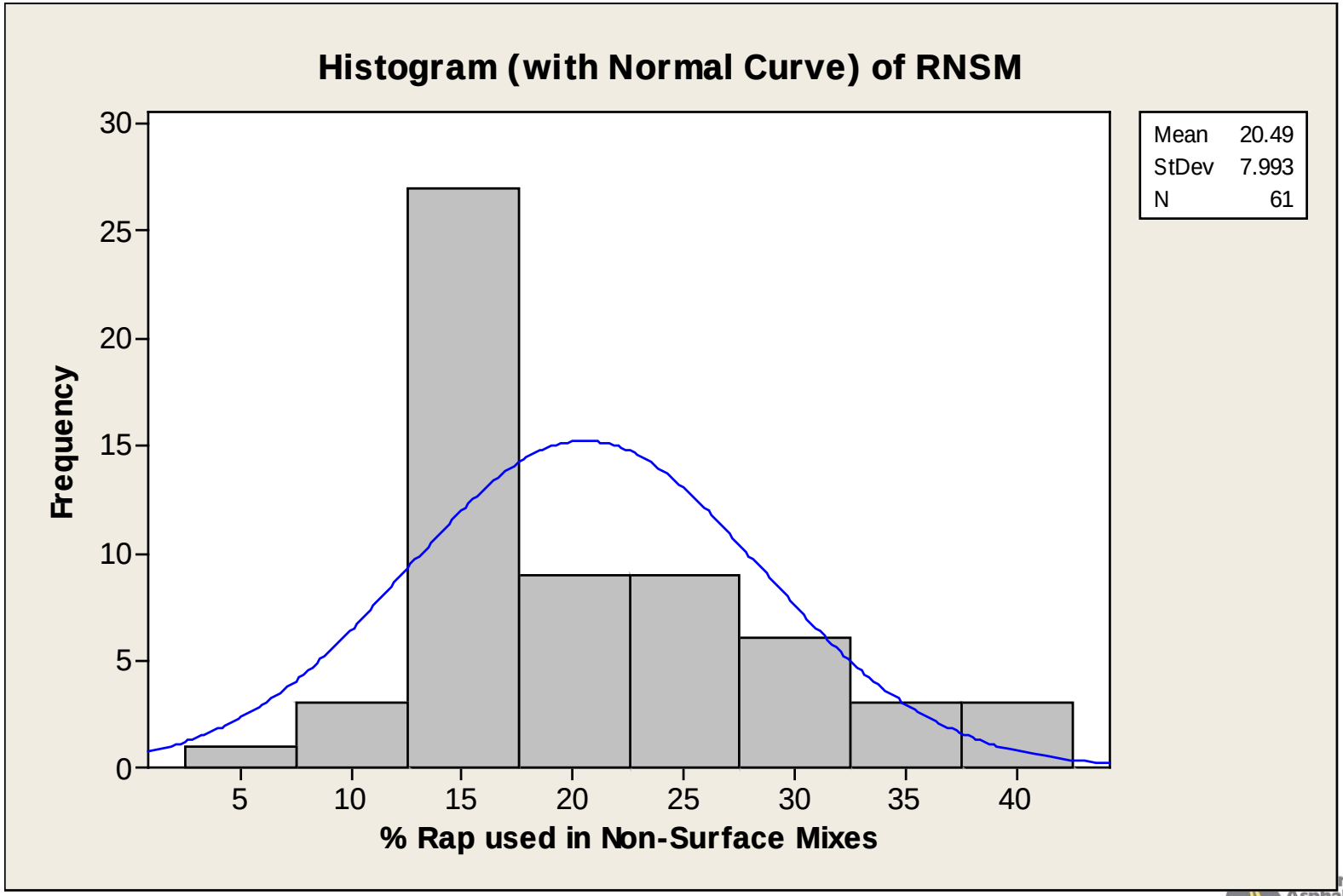
