Charmor®

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

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Perstorp
WINNING FORMULAS

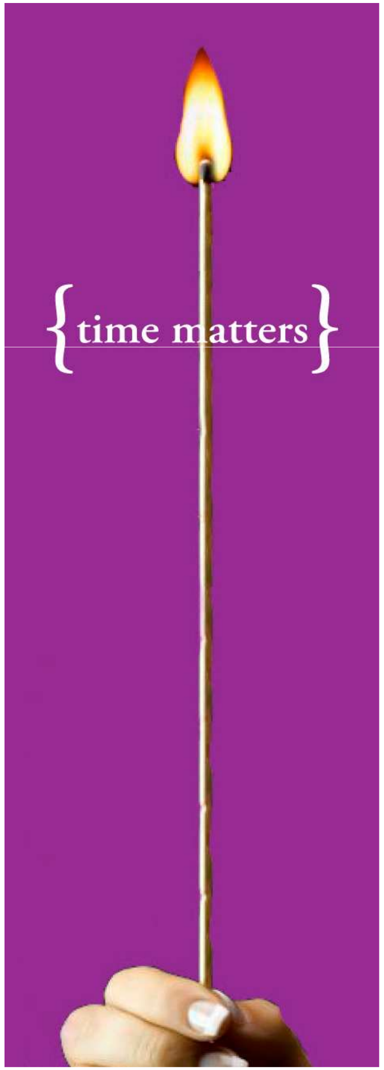
Overview

- 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 INTUMESCANT COATINGS MADE WITH CHARMOR®

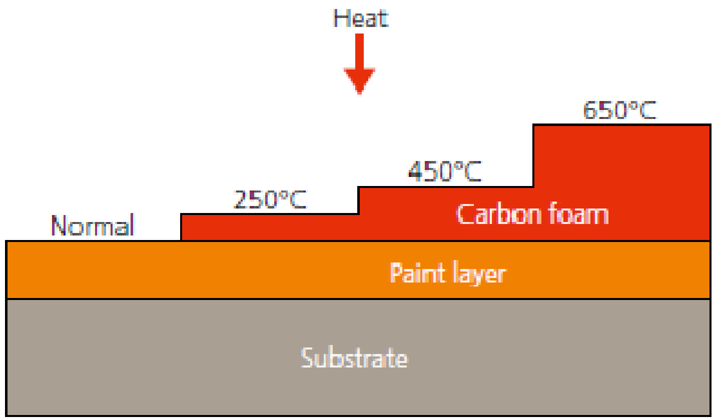
- Prolong evacuation time during fire breakout.
- Limit structural damage to properties.

