Introduction to
Cold Central Plant Recycling
Session 130: 2017 Purdue Road School

Jason Wielinski, P.E.
Heritage Research Group
Pavement Recycling

**Why Recycle?**

- Provides additional rehabilitation techniques for existing roadways
- Reuse and conservation of non-renewable natural resources
- Reduce landfilling or stock-piling material
- Energy conservation
- Reduction in user delays
- Improve physical properties of the existing pavement section
- **Cost savings realized by agencies**
Full Depth Reclamation

- Deepest Recycle Treatment (5 - 10 in.)
- Entire asphalt pavement and portion of underlying materials
- Uniformly crushed, pulverized and blended
- Results in stabilized base course when recycling agents are used
  - Asphalt Emulsion
  - Cement
- Requires Wearing Course
Cold In-place Recycling

- Pulverize existing HMA pavement (2 – 5 inches)
- Include minor amounts of aggregate base
- Laydown with Paver
- Compaction
- Wearing Course
Cold Central Plant Recycling (CCPR)

**RAP = New Pavement:**

- Stockpile and keep clean
- Crush RAP to gradation
- Mix with recycling agent
- Additive if needed
- Transport to laydown area
- Pave as a recycled mix
- Compact to specified density
- Ready for surface treatment
Let’s discuss

- How are they built?
- How are they designed?
- How do they contribute to pavement design?
- Example Projects
CCPR RAP Source

From the Pavement

From an Existing Stockpile
CCPR Crushing and Sizing Equipment

Load Unprocessed RAP

Crushing Material to 1.25” Minus

 Crushed 1.25” Minus Material to Processed Pile
Crushing and Sizing Equipment

- 100% Closed Circuit System

- Crushing and sizing equipment capable of reducing RAP to the 100% passing 1.5” or 1.25” sieve
CCPR Recycle Unit

Processed RAP

Recycling Unit

Recycling Agent

Newly Recycled Material
Loading the RAP
Loading CCPR Mix into Trucks

- Trucks Clean with No Build Up
- Soap Truck Beds
- Load and Deliver ~< 1 hr.
CCPR Laydown

- Minimum 170 Hp Paver
- Do not heat the Screed
- Do not Clean with Diesel
- Avoid Buildup in Paver
Rollers
Quality Control

- **Nuclear Density Gauge**
  - Relative compaction 95%-105% of maximum
  - Based on break-over curve density
  - Re-establish maximum density and rolling pattern
    - with new break-over curve if test results are outside of compaction limits
- **Crushing and sizing of RAP meets maximum gradation**
  - Sample and Test – Every 500 tons
- **Emulsion meets specifications**
  - 2 1-quart samples taken from every tanker.
- **Sizing of RAP compared to Mix Design gradations**
  - Sample and Test
  - Air dried gradation measured to No. 30 sieve
Curing of CCPR Mixtures

- CCPR Mix Needs Time to Cure
- Release Moisture from Emulsion
- Less than 3.0%
- OK for Traffic until Surface
Surfacing the CCPR Mixtures

- CCPR needs a wearing surface
  - Higher Voids than HMA
  - Before Winter

- Low Volume
  - Double Chip Seal
  - Cape Seal

- Higher Volume
  - Single Lift HMA
  - Multiple Lifts of HMA
How are CCPR Mixtures Designed?

- Representative sampling from stockpile
  - Material is processed in lab similar to how it will be processed in field
  - Screening or screening and recrushing
- Cores collected from pavement
  - Cores cut at mill depth and crushed
  - Samples fabricated at multiple gradations to meet expected gradations
- Dosage and Formulation of Emulsion
  - Type and Amount Needed for Mix Design Requirements
What is Asphalt Emulsion?

