



# Warm Open Graded Friction Course (FC-5)

Feb. 23, 2006

Seminole Expressway



# Warm Mix

- Warm Mix uses an additive to lower the viscosity of the binder
- Allows production at lower temperatures
  - Reduction in fuel consumption
  - Lower emissions
  - Possibly allow placement in cooler ambient temperatures
- Traditionally used with Structural Mixes (Used in Europe; trial mixes in US)
- To date, only two known Warm OGFC Mixes in the World (Beijing, China, October, 2005; Orlando, FL, February 2006)



# Zeolite ?

- Used a zeolite material as the Warm mix additive (AsphaMin is the proprietary name)
- Zeolite is a crystalline hydrated aluminum silicate
  - Framework silicates with large empty spaces in their structures
  - Contains approximately 21 percent water
  - When zeolite is added to mix at same time as binder, water is released
  - The water creates a volume expansion in binder (foams) and significantly lowers the viscosity
  - Allows the material to be workable at lower temperature



# Seminole Expressway Background

- 230 tons of zeolite warm mix FC-5 was placed on the Seminole Expressway (SR 417) on February 23, 2006
- Mix Temperature
  - Conventional Mix FC-5: 320° F
  - Warm Mix FC-5: 270° F
- Georgia Granite Polymer Modified FC-5
- Mix included 1% Lime
- Mix had 0.3% Zeolite (6 pounds per ton)
- Mix also included 0.4% fiber



# Seminole Expressway Background



- Production day included 105 tons conventional FC-5
- Immediately following the 230 tons of the warm FC-5 was placed
- Material is located between the Winter Springs Bridge and the Red Bug Lake Road Bridge Southbound Passing Lane



# Seminole Expressway Background



- Zeolite additive is only difference between Conventional FC-5 and the Warm FC-5
- Production and Placement between two mixes were compared
- Material Transfer Device with re-mix capability was used
- Two static steel wheel rollers were used
- Haul time was around 20 minutes
- Weather: 80 to 85° and Sunny



# Seminole Expressway





# Seminole Expressway





# Seminole Expressway Results



- Operation went well with only minor issues
- Paving crew said placement felt same with both mixes
- Noticed roller operator was holding back
  - Operator said mix was picking up
- Material was not segregated – Mat looked very good



