Staying a step ahead: A Contractor’s Look at the Changing World of Asphalt Technology

2012 Arizona Pavement/Materials Conference
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Outline

- Industry Challenges
- Industry Opportunities and Role of New Technology
- Our Role
Importance of Technology & Innovation

- Critical to Environmentally Responsible Supply
- Factor in Market Share
- Proven Track Record
  - Materials and Processes
- BUT, Pace of Implementation of New Technologies
Industry Challenges

- Infrastructure Condition
- Economy / Funding
- Asphalt Binder Supply / Cost
- Competing Industry
- Slow Pace of Innovation and Implementation of New Technologies
- Societal Changes
Infrastructure Condition*

- Grade = D-
- ≈ 1/3 of US Roads Poor or Mediocre Condition
- ≈ 1/2 of Urban Highways Congested
- Lack of Investment through 2020 Will Cost:
  - ≈ 900,000 jobs
  - Suppress GDP by ≈ $900B
- System Backbone of US Economy

*ASCE 2009 and 2011 Report Card for Americas Infrastructure: Roads
Economy / Funding

- Asphalt Pavement Market:
  - Historically: ≈ 65% Publicly Funded Highways
    - Federal, State, Local Funding
  - Federal $ = Highway Trust Fund
  - Highway Trust Fund = Gas Taxes

- Federal Transportation Bill
  - Finally
  - We Still Need More
Economy / Funding

- Gas Taxes Not Raised Since 1993
  - Reduced Purchasing Power
    - Inflation
    - Raising Construction / Materials Costs
  - Reduced Gas Consumption
    - Vehicle Miles Traveled
    - Improved Fuel Mileage
Dec 1979 Monthly Ave Oil Price $108.59 in Dec 2010 Dollars

Dec 1979 Nominal Monthly Ave Oil Price $38.00 in Dec 2010 Dollars

Dec 2009 Average Price = $107 in Dec 2009 Dollars

June 2008 Monthly Ave Oil Price $126.54 in Dec 2010 Dollars

Sources of Information:
Oil Prices: Illinois Oil & Gas Assoc.
CPI: Bureau of Labor Statistics
Asphalt Binder Supply / Cost

2011-2012

- Availability of Supply
  - Crude + Modifiers + Chemicals = Paving Grade Binders
  - 21 Cokers On-line by 2014

- Refinery Capacity and Inventory
  - Capacity Down (50-80%), but Available
  - Inventories Low, Peak Season Supply?

- Cost = f (Raw Product Cost, Capacity, Supply and Demand)

- Peak Season Supply and Cost
  - July 2012: ≈ $650/ton and $800/ton
  - July 2013: $650+/ton and $800+/ton?
Competing Industries

- Perception
- Economics
- Environmental Impacts
- Sustainability

Fundamental Science Needed with LCA
- Cradle to Grave
Pace of Innovation and Implementation of New Technology

- USA Built on Innovative/Technical Leadership
- Pace of New Technology Implementation is Slow
  - Many Barriers We Must Breakthrough
  - Must Wisely Manage Risk
  - Need to Accelerate the Time to Evaluate New Technology
    - Evaluation Time ≠ Material Life
Societal Change

- Global Economy
- Sustainability
- Environmental Stewardship
- Social Responsibility
- Long-term Economic Prosperity
- Industry’s Role: Public and Private
Outline

- Industry Challenges
- Industry Opportunities and Role of New Technology
- Our Role
Industry Opportunities

- Infrastructure Condition
- Economy / Funding
- Asphalt Binder Supply / Cost
- Slow Pace of Innovation and Implementation of New Technologies
Industry Opportunities
(Infrastructure Condition)

- Capacity and Ability Exists to Build and Preserve Asphalt Infrastructure
- Maintenance / Preservation
  - Seals
  - Thin Overlays
- Rehabilitation
  - Overlays
  - Mill & Fill
- Reconstruction
  - Structural Section
  - Replacement
Industry Opportunities
(Economy)

- **Potential Economic Impact**
  - US Unemployment ≈ 8.5%
  - Construction Unemployment ≈ 20%
  - Highway Construction Investment Impacts
    - Every $1 Billion Spent ≈ 35,000 Jobs
    - Every $1 Invested ≈ $1.80 GDP

