Fire protection for commercial and petrochemical installations

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Agenda

1. AkzoNobel at a glance
2. Intumescent Paints, how they work?
3. Fire curves
4. Available technologies
5. Intumescent systems. Key aspects
Agenda

1. Fire Protection in Commercial Buildings
2. Intumescent Paints and ISO12944
3. Fire Protection in Petrochemical Installations
4. Enhancing productivity
5. Fire Design
The world of AkzoNobel*

- **€14.9 billion revenue**
- **€2.1 billion EBITDA**
- **€1.6 billion operating income**
- **€3.95 earnings per share**
- **80+ countries**
- **45,600 employees**

**Key regions by revenue**
- **North America**: 17%
- **Mature Europe**: 36%
- **Emerging Europe**: 7%
- **Asia Pacific**: 27%
- **Latin America**: 10%
- **Other countries**: 3%

**Revenue by end-user segment**
- Buildings and Infrastructure: 43%
- Transportation: 17%
- Consumer Goods: 18%
- Industrial: 22%

**Revenue by Business Area**
- Decorative Paints: 27%
- Performance Coatings: 40%
- Specialty Chemicals: 33%

*All figures are based on year-end 2015
Buildings and infrastructure

New build projects
Maintenance, renovation & repair
Building products and components

43% of revenue

Transportation

Automotive repair
Automotive OEM, parts and assembly
Marine and air transport

17% of revenue

Consumer durables
Consumer packaged goods

18% of revenue

Consumer goods

22% of revenue

Industrial

Natural resource and energy industries
Process industries
Performance Coatings at a glance

**Vision:**
To be the leading coatings company from a performance perspective

**Revenue by geographic spread**

<table>
<thead>
<tr>
<th>€ million</th>
<th>FY 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>5,955</td>
</tr>
<tr>
<td>EBITDA</td>
<td>938</td>
</tr>
<tr>
<td>Operating income</td>
<td>792</td>
</tr>
<tr>
<td>Return on sales</td>
<td>13.3%</td>
</tr>
<tr>
<td>Return on investment</td>
<td>29.4%</td>
</tr>
<tr>
<td>Employees</td>
<td>19,300</td>
</tr>
</tbody>
</table>

84 sites in 31 countries
Protective Coatings in AkzoNobel

- 2 leading brands
- 16 production sites
- 60 countries

Supplying protective coatings and passive fire protection to global projects, locally

AkzoNobel

- €1bn business, part of the larger
- €14bn AkzoNobel company
- 2,700 people spread globally

All figures relate to 2014
Passive fire protection

Protecting over 60% of offshore structures from the potential devastating affects of fire

- Chartek
- Interchar
- Interkote
Intumescent paints, how they work?
Intumescent paints, how they work?
Structures in Fire

At 550 deg C steel has lost over 40% of its strength.
All products supplied and technical advice and recommendations given are subject to our standard conditions of sale. Any information given here is for guidance only and no representation or warranty is given as to its potential use.

Cellulosic Fire Curves

Typical Fire Curves

\[ T = \frac{1100 \times (1 - 0.325 \times \exp(-0.1667 \times t)) - 0.204 \times \exp(-1.417 \times t) - 0.471 \times \exp(-15.833 \times t))}{1 - 10^{-0.1667 \times t}} \]

\[ T = 345 \times \log(T + 1) + 20 \]

Based on predefined points

- Cellulosic [BS 476] & EN13381-8
- Hydrocarbon [ISO 834]
- UL 283 (Practically identical to ASTM E119 curve)
Intumescent paints, how they work?

Char, dependent on fire protection coating

- Epoxy system (Chartek 7)
- Epoxy system (Interchar 212)
- Acrylic system (Interchar 404)

Density of char
Available technologies in the market

- **ACRYLIC WB**
  - Lower thicknesses
  - Very low VOC emissions
  - Low water / humidity resistance
  - Limited mechanical properties

- **ACRYLIC SB**
  - Low - medium thicknesses
  - Higher VOC emissions
  - Medium water / humidity resistance
  - Limited mechanical properties

- **HYBRID**
  - Higher thicknesses
  - Low VOC emissions
  - Good water / humidity resistance
  - Improved mechanical properties versus standard acrylics

- **EPOXY**
  - Higher thicknesses
  - Very low VOC emissions
  - Excellent water / humidity resistance. Corrosion protection
  - Excellent mechanical properties
Intumescent Systems

* A mesh may be required for hydrocarbon fire protection
Intumescent System. Key Aspects

Specification of fire protection must be seriously considered; Incorrect advice on primers can lead to reduced performance of the intumescent coating in a fire, whilst unsuitable topcoats may impede the reaction of the intumescent coating. The obvious consequence of this could be loss of life.

1. **Surface Preparation:** Sa2½ (SSPC SP10), with a surface profile of ≥50μm.

