



Interaction between Specifications and Pilots for New Concrete Technologies/NRRA

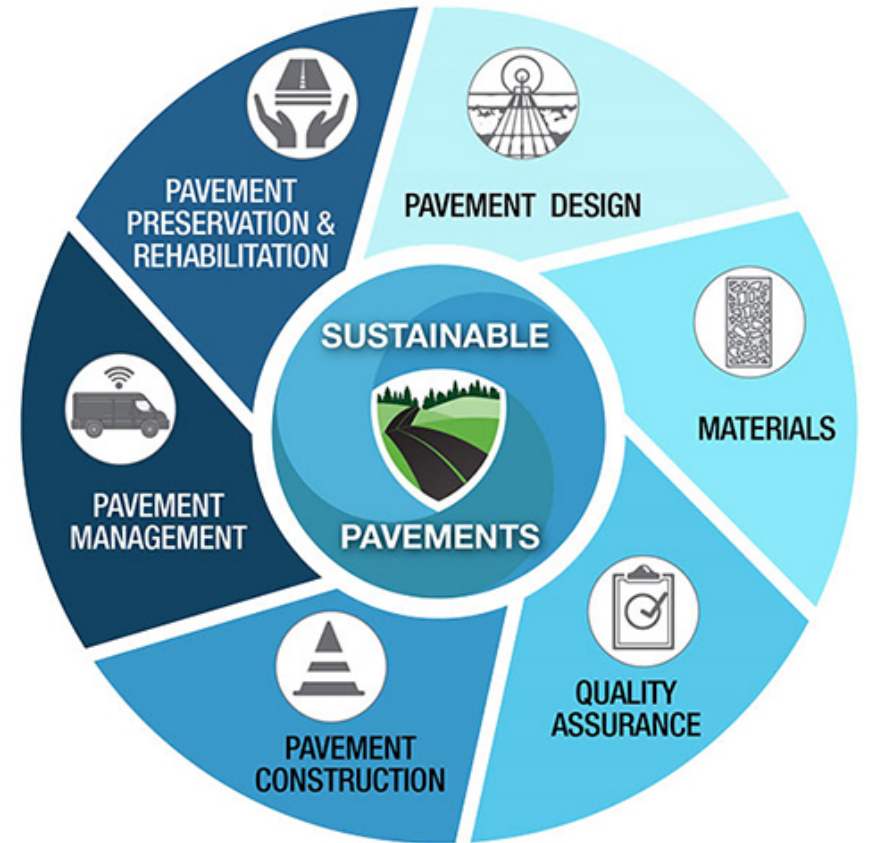


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Can MnDOT make concrete more sustainable?

- 25+ year history of building high-quality concrete pavements
- Reduce Total Cementitious in the Mix
- Reuse Materials
 - Allow non-traditional SCMs
 - Recycled Aggregate
- What is the global warming potential (GWP) of this concrete paving mix design?
 - Ask for EPDs (Environmental Product Declarations)
 - MnDOT has several active research projects for gathering EPD's



Source: FHWA.

How Do DOTs Accept Non-traditional Materials?

- Balance Risk vs. Benefit
 - Long-term performance
 - National Standards for Acceptance
 - **Demonstration Projects**
 - Research Projects on materials
 - Constructable
 - Material Availability and Supply
 - Cost
 - Engineering Judgment



MnROAD- Minnesota Road Research Facility



MnROAD I 94 Original westbound (1972)

MnROAD I 94 Mainline



I 94 westbound to St. Cloud

MnROAD Site Office and Operations

MnROAD Low Volume Road



Concrete Mixture Requirements

- Designed per MnDOT low w/c ratio paving specifications
 - *Portland cement mixes will use an ASTM C595 Type II(10) blended cement*
 - *Coal Combustion Products (30% of total cementitious)*
 - Optimized Gradation per MnDOT Specifications (Tarantula Curve)
 - Air Content from 5 to 8 percent
 - Minimum flexural strength of 500 psi at 28 days
 - Meet performance requirements based on AASHTO PP-84 Performance Engineered Concrete Pavement Mixtures

Logistics for MnROAD Project

- Material availability
 - Some suppliers didn't have enough material to build a full length test cell
- Handling
 - Additives delivered by supersacks or smaller sacks (similar to fibers sacks)
 - Dedicated silo for various additives
 - Many ready-mix plants are not equipped to alternate unique materials