- **AASHTO Report to Congress**
  - 9,500 Projects “Ready to Go” (within 120 days)
  - $69 Billion Value
  - Highway Investment Most Effective Economic Stimulator
Industry Opportunities (Economy)

- 2010 On...
  - Economics and Sustainability No Longer Independent
  - Sustainability is Key
  - Green Construction Technologies are Available
    - Materials
    - Processes
    - We Need to Grow the List
Industry Opportunities
(Asphalt Binder/Supply)

- Bigger than Asphalt Binder/Supply: Green Construction Technologies
  - Technologies
    - Recycling
      - Materials
      - Processes
    - Warm Mix Asphalt (WMA)
    - Preventive Maintenance Treatments
  - Significant Sustainable Benefits through Green Technology
Industry Opportunities

- Recycled Materials
  - HMA: Most Recycled Material in the World ≈ 100M tons/yr RAP
    - Conventional and High RAP HMA
  - Tires
    - CRM (wet process) and Terminal Blend Binders
  - Shingles (RAS)
    - Manufacture Byproduct and Tear Offs
  - Aggregate Base
States Use of Recycled Materials

- **RAP**
  - ≈ 75% of States Allow 10+% RAP in Surface Course
  - ≈ 30 States Increased Allowable % RAP Since 2007

- **Shingles**
  - ≈ 20 States Allow 5% Shingles in HMA

- **Tires - CRM**
  - Primarily South(east & west)

- **Aggregate Base**
  - 0 to 100%
Recycling Processes

- Recycle Processes
  - Cold In-place Recycling
    - Partial and Full Depth
  - Cold Foam In-place Recycling
  - Hot In-place Recycling
  - Aggregate Base Recycling
State’s Use of In-Place Recycling

- **CIPR**
  - ≈ 20 States Specify
  - Most States have Experimented

- **HIPR**
  - ≈ 10 States Specify
  - Over 30 States have Experimented

Red = 4+ Projects  Green = No use
Blue = Low/limited use  White = No response
Recycling Benefits

- Conservation
  - Materials (aggregate and asphalt binder)
  - Energy - burner fuel & trucking (in-place processing)

- Preservation of Environment
  - Landfill
  - Emissions / Green House Gases (global warming)

- Economics
  - Important to Look at Life Cycle Costs through Recycle Products & Processes
  - Complete Reconstruction vs. Alternative Methods
  - Recycling Benefits Often Overlooked in Economic Analysis
## Recycled Materials in HMA % Savings

<table>
<thead>
<tr>
<th>Material / Process</th>
<th>Recycled Material Content, %</th>
<th>Recycled Asphalt Binder Content, %</th>
<th>Price</th>
<th>Energy</th>
<th>CO$_{2eq}$</th>
<th>AC</th>
<th>Agg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional HMA</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>RAP</td>
<td>15</td>
<td>4</td>
<td>5.7</td>
<td>6.1</td>
<td>4.7</td>
<td>11.5</td>
<td>15.2</td>
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<td></td>
<td>25</td>
<td>4</td>
<td>9.5</td>
<td>10.1</td>
<td>8.0</td>
<td>19.2</td>
<td>25.3</td>
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<tr>
<td>Post Industrial Shingles</td>
<td>5</td>
<td>18</td>
<td>6.6</td>
<td>7.6</td>
<td>4.5</td>
<td>17.3</td>
<td>4.3</td>
</tr>
<tr>
<td>Post Consumer Shingles</td>
<td>5</td>
<td>32</td>
<td>12.0</td>
<td>13.2</td>
<td>7.4</td>
<td>30.8</td>
<td>3.6</td>
</tr>
<tr>
<td>WMA</td>
<td>0</td>
<td>0</td>
<td>0.8</td>
<td>4.3</td>
<td>1.5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>
## RAP is Green!

