Cost Analysis of RAP/RAS Usage

Serji Amirkhanian
Human Being

SCAPA Winter Annual Conference
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Agenda

- Introduction
- Background: RAP & RAS
- Research Objectives
- Lit Review Results
- Findings/Conclusions
- Some none sense comments
Cold enough for you yet??
Production Cost Categories (%) for a Typical Construction Project
Background

• The asphalt paving industry has been recognized as the number one recycler in the country.
• Approximately 56 million and 62 million tons of RAP in 2009 and 2010.
• This equates to over 3 million tons (19 million barrels) of reclaimed asphalt binder being used in new mixtures.
• NAPA: approximately 96% of contractors are using RAP
Background

• The utilization of WMA, there has been increased interest in using higher percentages of RAP.
• Some initial findings indicate that warm mix reduces the amount of initial oxidation in the virgin liquid binder so that it interacts more readily with the RAP binder.
• After the increase of petroleum prices in 2008, many DOTs & the paving industry recommitted themselves to the utilization of higher percentages of RAP.
• Now, the drop in oil prices......?????!!!!!!!
RAP Benefits

• Conservation of resources (e.g., aggregate and binder)
• Life-cycle cost savings
• Environmental issues (e.g., conserving landfill space, etc.)
• Quality performance
Shingles (RAS)

- RAS = asphalt binder + quality aggregates + fiber
- NAPA Survey: 57% increase in usage of RAS, manufacturer’s waste and tear-offs (from 702,000 to 1.10 million tons) from 2009 to 2010
- Assuming an asphalt binder content of 20% for shingles, this would translate to 234,000 tons (1.5 million barrels) of asphalt binder conserved annually in the USA
RAS Background

• Today, 12 states allow the use of manufacturers’ shingle waste in hot mix asphalt mixtures.
• In addition, 10 states allow the use of manufacturers’ waste or roofing tear-offs in their mixtures.
• An estimated 10 million tons of tear-off waste and 1 million tons of manufacturer waste are produced each year.
• It is estimated that approximately 1.8 million tons of asphalt binder could be conserved if all these could be incorporated into asphalt paving mixtures.
RAS Benefits

• Partial virgin binder replacement
• Partial fine aggregate replacement
• Improved rut resistance
• Reduced landfilling of a valuable resource
Barriers to Use of RAS

- Supply
- Asbestos
- Processing
- Handling
- Storage
- Lack of specifications
- In some cases, lack of data on the performance of pavements utilizing RAS
Construction OOPS!!
Construction OOPS!!
Construction OOPS!!
Construction OOPS!!
Construction OOPS!!!
Construction OOPS!!
How you think you look like when giving that sexy stare to a girl
Misconception??

How you actually look like
Objectives of the Research

• Analyze the cost benefits to the Department from the past utilization of RAP, RAS, and RAP/RAS in various mixtures
• To develop a proposed pay schedule for aged binder versus virgin binder
• Predict the potential cost savings to SCDOT from the use of increased amounts of RAP and RAS based on the past project cost data and the proposed future pay schedule
# RAP Survey: NAPA

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<td>20%</td>
<td>22%</td>
<td>24%</td>
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SCDOT Research Survey: %RAP Use Method

- Maximum % RAP by weight of total mix: 13
- Maximum % RAP by % aged binder by weight of total binder: 6
- Other: 3
SCDOT Survey: Higher %RAP w/WMA

Does your state allow a higher % of RAP when using WMA?

- Yes: 17 responses
- No: 2 responses

Number of Responses
SCDOT Survey: RAS Use

Does your state allow for the use of RAS?

Number of Responses

- Yes: 13
- No: 6
SCDOT Survey: RAP+RAS in the Same Mix

Number of Responses

does your state allow for the use of RAP and RAS in the same mix?

- Yes: 12
- No: 1
SCDOT Survey: Any Estimated Cost Savings?

Does your state have a method to estimate the cost savings of using RAP and/or RAS?

- Yes: 3 responses
- No: 16 responses
SCDOT Survey: %Aged Binder Content?

Is percent aged binder content determined in your state?

- Yes: 14 responses
- No: 5 responses
SCDOT Survey: Pay Schedule for Virgin & Aged Binder?

Does your state have a separate pay schedule for virgin and aged binder?

Number of Responses

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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<tbody>
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SCDOT Survey: Softer Binder in High RAP Mixes

Does your state require the use of a softer binder grade for High-RAP and/or High-RAS projects (>30%)?

- Yes: 12 responses
- No: 6 responses
- No Response: 1 response
Research Results

Districts (All)

Year | Average % of RAP in Mix
--- | ---
2008 | 15.96
2009 | 18.06
2010 | 19.48
2011 | 21.58
2012 | 20.46
2013 | 21.36
Average Percentages of RAP in all Mixes per SCDOT Engineering District per Year

Year/District

Average % of RAP in Mix

0.00  5.00  10.00  15.00  20.00  25.00  30.00


1  2  3  4  5  6  7

2008  2009  2010  2011  2012  2013
Average % RAP in all Mixes
%RAP: Surface Course Type A

HOT MIX ASPHALT SURFACE COURSE TYPE A

<table>
<thead>
<tr>
<th>District</th>
<th>Average % of RAP in Mix</th>
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<tbody>
<tr>
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<td>9.03</td>
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<td>2</td>
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<td>3</td>
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<tr>
<td>6</td>
<td>8.89</td>
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<tr>
<td>7</td>
<td>3.33</td>
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</table>
%RAP: Base Course Type A

