Next Generation RMRC
Applied Research & Outreach
To Meet State Needs

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2 August 2011
Why recycled materials?

• Quality materials are required for quality products

• Recent studies show materials control environmental footprint of a project

• Recycled materials are most effective for their
  – Economical benefits
  – Environmental benefits
Keys to Successful Recycling Based on 20 yr of Experience

1. Defining engineering properties & durability.
2. Assessing environmental safety.
3. Developing diverse suite of applications.
4. Demonstrating success in field quantitatively.
5. Ensuring material availability & economics.
6. Training technical personnel on engineering and assessment with recycled materials.
Background

• Current RMRC is a joint venture between the University of New Hampshire and University of Wisconsin-Madison

• Base funded by FHWA, supplemented by FHWA-administered pool fund supported by 7 states.

• Current contract ends December 31, 2011. No plans for continuation.
Accomplishments (2007-11)

- Practice oriented research on:
  - Bound Materials (4 projects)
  - Unbound Materials (8 projects)
  - Environmental Assessment (5 projects)
  - Life Cycle Tools (2 projects)

- Field demonstrations and development of design guidelines

- Standards and specifications development (AASHTO, ASTM D18.14, Int. Symposium)

- Outreach: webinars, short courses, workshops

- Website for information dissemination

- FHWA funds leveraged 1:4 from other sources
Summary of Funds Distribution

Distribution of Base Research Funds by Topic

- Unbound Materials: $444k (48%)
- Bound Materials: $250k (27%)
- LCA: $50k (5%)
- Environ. $189k (20%)

Total: $944k
Summary of Funds Distribution

Distribution of Base Funds
- Admin: $204k (10%)
- Research: $933k (47%)
- Outreach: $863k (43%)

Distribution of Total Funds
- Cost Share: $398k (8%)
- Leverage: $2679k (53%)
- Base: $2000k (39%)
3-G RMRC

- RMRC is a great resource to grow with direct focus on state needs (currently no direct engagement with states)
- Proposed to establish a new Pooled Fund directly managed by states (supported by FHWA as the next logical step in providing practical information that can be directly applied by states)
- Directed by Executive Committee consisting of state participants in the pool fund
- $25K per state per year
- Five years
For Further Information

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www.recycledmaterials.org
## Bound Materials

<table>
<thead>
<tr>
<th>Project</th>
<th>RMRC ($K)</th>
<th>Other ($K)</th>
<th>Other Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis of Dynamic Modulus and Binder Data for High RAP</td>
<td>0</td>
<td>33</td>
<td>RMRC Pooled Fund</td>
</tr>
<tr>
<td>Long Term Performance of High RAP Sections</td>
<td>50</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Synthesis of the Use of Crumb Rubber in Hot Mix Asphalt</td>
<td>150</td>
<td>20</td>
<td>Modified Asphalt Research Center (MARC)</td>
</tr>
<tr>
<td>Binder Properties in Recycled Asphalt Shingles (RAS)</td>
<td>50</td>
<td>50</td>
<td>MARC (50), RMRC Pooled Fund (25)</td>
</tr>
<tr>
<td>Aging of Recycled Asphalt Mixtures</td>
<td>0</td>
<td>50</td>
<td>RMRC Pooled Fund</td>
</tr>
<tr>
<td><strong>Total (not include 2010 pool)</strong></td>
<td><strong>250</strong></td>
<td><strong>103</strong></td>
<td>-</td>
</tr>
</tbody>
</table>

**Total projects = 4**

**Leveraging factor = 0.4**
## Unbound Materials

<table>
<thead>
<tr>
<th>Project</th>
<th>RMRC ($K)</th>
<th>Other ($K)</th>
<th>Other Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Properties of RAP and RCA for Unbound Applications</td>
<td>100</td>
<td>400</td>
<td>MnDOT Pooled Fund (350), RMRC Pool Fund (50, 25)</td>
</tr>
<tr>
<td>Recycled Asphalt Shingles as Structural Fill</td>
<td>17</td>
<td>33</td>
<td>RMRC Pooled Fund (33, 25)</td>
</tr>
<tr>
<td>Pavement Materials Stabilized with CKD*</td>
<td>50</td>
<td>99</td>
<td>RMRC Pooled Fund (33), PCA (66)</td>
</tr>
<tr>
<td>Dynamic Moduli and CBR for Construction and Demolition Debris</td>
<td>77</td>
<td>48</td>
<td>UNH</td>
</tr>
<tr>
<td>Reconstruction of Railroads and Highways with In-Situ Reclaimed Materials</td>
<td>50</td>
<td>131</td>
<td>CFIRE</td>
</tr>
<tr>
<td>Cracking of Stabilized Layers</td>
<td>50</td>
<td>100</td>
<td>NCHRP</td>
</tr>
</tbody>
</table>

