Dow Coating Materials presents: FASTRACK™ binder for water-borne paints
A highly durable, cost effective and ecological road-marking solution increasing road safety

Advancing performance. Accelerating change
Water-borne. VOC limits and enhanced performance driving change from solvent-borne to water-borne paints.

Water-borne.
Environmentally friendly without compromising on performance.
Why does durable road-marking matter?

Source: Dow 2016
5 Main Properties

1 – Daylight visibility – luminance QD.

2 – Nighttime visibility – Retroreflection RL – under all weather climates.

3 – Antislip SRT: Skid Resistance Test.

4 – Durable traffic and weather resistance.

5 – Easy to lay down application.

Source: Dow 2016
Nighttime Visibility (Retroflexion – RL)

The **true quality** of a road marking is revealed under **less favorable** light and weather conditions (i.e. at night, foggy, rainy).

Source: Dow 2016
Road Fatalities are real!

People die every day on European roads

Town of 27,000 inhabitants disappearing every year

Road Fatalities per year

Billion € 51

Road accidents per year

Billion € 30

« Marking the way towards a safer future » - ERF position paper – 2014
Population ageing
Day & night visibility becoming more important

Demographic projection 65+ years
in Europe (Million)

<table>
<thead>
<tr>
<th>Year</th>
<th>2011</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>2060</th>
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</thead>
<tbody>
<tr>
<td>Value</td>
<td>78.7</td>
<td>103</td>
<td>122.3</td>
<td>140.8</td>
<td>150.3</td>
<td>154.2</td>
</tr>
</tbody>
</table>

Source: Dow 2016
Improved Road Safety
Resulting into min 20% less accidents

<table>
<thead>
<tr>
<th>Traffic marking</th>
<th>Sideway</th>
<th>Axial roads</th>
<th>Turn arrows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accidents reduction</td>
<td>-20%</td>
<td>-36%</td>
<td>-20%</td>
</tr>
</tbody>
</table>

Source: agent & AI (1996)

-32 to -34% Accidents when implementing high performance road markings.

40% Crash reduction in nighttime fatal & injury.
29% Crash reduction in daytime fatal & injury.
Where is water-borne paint being used?

Source: Dow 2016
Successful transition to water-borne paint in the US

Driven by VOC limit.

In North America, 2/3 of linear markings applied every year are water-borne paints.

Source: Dow 2016
FASTRACK™ binder for water-borne paints
A demonstrated road-marking paint solution across Europe

Driven by VOC-limit and durable performance

Driven by eco-label and better performance than solvent-borne

Driven by ecological profile, best solution to repaint old markings

Other markets where FASTRACK™ binder for water-borne paint is used and introduced:
– Italy
– Belgium
– Austria
– Poland
– Hungary ...

Source: Dow 2016
VOC limitations driving change towards water-borne

In Finland, in public tenders, a factual ban of solvent-based road marking paints is in force since 2007 due to a VOC limit of 2 wt-%

In Sweden, in 1986, the Swedish Road Marking Administration decided to restrict the solvent content of road markings in public tenders with a limit value of 2 wt-%

In the USA, the Clean Air Act Amendment (CAAA) of 1990 restricted the VOC solvent content in “architectural coatings”, also covering “traffic marking coatings” with limits of 150 g/l, equivalent to 3 - 8 wt-%.

In Canada, the regulation determines a maximum VOC solvent content of 150 g/l for the use road markings from 1 May to 15 September, and 450 g/l in the rest of the year

~40 kMT Potential VOC reduction impact in EU by 2020 by limiting VOC level to 60 g/L

FASTRACK™ references

- 600 000 km of water-borne traffic paint with FASTRACK™ binder already applied on European roads.

- Global references in demanding applications (Airports, Formula1, etc.).

Punishing laps at 200 MPH put the most durable line marking to the test. Brazil's Interlagos Racetrack adopted FASTRACK™ technology to withstand grueling Formula I™ tire heat and friction.

Sighting the runway for returning Space Shuttles is greatly assisted with proper markings.

Nighttime shot at Bahrain International Airport taken – 1 year after application of high durability (Type III) water-borne paint based on FASTRACK™ HD-21A and high index glass beads (Type III).

Source: Dow 2016
Why FASTRACK™ binder for water-borne paint?
FASTRACK™ water-borne paint delivers …
Durable road safety

Water-borne paints with FASTRACK™ offer more durable day and night visibility than solvent-borne paints.

Source: Dow 2016
FASTRACK™ water-borne paint delivers ...
Fast drying & Low Traffic Disturbance

Paint without FASTRACK™ after 60 min drying @ 90% humidity.

