In-Place Recycling & Reclaiming Seminar with LIVE Demonstration
June 27-28, 2017

Champion Hosts:
Full Depth Reclamation & Soil Stabilization

Jonathan Pease, President
Rock Solid Stabilization & Reclamation, Inc.
Dickinson, ND ARRA In-Place Recycling Seminar 2017
• Purchased the family road construction business in 2002
• Formed Rock Solid Stabilization in 2007 & Joined ARRA
• Joined the Board of Directors of ARRA in 2015

“The reasonable man adapts himself to the world: the unreasonable one persists in trying to adapt the world to himself. Therefore all progress depends on the unreasonable man.”

~George Bernard Shaw
Asphalt Recycling & Reclaiming Association’s (ARRA) primary function has been to promote the recycling of existing roadway materials through various construction methodology, to preserve resources and reduce costs. Made up of a mix of Material & Equipment Manufactures, Engineers, DOT’s and Contractors.

ARRA is a partner of the Pavement Preservation & Recycling Alliance (PPRA) a unified voice collectively promoting technological processes and applications currently represented and promoted independently by AEMA, ARRA & ISSA

arra.org
ppralliance.org
**PAVEMENT LIFECYCLE CURVE**

- **Excellent (100%)**
- **Good (80%)**
- **Fair (60%)**
- **Poor (40%)**
- **Very Poor (20%)**
- **Failed**

**PAVEMENT CONDITION INDEX (PCI)**

- **40% drop in quality, 75% of roadlife left**
- **40% drop in quality, 12% of roadlife left**

**Pavement Preservation**
- **HIR (Hot In-Place Recycling)**
- **CIR (Cold In-Place Recycling)**
- **FDR (Full Depth Reclamation)**

**Average Savings Compared to Conventional Remove & Replace**
- **HIR** 10-15%
- **CIR** 20-30%
- **FDR** 35-70%
- **Soil Stabilization** 40-80%
• Visual site investigation
• Subsurface investigation (includes subgrade)
• Is there a need for water control?
• Classify & Quantify each layer to determine existing condition/performance
• Mix Design and/or recommendations from experienced person for all present varying conditions, choose the “right team”
• Cost comparison of available options
• Fix subgrade drainage issues if needed
• Utilizing a competent “team” of civil engineer, geotechnical engineer and contractor
• Realize and inform customer that there can be field changes due to unforeseen circumstances at times
• Infield QC/QA when possible

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Full Depth Reclamation is a technique in which the full flexible pavement section and a predetermined portion of the underlying materials are uniformly crushed, pulverized, or blended, resulting in a stabilized base course; further stabilization may be obtained through the use of available additives. By addressing the entire pavement section, full depth reclamation is able to correct delinquent cross sections, increase the load-bearing strength of the base, and utilize 100% of the existing materials. (ARRA)
CONVENTIONAL METHODS vs. FDR
**FDR: Types**

**Mechanical**
- Asphalt Pulverization
  - Can add rock to change the matrix of the gravel base

**Bituminous**
- Emulsified Asphalt
  - Typically 3-3.5%
- Foamed/Expanding Asphalt
  - Typically 2.5%+-
- Single pass or multiple passes for consistency with thick/irregular pavements

**Chemical**
- Portland Cement (dry or slurry)
  - Typically 3-6%
- Fly Ash – Type “C” not “F”
  - Typically 6-12%
- Polymers, Enzymes & Ect.
FRD: Process Cross Section

EXISTING ROAD
Removal of existing material if necessary

PULVERIZATION
TO DESIRED DEPTH

SELECT MATERIAL &
ADD STABILIZING AGENTS
(Mix, Reshape, Compact)

FINAL SURFACE TREATMENT
## 108th FDR vs. REMOVE & REPLACE

<table>
<thead>
<tr>
<th>Existing Road</th>
<th>R&amp;R w/ 18” Gravel</th>
<th>R&amp;R w/ 8.5” HMA</th>
<th>10” FDR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing HMA</td>
<td>Gravel Base/Sub-base</td>
<td>Base/Sub-base</td>
<td>FDR Base/Sub-base</td>
</tr>
<tr>
<td>Base/Sub-base</td>
<td>Subgrade</td>
<td>Subgrade</td>
<td>Subgrade</td>
</tr>
<tr>
<td>Subgrade</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Existing HMA**
  - Base/Sub-base
  - Subgrade
  - **0.14 S^n/in.**
  - **2.52 IBR**
  - **$696,000**

- **R&R w/ 18” Gravel**
  - Base/Sub-base
  - Subgrade
  - **0.30 S^n/in.**
  - **2.55 IBR**
  - **$813,000**

- **R&R w/ 8.5” HMA**
  - Base/Sub-base
  - Subgrade
  - **0.25 S^n/in.**
  - **2.50 IBR**
  - **$385,000**

### ARRA™

**Responsible Renewal. Reliable Results.**
Spec’d or Value Engineered on Asphalt Pavements in Need of Replacement

- Frequent Deep Cracking
- Reflective Cracking
- Heavy Pothole Patching
- Severe Rutting/ Shoveling
- Frost Heaves (may require drainage corrections)
- Insufficient Base Strength

FDR: When & Where

- Parking Lots
- Industrial Storage Lots
- Secondary Roads
- City Streets
- Interstate Highways
- Airport Runways
The Reclaimer uses a powerful milling and mixing rotor to granulate and mix the existing soil without added binders.