<table>
<thead>
<tr>
<th></th>
<th>Annual Consumption/Production</th>
<th>Estimated Annual Savings</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>15% RAP</td>
</tr>
<tr>
<td>Asphalt Binder, tons</td>
<td>23M</td>
<td>2.6M</td>
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<tr>
<td>Aggregate, tons</td>
<td>407M</td>
<td>59M</td>
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<tr>
<td>HMA Price, $</td>
<td>34B</td>
<td>1.0B</td>
</tr>
<tr>
<td></td>
<td>($2.40/ton)</td>
<td>($4.00/ton)</td>
</tr>
<tr>
<td>Energy, (10^{12}) Btu</td>
<td>234</td>
<td>12</td>
</tr>
</tbody>
</table>
Another Opportunity:
Warm Mix Asphalt

Many, Many Technology Options Available Today
Many Discussed in Next 2 Days
Benefits of WMA
(NAPA QIS 125)

- Reduced Fuel Use
- Reduced Emissions
- Improved Working Conditions for Workers
- Paving Benefits
  - Compaction Aid
  - Cold-Weather Paving
  - Longer Haul Distances
  - Use of Higher %RAP
  - Beneficial in Non-Attainment Areas
Unique Design Considerations

- Specialty Materials
  - SMA
  - Porous Asphalt
  - Thin Overlays
- Design Procedures
  - Perpetual Pavements
  - Thin Overlays
- Performance Tests
  - NCHRP Ray Today
Stone Matrix Asphalt (SMA) 
(NAPA IS 128)

- Surface Course Only
- Superior Rut Resistance
- Superior Durability
- Gap Graded
- Premium Cost
- Primary Use in East and So. East
- Perpetual Pavement Surface Course
Porous Asphalts (NAPA IS)

- Dual Purpose Pavements
  - Parking Lots
  - Stormwater Management
    - Drains Recharge Bed
    - Infiltrates Soil
- Improve Water Quality
- Eliminate Detention Basins
- Cost-Effective
- UHI Tool
Thin Overlays
(NAPA IS 135)

- Improve Ride Quality
- Reduce Pavement Distresses
- Maintain Surface Geometrics
- Reduce Noise
- Reduce Life Cycle Costs
- Many Materials Can Be Used
  - HMA, WMA, RAP, RAS, PMB
Perpetual Pavements
(APA PerRoad Software)

- Long Life Multilayer Design with Routine Maintenance
- Benefits
  - Durability
  - Safety
  - Smoothness
  - Long Lasting
  - Cost Effective
  - No Expensive Time-Consuming Major Rehabilitation
- Limited Use
Tools for Unique Design Considerations

- **Equipment is Available**
- **Materials and Materials Selection**
  - Numerous NAPA Publications
  - APA Publications
- **Processes (Design and Economics)**
  - Perpetual Pavement Design Software
    - APA PerRoad Software
  - Life Cycle Cost Analysis Software
    - APA LCCA and LCCAEExpress
  - Must Go To LCA
Outline

- Industry Challenges
- Industry Opportunities and Role of New Technology
- Our Role
Putting Technologies Together

- RAP & RAS
- RAP & WMA
- RAP, RAS, & WMA
- CRM & RAP
- CRM, RAP, & RAS
- SMA, Thin Lifts
- Porous Pavements
- Perpetual Pavements
- Production/Equip. Capabilities in Place
- Design Tools Available
We Have The Technology!

- We Have Implementable Technologies
- Why Aren’t They More Rapidly Implemented?
  - High RAP  WMA
  - Shingles  CRM
  - CIPR  HIPR
  - SMA  Porous Asphalt
  - Perpetual Pavements

- Are You Satisfied with the Pace?
- What Can You Do?
- What is The Next New Technology?
  (Could just be a combination of previously mentioned items…)
Use Latest Resources

- APA
  - Software
  - Documents
    - *Carbon Footprint: How Does Asphalt Stack Up* Whitepaper
    - Asphalt in Livable Communities
    - Pavement Smoothness and Fuel Economy
    - Pavement Type Selection

- NAPA
  - Documents
  - Conference/Workshops
Dec 1979 Nominal Monthly Ave Oil Price $38.00 in Dec 2010 Dollars

Sources of Information:
- Oil Prices: Illinois Oil & Gas Assoc.
- CPI: Bureau of Labor Statistics
Pace of Acceptance

- Technology Implementation is TOO Slow
- Over 30 Years Experience with Many
- Accelerate Evaluation Process / Time
  - Design Procedures
  - Lab and Test Tracks, Field
- Optimize Benefit, Cost, and Risk
We Should ALL Be Committed to…

- Recognizing Infrastructure Condition / Forecast
- Maximizing Effectiveness of Declining Budget
- Using Technology / Innovation to Help
- Support Rapid Implementation of New Technology-mATERIALS and processes
- Adapting to Changing and Improving Society
Thank You!