Charmor®
for best-in-class intumescent coatings
Protecting people and property

Eugénie Charrière, Market Development Director
Overview

- Charmor® main benefits
- Introduction to Fire Protection Systems
- Intumescent coatings: main characteristics and key components
- Intumescent mechanism
- Typical paint formulations - Fire Testing & Results
- More About Charmor®
- Summary
Charmor®
main benefits

- Charmor® products from Perstorp provide better insulation in intumescent coatings:
  - consistent high purity products
  - narrow particle size distribution

- Intumescent coatings based on Charmor®:
  - offer safer alternative to asbestos
  - maintain aesthetics of steel beams ➔ freedom of design
  - provide lower maintenance and upkeep compared to sprinklers
Fire Protection Systems

Fire Prevention
- This is to minimize ignition sources
  e.g. fire safety education, fire drill, fire service response and emergency evacuation, etc.

Active Fire Protection (AFP)
- It is the action to control and extinguish the fire (if possible)
  e.g. manual or automatic fire detection and fire suppression.

Passive fire protection (PFP)
- It is to limit and control the fire once it has occurred
  e.g. the use of fire-resistance rated walls and floors, and intumescent coatings
**Charmor® for intumescent coatings**

**MARKET TRENDS**
- Raised awareness of the risk of fire and the need for protection
- Higher standards in fire protection
- Increasing use of structural steel around the world

**BENEFITS OF INTUMESCENT COATINGS MADE WITH CHARMOR®**
- Prolong evacuation time during fire breakout.
- Limit structural damage to properties.

**MECHANISM**
- This is an innovative coating technology which uses **char formation** to prevent fire spread.
- Intumescent coatings can **swell up by a factor of 100** on heating (from 1mm to 10 cm thick foam).
- Intumescent paint works as an active fire protecting surface treatment which is activated at **150-200°C**.
Intumescent paint: main characteristics

- Mostly physical drying, thermoplastic paint systems
- High PVC
- Three main active ingredients
  - Acid donor
  - Carbon donor
  - Blowing agent
- High layer thickness (~1000 µm)
  - Applied by brush or spraying
- Heat activated (200-250 °C) insulating paint
- Swelling 40-80 times
- Application: mainly structural steel
Main components of Intumescent Paint

Carbon donor
⇒ e.g. Charmor® product

Acid donor
⇒ f. ex. Ammonium Polyphosphate (APP)

Blowing agent
⇒ f. ex. Melamine

Binder
⇒ f. ex. Poly(vinylacetate)
How does it work?

The intumescent process starts at 200-250°C. The main stages, when paint is exposed to fire and starts to intumesce, are as follows:

1. The binder melts, facilitating chemical reactions in a soft matrix
2. The acid donor decomposes to form polyphosphoric acid
3. The polyphosphoric acid reacts with the carbon donor to form polyphosphoric acid esters
4. The esters decompose to form a foaming carbon matrix
5. The blowing agent releases gases that cause the carbon matrix to create foam that expands to form a tough insulating char barrier that adheres to the substrate
# Charmor® PM40 & PM15 in waterborne paint formulation

**Materials**

<table>
<thead>
<tr>
<th>Part I, Grinding part</th>
<th>Charmor® PM40</th>
<th>Charmor® PM15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>14.2</td>
<td>14.2</td>
</tr>
<tr>
<td>Disperbyk 190 (BYK Chemie)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Kronos 2063 (TiO2, Kronos)</td>
<td>6.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Charmor® PM40 (carbon donor, Perstorp)</td>
<td>9.0</td>
<td>--</td>
</tr>
<tr>
<td>Charmor® PM15 (carbon donor, Perstorp)</td>
<td>--</td>
<td>9.0</td>
</tr>
<tr>
<td>Aerosil 200 (fumed silica, Evonik)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Melafine (blowing agent, DSM)</td>
<td>7.5</td>
<td>7.5</td>
</tr>
<tr>
<td>Exolit APP 422 (acid donor, Clariant)</td>
<td>22.0</td>
<td>22.0</td>
</tr>
<tr>
<td>BYK 080 (BYK Chemie)</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Natrosol Hr 250 , 2 % water solution</td>
<td>4.0</td>
<td>4.0</td>
</tr>
</tbody>
</table>

**Part II, Let down**

<table>
<thead>
<tr>
<th>Charmor® PM40</th>
<th>Charmor® PM15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mowilith DM 230 (PvAc dispersion, Celanese)</td>
<td>25.0</td>
</tr>
<tr>
<td>NX 795 (coalescing agent, Perstorp)</td>
<td>1.3</td>
</tr>
<tr>
<td>Sodium Polyphosphate , 10% water solution</td>
<td>0.75</td>
</tr>
<tr>
<td>Water</td>
<td>8.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

**Procedure**

**Grinding Part**

Mix Part I in a high speed dissolver (3000-4000 rpm, 20-30 minutes), T°C should stay below 50°C.

**Let Down**

Add Part I and the rest of the raw materials to the binder, stirring continuously.
Fire Testing Method

Preparation of Test Specimens

- Primed metal panels (4mm)
- Applied with brush or airless spray
- Film thickness – 800-1000 µm
- Dry for 4 weeks @ 23°C & 50% RH

N.B.
To improve abrasion resistance and water resistance a thin coat of a conventional paint may be applied to the intumescent paint.