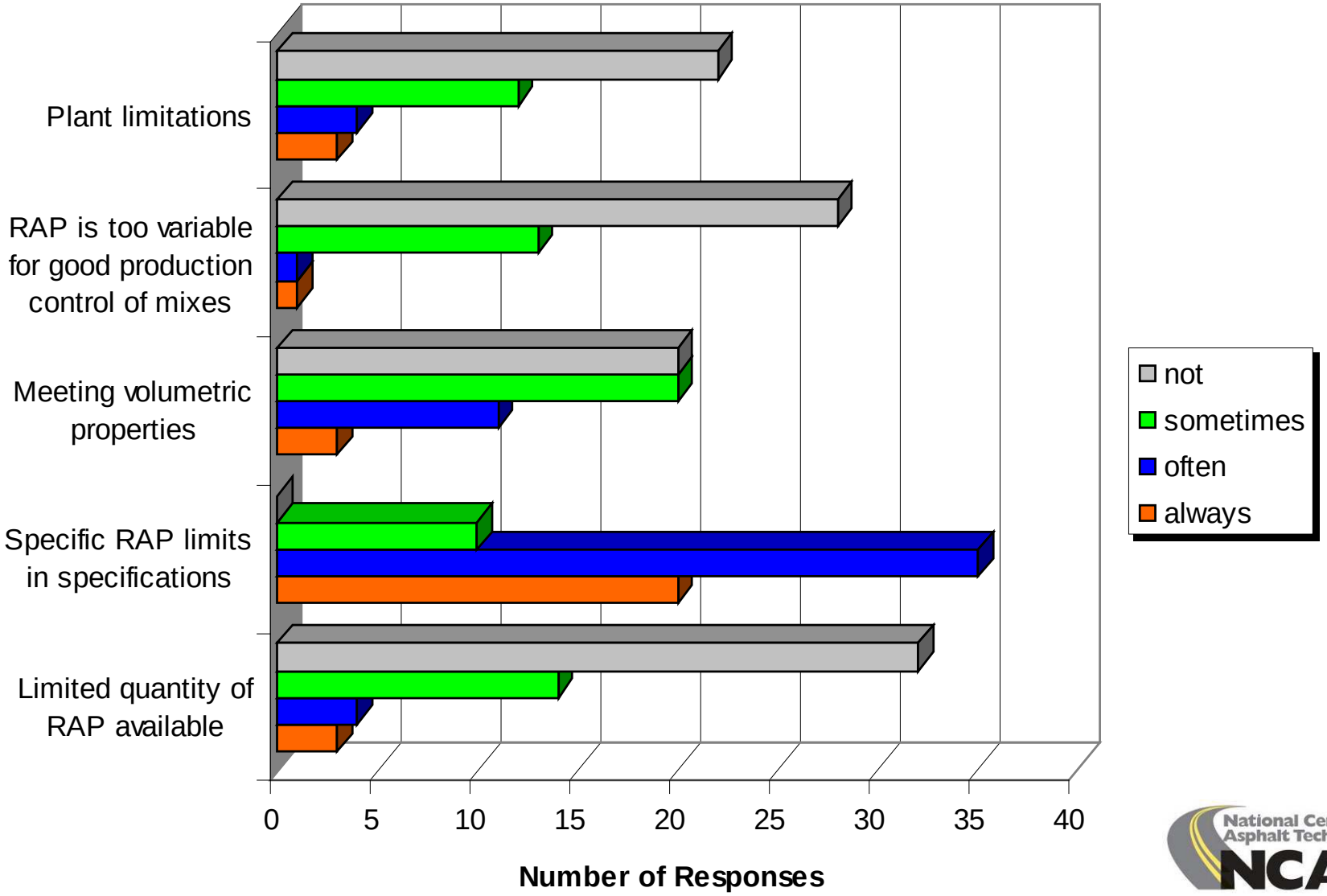
%RAP Used: Surface Mixes



