Cold Foam In-Place Recycling (CIR)

FONSECA/McELROY GRINDING CO., INC.
Cold Foam CIR
Cold In-Place Recycling Foamed Asphalt

The larger surface area allows the mixing of bitumen with cold and damp aggregate.
Example of CIR Process

- Hose connection to the bitumen tanker
- Microprocessor-controlled pump for injecting hot bitumen
- Microprocessor-controlled pump for injecting water for foaming the bitumen
- Hose connection to the water tanker
- Microprocessor-controlled pump for injecting water for compaction
- Working direction

Diagram:
- Damaged asphalt pavement
- Milling and mixing rotor
- Prepared mixture of materials
- Spreader auger
- Tamping screed
- Water tanker
- Bitumen tanker
- 2200 CR: milling, mixing, placement and precompaction
• Visual inspection
• Feasibility Report
• Random profiling samples collected at 1,000 linear feet or where you can see different mixes
• Mix Design
• Lower all existing utilities, iron, manholes, etc...

• Pre-mill wedge-cut existing pavement (if necessary) to accommodate the fluff of recycling and the required thickness, as well as make room for wear course
Cement Spreading

Spread cement on area to be recycled
*On average 1%
Cold Foam In-Place Recycling

- Add the designated percentage of liquid asphalt, proportional to working speed (On average 2.5%)
- Adding metered amount of compaction moisture to suit vary in-situ conditions, water taken from on-board tank (On average 2-4%)
- Place recycled and stabilized material with an attached screed
- Compact immediately behind the screed with double steel drum rollers, finishing the recycled surface by pneumatic roller
Fog Seal and Sand

- Spread sand over the fog sealed surface
- Open traffic immediately
- No rutting, no supplemental compaction necessary
Finished CIR Surface

After two days (depending on moisture content), place wearing course over the recycled surface.
Engineering, Testing, and Compaction

Anthony Alloppenna

Condor
• Perform CFA Mix Design(s) on materials to be processed prior to construction

• The in place materials are sampled and tested every 3000 square yards recycled

• Test performed include:
  ▪ California Test Method 216 Compaction Curve (1 per lot)
  ▪ Grain Size Analysis (1 per lot)
  ▪ Compaction tests per California Test Method 231 at +98% of CTM 216 (Min. 10 per lot)
  ▪ Marshall Compaction of Briquettes (6 per lot)
  ▪ Indirect Tensile Strength of 4” Compacted Briquettes (6 per lot, 3 dry, 3 soaked)
  ▪ Visual Inspection of the following:
    ✓ Cement Spread Rate
    ✓ Bitumen Temperature prior to foaming
    ✓ Percentage of foam introduced to processed material
    ✓ Foaming Characteristics (half-life vs. expansion)
    ✓ Rate of Recycle
    ✓ Temperature of Material Pre and Post Recycling
    ✓ Percentage of water added bitumen to create foam
    ✓ Percentage of water added post foam or Compaction
Monterey Road, San Jose
Project Specifications

- 638,040 Square Feet
- 4’ CIR with 2” AC Rubberized A/C
Existing Pavement Conditions

- Alligator cracked surface
- Years of patching
- Raveling/Potholes
- Aged oxidized pavement
- Type II Slurry Seal
- Areas of Petromat
Project Details

• Wedge cut existing pavement to allow for 2” rubberized wearcourse
• Adding the designated percentage of foamed asphalt, proportional to working speed
• Adding metered amount of compaction moisture to suit vary in-situ conditions, water can be taken from on-board tank, reducing the length of the train
• Paving the recycled and stabilized material with an attached screed
Pre-spread cement at a rate of 1%
Add approx. 2.5% liquid asphalt-PG 64-10
Recycling pass
  - 12’6” wide
  - 4” depth
Compact immediately behind the screed with one each, 14-ton double steel drum vibratory roller, followed with another 12-ton double steel drum vibratory roller and 11.5-ton double steel drum vibratory roller
98% compaction minimum per CTM 216 method
Recycling layer surface finished with two each 10-ton pneumatic rollers
Spread fog seal with sand
2” rubberized asphalt concrete overlay
Resulting in a new continuous, homogenous, 6” structural section
**CIR vs. Conventional R&R**

**Conventional R&R**
- 3” Mill
- 6” Digouts
- 1.5” HMA
- 1.5” RHMA
  
  Total = $2,540,470

**Cold In-Place Recycling**
- 2” Wedge Cut
- Minimal 6” Digouts (areas inaccessible)
- 4” Foam CIR
- 2” RHMA
  
  Total = $2,122,400

**NET SAVINGS**
16% or $418,070
Benefits (Aside From Cost Savings)

- Elimination of costs for 780 truckloads of importing and off haul costs of over 15,600 tons of aggregates to and from landfill and/or asphalt plant or quarry

