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# **Recycled Materials and New Pavement Technologies**

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**DelDOT Design Teams**  
**September 1, 2009**

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# Topics

## ◆ Currently Used Recycled Materials

- Soils/Bases
- HMA
- PCC

## ◆ New Pavement Technologies

- FDR/CIPR
- WMA
- PCCP

# Currently Used Recycled Materials – Soils/Bases

## ◆ Shredded Tires

- Lightweight fill (1/2 unit weight of conventional soil).
- Used on 6<sup>th</sup> Street over CSX.
- Tires shred to 2” pieces.
- Make a soil “sandwich;” max depth of shredded tires is 10’ per lift. Use 10’ tires + 3’ conventional soil + 10’ tires (etc).

# Currently Used Recycled Materials – Soils/Bases (cont)

## ◆ Rotomillings

- Used in lieu of quarried GABC as a base.
- Since there is residual asphalt, in the summer hardens almost like pavement.
- Bid option note (302514).
- Can use millings from other projects.
- No intermingling of materials.....

# Currently Used Recycled Materials – Soils/Bases (cont)

## ◆ Crushed Concrete

- Used in lieu of quarried GABC.
- In a wet area, due to the residual cement, tightens up like concrete.
- Be careful of excessive other deleterious materials in the crushed material.

# Currently Used Recycled Materials – Soils/Bases (cont)

## ◆ Fly/Bottom Ash (Flowable Fill)

- Can be used as an embankment (SR1).
- Can be incorporated into flowable fill.
- Use for pipe trenches.
- Material flows like water so make sure forms are tight.

# Currently Used Recycled Materials – HMA

## ◆ Recycled Asphalt Pavement (RAP)

- Make-up: aggregate and asphalt.
- Use reduces amount of virgin material needed.
- Have allowed up to 35% in new mixes.
- Have to use softer grade of virgin liquid (PG58-28) to make up for stiffness of RAP.

# Currently Used Recycled Materials – HMA (cont)

## ◆ Shingles

- Make-up: asphalt and fine aggregate.
- Pre-consumer waste (not post-consumer).
- Up to 5% of mix (asphalt binder very stiff).

# Currently Used Recycled Materials – HMA (cont)

## ◆ Ground Tires/Rubber

- Tires ground to a fine powder (steel removed).
- Add 10-18% to the liquid asphalt to stiffen.
- Increases cost.
- Supposed to make pavements quieter.
- Paved Upper King Road earlier this spring.

# Currently Used Recycled Materials – HMA (cont)

## ◆ Glass

- One supplier has used it on private work.
- Glass mix is prone to stripping.

## ◆ Ground Plastic

- Used to stiffen the liquid asphalt.
- Paved Yoder Road about 8 years ago.

## ◆ Shredded Newspaper

- Becomes fiber.
- Can increase asphalt content without having draindown.

# Currently Used Recycled Materials – PCC

## ◆ Ground Granulated Blast Furnace Slag (GGBFS)

- Byproduct of steel production.
- 35-50% Portland cement replacement.
- Mitigates ASR, lowers permeability, increases long-term strength, slower initial strength gain.
- Locally available.
- Cost is equivalent to cement.

# Currently Used Recycled Materials – PCC (cont)

## ◆ Fly Ash

- Byproduct of coal combustion.
- Mitigates ASR, lowers permeability, increases long-term strength, slower initial strength gain.
- Have had consistency issues.

# Currently Used Recycled Materials – PCC (cont)

## ◆ **Microsilica** (silica fume)

- Byproduct of silicon production.
- Very costly.
- Mitigates ASR, decreases permeability, helps with early and long-term strengths.
- Challenges with field placements.

# New Pavement Technologies

◆ FDR/CIPR

◆ WMA

◆ PCCP

# Full Depth Reclamation (FDR)

- ◆ Mixing of subgrade (HMA, surface treatment, soils, etc) with cement.
- ◆ Successful projects completed in 2008 and 2009.
- ◆ Couple of issues:
  - Curing/Striping
  - Cracking
  - Surface Condition
- ◆ Extensive exploratory coring needed in pre-construction.