%RAP Used: Non-Surface



Factors that Limit RAP Usage in Surface Mixes



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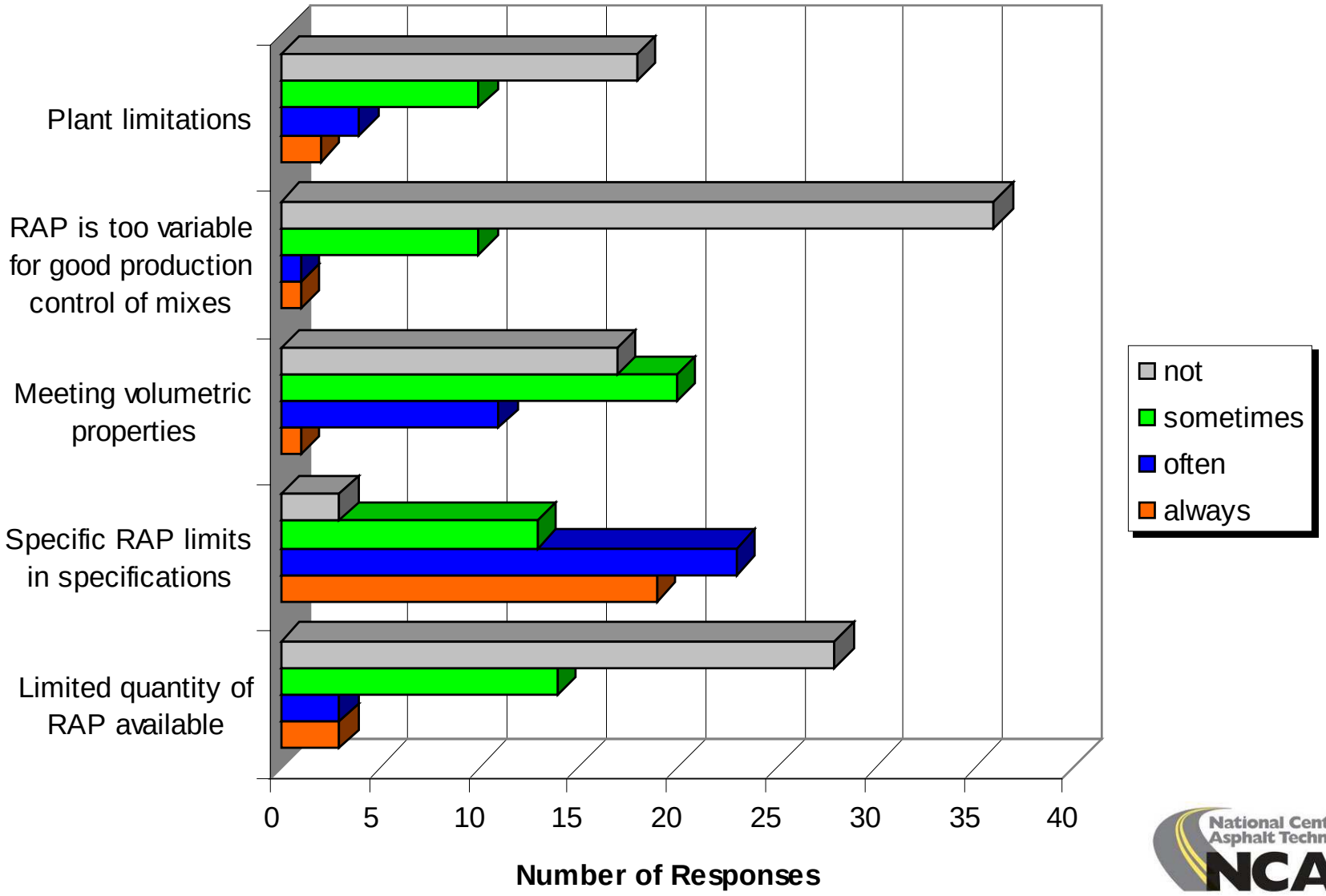
Factors that Limit RAP Usage in Non-Surface Mixes



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Quality Control: Frequency of Testing RAP Stockpiles

Testing Frequency (one test per…)	% of Responses
500 tons or less	43%
Greater than 500 tons, less than or equal to 1000 tons	33%
Greater than 1000 tons, less than or equal to 2000 tons	20%
Greater than 2000 tons	4%