HOT MIX ASPHALT BASE COURSE - TYPE A

<table>
<thead>
<tr>
<th>District</th>
<th>Average % of RAP in Mix</th>
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<tr>
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<td>2</td>
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<td>3</td>
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%RAP: Surface Course Type B

HOT MIX ASPHALT SURFACE COURSE TYPE B

Average % of RAP in Mix

District

1  15.57
2  15.83
3  15.56
4  16.63
5  12.10
6  18.93
7  16.98
Cost: Surface Type A

(AII) HOT MIX ASPHALT SURFACE COURSE TYPE A

<table>
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<tr>
<th>District</th>
<th>Average Total Unit Cost</th>
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<td>5</td>
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<td>6</td>
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<tr>
<td>7</td>
<td>70.55</td>
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</table>
County Cost: Surface Type A

(AII) HOT MIX ASPHALT SURFACE COURSE TYPE A

Average Total Unit Cost

County

Counties: 2, 4, 7, 10, 11, 12, 14, 16, 17, 18, 21, 22, 23, 27, 28, 30, 32, 36, 38, 40, 42

Costs: 63.96, 73.04, 103.66, 111.68, 62.35, 63.39, 70.71, 64.20, 75.30, 104.81, 67.48, 67.34, 74.68, 74.68, 77.26, 105.59, 83.42, 77.14, 74.60, 70.21, 73.31, 74.25
Average Unit Cost per Each Binder Group for Each Month (2008-2013)
Conclusions from other studies

Major money was spent to conduct these research work
Rooms with broken air conditioners are hot

By Harrison Metzger

Times-News Staff Writer

When teacher Sheila Murphy opened the door to her classroom Monday morning at Bruce Drysdale Elementary School, the blast of hot air inside felt like an oven. It was 92 degrees.

Murphy teaches a self-contained classroom for emotionally handicapped children. These little ones don’t adapt well to change or distractions. So after spending a few minutes in the library, they were returned to the classroom where some fans had been turned on.

But the fans just blow hot air around, and the temperature in the room has hovered near 90 most of the week,” Murphy said. “The heat tends to exacerbate problems for these children.

said Wednesday, “I’ve heard they spent $150,000 on a new press box at one of the high schools. I feel like we need to get our classrooms situated.”

Bruce Drysdale is not among the seven schools administrators usually name when listing those with non-air-conditioned classrooms. The school has air conditioning units in all classrooms, but not all of them work. And administrators don’t know when the problem will be fixed.

The classrooms with no air conditioning include Murphy’s room, which tends to catch both morning and afternoon sun. The room houses only three students, although she expects a couple more students may join the class soon.

There is also a third grade classroom, with 22 or so students, that has two broken
A HARD LOOK

Texans support death penalty, but only for the guilty

A close look at the death penalty is appropriate in Texas, especially in Harris County, where prosecutors secure a large number of capital punishment convictions. Capital punishment has strong public support in this state, but the belief that the death penalty is a suitable punishment for those who commit society’s most violent crimes does not mean Texans are uninterested in ensuring fairness in the process that leads to death row. It is important to every thinking person that only the guilty wind up there.

Furthermore, the state should never execute those who committed a capital crime as a juvenile. Nor should the mentally incompetent be put to death, even though crafting a law impervious to abuse by defense lawyers and anti-death-penalty activists will require a large measure of thoughtfulness and hard work. Still, it must be done.

Death penalty discussions often focus on punishment, but an equally important aspect of the question is how well the system provides a defendant every reasonable opportunity to prove innocence. This means defendants should not risk an undeserved guilty verdict because they cannot afford to
Ohioans cautioned against using toilet bowl cleaner on their hair
Greenland meteorite may be from space

COPENHAGEN
A meteorite which crashed into Greenland last December may have come from outside our solar system.
Since we did not spend as much of above research work, our conclusions:

• Most Contractors: RAP is great!!
• Some aggregate producers: “u r ded to me if u talk about rap, kapish!!”
• Use RAP if you want to and if you do not like it, please feel free not to use it!!
Conclusions

- SCDOT specifications and contractors willingness to use RAP in SCDOT mixes has produced very high percentages of SCDOT mixes that use RAP.
- Few South Carolina contractors that are utilizing maximum RAP percentages that are allowed under SCDOT specifications.
- However, average percent RAP per mix is not being utilized to its full extent by the majority of contractors during the time period of this study for the mixes studied.
Conclusions

• Most state agencies are either unaware of exact recycled materials usage rates and/or economic impact their usage.

• At best estimates are based on assumed tonnages placed, an assumed average percent RAP used, and average assumed binder and aggregate material costs that were replaced.
Conclusions: If everything else fails, use duct tape!!
Today’s Quiz

Six Acronyms??

Can you guess any of them??
If you guess all of them, then there is a prize at the end of the presentation.
Yet Another Hierarchical Official Oracle!!
NECCO
New England Confectionery Company!!
Product of Arthur Meyerhoff!!
Mars & Murrie’s
the last names of the candy’s founders
Consumer Value Stores!!
Water Displacement - 40th Attempt
IF you have guessed all of them:

Can have lunch today or take a break now!!