Hot Mix Asphalt Facilities

Chattanooga, TN
PHOTO OF BOTHELL ROAD
TAKEN MAY 8, 1912
BY & S SEATTLE, WASH.
Reducing Energy Costs at HMA Facilities

NEUPG Meeting
October 2006
Hot Mix Asphalt Trivia...

- How many tons of HMA are placed/yr?
  - 675-750 Million Tons or 2.25-2.50/person

- How many miles of roads in USA?
  - 4 Million Miles of Roads

- How many miles are paved?
  - 2.4 Million Miles
Hot Mix Asphalt Trivia

• How many of those are paved w/ Asphalt?
• 2.3 of the 2.4 Million Miles are paved w/ HMA

• How many tons HMA removed annually?
• 120 Millions tons

• How many tons HMA on roads today?
• About 18 Billion tons
Asphalt Plant Trivia…

• How many Asphalt Plants are in the United States?
  • About 3900

• How many tons of HMA do states, cities and counties have in inventory?
  • About 18 Billion Tons on the road alone
BIG THREE ENERGY COSTS

- ASPHALT CEMENT
- DRYING AND HEATING FUELS
- ELECTRICITY
How can we run more RAP?

How can we reduce our energy costs related to our AC (OIL)?
Reclaimed Asphalt Pavement (RAP)

RAP Pile With 1/2” Minus to 3/4” Minus Aggregate
SUPERPAVE MIX WITH 1/2 RAP

White Rock
4-0

White Rock
3/8 - 4

White Rock
1/2 - 3/8

RAP
1/2 - 0

C%

AA%

B%

A%

X%
Run More RAP

- With Superpave and other specifications, regardless of percentages allowed, we have found that:
  - Volumetrics force sizing RAP to same size as virgin materials to raise RAP percentage allowed in mix
Why Size RAP?

• In most cases with traditional handling, at over 20% RAP gradation can become an issue
  – Most RAP around the country is either milled material or ½” Minus Crusher Run
    • Tough on Lab to get uniform mix
    • Volumetrics
Why Size RAP

- Segregated piles usually give lab techs headaches
  - Depending on loader you can get too many fines and minus 200’s that fill voids and have too much liquid...
  - 1970’s, 1980’s, 90’s
Size RAP

- Variations in liquid content are due to surface area differences in aggregate size differences
  - Get lab to compare liquid in 1 pound of coarse vs. 1 pound of fine RAP to see…
Size RAP

- On average around the U.S. we see that in RAP:
  - $\frac{1}{2} \times \frac{1}{4} = 3\%$ AC
  - $\frac{1}{4} \times 0 = 7\%$ AC
  - Easy to see how that could throw off mix design if pile is segregated
Recycle

.5” x .25” (1mm x .6mm)

.25” x 0mesh (1mm x 0)
VOLUMETRICS

• Can be confusing, but not too difficult
  – Very basically
  • The lab makes a cylindrical sample in a gyratory compactor
  • A weight for the cylinder is calculated (Dia x Ht)
  • That’s compared to total weight of rock (based on the rock’s specific gravity) and the liquid AC
  • What’s left after adding those two together is assumed to be air (expressed as %)
VOLUMETRICS

• Continuing...(based on most mix designs today)...
  – 4-5% air is usually desired, expecting the traffic to take it to 3%
  – Below 3% will move on you
  – Above 6% too open and can oxidize on you
Why Size…

• Typically what we see around the country is too many fines in the loader over a certain time period leading to poor numbers and issues in the lab and field due to liquid variations and stability issues.
  – Contractors Sizing the RAP to match virgin rock sizes have virtually eliminated this problem and have been able to increase RAP USE
  – Play with designs, use RAP in different ways
PROCESSED RAP SCREENED TO ORIGINAL INGREDIENTS
SUPERPAVE MIX WITH PROCESSED RAP - CHOICE #1
White Rock 1/2 - 3/8
Black Rock 4-0
White Rock 3/8 - 4
Black Rock 3/8 - 4
White Rock 4-0
Black Rock 1/2 - 3/8