- Keeps pulverized material in same path
- Creates homogenous blend
- Adds volume/ raises grade
- > 6” compact before grading
- Collects millings into central windrow
- Utilize to remove surface asphalt if your project is sensitive to grade/ elevation
Pre-Pulverization

• Using a Reclaimer, the old asphalt and granular base is crushed & mixed to a predetermined depth.

• Water is the only additional material used in this process to achieve the required density.
Pre-Shape/Grade

- Important to meet desired elevations & cross slope of the finished plans. To avoid cuts and fills after the fact.
Transport

- Pneumatic hauling
- Bulkers are necessary to transport materials that will be used with a spreader
Spread

- Computerized & meter controlled for uniform distribution
- Spreaders cause less dust than old dup and spread methods, making it more environmentally friendly
Incorporating Stabilizing Agents

• Mixing powders with water injection creates greater control over water distribution and percentages than top dressing

• Mixing with a Tiller ensures a uniform cut depth and consistent gradation
Incorporating Bituminous Agents

- Direct incorporation with water injection creates consistent distribution
- Mixing with a Tiller ensures a uniform cut depth and consistent gradation
Initial Compacting/Breakdown

- Intelligent compaction
- Proper roll patterns
- Density testing
- Speed Control
- Proper “break” times
- Quality testing
Grading

- Match predetermined cross sections
Smooth Finish Roll

- Static rolling
- Initial curing
  - Wet curing (fogging)
  - Emulsify curing
- After 48 hours, micro-cracking is possible
FDR: Benefits

- Eliminates rutting below surface
- Reduces moisture susceptibility
- Reuses up to 100% of the existing road bed
- Allows for thinner pavement sections
- Increase rigidity spreads weight loads

<table>
<thead>
<tr>
<th></th>
<th>FDR</th>
<th>Overlay</th>
<th>Remove &amp; Replace</th>
</tr>
</thead>
<tbody>
<tr>
<td>New pavement</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Fast construction</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>Minimal traffic disruption</td>
<td>✓</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Minimal material transportation</td>
<td>✓</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Conserves resources</td>
<td>✓</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Maintains existing elevation</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td>Lower cost</td>
<td>✓</td>
<td>×</td>
<td>×</td>
</tr>
</tbody>
</table>
Soil Stabilization
• long-term physical and chemical alteration of soils to enhance their physical and engineering properties
• incorporating available additives can increase the shear strength of a soil and/or control the shrink-swell properties of a soil, thus improving the load bearing capacity of a subgrade to support pavements and foundations. (ARRA)

Soil Modification
• sometimes referred to as “mud drying”
• primarily intended to reduce moisture content and the plasticity in order to expedite construction
Unstable Wet Subgrade

SOIL STABILIZATION VS. SOIL MODIFICATION

Stabilized Subgrade
SOIL STABILIZATION/SOIL MODIFICATION: Candidates

Soil Stabilization
- Spec’d to add strength to the top 8” – 14” of subgrade
- Spec’d to reduce moisture and stabilize soil characteristics of swelling and/or shrinkage

Soil Modification
- Up to 20’+
- Dry wet/ unstable soil that cannot be properly compacted due to high moisture
  - High groundwater
  - Previous rain events
  - Unstable soil
- Reduce moisture/ strengthen subgrade
Example:
Road project, 9,000 SY, 80 – 85% failed proof roll

**12” UNDERCUTTING**
Excavation of 2500 CY at $50.00/CY___________________ $125,000.00
(unsuitable soil hauled off site)

**SOIL STABILIZATION**
9,000 SY stabilized @ 12” depth @ $4.25/ SY__________ $38,250.00

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Undercut vs. Stabilization savings of $86,750.00

**Modified Pavement Cross Section – Value Engineering**
7,900 SY of 2” HMA @ $4.80/ SY___________________ $37,920.00
9,000 SY Stabilized @ 12” depth @ $4.25/ SY________($38,250.00)

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Change Order Costs after Value Engineering $0!
Reactive
• To avoid project delays
• To reduce costs of undercuts
• To utilize onsite materials
• To improve subgrade prior to aggregate placement (pass a proof roll)
• With stands future moisture influx in the soils and has retained strength
Spec’d
To improve structural integrity of the entire pavement section

To reduce thickness of aggregate base or asphalt to achieve overall structural strength determined by the engineer
1” stabilized subgrade = 1” compacted aggregate base (.10 - .14 structural coefficient)
### Soil Stabilization/Modification:

#### Typical Stabilizers & Binders

<table>
<thead>
<tr>
<th>KEY:</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Stabilizer</td>
<td>Portland Cement</td>
<td>Lime</td>
<td>Kiln Dust</td>
</tr>
<tr>
<td>Fine-Grained: More than 35% Passing No. 200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Course-Grained: Less than 35% Passing No. 200</td>
<td>0</td>
<td>10</td>
<td>+</td>
</tr>
</tbody>
</table>

- Lime (%)
- Lime Kiln Dust (LKD) (3-6%)
- Quicklime (1-3%)
- Fly Ash (%)
- Class C (8-12%)
- Class F, not on its own
- Portland Cement (3-6%)
- Type I/II
- Slurry
- Mostly urban areas
- More expensive than powders
- Less dusty
- Others
- Enzymes, polymers, other stabilizers

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SOIL STABILIZATION/MODIFICATION: Benefits

- Prevents lateral spreading of the base
- Increases the stiffness and strength of the base
- Improves vertical stress distribution on the subgrade
- Reduces overall stress in the subgrade
- Increases the pavement life and reduces the potential for reactive maintenance
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