The State of RAP in America
Traditional RAP Wisdom Says...

3 Factors Determine RAP Percentage Used
# 3

How Much RAP Does the Producer Have?
# 2 How Much RAP Does the DOT/County/Agency Allow?
How Much RAP is your competition using?
How much can your plant handle?

Nope...see number #1!
RAP is like money in the bank...

…but only if you can spend it!
RAP/RAS Pavement Failures...

...and Some Pavement Failures Blamed on RAP/RAS
RAP and RAS - Different Binders

Most shingles contain air-blown asphalt cement which is substantially harder than the normal asphalt binder used in a standard HMA mix.

A Growing State DOT Perspective

\[ RAS \neq RAP \]
An Old Irish Blessing

“May you have the hindsight to know where you've been,
The foresight to know where you are going,
And the insight to know when you have gone too far”
RAP in America

Where We’ve Been...

Where We Are...

Where We Are Going...
33 Years Ago

Program Schedule

January 25, 1984

8:00-9:00 AM  Registration and Coffee
9:00-9:15 AM  Introduction and Orientation
              Richard J. Sebree, Executive Vice-President, Virginia Asphalt Association
9:15-9:30 AM  Welcome Address
              Harold C. King, Commissioner, Virginia Department of Transportation
10:00-10:30 AM Asphalt Recycling—The Purpose and the Process
              Douglas A. Bernard, Chief of Transportation Projects Division, Federal Highway Administration
10:30-11:00 AM An Overview of Recycling—The Florida Experience
              Charles F. Potts, State Materials and Research Engineer, Florida Department of Transportation
12:00 Noon  Lunch
12:15-1:00 PM  Innovative Batch Plants
              Wayne R. Hardenberg, Marketing Coordinator, Thermotech Systems, Inc.
1:00-1:15 PM  Material Removal and Handling
              Ronald D. Clark, District Manager, CMI Corporation
1:15-2:00 PM  Break
1:30-2:45 PM  Batch Plant Recycling
              Thomas M. Moe, Product Sales Manager, Barber-Greene Company
2:45 PM  Closure

January 26, 1984

8:00 AM  Registration and Coffee
8:00 AM  The Economics of Asphalt Recycling
              Dr. J. Don Brock, Ph.D., PE, Astec Industries, Incorporated
9:45 AM  Material Removal and Handling
              Ronald D. Clark, District Manager, CMI Corporation
10:00 AM  Break
10:15 AM  Batch Plant Recycling
              Thomas M. Moe, Product Sales Manager, Barber-Greene Company
11:30-12:00 Noon  Innovative Batch Plants
              Tom Holley, District Sales Manager, Standard Havens, Inc.
12:00-1:15 PM  Lunch
1:15-2:00 PM  Drum Mix Recycling
              Gerald S. Triplett, President, The Asphalt Institute
2:00-2:45 PM  Making it All Work for You
              Aubrey D. Newman, Pavement Management Engineer, Virginia Department of Highways and Transportation
3:00-3:15 PM  Questions and Answers
23 Years Ago

Superior Performing Asphalt Pavements (Superpave): The Product of the SHRP Asphalt Research Program

Thomas W. Kennedy
University of Texas at Austin

Gerald A. Huber
Heritage Research Group

Edward T. Harrigan
Strategic Highway Research Program

Ronald J. Cominsky
University of Texas at Austin

Charles S. Hughes
University of Texas at Austin

Harold Von Quintus
Brent Rauhut Engineering, Inc.

James S. Moulthrop
University of Texas at Austin

Strategic Highway Research Program
National Research Council
Washington, DC 1994

New Binder Grading System Included

No Research of RAP Included
17 Years Ago

FHWA Superpave Mixtures Expert Task Group developed a tiered approach for RAP usage.

- **0 to 15% RAP:** No change in the virgin binder grade.

- **15% to 25% RAP:** Virgin binder grade should be decreased one grade—to soften the blend—on both the high and low temperature scales.

- **Over 25% RAP:** Blending charts should be used to determine required PG grade.
10 Years Ago

SUPERPAVE Mix Issues Impacting RAP Mix Performance

- High compaction/gyration levels yielded “dry” mixes.
- Coarse graded mixes that avoided “Restricted Zone” resulted in increased permeability, low binder contents.
- Use of high viscosity(stiff) PG binders made mixes too stiff.