EE%
C%
X%
5%

SUPERPAVE MIX WITH PROCESSED RAP - CHOICE #3
Increasing RAP: Success Story

- Banks Const - SC
  - Gov’t HMA RAP increases 10% on average
  - Private Mix HMA RAP increases 15-20% on average
- Over 500,000 tons
Horizontal Shaft Impactor for High RAP Capacities
Sizing RAP and Equipment

- Screening equipment
- RAP Bins
- Crushing Equipment

- Plant RAP feed – new look…
Hardness of AC in RAP

• Schools of Thought:

• Spec softer AC from suppliers

• Add 2% extender oil in AC line at Plant

• Do Nothing: It’s better than what’s being supplied anyway
30,000 Tons of RAP

= 70 - 6,000 Gallon Transport Trailers and 28,200 Tons of Clean Aggregate

RAP is Worth the Virgin Material It Replaces
Virgin Aggregate (per ton) .......... $10 x 0.94 = $ 9.40
Liquid Asphalt (per ton) .......... $350 x 0.06 = $21.00

\[ \text{Total Cost} = 9.40 + 21.00 = 30.40 \]

RAP Milling Cost (in job) .................. $0
Trucking (per ton) .................. - $ 3.40

\[ \text{Difference} = 30.40 - 3.40 = 27.00 \]

10% RAP ...... $2.70/ton 10 tons mix
20% RAP ...... $5.40/ton 5 tons mix
50% RAP ...... $13.50/ton 2 tons mix

Savings: Virgin Materials vs. RAP (if RAP at no cost)
Virgin Aggregate (per ton) ........ $10 x 0.95 = $ 9.50
Liquid Asphalt (per ton) ............. $350 x 0.05 = $17.50

$27.00

Cost of RAP (per ton) .............. $ 2.00
Crushing Cost (per ton) ........ $ 3.00
Total Cost of RAP (per ton) ....... $ 5.00

$5.00

Difference $22.00

10% RAP ...... $2.20/ton 10 tons mix
20% RAP ...... $4.40/ton 5 tons mix
50% RAP ...... $11.00/ton 2 tons mix

Savings: Virgin Materials vs. RAP (if RAP is purchased)
No Shoulder or Guardrail Changes with Milling
Milling Creates a Grooved Surface
Grade and Slope Controls Ensure Accurate Milling
Sufficient Material for Roll-Down

First Pass (Cold)
Mix Contained
No Segregation
No Density Change

Second Pass (Hot)
Mix Contained

Milling Ensures Consistent Pavement Density
Weight Limits Remain Constant with Milling
Close-Coupled Paving Operation

- Rollers
- Paver
- Milling Machine

New Overlay

Milled Roadbed 150 to 200 feet

Original Roadbed
Multiple Overlays Create Drainage Problems
State D.O.T has $5,000,000.00 to spend on mix…

no haul, no laydown, milling paid separately

<table>
<thead>
<tr>
<th>Assume</th>
<th>- $400.00 Liquid – 64-22</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- $450.00 Liquid when using Recycle</td>
</tr>
<tr>
<td></td>
<td>- 5.5% Liquid</td>
</tr>
<tr>
<td></td>
<td>- Processing Recycle Cost – $3.00 / ton</td>
</tr>
<tr>
<td></td>
<td>- Haul Cost – $3.00 / ton</td>
</tr>
<tr>
<td></td>
<td>- Aggregate Cost – $10.00 / ton</td>
</tr>
<tr>
<td></td>
<td>- Plant Processing Cost – $6.00 / ton</td>
</tr>
<tr>
<td></td>
<td>- Overhead and Profit – $4.00 / ton</td>
</tr>
</tbody>
</table>

1. If State D.O.T. purchases – All Virgin Mix

   Tons of Virgin Mix = 120,627 tons

2. If State D.O.T. purchases 50% RAP Mix – 2" Inlay – Contactor gets RAP

   Tons of RAP Mix = 166,113 tons
<table>
<thead>
<tr>
<th>Description</th>
<th>Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane miles paved with All Virgin Mix</td>
<td>162</td>
</tr>
<tr>
<td>Lane miles paved with 50% RAP Mix</td>
<td>223</td>
</tr>
<tr>
<td>Additional miles paved through use of Recycle</td>
<td>61</td>
</tr>
</tbody>
</table>
How can we reduce other energy costs at the plant?
THE DRYING PROCESS

