Recycled Materials and New Pavement Technologies

DelDOT Design Teams

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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 6th 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 will 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.
- 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 concerned 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?
For DelDOT, multiple WMA locations to date.

Marrow 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.
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.
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.
**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.
DelDOT 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?