Current AASHTO $N_{\text{design}}$ Table

<table>
<thead>
<tr>
<th>Traffic Level</th>
<th>Compaction Level</th>
<th>$N_{\text{Initial}}$</th>
<th>$N_{\text{design}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.3</td>
<td>6</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>0.3 to &lt; 3.0</td>
<td>7</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>3.0 to &lt; 30.0</td>
<td>8</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>&gt; 30.0</td>
<td>9</td>
<td>125</td>
<td></td>
</tr>
</tbody>
</table>

Some States use different $N_{\text{design}}$ Tables
3 Years Ago

Turner-Fairbank Highway Research Center High RAP ALF Study

- Focus on fatigue cracking of high RAP mixes (20%, 30% and 40%)
- Three year completion; 2 ALF units for 2 years of loading allows simultaneous loading
- Unmodified binder for all lanes, but 2 different grades
- Use of WMA technology that does not change PG grade
- 10 kip single wheel = 20 kip equivalent axle
- 4-inch total asphalt thickness
Where We Are...

NAPA’s Latest Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage

Survey responses are 42% of the estimated total tons for the 2015 construction season.
2015 Survey Highlights - RAP

- +99% of RAP from old pavements put into new pavements.
- +74 million tons of RAP used in asphalt mixes in 2015.
- 3% increase over 2014 and +32% increase over the 2009 usage.
- 1% decrease in respondents using RAP (from 100% to 99%).
- A few producers reported landfilling RAP in 2015.
- Estimated 2015 savings from RAP usage; 3.7 million tons of binder and +70 million tons of aggregate (over $2.4 billion).
- Estimated +85 million tons of stockpiled RAP yearend 2015.
- 23% of RAP used fractionated, 24% of RAP mixes used softer binder, and 3% of RAP mixes used some type of rejuvenator.
2015 Survey Highlights - RAS

- RAS decreased almost 2% to an estimated 2 million tons in 2015.
- 2015 RAS still 175% more than 2009.
- 2015 RAS usage reduced the need for 386,200 tons of binder and nearly 965,500 tons of aggregate, for a total saving of $194 million.
2015 Survey Highlights - WMA

- **119.8 million tons** produced in 2015 using **WMA** technologies.
- This was an increase of **5%** increase over 2014, and a **614%** increase from the 2009 construction season.

- **WMA technologies** used in **33%** of all mixes produced in 2015.
- **Plant foaming** most widely used technology for WMA (**+72%**).
- At **+25%**, chemical additives are the second most used WMA technology.
World View on Recycling is Different
British Columbia View of RAP is Different

RAP Paving – RAP is ^ CRAP
British Columbia Perspective

Presented by
Vipin Sharma, P.Eng. PMP
Where We Are Going...

REthinking

Asphalt Recycling
In America
RAP in America – Breaking Ranks

Separating RAP and RAS

Recycled Asphalt Pavements (RAP)
- Aged HMA Binder
- Absorbed Binder
- Processed Aggregates

Recycled Asphalt Shingles (RAS)
- Very Hard Air-Blown Binders
- Very High Melting Point
- Deleterious Materials Issues
- How to Soften RAS Binders
Fractionation vs Crusher Run

Fractionation provides gradation controls necessary for higher RAP percentages.

Crusher run aggregates in HMA were outlawed by most states years ago due to lack of gradation control.
RAP in America – Breaking Ranks
Rural Producer vs Urban Producer

Little RAP vs Mountains Of RAP
Greening the Streets of New York

Asphalt pavement is a mixture of stone, gravel, or sand and liquid asphalt. All of those things, if extracted from worn-down New York City streets, are sustainable. Thanks to the City’s roadway resurfacing program, asphalt pavement used on these streets can be recycled into new asphalt and repurposed for locations throughout the five boroughs.

Right now, the NYC uses a minimum of 30% recycled asphalt pavement (RAP) to create new asphalt according to Local Law 71. DDC, together with Green Asphalt, wants to make that 100%.
Plant type, design and technology have a significant impact of the amount of RAP that be incorporated into mixes they produce.
RAP in America – Breaking Ranks

ASTEC DOUBLE BARREL XHR®

65% RAP @ 5% RAP Moisture

70% RAP @ 3% RAP Moisture (with caveats)
RAP in America – Breaking Ranks
HMA/WMA vs Cold Central Plant

WHAT IF I TOLD YOU

PUTTING 50% RAP IN YOUR MIX ISN’T ENOUGH?
RAP in America – Breaking Ranks
HMA/WMA vs Cold Central Plant