FASTRACK™ 53 based paint after 20 min drying @ 90% humidity.

Source: Dow 2016
FASTRACK™ water-borne paint delivers …

Fast drying & Low Traffic Disturbance

FASTRACK™ QS-2 is suggested at low temperature/high humidity (80 – 90%). This product is available from glass bead manufacturers who mix this drying aid with their glass beads.

Source: Dow 2016
FASTRACK™ Water-borne paint delivers …
An ideal solution to restripe old markings in cities

Why does my marking crack?
- Poor flexible markings: Marking cannot absorb « stress energy » from tire hits/ temperature variations
- Poor adhesion on old marking
- Too high thickness: old markings show different expansion than new markings → delamination

<table>
<thead>
<tr>
<th></th>
<th>Adhesion</th>
<th>Flexibility</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterborne paint</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solventborne paint</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermoplastics</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Water-borne paint has a better adhesion on thermoplastics and is more flexible than solvent-based paint which results in no/less cracking.
FASTRACK™ water-borne paint delivers …

A sustainable and safe road marking solution

FASTRACK™ water based paints:
– are non-flammable.
– are non-hazardous.
– VOC emissions can be reduced by up to 90%
– Carbon footprint can be reduced by up to 50%

Source: Dow 2016
FASTRACK™ water-borne paint delivers …

The safest road marking material

<table>
<thead>
<tr>
<th></th>
<th>Water-borne</th>
<th>Solvent-borne</th>
<th>Thermoplastics</th>
<th>Cold plastics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health risks</strong></td>
<td>No risks</td>
<td>• Flammable</td>
<td>• Release of</td>
<td>• Flammable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Irritant</td>
<td>formaldehyde at</td>
<td>• Irritant</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Harmful</td>
<td>high temperature</td>
<td>• Harmful</td>
</tr>
<tr>
<td><strong>Cleaning</strong></td>
<td>Water</td>
<td>Solvent</td>
<td>No cleaning</td>
<td>Solvent</td>
</tr>
<tr>
<td><strong>Hazardous transport</strong></td>
<td>No</td>
<td>Yes</td>
<td>Potential risk with powder</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>VOCs, carbon footprint</strong></td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td><strong>Labels</strong></td>
<td>No labels</td>
<td></td>
<td>No labels</td>
<td></td>
</tr>
<tr>
<td>Approved by NF331 – French ecolabel</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Water-based paint most sustainable solution supporting Green cities ambitions
Case studies
Water-borne paint Aqualiner on the roads in Poland

3. Voivodo road no 913 – May 2014
4. City Wrocław – September 2013
5. South Poland Cieszyn – July 2013
Comparative application on the National road 28 made 5 July 2016

- Application with Road Authority;
- SB vs. WB comparison;
- Dry time to reopen to traffic: 3 min (27°C; humidity 30%)  
- After 9 months, waterborne has more than twice better retroreflectivity compared to solventborne paint on middle and edge line
Road marking on the national road no 25 - 17.10.2014

- maintenance of chemo in 12 deg and 80% RH;
Comparative application on the provincial road No. 913 - 28 May 2014

- Application with Road Authority;
- SB vs. WB comparison;
- After 5 months 222 RI, which means 122 above requirements;
- After 10 months RI 150, Qd 180.
Comparative application on the provincial road No. 913 - 28 May 2014
Comparative application on the provincial road No. 913: RL results after 10 months
Pedestrian crossings in Wroclaw - 28.09.2013

- The temperature of 18 degrees with 75% humidity;
- Asphalt and granite;
- After 4 months, the mean RL 176 which is 76 above requirement;
- Ecology and safety in cities becomes more important. Reduced smell to applicators and citizens.
Application trials at experimental road - 30.07.2013

- Temperature 28 deg RH 55%
- Comparision with two market SB paint
- After 5 month WB paint is TWICE better in RI
- Experimental road close to the PPG plant, high traffic by heavy trucks.
Temperature 25 deg, RH 40%.

Comparision with market SB paint;

After **22 months** WB paint much better compare to the market SB paint (>150 RI);

2,5 million wheel passages.
## Road tests Utelle (Southern France)

<table>
<thead>
<tr>
<th>Name</th>
<th>g/m²</th>
<th>Glass beads</th>
<th>Temp/humidity</th>
<th>Drying time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aqualiner</td>
<td>460</td>
<td>370g/m² 125-600</td>
<td>23 deg C/40% RH</td>
<td>&lt;15 min</td>
</tr>
<tr>
<td>Reference WB paint</td>
<td>480</td>
<td>360g/m² 125-600</td>
<td>&lt;15 min</td>
<td></td>
</tr>
<tr>
<td>Commercial SB acrylic 1</td>
<td>510</td>
<td>310 g/m² 125-600</td>
<td>28 deg C/40% RH</td>
<td>40 min</td>
</tr>
<tr>
<td>Commercial SB acrylic 2</td>
<td>530</td>
<td>360 g/m² 125-600</td>
<td>38 min</td>
<td></td>
</tr>
</tbody>
</table>
22 months results - Retroreflectivity (Night visibility)