MOISTURE REMOVAL

HEATING AGGREGATE
## FIG. 5

<table>
<thead>
<tr>
<th>MOISTURE</th>
<th>REMOVE MOISTURE (250°F STACK)</th>
<th>HEAT ROCK TO 300°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>7%</td>
<td>1.12 gal. / ton</td>
<td>0.83 gal. / ton</td>
</tr>
<tr>
<td>6%</td>
<td>0.96 gal. / ton</td>
<td>0.83 gal. / ton</td>
</tr>
<tr>
<td>5%</td>
<td>0.80 gal. / ton</td>
<td>0.83 gal. / ton</td>
</tr>
<tr>
<td>4%</td>
<td>0.64 gal. / ton</td>
<td>0.83 gal. / ton</td>
</tr>
</tbody>
</table>
Production — 400 Tph..... 10 hours = 4,000 Tpd

Moisture — 7%......28 Tph water = 56,000 lb. = 6,747 gal. / hr.
= 67,470 gal. / day or 11.25 Transport Loads / Day

Moisture — 6%......24 Tph water = 48,000 lb. = 5,783 gal. / hr.
= 57,830 gal. / day or 9.64 Transport Loads / Day

Moisture — 5%......20 Tph water = 40,000 lb. = 4,819 gal. / hr.
= 48,190 gal. / day or 8.03 Transport Loads / Day

Moisture — 4%......16 Tph water = 32,000 lb. = 3,855 gal. / hr.
= 38,550 gal. / day or 6.42 Transport Loads / Day

Fig. 6A  WATER EVAPORATION REQUIRED
WATER DRAINS FROM SLOPED STOCKPILE
MATERIAL SINKS INTO THE GROUND UNDER UNPAVED STOCKPILES
ELEVATION OF STOCKPILES ON UNPAVED SURFACE TENDS TO GROW
STOCKPILES WITH IDEAL 6 PERCENT SLOPE
<table>
<thead>
<tr>
<th>Material type</th>
<th>ground level</th>
<th>4' level</th>
<th>Avg. use level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>15.6%</td>
<td>5.6%</td>
<td>10.6%</td>
</tr>
<tr>
<td>Screenings</td>
<td>10.0%</td>
<td>6.0%</td>
<td>8.3%</td>
</tr>
<tr>
<td>No. 78</td>
<td>2.9%</td>
<td>1.4%</td>
<td>2.2%</td>
</tr>
<tr>
<td>No. 67</td>
<td>1.0%</td>
<td>0.8%</td>
<td>0.9%</td>
</tr>
<tr>
<td>RAP (-1/2&quot;)</td>
<td>7.7%</td>
<td>5.7%</td>
<td>6.7%</td>
</tr>
</tbody>
</table>

AVERAGE MOISTURE CONTENT STOCKPILES ON UNSLOPED, UNPAVED SURFACES
<table>
<thead>
<tr>
<th>Material type</th>
<th>Sloped and Paved</th>
<th>Unsloped and Unpaved</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>5.4%</td>
<td>10.6%</td>
<td>5.2%</td>
</tr>
<tr>
<td>Screenings</td>
<td>6.5%</td>
<td>8.3%</td>
<td>1.8%</td>
</tr>
<tr>
<td>No. 78</td>
<td>1.4%</td>
<td>2.2%</td>
<td>0.8%</td>
</tr>
<tr>
<td>No. 67</td>
<td>0.8%</td>
<td>0.9%</td>
<td>0.1%</td>
</tr>
<tr>
<td>RAP (-1/2&quot;)</td>
<td>5.7%</td>
<td>6.7%</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

**COMPARISON OF STOCKPILE MOISTURES (AT USE LEVEL)**
<table>
<thead>
<tr>
<th>Aggregates from stockpiles on sloped and paved surfaces</th>
<th>Aggregates from stockpiles on unsloped and unpaved surfaces</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.84%</td>
<td>7.10%</td>
<td>2.26%</td>
</tr>
</tbody>
</table>