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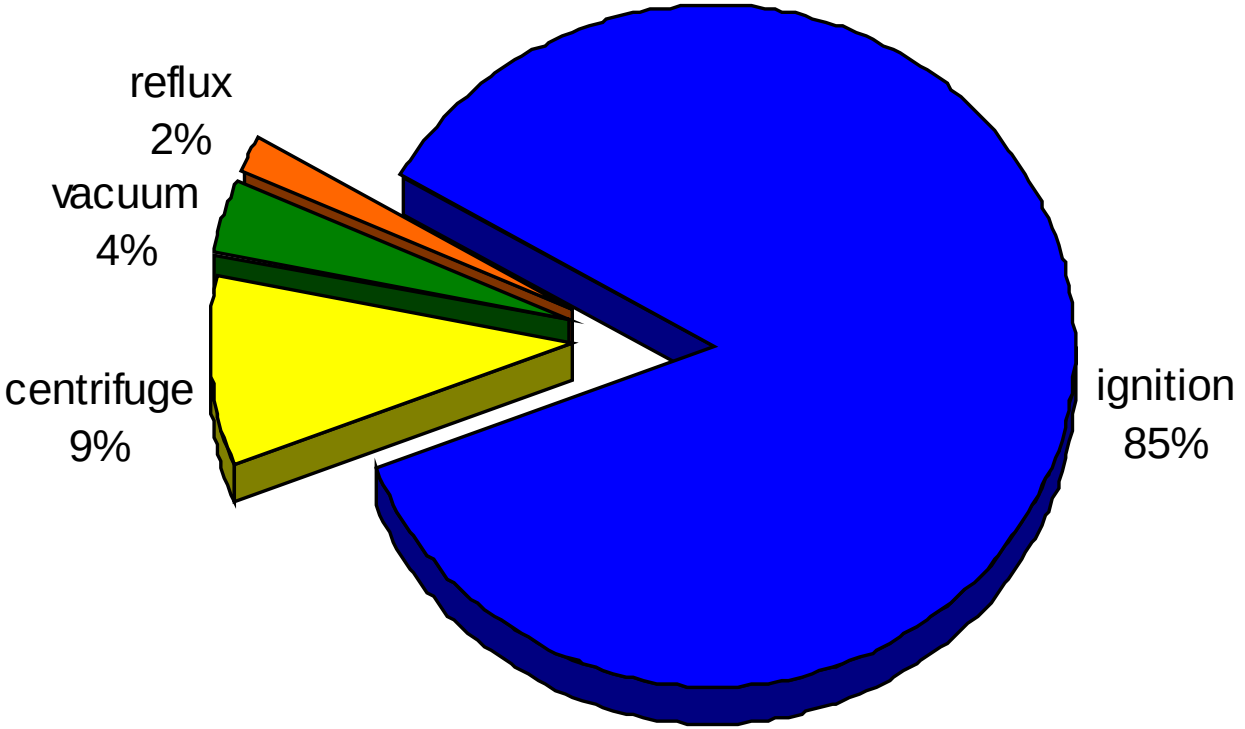
AC Content of RAP Stockpiles



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RAP QC Statistics

RAP property	n	Average (%)	Standard Deviation (%)	
			Average	Range
Asphalt Content	70	5.0	0.46	0.1 to 1.5
% Passing Median Sieve	58	51.7	4.32	0.78 to 9.0
% Passing 75 micron Sieve	58	7.37	1.09	0.3 to 3.0

These data are consistent with other reports

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Key Findings

- Most HMA producers have a limited supply of RAP (only 27% of producers have enough RAP to run 25% in all mixes)
- Nearly half of producers use the same RAP% in surface and non-surface mixes
- Most HMA producers claim that the greatest factor limiting RAP usage is agency specifications

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Key Findings

- Most HMA producers do not use best practices for RAP management
  - Separate stockpiles for different sources
  - Crushing to minimize dust
  - Minimizing moisture in RAP stockpiles
  - Fractionating RAP
- Meeting volumetric properties during production is the second most cited limiting factor for increased RAP usage