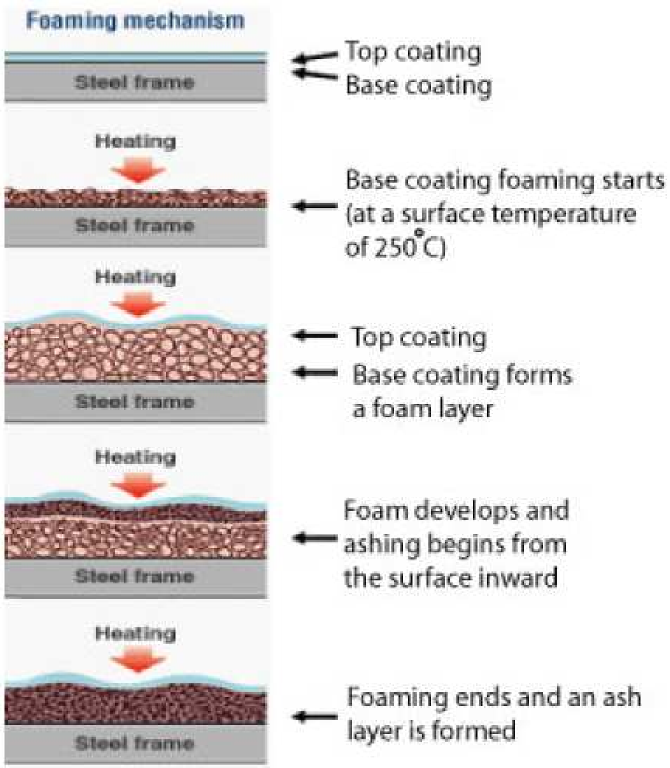
MECHANISM

- 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





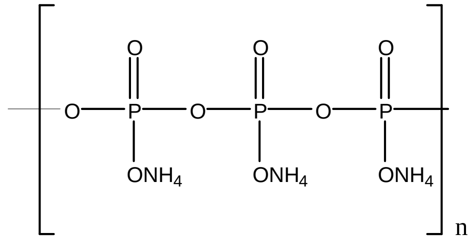
Main components of Intumescent Paint

Carbon donor

- e.g. Charmor® product

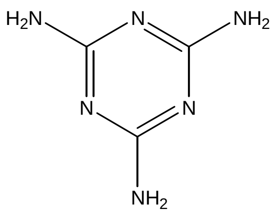
Acid donor

- f. ex. Ammonium Polyphosphate (APP)



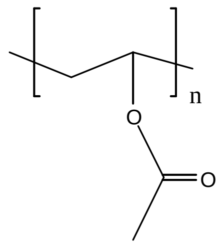
Blowing agent

- f. ex. Melamine



Binder

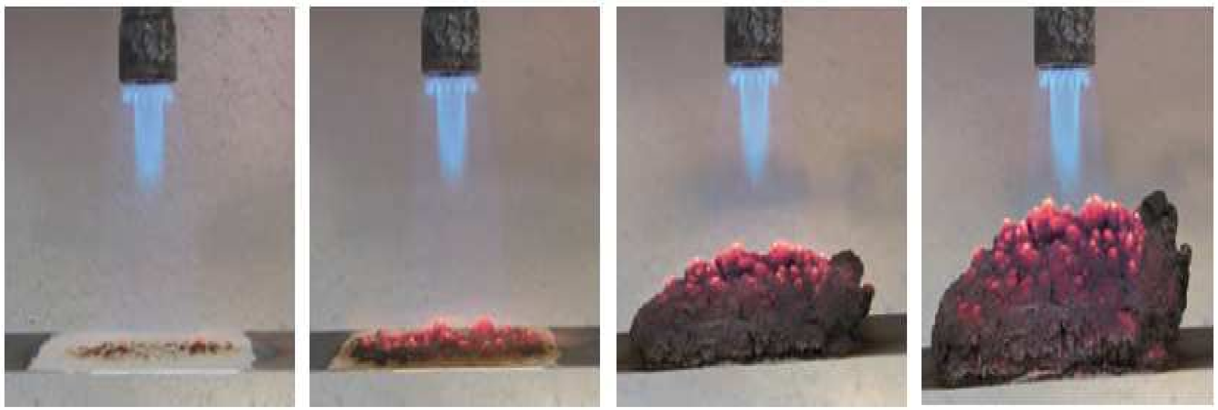
- f. ex. Poly(vinylacetate)



How does it work?

The intumescing 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 polyphoshoric 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

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Materials Part I, Grinding part	Charmor® PM40	Charmor® PM15
Water	14.2	14.2
Disperbyk 190 (BYK Chemie)	1.0	1.0
Kronos 2063 (TiO2, Kronos)	6.0	6.0
Charmor® PM40 (carbon donor, Perstorp)	9.0	--
Charmor® PM15 (carbon donor, Perstorp)	--	9.0
Aerosil 200 (fumed silica, Evonik)	1.0	1.0
Melafine (blowing agent, DSM)	7.5	7.5
Exolit APP 422 (acid donor, Clariant)	22.0	22.0
BYK 080 (BYK Chemie)	0.25	0.25
Natrosol Hr 250 , 2 % water solution	4.0	4.0
Part II, Let down		
Mowilith DM 230 (PvAc dispersion, Celanese)	25.0	25.0
NX 795 (coalescing agent, Perstorp)	1.3	1.3
Sodium Polyphosphate , 10% water solution	0.75	0.75
Water	8.0	8.0
Total	100.00	100.00
PVC, %	68±2	68±2
Density, g/l	1.28±0.01	1.28±0.01
pH	8.2±0.2	8.2±0.2
Viscosity, mPas	500	520

