Waterborne Traffic Markings
Technology and Testing

Presented to:

Partnerships for Progress
in Transportation

LOUISIANA TRANSPORTATION
CONFERENCE
February 17-20, 2013
River Center, Baton Rouge

Cindy Randazzo
Dow Coating Materials
February 18, 2013
AGENDA

- Overview of TP Market
- Importance of Dry Time
- Quick Dry Technology
- FASTRACK™ Product Line
- FASTRACK™ HD-21A Performance
- FASTRACK HD-21A and VISILOK™ drying additive
- Traffic Paint Testing
- Wet Night Visibility
- Life Cycle Assessment

VISILOK™ is a product of Potters Industries

The DOW Diamond and FASTRACK are trademarks of The Dow Chemical Company (“Dow”) or an affiliated company of Dow.
PAINTING - Waterborne

Waterborne provides an Improved Environmental Profile, Is EASY TO USE, and QUICK DRYING

Pictures: Central Seal Company

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Night Visibility Relies on Reflective Beads (usually glass) Embedded in the Marking

Retroreflected luminance - brightness of a road marking paint as seen by the driver under the illumination of the road by the car headlights.

Measuring Retroreflectivity using 30 Meter Geometry

At least 100 mcd retroreflectivity needed for Nighttime Visibility
Night Visibility = Safety

Which Road Do You Want To Drive On?

Retroreflectivity is Essential for Roadway Safety

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Marking Needs: FAST DRY

Tracking Resistance - onto roadways and cars

Tracking onto the roadway is **unsightly** as well as **damaging** to the marking’s performance.

Paint splatter on cars can result in **Costly Detailing Claims** against the state.
Marking Needs: FAST DRY

Wash-off Resistance

Unexpected rain events can cause significant problems when you don’t have Quick Dry Technology!
Dow Quick Dry Technology

• Paints are stable at high pH

• Ionic Crosslinking as pH drops following application

• Quick dry properties without complete water evaporation

High pH > 9.7

Ammonia

Quick No Track and Rain Resistance

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FASTRACK™ Binders Answer the Challenges of the Industry

Traffic Markings need FAST DRY, Visibility and Durability

The Industry’s First Fast Dry Binders for Exceptional Quick Dry / No Track Performance and Wash-Out Resistance

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Increasing Durability

Traffic Markings need Dry Time, Visibility and DURABILITY

Durability Improvements

2 Years on Concrete Surface (Rt 202, Pennsylvania, 1994)
FASTRACK™ Binders Answer the Challenges of the Industry

1990
FASTRACK™
2706
1st Gen WB
Fast Dry
Emulsion

1995
FASTRACK™
3427
Fast Drying
Improved Durability

2000
FASTRACK™
HD-21A
High Build
Higher Durability

The Industry’s First High Build, High Durability Binder for Multiyear Durability
The new Specification contains Type III material - For increased durability

“100% cross-linking acrylic as evidenced by infrared peaks at wavelengths 1568, 1624, and 1672 cm⁻¹ with intensities equal to those produced by an acrylic resin known to be 100% cross-linking.”
Georgia DOT Trial with FASTRACK™ HD-21A

- Applied: 7/12/06  State Rte 19 in Griffin, GA  12K ADT
- Conditions: ~92 °F air / ~110 °F road / ~55% RH
- Surface: old thermo line on asphalt road with ~24 wet mils (630 microns) of HD-21A based paint
- Readings at initial, 2 week, 12, 21, 34 & 47 months

**Results:**

After 47 months:

Yellow Edge Line, White Edge Line and White Skip Line

ALL had Retro above 200 mcd
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After 3 years: The average retro is \(~200\) mcd, except for the system with Ultra 1.9 beads which is \(~500\) mcd.

Approximate Cost per linear foot is 7 - 14¢
# Lifetime Costs of FASTRACK™ HD-21A Systems vs. Other “Durable Technologies”

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard WB Paint</td>
<td>0.08</td>
<td>1</td>
<td>0.08</td>
</tr>
<tr>
<td>HD-21A WB Paint</td>
<td>0.13</td>
<td>2</td>
<td>0.065</td>
</tr>
<tr>
<td>Spray Thermoplastic</td>
<td>0.33</td>
<td>3</td>
<td>0.11</td>
</tr>
<tr>
<td>Epoxy</td>
<td>0.30</td>
<td>3</td>
<td>0.10</td>
</tr>
<tr>
<td>Tape</td>
<td>2.7</td>
<td>5</td>
<td>0.54</td>
</tr>
<tr>
<td>Polyurea</td>
<td>0.71</td>
<td>4</td>
<td>0.18</td>
</tr>
</tbody>
</table>