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Key Findings

- Most HMA producers test RAP stockpiles at least once per 1000 tons
- 85% of contractors use the ignition oven to determine RAP asphalt content
- Typical standard deviations:
  - Asphalt content: 0.46%
  - %Passing median sieve: 4.3%
  - % Passing 0.075 mm sieve: 1.1%

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RAP QC Statistics

Recycled Hot-Mix Asphalt Concrete in Florida: A Variability Study
ICAR – 401-1/98

RAP property	n	Average (%)	Standard Deviation (%)	
			Average	Range
Asphalt Content	20	5.4	0.30	0.1 to .55
% Passing Median Sieve	20	47.9	3.11	1.29 to 5.66
% Passing 75 micron Sieve	20	9.1	0.93	0.45 to 2.22

Data from p.7 & 8

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ICAR-401-1/98
Recycled Hot-Mix Asphalt Concrete

- The statistical analysis revealed that increasing the percentage of RAP does not increase the coefficient of variation of the mix. (This is in the RAP range of 15 to 40% and most of the mixes had between 25-25 percent RAP).
- Based on stockpiles at contractors plant site…
- Analysis of variance on the median coefficient of variation revealed that RAP had a lower variation than virgin aggregates
- ANOVA for the maximum CV indicated that no significant difference between any of the materials: HMAC, RAP, or virgin aggregate.

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The RAP Summit

October 9, 2008
Auburn, Alabama

U.S. Department of Transportation
Federal Highway Administration

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The RAP Summit

- Invited Chief Engineers from all state highway agencies and state asphalt pavement executives
- Engineers from 24 state highway agencies + District of Columbia attended

- Goal: to share information on why we need to recycle asphalt, the benefits of recycling, and how it should be done to ensure a quality long-lasting pavement.

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Distinguished Speakers

- Kevin Keith, Chief Engineer, MODOT
- Pete Stephanos, Director, FHWA OPT
- Dennis Rickard VP Asphalt, Oldcastle Matls
- Charles Potts, CEO, Heritage Const. & Materials
- Jon Epps, Recycling Mgr, Granite Construction
- Randy West, Director, NCAT
- David Newcomb, V.P. Research, NAPA
- Don Brock, CEO, Astec Industries
- Cecil Jones, State Materials Engineer, NCDOT
- Jay Winford, President, Prairie Contractors
- Ron Sines, VP HMA OPS, Oldcastle Matls.

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Kevin Keith

- Prior to 2003 MODOT did not allow the use of RAP.
- Since 2003, MODOT has incorporated over 1.2 million tons of RAP into its hot mix asphalt.
- In 2006 alone, we saved nearly $10 million by utilizing RAP. (444,800 @ $21.00 / ton = $9,340,800)
- MODOT's total savings over the last 5 years is estimated at $34 million

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What's Needed?

1. Clear engineering and environmental **standards and policy** for the use of RAP.
2. Funded, coordinated **research** to support standards.
3. Public and industry **working groups.**
4. Education.

Macro Factors that Influence Asphalt Supply and Price

- Crude cost
- Regional and state budgets, 2007 demand declined by as much as 15%
- 15,000,000-19,000,000 tons/yr residuum shifted from asphalt and fuel oil to coker feed over the next three years. (2008-2010)
- Considering historical and current economics, coker feed will be the most economical use for the refinery residuum supply. Fuel oil and asphalt economics will compete for the remaining supply.
- World demand for fuel oil has caused recent prices to be higher than asphalt prices and will most likely continue to cause upward price pressure on asphalt.
- World crude is being produced at maximum rates, expect an average $90/bbl WTI or greater for 2008
- US refining running at maximum capacity-expansion required to meet demand
- Refinery capacity expansion limited to Cokers and to lesser extent minor crude unit expansion to accommodate heavier crude.
- Asphalt will have to compete with alternate residuum uses

- In mid-1980 the Florida DOT began state-wide implementation of hot mix recycling as a standard design alternative to be included as a consideration for all rehabilitation projects.
- Numerous technical reports were produced by the Florida Department of Transportation Bureau of Materials and Research.
- One report was entitled “Guidelines for Hot Mix Recycling of Asphalt Pavements,” developed for use in Florida were reproduced and distributed nationally.