* = completed project.
## Unbound Materials - 2

<table>
<thead>
<tr>
<th>Project</th>
<th>RMRC ($K)</th>
<th>Other ($K)</th>
<th>Other Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stabilization of Reclaimed Pavement Material and Road Surface Gravel</td>
<td>50</td>
<td>148</td>
<td>MnDOT</td>
</tr>
<tr>
<td>with CCPs*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using High Carbon Coal Fly Ashes to Stabilize Recycled Asphalt Pavement</td>
<td>50</td>
<td>750</td>
<td>US DOE and MnDOT</td>
</tr>
<tr>
<td>Materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total (not include 2010 pool)</strong></td>
<td>444</td>
<td>1709</td>
<td>-</td>
</tr>
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Total projects = 8  
Leveraging factor = 3.8
## Environmental Assessment

<table>
<thead>
<tr>
<th>Project</th>
<th>RMRC ($K)</th>
<th>Other ($K)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment of Leaching in Embankments Constructed with Coal Fly Ash</td>
<td>0</td>
<td>37</td>
<td>EPA (22), UNH (15)</td>
</tr>
<tr>
<td>Mechanisms Controlling Release of Trace Elements from Soil-Coal Fly Ash Mixture*</td>
<td>50</td>
<td>106</td>
<td>CFIRE</td>
</tr>
<tr>
<td>Evaluation of Testing Protocols for Assessment of Fly Ash Stabilized Subgrade Materials</td>
<td>89</td>
<td>217</td>
<td>MD DEQ &amp; UMD</td>
</tr>
<tr>
<td>Evaluation of the Environmental Performance of CCPs in Roadway Applications</td>
<td>50</td>
<td>86</td>
<td>EPA</td>
</tr>
<tr>
<td>Assessment of US EPA’s IWEM Model*</td>
<td>0</td>
<td>40</td>
<td>EPA</td>
</tr>
<tr>
<td>WiscLEACH Update</td>
<td>35</td>
<td>70</td>
<td>EPA (40), JSU (30)</td>
</tr>
<tr>
<td><strong>Total (not include 2010 pool)</strong></td>
<td>189</td>
<td>486</td>
<td>-</td>
</tr>
</tbody>
</table>

Total projects = 5, Leveraging factor = 2.6
# Life Cycle Tools

<table>
<thead>
<tr>
<th>Project</th>
<th>RMRC ($K)</th>
<th>Other ($K)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metrics to Evaluate Sustainable Highway Construction in Wisconsin</td>
<td>0</td>
<td>100</td>
<td>UW &amp; CFIRE</td>
</tr>
<tr>
<td>Evaluation of Energy, Water Use, and GHG Associated with CCPs Used in Sustainable Construction*</td>
<td>50</td>
<td>156</td>
<td>EPRI</td>
</tr>
<tr>
<td>Quantifying Benefits of Recycling Using Real Construction Projects</td>
<td>0</td>
<td>50</td>
<td>RMRC Pooled Fund</td>
</tr>
<tr>
<td>Total (not include 2010 pool)</td>
<td>50</td>
<td>256</td>
<td>-</td>
</tr>
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</table>

Total projects = 2  
Leveraging factor = 5.1
## Outreach Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>RMRC ($K)</th>
<th>Other ($K)</th>
<th>Other Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Highways Partnership Specifications Harmonization and LCA Project</td>
<td>0</td>
<td>50</td>
<td>EPA</td>
</tr>
<tr>
<td>Outreach Materials for the Local Technical Assistance Program</td>
<td>0</td>
<td>75</td>
<td>EPA</td>
</tr>
<tr>
<td>Update of the Beneficial User Guidelines</td>
<td>50</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>50</strong></td>
<td><strong>125</strong></td>
<td></td>
</tr>
</tbody>
</table>

Total projects = 3  
Leveraging factor = 2.5

*This slide summarizes specific outreach projects. Other outreach activities are summarized in the following slides.*
Principles for Selecting Projects

1. Practical importance and relevance.
2. Distribution within major topics.
3. Input from advisory board (includes FHWA).
4. Availability of matching (prefer at least 1:1, required to generate $800k by contract).
5. Ability to leverage base funds.
Outreach

Face-to-Face Tech Transfer

- Foundry sand workshop
- Shingle workshop
- NHI training program
- IMR 101 workshops
- GHP harmonization
- TDI workshop (in review)
- Talks to numerous groups (e.g., AASHTO RAC next week)
Outreach

Webinars

- Foundry sands
- CCPs in unbound materials
- HMA with recycled materials
- RAP-RCA as unbound base (11k pool)
- RAS as structural fill (11k pool)
- EPA IMR training series
- ASCE recycled materials training series
- FHWA brown bag
Outreach

Standards and Specifications
- AASHTO Specifications
- ASTM D 18.14 – Sustainable construction

ASTM Symposium

Website and IT

Total invested in outreach = $813k
(2010 pool not included)