# Seminole Expressway Results



Conventional Hot Mix FC-5 Texture

Zeolite Warm Mix FC-5 Texture





# Seminole Expressway Results



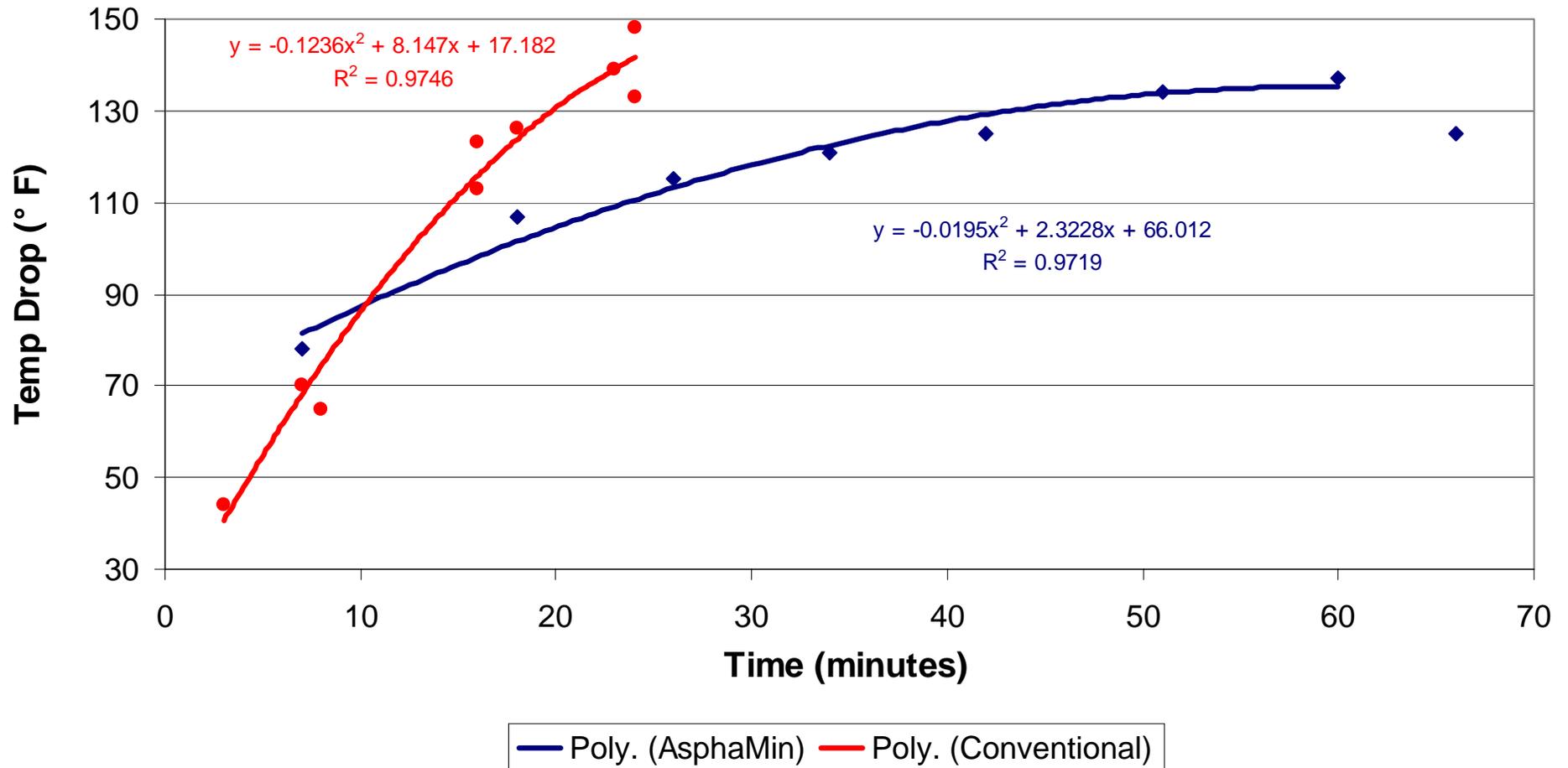
- Hot Mix FC-5 Temperatures:
  - Hot Mix FC-5 was 307° F in the truck at the plant (avg.)
  - Hot Mix FC-5 was 283° F coming out of the screed (avg.)
  - This is an average drop of 24° F between plant and screed
- Warm Mix FC-5 Temperatures:
  - Warm Mix FC-5 was 269° F in the truck at the plant (avg.)
  - Warm Mix FC-5 was 253° F coming out of the screed (avg.)
  - This is an average drop of 16° F between plant and screed
- Difference due to different starting temps
  - (further from ambient temperature will have faster dropping temps)



# Seminole Expressway Results



### Temp Drop vs. Time





# Seminole Expressway Results



- Joints with bridge:
  - Material got stiff and unworkable quickly
  - Not sure if this was due to low temp or material “break”
- Striping Vehicle:
  - Vehicle pulled onto Warm FC-5 and stopped
  - When the Vehicle started moving again, the material pulled up



# Warm Mix FC-5 Cautionary Statements

- “Break” time has not been determined:
  - At some time the trapped water vapor will dissipate
  - This would be similar to an emulsion breaking
  - I have not seen any data showing when this occurs
  - This could be catastrophic on longer haul times
- The material needs to be tested for skid resistance:
  - Zeolite is a material commonly used in laundry detergent
  - We do not know if this material will decrease skid resistance



# Warm Mix FC-5 Cautionary Statements

- Permeability may be different between the two mixes:
  - Zeolite is a dust-size particle and it increases the dust content in the mix
  - The change in gradation and the different temp used could change permeability in the mix
  - Coring crew indicated permeability seemed lower
- Moisture is involved in production and the aggregate is not heated as much; therefore, moisture may be a problem
  - Other zeolite tests have indicated an increase in moisture sensitivity
  - Moisture Susceptibility tests should be performed



# Warm Mix FC-5 Cautionary Statements

- Moisture is involved in production and the aggregate is not heated as much; therefore, moisture may be a problem
  - Other zeolite tests have indicated an increase in moisture sensitivity
  - Moisture Susceptibility tests should be performed
- General Durability could be reduced or increased
  - Durability tests should be conducted such as the Contabro test to determine what affect the zeolite has on the FC-5 mix
  - High technical crack tests should also be conducted on the mix to determine if we can expect a change in crack resistance



# Warm Mix FC-5

Thank you