Recycling Benefits

- Conservation
  - Materials (aggregate and asphalt binder)
  - Energy (burner fuel, trucking, etc.)
- Preservation of environment
  - Landfill
  - Green house gases (global warming)
  - Sustainability
- Economics
  - Reduce first and life cycle cost
  - Complete reconstruction vs. alternative methods
  - Increased contractor competition

Recycled HMA Performance Summary

- Few reports are available to evaluate long-term performance of moderate and high RAP mixes
- RAP mixes perform very well with regard to rutting
- Comparisons of field cracking performance range from no difference to slightly more cracking with RAP mixes
- Detailed documentation of older projects would be helpful

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Barriers to Increasing RAP

- Mixture Quality Performance Test
- Use of Solvents in Extraction/Recovery
- Comingling of Aged and New Binders
- Need for Changing Binder Grade
- Laboratory Heating/Mixing Procedures
- RAP Availability
- Variability of RAP
- Establishment of Best Practices
- Documented Performance of high RAP Pavement
- Polymer Modified Binders and Asphalt-Rubber with RAP

Have No Doubt. . .

Barriers must be removed!

Technical issues must be resolved!

White Rock
4-0

White Rock
3/8 - 4

White Rock
1/2 - 3/8

Black Rock
4-0

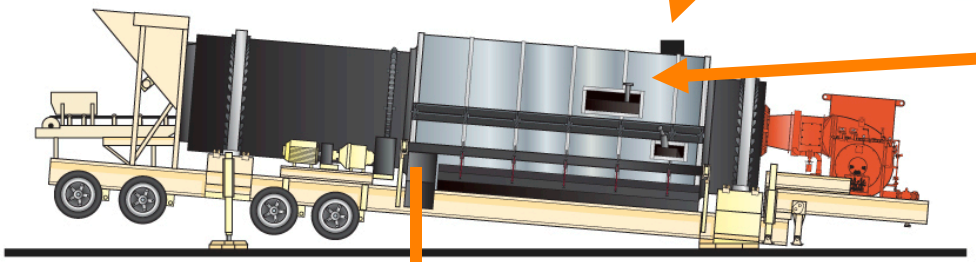
Black Rock
3/8 - 4

B%

C%

BB%

Black Rock
1/2 - 3/8



X%

SUPERPAVE MIX WITH PROCESSED RAP - CHOICE #1

For the Producer / Contractor

- Improved Workability
- No Smoke – No Smell
- High Percentage Recycle Mix with Standard Grade of Asphalt
- 14% Less Fuel
- 14% Higher Production
- Reduces Cost

Barriers to Increasing RAP Use

- Surveyed AASHTO Subcommittee on Materials
- One Question
- What is the major barrier to your state increasing the use of RAP in HMA?
- Response from 41 States

EXAMPLE OF BAD RAP USAGE:

- A DOT used 10,000 tons of RAP on front slopes of newly constructed four lane.

-So, RAP value = $70.00 x 10,000 tons

$700,000 material cost

Had they used stone @ $30.00 per ton

$300,000 material cost

Therefore loss to taxpayer = $400,000!

Note: Assumes same transport to project for each product.

PRAIRIE
OPELOUSAS, LA.

Post Summit Action Plan

- Address Specifications
  - Where appropriate set specification limits:
    - Surface mixes minimum of 15%
    - Non-surface mixes minimum of 25%
  - Establish specification requirements to ensure quality mixes are constructed
    - "Set the bar" at an appropriate level and let industry innovate to clear the bar
  - Implement programs to move toward higher RAP percentage mixes

Oldcastle Materials

Post Summit Action Plan

- Non-DOT RAP Use
  - Reconsider specifications which may preclude the use of RAP from random piles or non-DOT projects
    - New processing techniques may allow the use of a portion of the RAP while still assuring mix quality and safety concerns

The RAP Summit

- Very positive from attendees
- Presentations available on RAP ETG website
- Video to be produced for broader audience

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