# Cold In-Place Recycling (CIPR)

- ◆ Mix existing HMA layer with asphalt emulsion.
- ◆ Completed locations in 2008 and 2009.
- ◆ Couple of issues:
  - “Tenderness” of mix
  - Depth of HMA for CIPR – more exploratory coring prior to construction.

# Warm Mix Asphalt

- ◆ Through modification, mixes can be produced and placed at lower temperatures (190°F - 250°F).
- ◆ Results have shown nationally that performance is not adversely affected by the lower production and placement temperatures.

## WMA (cont)

### ◆ Some potential benefits of WMA:

- Lower production temperatures.
- Lower energy costs for supplier.
- **Lower prices Department pays.**
- Less fumes.
- Less emissions.
- Less temperature loss.
- Extended paving season.
- Use over crack sealant material.

## WMA (cont)

- ◆ Only concern raised to date has been possible moisture damage within the pavement.
- ◆ Caused by the possible lack of completely dry aggregates due to the lower production temperatures.
- ◆ State tests have varied on this issue.

## WMA (cont)

- ◆ Even with lower mix temperatures, performance of materials is the same as conventional HMA.
- ◆ Additives at plant modify viscosity of the asphalt binder.
  - Additives can be waxed based materials or foaming operations using water.
- ◆ May be able to modify roller activities?

## WMA (cont)

- ◆ For DelDOT, multiple WMA locations to date.
- ◆ Marrows Road, US 113/SR1.
- ◆ Diamond Materials produced and placed the material.
- ◆ Mix temperature was 245°F; less than 5°F temperature loss from plant to location.

# WMA (cont)

## ◆ Future of WMA in Delaware:

- Several possible locations have been scoped.
- DRAFT specification has been written.
  - ◆ Modification method will be up to supplier.
  - ◆ New item numbers will be used.
- Certification of WMA systems on a national level?

◆ National thinking is that in the coming years, 100% of production could be WMA.

# Precast-Prestressed Concrete Pavement

- ◆ Roadway slabs that are cast off-site.
- ◆ Varying widths, depths, and lengths can be cast.
- ◆ Dimensions are mostly controlled by transportation.
- ◆ Varying reinforcement can be used.
- ◆ Various methods available – some are proprietary.

## PPCP - Location (cont)

- ◆ Looked for an application for the last few years.
- ◆ Several locations have been reviewed by industry, FHWA, and consultants.
- ◆ Most posed some logistical issue.
- ◆ Finally, a location was reviewed and seemed to be a good candidate.

## **PPCP - Location** (cont)

- ◆ Location had adequate work space.
- ◆ Multi-lanes so traffic can be maintained during construction.
- ◆ High traffic count location to test the reliability of the PPCP.
- ◆ Large enough quantity to make the project attractive to bidders.

## **PPCP - Location** (cont)

- ◆ SR 896 NBR & SR 40 EBR
- ◆ Severe deterioration of the existing PCC joints due to ASR.
- ◆ Has been on the Pavement Management list for rehabilitation.
- ◆ Rehab needed both at intersection and other joints in the area.

## **PPCP - Location** (cont)

- ◆ Construction Contract was a combination of PPCP and conventional high-early strength PCC patches.
- ◆ Plan was to have contractor pour conventional PCC patches while PPCP are being prepared.

# PROJECT OVERVIEW – Fact Sheet



## Fact Sheet:

- **Functional Class – Principal Arterial.**
- **AADT – 37,679; % Trucks – 9%.**
- **Existing Pavement Section – 12” PCC over 8” stone.**
- **Replace failing jointed plain concrete pavement within the right and left turn lanes with Precast-Prestressed Concrete Pavement (PPCP). 8” PPCP over 4” pervious concrete**

# PPCP – Project Development (cont)

## ◆ Construction

- Proposed Schedule: Sunday evening through Friday morning.
- Restricted Working Hours: 7:30 PM – 5:30 AM
- All lanes restored to unrestricted use at the end of each workday.

# DeIDOT Expectations

- ◆ Success of a new product/process.
- ◆ New option for PCC patching.
- ◆ Gain further experience.
- ◆ Department is always open to new ideas and technologies.



Thank you for your time and  
attention....

Any questions or comments?