Data above is from the 2008 ATSSA Survey

When factoring in cost and service lifetime for the different systems, FASTRACK™ HD-21A WB Paint is the most economical option.
State Usage of “High Build” Waterborne

Every State uses Waterborne Paint - some have moved to High Build

FASTRACK™ HD-21A is a High Build / High Durable WB

Light Blue = Durable WB in use or specified

Dark Blue = States with Durable used for Wet Night Visibility
Making High Build Waterborne Dry Even FASTER

VISILOK™ Drying Additive
For High Build Paint

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Drying Additive for FASTRACK™ HD-21A
High Build Water Based Traffic Markings

High Build Paint
with
VISILOK™

VISILOK™ injected into the paint stream

GLASS BEADS
HD-21A PAINT (up to 35 wet mils)
Drying Additive
Small Glass Beads
VISILOK™ is a product of Potters Industries

ROAD SURFACE

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High Build Paint with FASTRACK™ HD-21A: With and Without VISILOK™ Drying Additive

Heavy rain within 2 hours after application

- 202 S, Doylestown, PA
- 35 wet mils (~880 microns)
- 70 F, 65% relative humidity

Adding VISILOK™ to a high build paint can cut the drying time in half.

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2011 PA NTPEP Data: FASTRACK™ HD-21A and VISILOK™

Data represents averages from both Concrete and Asphalt surfaces.

This data represents official NTPEP readings.

White Paints

Systems with and without VISILOK provide EQUAL durability after 1 year.

Both systems received an 8 for overall adhesion.

Scale: 1 - 10 10 = best

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FASTRACK™ Binders Answer the Challenges of the Industry

- **1990**: FASTRACK™ 2706
  - 1st Gen WB
  - Fast Dry Emulsion

- **1995**: FASTRACK™ 3427
  - Fast Drying
  - Improved Durability

- **2000**: FASTRACK™ HD-21A
  - High Build
  - Higher Durability

- **2005**: FASTRACK™ XSR
  - Low Temp
  - Extended Season

**Low Temperature Application Challenge Answered by FASTRACK™ XSR (eXtended Seasonal Range)**

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Low Temperature Paint – FASTRACK™ XSR:

Test Deck (PA, asphalt, 6 months)
Applied Air ~48°F / Road ~54°F

Standard Paint
Retro: 194 / 66 mcd
(Skip/Wheel)

FASTRACK XSR
Retro: 304 / 160 mcd
(Skip/Wheel)
Quality – State Specifications and Testing

- Specifications - Tighter the Better for both performance based and compositional specs

- Testing - Meaningful Laboratory Tests
  Meaningful Roadway Testing

- Markers - Physical Evidence
Quality – State Specifications and Testing

ASTM D913
for Evaluating the Degree of Traffic Paint Line Wear

Retroreflectivity at Skip and Wheel Track

ASTM D7538
for Evaluating the Water Wash-Off Resistance using an Atomizing Spray Device

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Dry Time Testing – 90% Relative Humidity

Humidity Chamber

Simple and Definitive

ASTM D7539 for Using a Test Chamber for Humidity Conditioning

ASTM D711 for No-Pick-Up Time
# Traffic Paint Dry Time

A Critical Property for Pavement Marking Performance

Tested at **50% Relative Humidity** and Room Temperature (~78 °F)

<table>
<thead>
<tr>
<th>Paint</th>
<th>Dry to No Pick-Up (D-711) in minutes</th>
<th>Dry Through</th>
<th>Wash-Out @ Dry Through (# of pumps to Fail - 6 pumps max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FASTRACK™ 2706 based paint - white</td>
<td>3.5 min</td>
<td>11 min</td>
<td>Pass</td>
</tr>
<tr>
<td>Non-Quickset Technology- white</td>
<td>19 min</td>
<td>22 min</td>
<td>Fail @ 1 pump</td>
</tr>
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# Traffic Paint Dry Time

A Critical Property for Pavement Marking Performance

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</tr>
</thead>
<tbody>
<tr>
<td>FASTRACK™ 2706 based paint - white</td>
<td>24 min</td>
<td>30 min</td>
<td>Pass</td>
</tr>
<tr>
<td>Non-Quickset Technology - white</td>
<td>140 min</td>
<td>145 min</td>
<td>Fail @ 1 pump</td>
</tr>
</tbody>
</table>

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Market Trends – Wet Night Visibility

What happens to the glass beads when it rains?