**COMPARISON OF MOISTURES IN AGGREGATES FOR A SPECIFIED SURFACE MIX**
<table>
<thead>
<tr>
<th></th>
<th>DOUBLE BARREL</th>
<th></th>
<th></th>
<th></th>
<th>COUNTERFLOW DRYER</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>moisture</td>
<td>gal/ton</td>
<td>cu ft gas/ton</td>
<td>tph</td>
<td>moisture</td>
<td>gal/ton</td>
<td>cu ft gas/ton</td>
</tr>
<tr>
<td>Sloped and Paved</td>
<td>4.84%</td>
<td>1.68</td>
<td>235</td>
<td>279</td>
<td>4.84%</td>
<td>1.75</td>
<td>254</td>
</tr>
<tr>
<td>Unsloped and Unpaved</td>
<td>7.10%</td>
<td>2.26</td>
<td>316</td>
<td>196</td>
<td>7.10%</td>
<td>2.35</td>
<td>329</td>
</tr>
</tbody>
</table>

**PRODUCTION RATES AND FUEL USAGE (BASED ON 38,500 ACFM)**
### Percent of Moisture Removed and Gallons of Fuel per Ton

<table>
<thead>
<tr>
<th>DRUM DIAMETER</th>
<th>PROCESS GASES THRU DRUM</th>
<th>3%</th>
<th>4%</th>
<th>5%</th>
<th>6%</th>
<th>7%</th>
<th>8%</th>
<th>9%</th>
<th>10%</th>
<th>11%</th>
<th>12%</th>
<th>TOTAL EXHAUST THRU SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>6'</td>
<td></td>
<td>280</td>
<td>226</td>
<td>200</td>
<td>174</td>
<td>154</td>
<td>138</td>
<td>124</td>
<td>107</td>
<td>104</td>
<td>95</td>
<td>30,487</td>
</tr>
<tr>
<td>7'</td>
<td></td>
<td>420</td>
<td>350</td>
<td>300</td>
<td>262</td>
<td>231</td>
<td>207</td>
<td>189</td>
<td>170</td>
<td>155</td>
<td>143</td>
<td>45,869</td>
</tr>
<tr>
<td>8'</td>
<td></td>
<td>559</td>
<td>467</td>
<td>400</td>
<td>349</td>
<td>308</td>
<td>276</td>
<td>249</td>
<td>226</td>
<td>207</td>
<td>191</td>
<td>60,700</td>
</tr>
<tr>
<td>9'</td>
<td></td>
<td>699</td>
<td>584</td>
<td>500</td>
<td>436</td>
<td>385</td>
<td>345</td>
<td>311</td>
<td>283</td>
<td>259</td>
<td>238</td>
<td>76,219</td>
</tr>
<tr>
<td>10'</td>
<td></td>
<td>839</td>
<td>701</td>
<td>600</td>
<td>523</td>
<td>463</td>
<td>414</td>
<td>373</td>
<td>339</td>
<td>311</td>
<td>286</td>
<td>91,737</td>
</tr>
</tbody>
</table>

- Process Temperatures: 240F Stack, 300F Mix, 5% AC
- Drum Process Oxygen = 9% (well-tuned burner)

Fuel: No. 2 Diesel with LHV of 132300 Btu/gal

Actual tonnage rates may be limited by mixing capacity, actual fuel heating values and/or maximum burner output.

### PRODUCTION RATES OF COUNTER FLOW DOUBLE BARREL MIXERS INCLUDING LIQUID ASPHALT (5.5%)
PAVED, SLOPED STOCKPILE AREAS SAVE MONEY
• Cost of Paving—30,000 ft.$^2$, 6" thick = $30.00 / ton
  1,020 tons x $30.00 = $32,700.00

• 150,000 tons / year; 70¢ / gal. of fuel
  Fuel Savings 0.58 gal. / ton
  150,000 tons x 0.58 gal. / ton x 0.70¢ / gal. = $61,950.00

• ROI ≈ 6 months
Stockpiles Managed...

