



Higher RAP Percentages in HMA A Florida DOT Perspective

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(The King of Asphalt and a Prince of a Man)

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Overview

- Background on use of RAP in Florida.
- Benefits of using RAP.
- Current Florida Specifications.
- Eliminate artificial restrictions on use of RAP.
- What are the real restrictions on use of RAP.
- Trade-offs and Risk of increasing RAP.

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FL Recycling Background

- Joint effort
Industry and Agency.
- Full implementation in 1980.
- Separated milling and HMA decisions.
- Contractor ownership of RAP.
- Expectation **equal performance** of HMA w RAP.



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FL Spec Concepts

- Permit use of RAP, not require.
 - Let contractor determine economics.
- Bid Ton mix to include binder (& RAP value).
- Characterize milled material and RAP stockpiles.
 - Gradation, binder content, binder stiffness.
 - Think of RAP as a commercial material with value.
- HMA specifications must assure quality.
 - At mix design and during production.

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Benefits of using RAP

- Environmental: reuse of resources.
- Energy conservation.
- **Economic \$\$\$.**
 - Agency: stretch our transportation dollar.
 - Contractor: edge in bidding.
 - \$400/ton binder, \$25/ton aggregate.
 - Material value RAP reduced by transportation, storage, additional processing (fractionation), waste, profit.
 - Not all RAP has equal value: Let competitive bidding rule.



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Current FL Specs

- RAP is permitted a component material.
 - Mix Design Manual covers obtaining Gsb for RAP.
 - Characterization for gradation, Pb, stiffness.
- RAP limitation (originally requested by Industry)
 - 50% max base and low traffic.
 - 30% max hi traffic >10M ESALs.
 - Reflects typical FL high dust content RAP.



Current FL Specs

- Additional RAP limitation.
 - 15% max modified PG76-22: polymer effectiveness.
 - No RAP in Friction course: aggregate specific specs.
- Binder Selection.
 - PG67-22 (3600 max vis) <20% RAP.
 - PG64-22 (2400 max vis) 20-29% RAP.
 - Recycle Agent (viscosity graded) >29% RAP.

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Current FL Specs

- Mix Design Criteria.
 - RAP or virgin, ALL mix design criteria must be met.
 - Recovered vis 4,000-12,000 poises.
- Mix Production.
 - No changes in acceptance criteria for HMA w RAP.
 - Recovered vis 4,000-12,000 poises.
- Why recovered Vis not PG?
 - RAP recovered = PG82-22 (not modified)
 - Need PG parameter identify ambient crack potential

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Remove Artificial Restrictions

- Minimum criteria for RAP.
 - Assure that it's aggregate and asphalt.
- Allow or permit the use of RAP.
 - In all mixes.
 - Contractor decision.
- Let mix characteristics govern amount of RAP.
 - Use same mix design criteria and acceptance.
 - Assure binder characteristics by recovery testing.

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Removing Restrictions in FL

- Minimum criteria for RAP.
 - Minimal since all aggregate commercial sources.
- Allow or permit the use of RAP.
 - No RAP in Friction Course: aggregate specific.
 - Practical decision: would consider for known aggregate.
- Let mix characteristics govern amount of RAP.
 - 15% max RAP in modified PG76-22
 - No performance test to assure modification of RAP binder.
 - Willing to eliminate other "max limits" on RAP

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Real Restrictions of RAP

- Aggregate Properties
- Binder Characteristics
- Workability of the Mix
- Gradation of the RAP



Real Restrictions of RAP

- Aggregate Properties
 - Geologic type
 - Hardness (LA Abrasion)
 - Soundness
 - Particle Shape (Flat and Elongated)
 - Deleterious Materials
- Most RAP aggregate from acceptable sources
 - Not necessary to check all RAP.

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Real Restrictions of RAP

- Binder Characteristics.
 - Binder interaction / compatibility
 - Black rock vs complete blending of binder.
 - Stiffness of RAP binder.
 - Availability of proper Recycling Agent
- Assume complete blending.
 - Works with low stiffness RAP & compatible RA's
- Problem in North getting proper recovered PG
 - Need PG parameter identify ambient crack potential

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Real Restrictions of RAP

- Mix Workability
 - Stiffness
 - Binder compatibility characteristics
- Fact of Life
 - Warm Mix technology is possibility for future



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Real Restrictions of RAP

- RAP Gradation
 - Maximum size
 - Distribution
 - Dust
- Usually it's the **Dust** that limits use of RAP
 - Maximum size can be handled by processing
 - Distribution is a given, handled by other components
 - Fractionation discussed by others (AC is in Dust)

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**So...if you have removed all
Artificial Restrictions,
and addressed the real ones,
How can you use more RAP?**

And what is the Impact?

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Increase RAP in Florida

- Get rid of "old FDOT fossils"
Set in their ways.
- Usually it's the **Dust** that limits use of RAP
 - Maximum size can be handled by processing.
 - Distribution is handled by other components.
 - Rarely a binder issue.
- Reduce VMA or Va requirements.
 - Or decrease Ndes for given Traffic Level (NCHRP)



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Impact of Reduced VMA

- Reduce VMA 1% - Increase RAP 6-10%
- Increase RAP 10% - Reduce Cost \$6/ton
 - And you are a Hero.
- ME Design Guide (performance)
 - Reduce VMA 1% - Reduce Pavement Life 3-4 years
- Initial resurface cost lower by 3%
- Annualized resurface cost increased 10-15%
 - Shoot the messenger.

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Additional Considerations

- Is VMA a function of Traffic Level?
 - Maybe one size does not fit all
- Do you believe the ME Design Guide?
 - Validation of materials characteristics & performance
- How much do we really **KNOW** about asphalt?

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Remember....

" Pavement Engineering is the art of molding materials we do not wholly understand into shapes we cannot precisely analyze, so as to withstand forces we cannot assess, in such a way that the community at large has no reason to suspect our ignorance"

