

RECYCLED ASPHALT PAVEMENT

SAVING PAVEMENT · SAVING MONEY · SAVING THE ENVIRONMENT

Dudley Bonte, Rieth-Riley

Becky McDaniel, North Central Superpave Center

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TODAY'S TOPICS

- What: RAP and its History
- Where: Uses of RAP
- When: Limitations to Use
- How: RAP Processing, Equipment, QC, Best Practices
- How: Current INDOT Specs, Other Specs and Potential Changes in Specs
- Why use RAP?



WHAT IS RAP?

- Reclaimed Asphalt Pavement (RAP)
- Existing pavements removed and reused
- Produced by
 - Milling -- Upper pavement layers removed and replaced with new pavement
 - Full-Depth Removal -- Pavement completely removed and reprocessed

TYPICAL ASPHALT MIX

- 95% aggregate (approx. 30% of cost)
- 5% asphalt binder (approx. 70% of cost)

Reusing:

- Reduces need to quarry more aggregate
- Reduces energy/costs to produce, process, transport aggregate
- Reduces asphalt demand

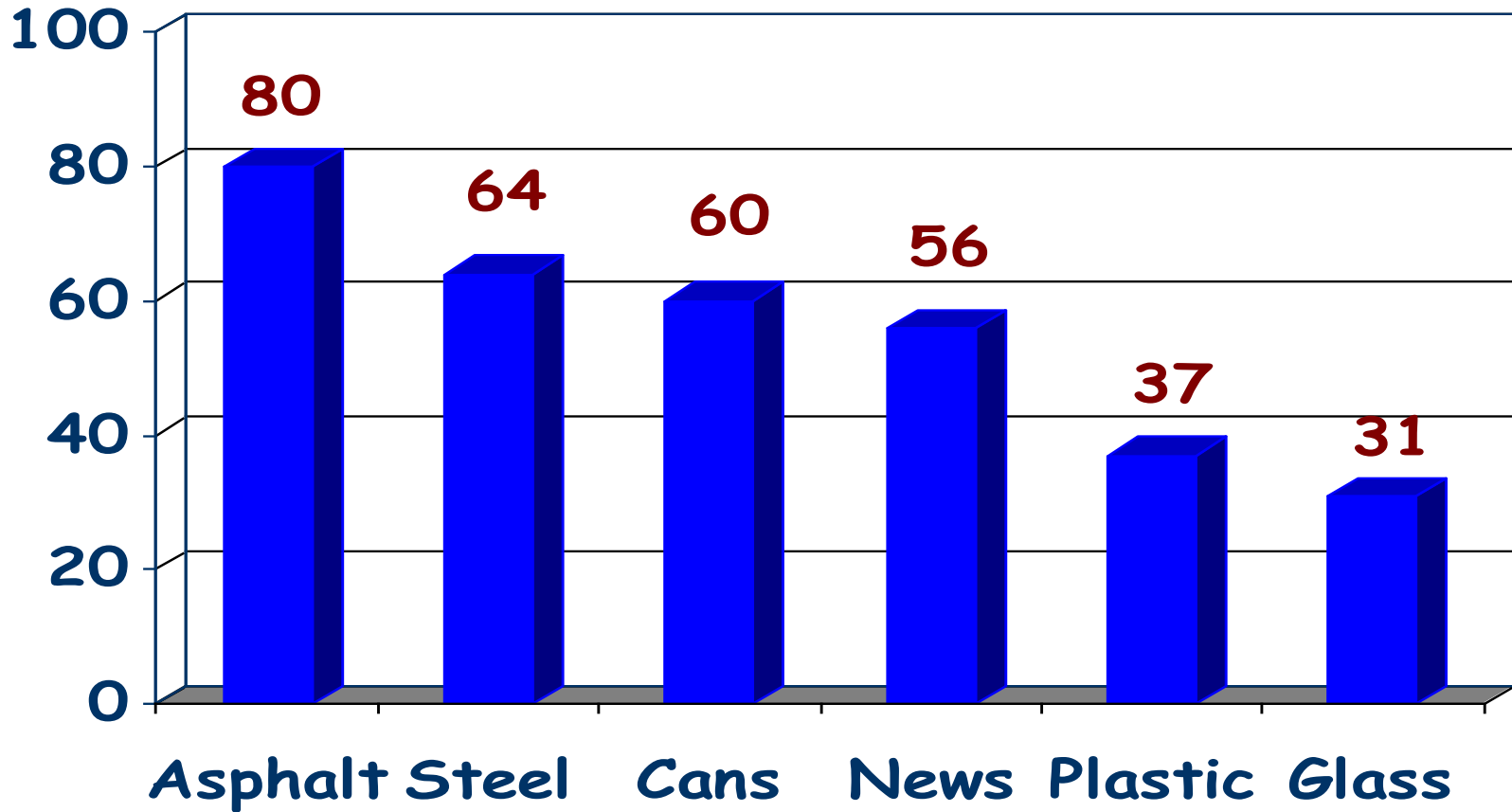
HISTORY OF RAP USE

- First used in 1915 (!)
- Major emphasis started in 1970's
 - Oil embargo and increased oil prices
 - Improved milling machines
 - Counterflow drum plants
- Became routine in many states
 - Necessary to be competitive (lower bid prices)

USES OF RAP

- RAP can be used for
 - Base
 - Fill
 - Shoulders
 - Alleys
- But, the highest and best use of RAP is back into new asphalt mixtures.
 - Most beneficial
 - Most cost effective

PERCENT RECYCLED - 1993



ALONG CAME SUPERPAVE

- No guidelines for using RAP
- New system – lots of unknowns
- Interim guidance based on old Marshall mixes
 - Up to 15% RAP, no change
 - 16-25% RAP, drop binder grade one increment
 - Over 25% RAP, blending chart needed
- National research confirmed those levels in 2001

CURRENT USAGE

- Most states are back to *or above* pre-Superpave usage levels.
 - Nationwide only a few states do not allow RAP.
 - AASHTO specs allow easy use of up to 25%.
- Contractors in most states reported using RAP whenever they can.
 - Lower bid prices.
- *Performance as good as virgin mixes.*

TODAY

- Strong incentives to increase RAP use
 - Increased material and energy costs
 - Binder costs rose over 300% in 2007 & 2008
 - Material supply issues
 - Growing environmental concerns
- Growing demand
 - Use RAP in more mixes (i.e. surfaces)
 - Use higher RAP quantities
 - Increased Availability of RAP from projects

WHERE CAN RAP BE USED?