- Conventional R&R method would have taken approximately 18 days, whereas the CIR method took only 9 days
Project Specifications

- 130,099 Square Feet
- 3” CIR with Double Chip Seal
Existing Pavement Conditions

- 3” A/C on dirt
- Alligator cracked surface
- Areas of patching
- Wheel track rutting
• Spread cement at a rate of 1% by mass
• 2.3% to 2.5% foamed asphalt – PG 64-10
• Recycling pass (overlap)
  – 12’6” wide
  – 3” depth
• Compact immediately behind the screed with 11-ton double steel drum vibratory roller, followed with another 8-ton double steel drum vibratory roller as intermediate roller
• 98% minimum compaction per CTM 216 method
• Recycling layer surface finished with ten ton pneumatic roller with another 7-ton pneumatic roller
• Double Chip Seal
• Resulting in a new 3” structural section
CIR vs. Conventional R&R

Conventional R&R
• 3” remove and replace asphalt surfacing @ $3.84 per SF = $499,580.16

Cold In-Place Recycling
• 3” CIR with foamed asphalt @ $1.75 per square foot = $227,673.25
• Double Chip Seal provided by Santa Clara County = $130,099.00
• Total = $357,772.25

NET SAVINGS
21% or $141,807.91
Benefits (Aside From Cost Savings)

• Elimination of costs for 100 truckloads of importing and off haul costs of over 2,012 tons of aggregates to and from landfill and/or asphalt plant or quarry

• Conventional R&R method would have taken 4 days, whereas the CIR method took only 2 days
Foamed A/C Longevity

INTERIM REPORT
CONSTRUCTION COMPLETION
FOR
COLD-IN-PLACE RECYCLING
Placer 80 PM 14.3 /33.3

North Region Materials
Marysville, CA
August 2006
Highway 80
Foamed A/C Longevity

Traffic Volume since Cold In Place Recycling

100,000 vpd, 8.5% trucks  Caltrans 2005 Figures

Construction 2005

Photo January 2011

5.5 Years Traffic estimated  137,000,000 vehicles

11,500,000 trucks

No Calls for Maintenance
## 2011 CIR Savings Summary

<table>
<thead>
<tr>
<th>Location</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alviso Trucking Yard</td>
<td>$50,000</td>
</tr>
<tr>
<td>Gilroy</td>
<td>$30,000</td>
</tr>
<tr>
<td>Redwood City</td>
<td>$38,144</td>
</tr>
<tr>
<td>Foster City</td>
<td>$100,078</td>
</tr>
<tr>
<td>Holsclaw Road</td>
<td>$141,808</td>
</tr>
<tr>
<td>Blackford High School</td>
<td>$54,594</td>
</tr>
<tr>
<td>Monterey Road</td>
<td>$418,070</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$832,694</strong></td>
</tr>
</tbody>
</table>


**Benefits of Foam Recycling**

**Environmental Factors:** Full use is made of the material in the existing pavement. Spoil sites do not have to be found and the volume of new material that has to be imported from quarries is minimized. Haulage is drastically reduced. The overall energy consumption is thus significantly reduced, as is the damaging effect of haulage vehicles on the road network. Reduced emissions from trucks on roads, less wear and tear on surrounding roads, and reduced traffic congestion.

**Quality of Recycled Layer:** Consistent, high quality mixing of the in-situ materials with water and stabilizing agents is achieved. The addition of fluids is accurate due to micro-processor controlled pumping systems. The recycled material and additives are rigorously mixed together in the mixing chamber.

**Structural Integrity:** The cold recycling process produces a layer that is homogenous and does not contain weak vertical interfaces between existing pavement when using the base repair method.

**Safety:** One of the most important benefits of this process is the high level of traffic safety that can be achieved. The full recycling train can be accommodated within the width of one traffic lane.
Benefits of Foamed Recycling

- **Shorter Construction Time:** The foamed AC process is capable of high production rates that significantly reduce construction times compared to alternative rehabilitation methods. Shorter construction times reduce project costs, as well as providing a largely intangible benefit for the road user in the reduced time that traffic is disrupted.

- **Cost Effectiveness:** The above benefits combined generate 20-40% cost savings, which makes cold recycling a most attractive process for pavement rehabilitation.

- **Material Savings:** 95% of the materials needed to reconstruct the roadway have already been purchased by the agency, owner, or the tax payer - No new aggregates purchased.
Why Recycle

Primary Reasons for Choosing Foam Recycling:

- History of success on previous foam full depth reclamation projects (over 13 years)
- Single Pass all-in-one Recycle Train, from milling to paving
- Open to traffic in as little as 3 to 4 hours
- Reduction in construction window traffic congestion
- Less construction equipment on roadway
- Fewer truck ingress/egress
- Preservation of natural resources
- Significant potential cost savings
- It’s the right thing to do
Acknowledgements