RECYCLING IN PAVEMENT
“THE BIG PICTURE”

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RECYCLING IN PAVEMENT CONSTRUCTION

ONE MAN’S TRASH IS ANOTHER MAN’S TREASURE

American Proverb

WE’RE NOT BAD…

BUT WE COULD BE BETTER!
RECYCLING IN PAVEMENT CONSTRUCTION

WHY?

• We use a LOT OF STUFF!
• Virgin materials are becoming scarce
• Increased disposal costs
• Societal pressure
• IT’S THE RIGHT THING TO DO!
ENGINEERING EVALUATION

• Select Material and Application
• Define and Evaluate Issues
• Screening Evaluation
• Laboratory Evaluation
• Field Scale Installation and Testing
COST CONSIDERATIONS

• Cost of the Material (raw material, processing, stockpiling, loading, transporting, etc.)

• Cost of Installation

• Life Cycle Cost of the Pavement When Using the Material
ENVIRONMENTAL CONSIDERATIONS

• Government Regulations
• Approvals
• Restrictions
• Effects of processing and construction methods
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ASPHALT CONCRETE PAVEMENT

Baghouse Fines, Blast Furnace Slag, Coal Bottom Ash / Boiler Slag, Coal Fly Ash, Foundry Sand, Kiln Dust, Mineral Processing Wastes, MSW Combustor Ash, Nonferrous Slags, Reclaimed Asphalt Pavement (hot and cold), Roofing Shingle Scrap, Scrap Tires, Sewage Sludge Ash, Steel Slag, Waste Glass
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CONCRETE PAVEMENT
Blast Furnace Slag, Coal Fly Ash, Foundry Sand

GRANULAR BASE
Blast Furnace Slag, Coal Bottom Ash / Boiler Slag, Mineral Processing Wastes, MSW Combustor Ash, Nonferrous Slags, Reclaimed Asphalt Pavement, Reclaimed Concrete Material, Steel Slag, Waste Glass
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EMBANKMENT OR FILL

Blast Furnace Slag, Coal Bottom Ash / Boiler Slag, Coal Fly Ash, Foundry Sand, Mineral Processing Wastes, Nonferrous Slags, Reclaimed Asphalt Pavement, Reclaimed Concrete Material, Scrap Tires
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STABILIZED BASE
Coal Bottom Ash / Boiler Slag, Coal Fly Ash, FGD Scrubber Material, Kiln Dusts, Reclaimed Asphalt Pavement, Sulphate Wastes

FLOWABLE FILL
Coal Fly Ash, FGD Scrubber Material, Foundry Sands, Quarry Byproducts
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COLD IN-PLACE RECYCLING
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FULL DEPTH RECLAMATION
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HOT IN-PLACE RECYCLING
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ASPHALT RUBBER

City of Calgary Asphalt Plant 2002 June 25
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SOIL STABILIZATION
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BOTTOM ASH FROST PROTECTION
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COLD MIX ASPHALT USING SAGD BY-PRODUCT
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WHAT ARE THE BENEFITS?
RECycling in Pavement Construction

GHG Emissions CO2 eq/kg/tonne

- Hot Mix Asphalt (HMA)
- High modulus HMA
- HMA with 15% RAP
- Crushed aggregate 0-20 mm
- Aggregate 0-112 mm
- Cement Concrete
- Continuous reinforced concrete
- Stabilized materials emulsion + cement
- Stabilized materials emulsion
- Crushed in place concrete slab (rubblizing)
- Reclaimed or milled materials

Croteau & Chaignon 2009 CUPGA
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Energy Use Per Tonne Of Material Laid Down

Source: The Environmental Road of the Future, Life Cycle Analysis by Chappat, M. and Julian Bilal. Colas Group, 2003, p.34

Croteau & Chaignon 2009 CUPGA

Ministry of Transportation
Ministère des Transports
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PRESERVE NON-RENEWABLE RESOURCES

AGGREGATE & BITUMEN
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REDUCED COSTS
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WHAT ARE THE OBSTACLES?
RECYCLING IN PAVEMENT CONSTRUCTION

- Linear-Landfill-Phobia
- “Not in My Road” Mentality
- Hesitancy to use “High RAP” % HMA/WMA
- Environmental Regulations
- “Region Specific” Byproducts
- Lack of Performance Experience
- Quantification of Environmental Benefits
Performance and Environmental Considerations

- Recycled Materials Information Database (NCHRP 4-21)
- Environmental Impact on Surface and Ground Waters (NCHRP 25-9)

Life Cycle Cost Analysis (LCCA) Including Environmental Economics (Energy Consumption, Emissions, etc.)
### Table 3. Use of recycled materials in roads in Sweden (million metric tons).

<table>
<thead>
<tr>
<th>Material</th>
<th>Annual Production</th>
<th>Amount Used</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old asphalt pavement</td>
<td>0.8 (1999)</td>
<td>0.76</td>
<td>In new asphalt (cold or hot recycling)</td>
</tr>
<tr>
<td>Blast furnace slag</td>
<td>1.0 (1999)</td>
<td>0.7</td>
<td>As aggregate in unbound layers (crushed, air-cooled)</td>
</tr>
<tr>
<td>Mining waste (rock without usable metals)</td>
<td>27.0 (1994)</td>
<td>0.1-0.3</td>
<td>Crushed aggregate in unbound layers</td>
</tr>
<tr>
<td>Unsorted building and road demolition waste</td>
<td>1.5-2.0</td>
<td>Small quantities</td>
<td>As fill material; some test sections/ subbase</td>
</tr>
<tr>
<td>Steel slag</td>
<td>0.2</td>
<td>0.2</td>
<td>Some in demonstrations/research</td>
</tr>
<tr>
<td>WTE bottom ash</td>
<td>0.34</td>
<td>0.34</td>
<td>Subbase and base in roads within facility boundary; some in demonstrations</td>
</tr>
</tbody>
</table>

*Recycled Materials in European Highway Environments, FHWA, 2000*
RECYCLING IN PAVEMENT CONSTRUCTION

User Guidelines for Byproducts and Secondary Use Materials in Pavement Construction

Origin, Performance Record, Material Processing Requirements, Engineering Properties, Design Considerations, Construction Methods, Environmental Considerations, Unresolved Issues

http://www.rmrc.unh.edu/tools/uguidelines/index.asp
User Guidelines for Waste and Byproduct Materials in Pavement Construction

Recycled Materials in the Highway Environment

OVERVIEW

At the FHWA, our goal is to encourage appropriate widespread use of secondary materials (i.e., waste and byproduct materials) and associated technologies in the construction and rehabilitation of highway infrastructure.

This will be done by:

- Disseminating information and practical knowledge on current technically-sound uses and technologies.
- Raising awareness on innovative technologies that are currently being successfully used but are not well known.
- Disseminating detailed information on the engineering, environmental, and economic benefits of recycling.
- Identifying available resources and support services that can provide technical assistance and help promote the adoption of secondary materials technology.
- Encouraging continued investigation of promising new secondary materials and technologies, including research and field trials.

Green Roads is a rating system designed to distinguish high-performance sustainable new or redesigned/rehabilitated roads.

It awards credits for approved sustainable choices/practices and can be used to certify projects based on point value.

http://www.greenroads.us/
Remember; it doesn't have to be perfect to last a long time!

Thank You!