Cost Effective Solution: A system of High Build, High Durable FASTRACK™ HD-21A based paint at 25 wet mils and Large Glass Beads that can remain above the water level in many cases.
Market Trends – Wet Night Visibility

High-build WB paint (based on FASTRACK™ HD21A) & 3M elements

3M provides optical elements

Rainy Night Visibility

Standard Waterborne

High Build + Advanced Optics

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Objective – Evaluate the performance of 16 different products over a 2 year period in Iowa, including their wet night visibility.

For WET Retro – rain box built according to ASTM WK 19806

Marking Materials included:
- Methyl Methacrylate (MMA)
- Tape
- Thermoplastic
- Epoxy
- Polyurea

Waterborne – High Build
(one with VISILOK™)
more...

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Iowa Highway Research Board
(IHRB Project TR-597)
Iowa Department of Transportation
(In Trans Project 08-332 and 08-333)

Test deck on US Highway 30 east of Ames, Iowa
Eastbound – asphalt / Westbound - concrete
Each section has 2,000 ft of grooved surface & 500 ft of surface prep
ADT is ~13,800 vehicle/day
WB Paint – Wet Reflective Performance in Iowa

Wet Retro and Wet Recovery Retro
(Surface and Groove Application – WHITE Skip Line)

Comments:
Wet Retro – The High Build Paint w/VISILOK™ measured well above the group average for initial values. After 1st Winter, only six sections had a measurement of above 100 mcd (grooved) – this included both paint sections.

Wet Recovery - The High Build Paint w/VISILOK measured well above the group average for initial values. After the 2nd Winter, six sections had a measurement of above 75 mcd (grooved) – including both paint sections.

COST* of the SIX sections that had Wet Recovery above 75 mcd after 2 winters, they ranged in price from $0.10 to $1.57. The 2 waterborne systems were $0.10 and $0.20 which are two of the most inexpensive materials tested.

*material cost only - $/ft for 4 in

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Data from Iowa State University CTRE – “Wet-Reflective Pavement Marking Demonstration Project” (IHRB Project TR-597)
Life Cycle Assessment

Waterborne Traffic Paints and Thermoplastic Pavement Markings

LCA can identify the key impacts of a product during its life cycle and assist with the implementation of a green procurement policy.

Life Cycle Assessment:
Is the “compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.”

Cradle-to-Grave

By: Dr. H. Kheradmand
European Technology Awareness and Innovation Manager
LCT, LCA & SD Expert

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LCA Assumptions:

Waterborne Paint

- Monomers
- Emulsifier
- Other RM's

Polymers

Binders

TiO2

CaCO3

Other RM's

Glass Beads Production

Water Based Paint Production

Distribution

Waterborne Paint & Glass Beads Application

Maintenance

End of Life

T = Transport

Thermoplastic

- Resin I
- Resin II
- TiO2
- Other RM's
- Glass Beads

Thermoplastic Production

TP package preparation (heat: -190 T°C)

TP & Glass Beads Application

Maintenance

End of Life

T = Transportation

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Life Cycle Assessment

FASTRACK™ 2706 is the Reference Point (100)

**Impact Assessment Comparison**

**NAR Road Marking Formulations/ FU**

FASTRACK HD-21A performs better in all these Environmental Impact Categories
Life Cycle Assessment Conclusions

FASTRACK™ HD-21A High Build, High Durable Waterborne Paint compared to Thermoplastic Pavement Markings

Examples of the Savings available if using FASTRACK HD-21A based Traffic Paint instead of Thermoplastic to these Impact Categories:

**VOC Reduction:** ~250 %

**Solid Waste Reduction:** ~150 %

**Chemical Oxygen Demand Reduction:** ~250 %

**Primary Energy Use Reduction:** ~150 %

**Human Toxicity Reduction:** ~175 %

Data from the previous graph

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The Sustainability Goal:
To provide practical solutions to improve the quality of human life while living within the carrying capacity of supporting eco-systems.
Dow continues to bring innovative products and sustainable solutions to the Pavement Marking Industry for Improved Safety

Thank You!

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