- Combination of:
  - Asphalt
  - Water
  - Surfactants
- Delivered and mixed at low temperatures
  - “Cold” Process
  - Workability
- Chemical Break
  - Formulated to release water
  - Gains strength upon break
  - Curing
CCPR Mix Design Parameters

- Which parameters do we investigate for good performance?
  - Stability
    - Resistance to rutting
    - Min 1250 lbs; 4 in. pill at 40C
  - Adhesion
    - Resistance to water damage
    - Retained 70% Stability
  - Strength Development
    - Rate of cohesive strength
    - 2% Max Loss in Raveling Test
  - ITM 592/ARRA Guidelines
CCPR and Pavement Design

- AASHTO 93
  - CCPR range 0.28 – 0.33

- PaveME
  - Modulus Values Being Developed
    - Model as HMA Layer with Appropriate Modulus
  - NCHRP 9-51
    - Modulus for FDR, CIR, CCPR
    - Field Projects- Lab Tested Dynamic Modulus

- NCAT
  - Track and US 280
  - Virginia
Example Projects

- Wexford, MI 2013
  - Low Volume County Highway
  - County Owned Stockpile of RAP

- Wolf Creek Subdivision, Holland, OH 2016
  - Reconstruction of Subdivision Pavement

- Ida West Road, Monroe County, MI 2016
  - Rehabilitation of a Composite Pavement
Example Project #1

- 46 Road in Wexford County, MI
- Demonstration Project
- County Acquired Stockpile of RAP
- Wanted to Try Something New
- Save Cost
Wexford Co, MI

- 46 Road
  - Low Volume
  - Approx. 1 mile
  - Lay 2.5 – 3.0 in CCPR
  - Double Chip
  - See What Happens!
Wexford Co, MI

- Wirtgen KMA 220 Plant
- Mix Design on Processed RAP
  - 3.0% Emulsion
- Local Contractor Lay Down
Wexford Co, MI

- Place first lane in one lift
- Second lane
  - Scratch to wedge/ level
  - Surface Lift Same Day
Wexford Co, MI

- Double Chip Seal
  - Late for Michigan
    - End of September
  - Evaluate Winter’s Toll
- Ultra Thin HMA
  - Little to No Distress
Example Project #2

- **Wolf Creek Subdivision- Holland, OH**
  - Subdivision Pavement
  - Pavement at End of Life
  - Required Some Base Repairs
  - Remove HMA
    - Complete Base Repairs/ Stone
    - Lay down 3” – 4” CCPR
    - Surface 1.5” 9.5mm HMA
Wolf Creek Subdivision

- Project Completed in Phases
  - ~15,000 square yards
- Half of the Area Stripped and Prepared
- CCPR Placed
- Other Half then Prepared
- CCPR Placed
- CCPR Cured
- HMA Paved all at Once
Wolf Creek Subdivision

- CCPR Mixture Production
- Mix Design
  - 3.5% Emulsion
  - 8.3 Gallons per Ton of RAP
- Haul Time
  - 20 to 35 minutes
Wolf Creek Subdivision
Wolf Creek Subdivision

- Carried Traffic Until Overlay
- Save Costs to Homeowners?
  - 20% Cost Reduction of Traditional HMA Base Mix
Example Project #3

- Ida West Rd- Monroe Co, MI Rehabilitation
  - Composite Pavement
  - HMA Stripped and Cracked
  - Concrete Repairs?
  - Remove HMA
  - Seal/ Fix Joints
  - CCPR
  - Multi-Lift HMA Overlay
Ida West Rd

- HMA Removal
- PCC Evaluation
- Chip Sealed
- RAP Processing
Ida West Rd Rehabilitation

- CCPR Mix Design
- 3.0% Emulsion
- 7.1 Gallons/ Ton RAP
- 5.5” Lift Thickness
- 1500-2000 Tons per Day Production
Ida West Rd Rehabilitation

- Multiple Lift HMA Overlay
  - All Winter Michigan Route
- Excellent Smoothness
- More CCPR in Monroe Co
Ida West Rd Rehabilitation
Cold Central Plant Recycling

- Third Process of Cold Recycling Technologies
- Reduced Costs to Agency
  - More Cost Effective than HMA
  - Used with soil stabilization/ base reconstruction
- Used on Low Volume and Higher Volume Roads
- INDOT Developing Specification
  - RSP Expected to be Presented to Standards Committee in March
Contact Information

- Thank you!
- Questions and Comments

- Jason Wielinski, P.E.
- Jason.wielinski@hrglab.com