Aqualiner system has >150 mcd retro after 22 months (~2.5 million wheel passages)
## 22 months results – Luminance (Day visibility)

<table>
<thead>
<tr>
<th></th>
<th>Aqualiner</th>
<th>Reference SB paint</th>
<th>Acrylic 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>mcd</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.2 months</td>
<td>180</td>
<td>190</td>
<td>180</td>
</tr>
<tr>
<td>6.2 months</td>
<td>170</td>
<td>180</td>
<td>170</td>
</tr>
<tr>
<td>9.4 months</td>
<td>160</td>
<td>170</td>
<td>160</td>
</tr>
<tr>
<td>12.2 months</td>
<td>150</td>
<td>160</td>
<td>150</td>
</tr>
<tr>
<td>22 months</td>
<td>140</td>
<td>150</td>
<td>140</td>
</tr>
</tbody>
</table>

With glass beads, SB paint loses beads faster = luminance a bit higher initially.

Without glass beads, Aqualiner keeps very high luminance after 22 months.
22 months results - Appearance

Aqualiner

Reference SB Acrylic 1
Summary

- Fast drying water-borne acrylic traffic paints improve road safety as it offers up to twice better retro reflectivity compared to solvent-borne paint.

- By replacing solvent-borne by water-borne traffic paints, VOC emissions can be reduced by up to 90% and carbon footprint by up to 50%.

- Water-borne paint is a cost-effective road marking solution as it combines excellent performance at low thickness resulting in cost-saving for authorities.
Thank You
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## Health & Safety Risks with road-markings

<table>
<thead>
<tr>
<th>Safety Risks on MSDS</th>
<th>Solvent-borne paint</th>
<th>2K cold plastic</th>
<th>Waterborne paint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flam. Liquid 2, H225, highly flammable liquid and vapor</td>
<td>Flam. Liquid 2, H225, highly flammable liquid and vapor</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Health risks on MSDS</td>
<td>Eye Irritant 2: H319 – irritating to eyes Repr 2: H361d-suspected of damaging the unborn child EUH066- Repeated exposure may cause skin dryness or cracking</td>
<td>Skin irritation 2: H315, causes skin irritation. Skin sensitisation 1: H317, may cause an allergic skin reaction</td>
<td>None</td>
</tr>
<tr>
<td>Eye Irritant 2: H319 – irritating to eyes Repr 2: H361d-suspected of damaging the unborn child EUH066- Repeated exposure may cause skin dryness or cracking</td>
<td>Skin irritation 2: H315, causes skin irritation. Skin sensitisation 1: H317, may cause an allergic skin reaction</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

In addition the initiator for 2K cold plastic is environmentally damaging
2 lobbying priorities involving biz dev and country manager

Top down:
- Lobby at Ministry of Transport* to get environmental specifications in tenders