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)

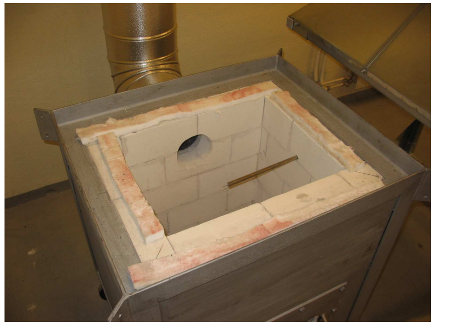
Applied with brush or airless spray

Film thickness – 800-1000 µm

Dry for 4 weeks @ 23°C & 50% RH

<u>N.B.</u>

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

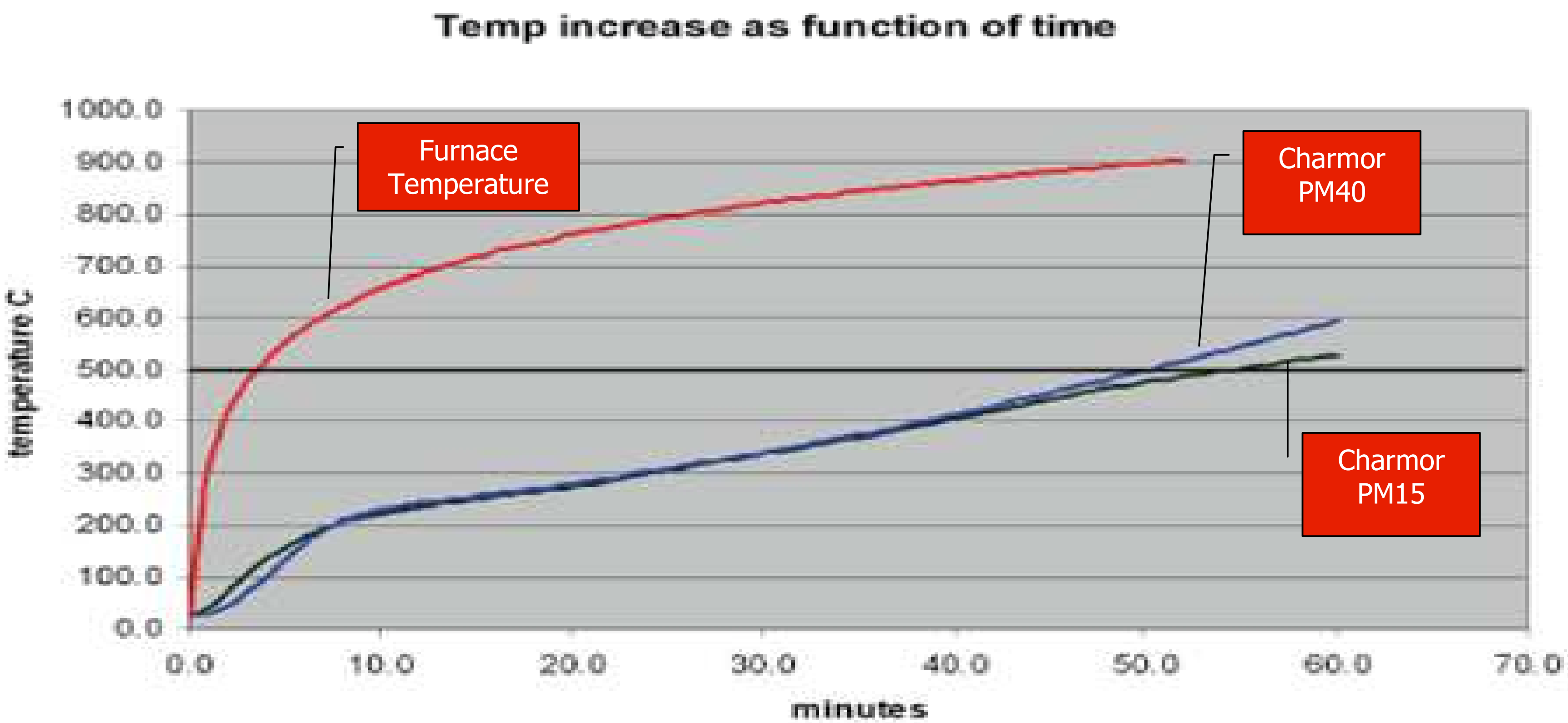
No direct contact with the flame

Temperature registered with thermocouples on back side

Furnace temperature – standard fire curve (ISO 02 48 20 / (ISO 834—1975)

Fire test result

Waterborne paint formulation



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.