What’s the most economical fuel we can use?
### Equivalent Energy Costs

<table>
<thead>
<tr>
<th>Type of Energy</th>
<th>Heating Value (Net or LHV)</th>
<th>Billing Units</th>
<th>Cost Comparisons Based On Heating Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO. 2 FUEL OIL</td>
<td>Btu/gal 132,000</td>
<td>Per Gallon</td>
<td>$0.80 $0.90 $1.00 $1.10 $1.20 $1.30 $1.40 $1.50 $1.60 $1.70 $1.80 $1.90 $2.00 $2.10 $2.20 $2.30 $2.40 $2.50</td>
</tr>
<tr>
<td>NO. 5 FUEL OIL</td>
<td>Btu/gal 143,250</td>
<td>Per Gallon</td>
<td>$0.87 $0.98 $1.09 $1.19 $1.30 $1.41 $1.52 $1.63 $1.74 $1.84 $1.95 $2.06 $2.17 $2.28 $2.39 $2.50 $2.60 $2.71</td>
</tr>
<tr>
<td>PROPANE (LPG)</td>
<td>Btu/gal 84,345</td>
<td>Per Gallon</td>
<td>$0.51 $0.58 $0.64 $0.70 $0.77 $0.83 $0.89 $0.96 $1.02 $1.09 $1.15 $1.21 $1.28 $1.34 $1.41 $1.47 $1.53 $1.60</td>
</tr>
<tr>
<td>NATURAL GAS</td>
<td>Btu/CCF (see note*) 90,500</td>
<td>Per CCF</td>
<td>$0.55 $0.62 $0.69 $0.75 $0.82 $0.89 $0.96 $1.03 $1.10 $1.17 $1.23 $1.30 $1.37 $1.44 $1.51 $1.58 $1.65 $1.71</td>
</tr>
<tr>
<td></td>
<td>Btu/Therm 100,000</td>
<td>Per Therm</td>
<td>$0.61 $0.68 $0.76 $0.83 $0.91 $0.98 $1.06 $1.14 $1.21 $1.29 $1.36 $1.44 $1.52 $1.59 $1.67 $1.74 $1.82 $1.89</td>
</tr>
<tr>
<td>ELECTRICITY</td>
<td>Btu/Kwh 3,413</td>
<td>Per Kwh</td>
<td>$0.02 $0.02 $0.03 $0.03 $0.03 $0.04 $0.04 $0.04 $0.04 $0.05 $0.05 $0.05 $0.06 $0.06 $0.06 $0.06</td>
</tr>
<tr>
<td>COAL</td>
<td>Btu/pound 12,000</td>
<td>Per Ton</td>
<td>$145 $164 $182 $200 $218 $236 $255 $273 $291 $309 $327 $345 $364 $382 $400 $418 $436 $455</td>
</tr>
</tbody>
</table>

Each column of cost comparisons relates the costs of various types of energy to each other based on heating values. For example, the cost of No. 2 fuel oil at $1.00 per gallon is equivalent to a cost of $1.09 for No. 5 fuel oil for the same Btu. Thus, if No. 2 fuel oil is $1.00 per gallon it doesn't pay to choose No. 5 fuel oil unless it is less than $1.09.

Likewise, it wouldn't pay to use electricity unless it is less than $0.03 per Kwh when No. 2 fuel oil is $1.00 per gallon.

The actual heating values of various fuels vary somewhat from one region to another. However, the values used here are for fuels commonly used in the U.S. CCF stands for 100 cubic feet. The net heating value of one cubic foot of natural gas is 905 Btu. However, natural gas is normally billed at its gross heating value, which is approximately 1,000 Btu per cubic foot.

Suppliers may show prices for natural gas as $ per MMBtu (dollars per million Btu). If so, divide the price by 10 to obtain the price Per Therm.
Fuel Unloading Pump
Insulate Oil Lines
STACK TEMPERATURES ACROSS THE DRUM
HOW WORN FLIGHTS AFFECT TEMPERATURES

NEW FLIGHTS

OLD WORN FLIGHTS
Under showering will cause a hot spot on opposite side of drum

Showering Problems
DIFFERENCE BETWEEN ANY TWO POINTS SHOULD NOT EXCEED 80°F

CORRECT SHOWERING
NEW BURNERS

- Mixing Screen
- Gas Injection Tubes
- Airflow Distribution Screen
- Expansion Absorbing One-Piece Cone
- Full-Throat Swirl Vanes
Burner Control System
SUPER-CLEAN GAS FLAME OF A PHOENIX IN THE LEAN-BURN MODE

20 PPM - OXIDES OF NITROGEN (NOX)
200 PPM - CARBON MONOXIDE (CO)
## COAL BURNER ECONOMICS

All numbers are estimated only.

