Charmor™ PM40 for solvent borne intumescent paint

General
Intumescent paint works as an active fire protecting surface treatment, which is activated at 150-200 °C. Main application area is building constructions made of metal, but other materials such as wood can also be protected. Basically an intumescent paint is formulated and prepared in the same way as conventional paint. However, there are some key raw materials that are essential for a successful formulation:

- A physically drying binder that melts and facilitates chemical reactions in a soft matrix.
- A chlorinated paraffin that facilitates creation of a soft matrix and flame retardant properties.
- A carbon donor (polyalcohol) that in the first step reacts with a polyphosphoric acid to form polyphosphoric esters, which in the second step decompose (carbonization) to form a carbon matrix.
- An acid donor that decomposes to form polyphosphoric acid which further reacts with a carbon donor to form polyphosphoric esters.
- A blowing agent that thermally releases inert gases which expand the carbon matrix to form a tough insulating foam to protect the coated object from heat.

Perstorp has a range of micronized polyalcohols, Charmor™, which has been developed in order to optimize and control performance in the intumescent process. By carefully controlling chemical purity and particle size a uniform performance can be expected in every formulation. Particle size influences the interfaces between the active raw materials which influence density and configuration of the foam. This will affect insulating effect but also strength, which is an important property in a turbulent fire.

In this technical information leaflet a solvent-borne start formulation, suitable for indoor application, is presented. Charmor™ PM40, with a particle size of less than 40 µm, is used as carbon donor.
Paint formulation

This is a guide formulation which should be adjusted to local requirements and available raw materials.

<table>
<thead>
<tr>
<th>Materials</th>
<th>Weight-%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pliolite VTAC-L (^1)</td>
<td>8.0</td>
</tr>
<tr>
<td>Pliolite AC3-H (^1)</td>
<td>3.2</td>
</tr>
<tr>
<td>Topcitthin 50 (^2)</td>
<td>0.3</td>
</tr>
<tr>
<td>Guardion CP70 (^3)</td>
<td>5.8</td>
</tr>
<tr>
<td>Cereclor S 52 (^4)</td>
<td>2.7</td>
</tr>
<tr>
<td>Kronos 2063 (^5)</td>
<td>6.4</td>
</tr>
<tr>
<td>Charmor(^6) PM40 (carbon donor)</td>
<td>9.0</td>
</tr>
<tr>
<td>Melafine (^7) (blowing agent)</td>
<td>9.0</td>
</tr>
<tr>
<td>Exolit AP 422 (^8) (acid donor)</td>
<td>27.6</td>
</tr>
<tr>
<td>Xylene</td>
<td>28.0</td>
</tr>
<tr>
<td><strong>Total charge</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

- PVC, %: 58.4
- Non-volatile content, %: 72
- Density, g/l: 1.29
- Viscosity (Brookfield), mPas: 7900
- VOC, g/l: 360

1 Vinyl toluene-acrylate, Eliokem
2 Soy lecithin, Cargill
3 Chlorinated Paraffin Wax, Chance & Hunt
4 Chlorinated paraffin, INEOS
5 TiO\(_2\), Kronos
6 Perstorp Specialty Chemicals AB
7 Melamine, DSM
8 Ammonium Polyphosphate, Clariant

Paint preparation

Ingredients were added in a standard high speed dissolver. Viscosity was adjusted with xylene. The paint was ground at 3000-3500 rpm (15-20 minutes). Paint preparation was finalized by adding the remaining xylene. Note: Temperature should not exceed +50 °C.
Comments
Several parameters in the formulation can be varied in order to customize the properties:

- Ratio between the three active ingredients
- PVC (pigment volume concentration)
- Ratio of chlorinated paraffin to resin

The formulation presented is recommended for dry indoor applications. A shielding top coat can be applied when the formulation is used outdoor or in humid conditions. However, adjustments can be made in the formulations to improve resistance to outdoor exposure and humidity:

- Use a more humidity resistant carbon donor such as Charmor™ DP40.
- Use a more outdoor resistant resin such as a styrene acrylate.

Other types of raw materials can also be considered in order for improving properties:

- Inorganic fibres, to reinforce the foam.
- Aluminum trihydrate (ATH) as a flame retardant additive.

Fire testing
Preparation of test panels
The paint was applied with a brush to primed (2K epoxy) sandblasted hot-rolled steel panels (53x63 cm). To obtain a dry film thickness of 800-1000 μm, the paint was applied between 6-8 times. Using high pressure spray equipment the number of applications was reduced considerably. To avoid delamination during the fire test adhesion to the steel and inter-coat adhesion was optimised with proper pre-treatment. The panels were dried for 4 weeks at room temperature before fire testing.

Test equipment
Fire tests were performed in a furnace heated with a propane burner whose flame had no direct contact with the test specimen. Prepared steel panels were placed on the top of the oven with painted side downwards. Temperature increase in the furnace was controlled according to ISO 02 48 20 and the temperature of the steel panel was recorded at various points on the rear with thermocouples.

Results
- You can see by the knee in the graph that intumescent mechanism starts after 7-8 minutes.
- Time for test specimen to reach 500 °C (T500) was recorded to 47 minutes.
Every endeavour has been made to ensure that the information given herein is true and reliable but it is given only for the guidance of our customers without any warranty and with reservation of all patent rights. Users are advised to confirm the suitability of our recommendations by their own tests.