Fire Test (Propane Burner)

- Paint faced downwards on the furnace
- No direct contact with the flame
- Temperature registered with thermocouples on back side
- Furnace temperature – standard fire curve (ISO 02 48 20 / (ISO 834—1975)
Charmor® PM15 and PM40 both present excellent properties in water-borne intumescent paints. Charmor® PM15 prolongs the time to reach 500°C, but the foam is slightly fluffier.
## Charmor® PM40
in solvent-based paint formulation

<table>
<thead>
<tr>
<th>Materials</th>
<th>Weight-%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pliolite VTAC-L (vinyl toluene acrylate binder, Eliokem)</td>
<td>8.0</td>
</tr>
<tr>
<td>Pliolite AC3-H (vinyl toluene acrylate binder, Eliokem)</td>
<td>3.2</td>
</tr>
<tr>
<td>Topcithin 50 (soy lecithin, Cargill)</td>
<td>0.3</td>
</tr>
<tr>
<td>Guardion CP70 (chlorinated Paraffin Wax, Chance &amp; Hunt)</td>
<td>5.8</td>
</tr>
<tr>
<td>Cereclor S 52 (chlorinated paraffin, INEOS)</td>
<td>2.7</td>
</tr>
<tr>
<td>Kronos 2063 (TiO2 pigment, Kronos)</td>
<td>6.4</td>
</tr>
<tr>
<td><strong>Charmor® PM40</strong> (carbon donor, Perstorp)</td>
<td><strong>9.0</strong></td>
</tr>
<tr>
<td>Melafine (blowing agent, DSM)</td>
<td>9.0</td>
</tr>
<tr>
<td>Exolit AP 422 (acid donor, Clariant)</td>
<td>27.6</td>
</tr>
<tr>
<td>Xylene (solvent)</td>
<td>28.0</td>
</tr>
<tr>
<td><strong>Total charge</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC, %</td>
<td>58.4</td>
</tr>
<tr>
<td>Non-volatile content, %</td>
<td>72</td>
</tr>
<tr>
<td>Density, g/l</td>
<td>1.29</td>
</tr>
<tr>
<td>Viscosity (Brookfield), mPas</td>
<td>7900</td>
</tr>
<tr>
<td>VOC, g/l</td>
<td>360</td>
</tr>
</tbody>
</table>
Fire test result
Solvent-based formulation

Intumescent mechanism started after 7-8 minutes
Time for test specimen based Charmor® PM40 to reach 500°C was 47 min
Possible improvements

- Possible variations in formulation
  - Vary ratio of active raw materials
  - Vary PVC
  - Vary between grades of APP
  - Add inorganic flame retardants, like ATH (Aluminum Trihydrate)
  - Add halogenated flame retardants
  - Add inorganic fibers

Other important factors
- Sufficient grinding
- Good pretreatment (sand blasting)
- Choice of primer
- Application procedures
- Drying
## Product data summary

### Charmor®

<table>
<thead>
<tr>
<th>Property</th>
<th>Charmor® PM</th>
<th>Charmor® PT</th>
<th>Charmor® DP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery form</td>
<td>White powder</td>
<td>White powder</td>
<td>White powder</td>
</tr>
<tr>
<td>Grades available</td>
<td>Micronized (PM40)</td>
<td>Micronized (PT40)</td>
<td>Micronized (DP40)</td>
</tr>
<tr>
<td></td>
<td>Supermicronized (PM15)</td>
<td></td>
<td>Supermicronized (DP15)</td>
</tr>
<tr>
<td>Melting point</td>
<td>260°C</td>
<td>250°C</td>
<td>222°C</td>
</tr>
<tr>
<td>Water solubility (% at RT)</td>
<td>5.25</td>
<td>4.70</td>
<td>0.22</td>
</tr>
<tr>
<td>Typical hydroxyl number</td>
<td>(mg KOH/g) 1,645</td>
<td>1,645</td>
<td>1,325</td>
</tr>
<tr>
<td>(mg KOH/g)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (kg/m³)</td>
<td>1,400</td>
<td>1,400</td>
<td>1,370</td>
</tr>
<tr>
<td>Main usage</td>
<td>For basecoats and indoor applications</td>
<td>Versatile quality</td>
<td>For superdurable outdoor coatings</td>
</tr>
</tbody>
</table>

### Choice of grade affects:
1. Water resistance
2. Melting behaviour (initiation temperature)
3. Paint formulation (difference of OH-number)
Foaming performance
of Charmor® PM40 and PM15

<table>
<thead>
<tr>
<th>Grade</th>
<th>Particle size</th>
<th>Expansion factor</th>
<th>Foam characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM40</td>
<td>&lt;40 µm</td>
<td>~20</td>
<td>Homogenous, soft, compact, more stable</td>
</tr>
<tr>
<td>PM15</td>
<td>&lt;15 µm</td>
<td>~30</td>
<td>Homogenous, soft, fluffier, better isolation</td>
</tr>
</tbody>
</table>

Conclusion:
Particle size matter
Consistency and reliability is important
Quality of Charmor®

- Consistent high Purity products
- Non-toxic
- Non-hygroscopic
- Small Particle size
- Narrow particle size distribution
- No coarse particles
- Responsible for the entire production process from formaldehyde to milling
Knowledge & reliability

Conclusions

- Largest world capacity
- Own production facilities
- Recently installed modern milling technology in Germany
- Real interest in fire protection
- R&D resources, lab facilities
  - Installed fire test equipment
  - Broaden application areas – PUR foams, TPU, gel coats, polyolefins, PVC
- Technical service and customer support
- Key suppliers recommend our products
- Global sales and distribution network
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Protecting people & property

For more information, please visit us on booth 2733 at the American Coatings Show 2010 in Charlotte, NC