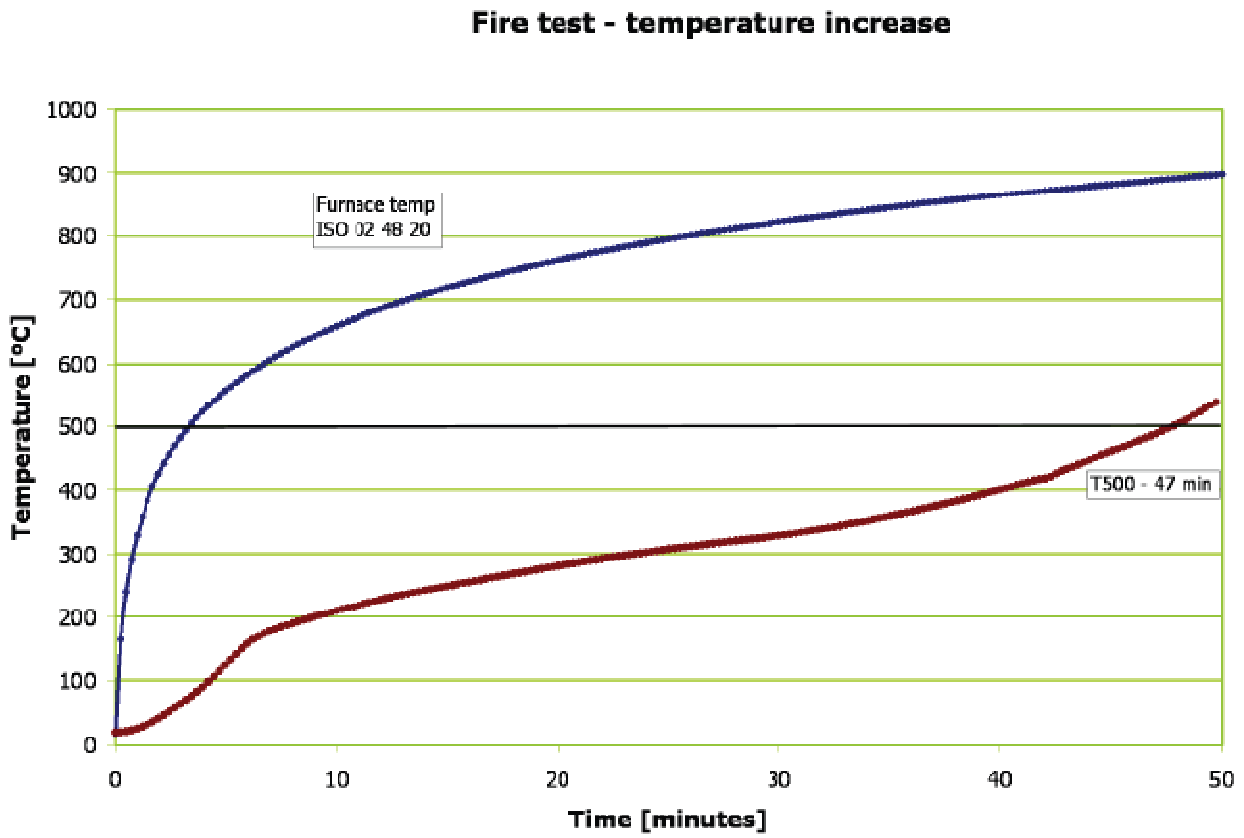
Charmor® PM40

in solvent-based paint formulation

Materials	Weight-%
Pliolite VTAC-L (vinyl toluene acrylate binder, Eliokem)	**8.0**
Pliolite AC3-H (vinyl toluene acrylate binder, Eliokem)	**3.2**
Topcithin 50 (soy lecithin, Cargill)	**0.3**
Guardion CP70 (chlorinated Paraffin Wax, Chance & Hunt)	**5.8**
Cereclor S 52 (chlorinated paraffin, INEOS)	**2.7**
Kronos 2063 (TiO2 pigment, Kronos)	**6.4**
Charmor® PM40 (carbon donor, Perstorp)	**9.0**
Melafine (blowing agent, DSM)	**9.0**
Exolit AP 422 (acid donor, Clariant)	**27.6**
Xylene (solvent)	**28.0**
Total charge	**100.00**
PVC, %	**58.4**
Non-volatile content, %	**72**
Density, g/l	**1.29**
Viscosity (Brookfield), mPas	**7900**
VOC, g/l	**360**

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

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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®

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

Choice of grade affects:

1. Water resistance