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal Cost per Ton</td>
<td>$60.00</td>
<td>dollars/ton</td>
</tr>
<tr>
<td>1 ton = 2,000 pounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal Cost per pound</td>
<td>$0.03</td>
<td>cents/pound</td>
</tr>
<tr>
<td>BTU's per pound of Coal</td>
<td>10,000</td>
<td>BTU's</td>
</tr>
<tr>
<td>BTU's per gallon of #2 Oil</td>
<td>140,000</td>
<td>BTU's</td>
</tr>
<tr>
<td>Pounds of coal = one gallon of fuel</td>
<td>14</td>
<td>pounds</td>
</tr>
<tr>
<td>Equivalent energy cost for coal</td>
<td>$0.42</td>
<td>per gallon</td>
</tr>
<tr>
<td>AT 80% COAL and 20% #2 OIL:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2 Oil Cost per Gallon</td>
<td>$1.50</td>
<td>per gallon</td>
</tr>
<tr>
<td>80% Coal</td>
<td>$0.34</td>
<td>per gallon</td>
</tr>
<tr>
<td>20% #2 Oil</td>
<td>$0.30</td>
<td>per gallon</td>
</tr>
<tr>
<td>Equivalent Energy Cost with Astec</td>
<td>$0.64</td>
<td>per gallon</td>
</tr>
<tr>
<td>Gallons used per Ton HMA</td>
<td>1.80</td>
<td></td>
</tr>
<tr>
<td>Fuel cost per ton strait #2 Oil</td>
<td>$2.70</td>
<td>per ton</td>
</tr>
<tr>
<td>Using 80% Coal and 20% #2 Oil</td>
<td>$1.14</td>
<td>per ton</td>
</tr>
<tr>
<td>Estimated savings over strait #2 Oil</td>
<td>$1.56</td>
<td>per ton</td>
</tr>
</tbody>
</table>
TOTAL POTENTIAL SAVINGS

Data  - Plant with Annual Production of 200,000 tons / year
       - $1.50 / gal. fuel for dryer; $2.00 / gal. for heater

1. Paving under stockpiles
   - Reduce fuel 0.6 gal. / ton
   - Savings 0.6 gal. / ton x $1.50 / gal. X 200,000
     tpy........................................$180,000 / yr.

2. Insulate all lines, a.c. piping, add stack heat exchanger
   - Savings .................................................................$ 70,000 / yr.

3. Electricity…add VFD drives to exhaust fan, burner blower
   - Savings.......................................................................$ 60,000 / yr.

4. Switch to Coal burner…$60.00 / ton coal
   Gals. / ton = $1.76
   Ownership, operating maintenance cost of coal system = $0.20
   Burn 20% oil; 80% coal
   Fuel cost = 0.2 ($1.50) + 0.8($0.36) = $0.59 / gal.
   Savings = ($1.50 - 0.59)($1.76 - 0.20)x 200,000
     tpy........................................$283,920 / yr.
     $1.42 / ton

Total Potential Savings……$593,920 / yr.
$2.97 / ton
Warm Mix Asphalt

- Came to United States in 2002
- NAPA Tour
- FHWA Providing Some Funding to NCAT
- Several Test Projects going on around U.S.
Warm Mix Asphalt

• What is Warm Asphalt?
  – Additives introduced to mixing process to lower mixing temperatures 50-75 degrees
  – Four commercial additives are Aspha-min, Sasobit, WAM-Foam and Evotherm (all NCAT discusses on Web)
Warm Mix Asphalt

- Reasons to look at increased use of warm asphalt – NCAT/others:
  - Reduced Fuel Consumption - Economical
  - Reduced fumes and odor - Environmental
  - Decreased Binder aging - Theoretical
  - Extended Paving Season - Economical
Warm Mix Asphalt

• What do the additives do?

  – Carry water and/or supply the appropriate chemical properties to make the asphalt meet proper viscosity to coat rock at lower temperatures and properly compact behind the paver
Warm Mix Asphalt

• Who is working on it?
  – NCAT has tested some, observed projects
  – Some states have done test projects
  – ASTEC Effort: Make it cost effective
THANK YOU - Questions