- Virtually any mix – following best practices
- Base and intermediate
 - Potential to use higher amounts
- Surface mixes
 - Tendency to allow lower amounts
 - Friction and cracking are potential concerns
 - Increased resistance to rutting

AGENCY CONCERNS (LIMITATIONS)

- Quality Concerns (including friction)
- Consistency of RAP
- Ability to Meet Volumetric Requirements
- Durability of Mixes
- Stiffness of Binder
- Use with Polymers

WHAT CONTRACTORS CAN DO TO OPTIMIZE RAP





OBTAINING & PROCESSING RAP

COMPOSITE SOURCES (GOK)

- Usually chunks and slabs from full depth pavement removal
- Plant cleanout
- Reject material or excess returned from jobs
- Excavation
- Other sources





In GOK Pile

***After
Processing***



Composite RAP is reprocessed (i.e. crushed, screened, stockpiled and QC tested)



The reprocessed products are very consistent components



RAP FROM MILLING

- Removes old/distressed pavement
- Improves smoothness
- Eliminates costly shoulder work
- Maintains drainage features, curbs, clearance
- Valuable rehab option



- Millings generally require no additional processing.
- After testing they may be incorporated into HMA mixtures
- Millings are stockpiled separately by job and size



FRACTIONATING TO $-1/4''$



COST/BENEFITS OF RAP

- Milling or Pavement Salvage Costs
 - Mill, haul & stockpile: ≈\$6.50/ ton
 - Excavate, haul & stockpile: ≈ \$7.00/ton
 - Reprocessing: ≈ \$5.00/ton
- Virgin Material Costs
- Coarse Aggregate ≈ \$12.00/t
- Fine Aggregate ≈ \$8.00
- PG Binder ≈ \$450.00

COST SAVINGS USING RAP FOR A TYPICAL 19.0MM INTERMEDIATE

% RAP	Per ton Savings \$ (materials only)	Notes
0	0	
15	\$3.40	
25	\$5.50	Does not include premium PG58-28
40	\$6.80	Includes premium PG58-28

25% RAP in an intermediate 19.0mm HMA will save approximately 11% per ton
Assuming a 3" lay; for every 1 million resurface dollar this will equate to approximately 2.2 lane miles of additional paving.

COST SAVINGS USING RAP FOR A TYPICAL 9.5MM SURFACE

% RAP	Per ton Savings \$ (materials only)	Notes
0	\$0	
15	\$3.40	
25	\$5.50	Does not include premium PG58-28
40	\$6.80	Includes premium PG58-28

25% RAP in a Surface 9.5mm HMA will save approximately 9% per ton.

Assuming a 1.5" lay; for every 1 million resurface dollars this will equate to approximately 2.6 lane miles of additional paving

RAP MANAGEMENT & BEST PRACTICES

- Monitor & control incoming RAP
- Stockpile job millings by job and size
- QC tests on all RAP
- Fractionate RAP (when applicable)
- Avoid contamination
- Keep the RAP dry –paved and sloped area, covered stockpile (BTU's= \$\$\$)
- Know Plant limitations (e.g. Batch plant)



**Contamination-
Not Good**

RAP IS JUST ANOTHER COMPONENT OF HMA



SAME STANDARDS AS VIRGIN MIXES

- INDOT Sec. 400 Standard Specifications
- Aggregate quality
- Superpave volumetric lab mix designs
- QC/QA verification testing and acceptance



RAP

Shingles



CURRENT INDOT SPECS

- Up to 25.0% RAP by weight of total mixture
- Up to 15.0% RAP in surface courses for 3 million ESALs or higher or for open graded mixtures
- No change in binder grade up to 15.0% RAP; drop one grade for greater than 15.0% RAP

POTENTIAL CHANGE IN INDOT SPECS

- Current research and testing suggests higher RAP contents may be feasible
 - RAP blending study
 - RAP friction study
- INDOT – industry meeting tomorrow
- Potential to allow up to 25% RAP without a grade change and up to 40% with change
- Watch for final decision and supplemental specs

REMOVING/LOWERING BARRIERS

- Nationwide specs vary widely
- Several states allow up to 50% RAP
- Work is on-going to encourage all states to allow RAP use
- Research is continuing to explore higher RAP contents
- Potential for WMA plus RAP

HMA RECYCLING ETG

- FHWA initiated in May 2007
- Managed by NCAT
- Purpose – Coordinate, develop national guidance and recommendations on RAP use
- Goal – encourage all states to allow 15-20% RAP, then increase some to 25-30%
- Demo projects, document performance, share info, best practices, research

HIGHER RAP CONTENTS

- Do work – do *perform* – if properly designed, produced and constructed
- But, need attention to detail
- Some precautions are needed
 - Many of these are the same as for aggregate best practices

CONCLUSIONS

- RAP has long history of successful use.
- Asphalt recycling is sustainable.
- Asphalt recycling is economical.
- Asphalt recycling works!



THANKS TO:

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 - Available on NAPA website
- Gerry Huber

- And to you!