2. Melting behaviour (initiation temperature)
3. Paint formulation (difference of OH-number)

Putting the care into chemicals

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Foaming performance
of Charmor® PM40 and PM15

Grade	Particle size	Expansion factor	Foam characteristics
PM40	<40 µm	~20	Homogenous, soft, compact, more stable
PM15	<15 µm	~30	Homogenous, soft, fluffier, better isolation

Conclusion:

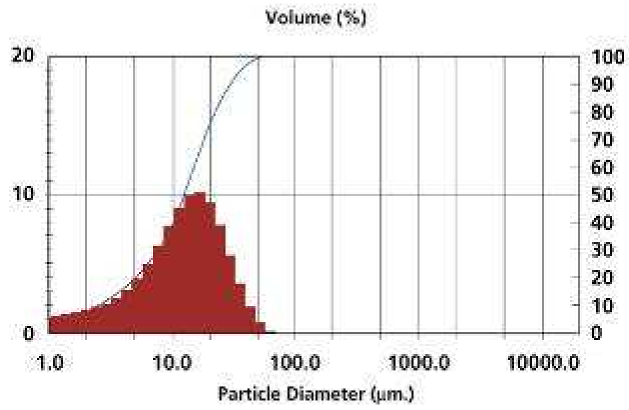
<u>Particle size matter</u>

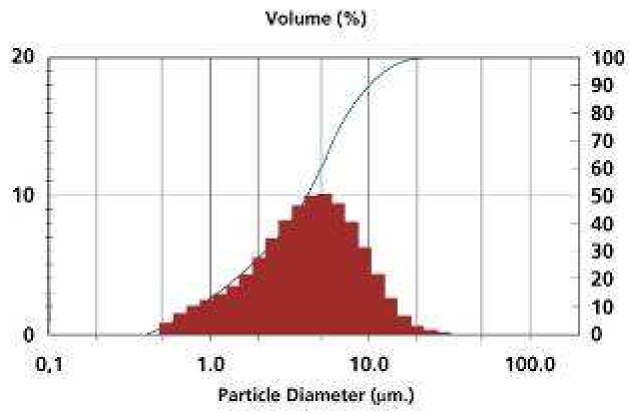
Consistency and reliability is important

Putting the care
into chemicals

Quality of Charmor®

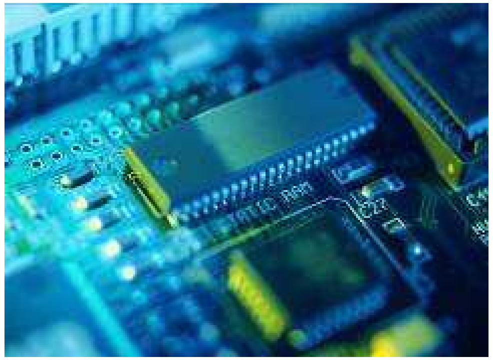
- Consistent high Purity products
- Non-toxic
- Non-hygroscopic
- Small Particle size
- Narrow particle size distribution
- No coarse particles
- Responsible for the entire production process from formaldehyde to milling





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

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