Bottom-up:
- Leverage success story and lobby at authorities for local roads

* Owner and timing: see slide 12
Homologation in Belgium 2016

<table>
<thead>
<tr>
<th>Année Bloq</th>
<th>Type</th>
<th>Producteur</th>
<th>Produit de base du marquage</th>
<th>Dosage</th>
<th>Produit de saupoudrage</th>
<th>Dosage</th>
<th>Producteur</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013 17</td>
<td>Peinture à eau</td>
<td>AXIMUM</td>
<td>TYPHON PREMIUM</td>
<td>525 g/m²</td>
<td>Ecochor 1 WBP SRT 110-12S</td>
<td>350 g/m²</td>
<td>SOVITEC</td>
</tr>
<tr>
<td>2013 18</td>
<td>Peinture à eau</td>
<td>AXIMUM</td>
<td>TYPHON STRATE</td>
<td>475 g/m²</td>
<td>Ecochor 1 WBP SRT 110-12S</td>
<td>350 g/m²</td>
<td>SOVITEC</td>
</tr>
<tr>
<td>2015 10</td>
<td>Peinture à eau</td>
<td>GEILEKO MARKETING - PLASTROUTE</td>
<td>MARAQUOUGE UWA 6-8</td>
<td>510 g/m²</td>
<td>Ecochor SRT 850-12</td>
<td>320 g/m²</td>
<td>SOVITEC</td>
</tr>
<tr>
<td>2013 22</td>
<td>Peinture à eau</td>
<td>VANDUINANT NV</td>
<td>RASKIA</td>
<td>300 g/m²</td>
<td>500-180 + 500-111-110-125 (BOGOS) WBP</td>
<td>300 g/m²</td>
<td>SOVITEC</td>
</tr>
<tr>
<td>2015 44</td>
<td>Peinture à eau</td>
<td>VELUVINE bv</td>
<td>VELUVIA CLAIRE</td>
<td>525 g/m²</td>
<td>Ecochor 5 SRT + ORI - 12</td>
<td>400 g/m²</td>
<td>SOVITEC</td>
</tr>
<tr>
<td>2013 56</td>
<td>Peinture à poli</td>
<td>AIB</td>
<td>UPRoad M4</td>
<td>550 g/m²</td>
<td>Ecochor 5 SFR ECO SRT</td>
<td>400 g/m²</td>
<td>SOVITEC</td>
</tr>
<tr>
<td>2013 65</td>
<td>Peinture à poli</td>
<td>AIB</td>
<td>UPIN M4</td>
<td>550 g/m²</td>
<td>Ectorat 5 SFR ECO SRT</td>
<td>150 g/m²</td>
<td>SOVITEC</td>
</tr>
<tr>
<td>2013 67</td>
<td>Peinture à poli</td>
<td>AIB</td>
<td>UPIN M4</td>
<td>550 g/m²</td>
<td>Ectorat 5 SFR ECO SRT</td>
<td>150 g/m²</td>
<td>SOVITEC</td>
</tr>
<tr>
<td>2007 11</td>
<td>Peinture à poli</td>
<td>GEILEKO MARKETING - PLASTROUTE</td>
<td>MARAQUOUGE UWA 6-8</td>
<td>510 g/m²</td>
<td>Ectorat 5 SFR ECO SRT</td>
<td>150 g/m²</td>
<td>SOVITEC</td>
</tr>
<tr>
<td>2007 03</td>
<td>Peinture à poli</td>
<td>DORFREUNTE</td>
<td>KYOTO</td>
<td>600 g/m²</td>
<td>Ectorat 5§ SFR ECO SRT</td>
<td>150 g/m²</td>
<td>SOVITEC</td>
</tr>
<tr>
<td>2006 48</td>
<td>Peinture à poli</td>
<td>VANDUINANT NV</td>
<td>RAS AL FAS</td>
<td>275 g/m²</td>
<td>Saupoudrage 600-125 + 500-111-110-125 (BOGOS) WBP</td>
<td>180 g/m²</td>
<td>SOVITEC</td>
</tr>
<tr>
<td>2006 47</td>
<td>Peinture à poli</td>
<td>VANDUINANT NV</td>
<td>RAS AL FAS</td>
<td>275 g/m²</td>
<td>Saupoudrage 600-125 + 500-111-110-125 (BOGOS) WBP</td>
<td>180 g/m²</td>
<td>SOVITEC</td>
</tr>
<tr>
<td>2013 22</td>
<td>Peinture à poli</td>
<td>VANDUINANT NV</td>
<td>RAS AL FAS</td>
<td>275 g/m²</td>
<td>Saupoudrage 600-125 + 500-111-110-125 (BOGOS) WBP</td>
<td>180 g/m²</td>
<td>SOVITEC</td>
</tr>
<tr>
<td>2013 26</td>
<td>Peinture à poli</td>
<td>VANDUINANT NV</td>
<td>RAS AL FAS</td>
<td>275 g/m²</td>
<td>Saupoudrage 600-125 + 500-111-110-125 (BOGOS) WBP</td>
<td>180 g/m²</td>
<td>SOVITEC</td>
</tr>
<tr>
<td>2007 26</td>
<td>Peinture à poli</td>
<td>VELUVINE bv</td>
<td>VELURCYL B</td>
<td>500 g/m²</td>
<td>VELURCYL B</td>
<td>400 g/m²</td>
<td>POTTERS</td>
</tr>
<tr>
<td>2006 37</td>
<td>Peinture à poli</td>
<td>VELUVINE bv</td>
<td>VELURCYL B</td>
<td>500 g/m²</td>
<td>VELURCYL B</td>
<td>400 g/m²</td>
<td>POTTERS</td>
</tr>
</tbody>
</table>

- Supporting better durability of FASTRACK Waterborne paint at lower thickness than solventborne paint
Conclusion

– Improved road safety.
– Improved durability.
– Improved Health & Safety and reduced environmental impact.
– Cost-saving for contractor and road-authority.
– Fast-Drying & Low traffic disturbance.