REthinking

97% RAP Recycling
When COLD is HOT!

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Executive Vice President
Virginia Asphalt Association
A HALF A CENTURY OF HOT MIX RECYCLING!

“...where reclaimed asphalt pavement (RAP) is combined with new materials to produce hot mix asphalt (HMA).”
30 YEARS OF RECYCLING IN VIRGINIA

1984 - 2014
HOT IN-PLACE (HIR) HAS BEEN AROUND AWHILE TOO!
SO HAS COLD IN-PLACE RECYCLING (CIR)
COLD CENTRAL PLANT (CCPR) GETS **HOT!**

PROCESSING FOR CCPR ARE SIMILAR TO THOSE FOR HMA/WMA RECYCLING
WHY ARE VIRGINIA ASPHALT PRODUCERS BUYING IN?
Despite Virginia’s aggressive recycling efforts excess RAP is a growing situation in most urban areas.
WE HAVE MOUNTAINS OF IT!

Over 800,000 tons and growing at one NOVA location!

At 5% AC content and $650/ton for PG64-22 that’s $26 million in binder alone!
VDOT “owns” over 300 million tons of RAP
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Warm Mix Asphalt (WMA)
mainstreamed foamed asphalt and lower mix temperatures in the U.S.
AND BECAUSE IT WORKS!

23,000 AADT
28% Trucks
7.2 Lane Miles
CCPR, CIR
FDR
$7.6 Million

VDOT Goes Prime Time

Lanford Brothers Uses
In-Place Pavement Recycling
on I-81 Project

Three recycling methods used in combination for the first time on a project in the U.S. will save Virginia both time and money.
More than 70% of the “new” pavement came from recycled materials!
I-81 PERFORMANCE TO-DATE HAS BEEN VERY GOOD...

But what About long-term?
2012 NCAT Test Track

NCAT Pavement Test Track

N4
- 4-inch AC
- 5-inch CCPR
- 6-inch Agg
- Subgrade

N3
- 6-inch AC
- 5-inch CCPR
- 6-inch Agg
- Subgrade

S12
- 4-inch AC
- 5-inch CCPR
- 8-inch FDR
- Subgrade

- N1 - N11, S5 - S6, and S8 - S13 are structural sections
- All other sections have deep perpetual foundations
- Research cycle of surface placement shown by color
- Off-Track sections on Lee Road 159 shown below
- W10
At +60% through the traffic loading cycle performance has been outstanding!
WHAT DO THESE HAVE IN COMMON?

GERMAN V2 ROCKET

FOAMED ASPHALT STABILIZATION & RECYCLING
Both technologies were developed in America!

1915
ROBERT H. GODDARD
CLARK UNIVERSITY
WORCESTER, MA

1956
PROF. LADISH H. CSANYI
IOWA STATE UNIVERSITY
AMES, IA
WHAT’S THE DIFFERENCE BETWEEN WMA AND CCPR FOAM MIX?

With HMA & WMA sufficient binder is added to coat aggregate and RAP particles for a “film thickness” bond.
CCPR incorporates a lesser amount of foamed binder is to provide “spot welding” bond.

SPOT WELDED ASPHALT
The best binder for foaming is one that expands the most and stays foamed as long as possible.

- 2-4% foamed binder content
- Typically, 2-3% water added
- Min expansion ratio of 8
- Min. 6 seconds half-life
- Binder temp of 300 to 340°F

Khosravifar 2012
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However, UK research suggests RAP reduces optimum foamed asphalt content (something else).

Foamed asphalt increases shear strength and reduces moisture susceptibility of granular materials.

Wirtgen suggests RAP is a “black rock”.

However, UK research suggests RAP reduces optimum foamed asphalt content (something else).
• Most CCPR includes 1% Portland cement.
• Fines (-#200 material), including cement, improve foam dispersion (foamed asphalt stabilization in the UK and South Africa).
• Can be anti-stripping agent, reduce moisture susceptibility and improve adhesion.
• Provides faster strength gain but can be brittle bonds (shrinkage and cracking).
• Increases cost.
• *Is it necessary with RAP?*
WHAT IS STRUCTURAL EQUIVALENCY OF CCPR?

We believe this is conservative!

Comparison Section – AASHTO ‘93
2013 MD STUDY ON FOAMED ASPHALT STABILIZED BASE (FASB) STRENGTH

Figure 26. Estimated layer coefficient ranges for 100%RAP FASB (Mix G).
WHAT DOES CCPR LOOK LIKE?
97% RAP CCPR, WHAT’S IN IT FOR YOU?
DOT WORKS IS NICE BUT... WE’RE GOING COMMERCIAL

MINIMUM PAVEMENT THICKNESS – ASPHALT/AGGREGATE

<table>
<thead>
<tr>
<th>Surface</th>
<th>Base</th>
<th>Aggregate Base</th>
<th>Subgrade Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>2”</td>
<td>2”</td>
<td>1.5”</td>
<td>Good (DCBR &gt;10)</td>
</tr>
<tr>
<td>6”</td>
<td>8”</td>
<td>2”</td>
<td>Fair (DCBR 6-10)</td>
</tr>
<tr>
<td></td>
<td>8”</td>
<td>2”</td>
<td>Poor (DCBR 3 - 6)</td>
</tr>
</tbody>
</table>

Typical Virginia Commercial Pavements
GRADING AND AGG BASE BY SITE CONTRACTOR

MINIMUM PAVEMENT THICKNESS – ASPHALT/AGGREGATE

SURFACE
BASE
SM-9.5
AGGREGATE
BASE
21B
SUBGRADE
CONDITION

Typical Virginia Commercial Pavements
CCPR MORE THAT DOUBLES ASPHALT WORK

With only minimal purchase of additional materials
WHAT'S IN IT FOR THE ASPHALT PRODUCER?

GREATER INCENTIVE TO USE SHINGLES
WHERE ARE WE HEADED?

RAP IS MONEY IN THE BANK...

...but only if you can spend it!
REMEMBER...ASPHALT IS THE SUSTAINABLE PAVEMENT

THIS IS RECYCLING

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THANK YOU!

ASPHALT
100 % Recycled