Constructability Requirements

- **GOAL:**
 - Batched and mixed at a central plant
 - Optimum workability to facilitate placement using conventional slipform paving equipment
 - Concrete maintains a plastic state for at least 45 minutes to allow for haul time and placement
- **REALITY:**
 - Many mixes needed all of the water and admixtures to be workable
 - Some mixes needed do-overs
 - Texturing was difficult in some cells



PCC Construction Testing

- Materials and Mix Properties (field and lab)
- Plastic Concrete Properties (field)
- Hardened Concrete Properties (field and lab)
- Carbon Capture (carbon uptake, thermal gravimetric analysis)



Over 600 samples fabricated during construction!



Mobile Concrete
Technology Center (MCTC)



Turner-Fairbank
Highway Research Center



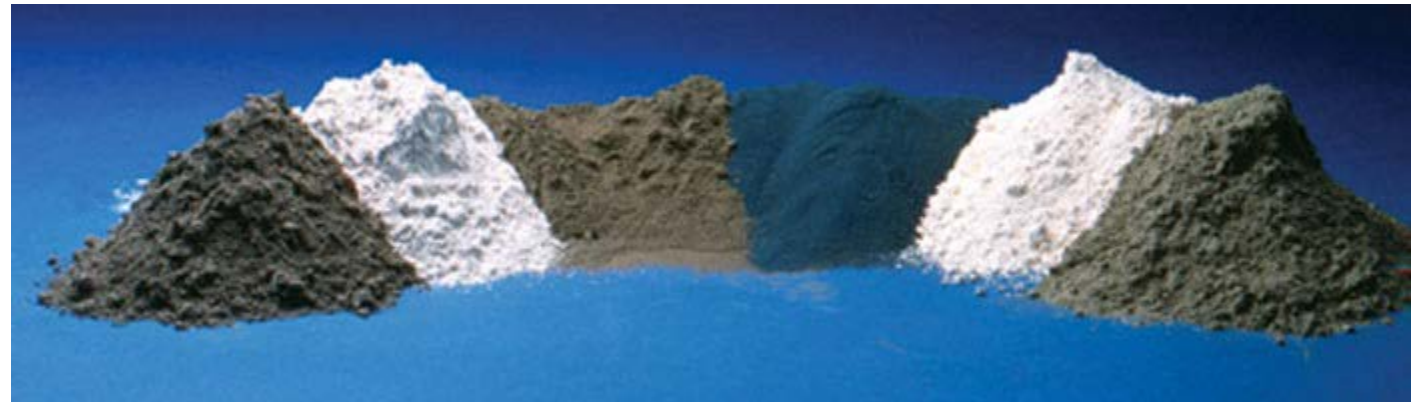
MnROAD Testing – Pavement Performance

- MnROAD Construction Report
- Environmental and Vehicle Load Response Sensors
- Pavement Smoothness
- FWD Testing
- Distress Surveys
- MIRA Mappings
- Faulting
- Pavement Surface Characteristics
- Albedo Testing
- Much more



Unique Materials Installed

- Injected – Industrialized Carbon Dioxide (CO₂)
- Processed Fly Ash with sequestered CO₂
- Calcined Clay
- Alkali Activated Cement
- Manufactured Fly Ash
- High Replacement Portland Limestone Cement
- Metakaolin
- Natural Pozzolan
- Ground Glass



Research Project Goals

Use of Carbon Dioxide for Sustainable and Resilient Concrete Pavements

IOWA STATE
UNIVERSITY

Use of Alternative Cementitious Materials (ACMs)

 applied pavement
TECHNOLOGY
www.appliedpavement.com

Use of Alternative SCMs Towards Reducing Cement Content in Concrete Pavements

 INCE

Constructability Evaluation

Evaluate performance of in-place concrete pavement over 3 years

Sustainability and Resiliency Comparison of Materials - Environmental Impacts

Measure the carbon uptake from all unique material combinations

Check out the NRRRA – Rigid Team Webpage - <http://www.dot.state.mn.us/mnroad/nrra/structure-teams/rigid/index.html>

- Strong support from FHWA, DOTs, and Industry for this research
- Allows non-traditional materials to be placed into a roadway section with interstate traffic with minimal risk to DOTs
- “Important project to begin the transition to new materials in road construction” – Tom Van Dam

Thank you again!

Maria Masten

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