2. **Primer Selection:** Primers need to have demonstrated suitable performance in accordance with the industry recognised fire test assessment. Typically primer thicknesses are in the dry film thickness range of 40 – 75 microns (1.3 – 2 mils).

3. **Topcoat Selection:** Topcoat selection is dependent upon the intumescent coating to which it is applied, on whether the function of the topcoat is decorative, protective or both. Any top coat used over an intumescent paint needs to demonstrate does not affect negatively the expansion of the intumescent in the event of a fire.
Surface Preparation

**Degreasing:** The presence of surface oil or grease prevents a coating from properly adhering to the substrate and can lead to rapid failure of the whole system. For this reason, all visible oil, grease and other soluble contaminants must be removed before the application of both primer and intumescent. Degreasing is also important before blast cleaning activities. Cleaning and degreasing should be carried out to SSPC-SP1 standard. Methods of degreasing include:

- Hot water washing
- Steam cleaning
- Detergents or emulsion/alkaline cleaners followed by steam or fresh water wash to remove detrimental residues

**Abrasive blast cleaning:** Blast cleaning to Sa2½ (ISO 8501-1:2007), SSPC-SP6 or NACE No. 3, with a sharp angular profile being obtained. The blast profile (Rz) should be 50 to 75 microns (2 to 3 mils) for carbon steel and the recommended method for measuring the blast profile is with replica tape or blast profile comparators.
System Application Guide

**Primer Application:** It is important to follow the recommendations stated in the TDS of each primer. Special care must be taken regarding the family type of the primer to be used and the thickness (Maximum and Minimum) to be applied.

**Intumescent Application:** All of our Interchar products have an Application Guide that should be followed at any time.

**Topcoating:** It is important to follow the recommendations stated in the TDS of Interthane 990, Intersheen 579 or Intercryl 525 as those are the only topcoats approved over our Interchar range.
Common mistakes on the system installation

- Poor surface preparation.
- Incompatible primer
- Incorrect primer thickness
- Poor cleaning after priming and before applying intumescent paint
- Incorrect intumescent thickness.
- Topcoat application over incorrect intumescent thickness.
- Incompatible topcoat
- Intumescent systems exposed to water
- Do not respect overcoating times between coats
- Solvent entrapment
Cellulosic systems in different ISO 12944 environments

- For single pack intumescent products exposed to cellulosic fires, external exposure can be detrimental to the coating’s ability to intumesce. Therefore, it is important to be realistic about the type of exposure that these products can be subjected to.

- **The key determining factor, used in guidance for product selection, is how wet the environment is likely to be in these environments.** For example, a rural, external C2 environment could be subject to a higher level of rainfall than a C3 or C4 environment.

- Also primer selection for use with the intumescent system must be suitable for the environmental category in which the system is to be exposed:
  - **Up to C3:** Either a zinc phosphate pigmented primer or zinc rich epoxy primer. Intergard 251 or Interzinc 52.
  - **C4 and above:** A zinc rich epoxy primer should be specified. Interzinc 52.
### Cellulosic systems in different ISO 12944 environments

<table>
<thead>
<tr>
<th>Corrosivity Category</th>
<th>Exterior</th>
<th>Interior</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 very low</td>
<td></td>
<td>Heated buildings with clean atmospheres, e.g. offices, shops, schools, hotels.</td>
</tr>
<tr>
<td>C2 low</td>
<td>Atmospheres with low level of pollution. Mostly rural areas.</td>
<td>Unheated buildings where condensation may occur, e.g. depots, sports halls.</td>
</tr>
<tr>
<td>C3 medium</td>
<td>Urban and industrial atmospheres, moderate sulphur dioxide pollution. Coastal areas with low salinity.</td>
<td>Production rooms with high humidity and some air pollution, e.g. food processing plants, laundries, breweries, dairies.</td>
</tr>
<tr>
<td>C4 high</td>
<td>Industrial areas and coastal areas with moderate salinity.</td>
<td>Chemical plants, swimming pools, coastal ship- and boatyards.</td>
</tr>
<tr>
<td>C5-I very high (industrial)</td>
<td>Industrial areas with high humidity and aggressive atmosphere</td>
<td>Buildings or areas with almost permanent condensation and with high pollution.</td>
</tr>
<tr>
<td>C5-M very high (marine)</td>
<td>Coastal and offshore areas with high salinity</td>
<td>Buildings or areas with almost permanent condensation and with high pollution.</td>
</tr>
</tbody>
</table>
Interchar Offer & ISO12944

- **Epoxy:** Interchar 212 C1-C5
- **Solvent:** Interchar 963, 2060, 2090, 404 C1-C3; C4*
- **Water:** Interchar 1260, 1160, 1190, 1120 C1-C3*
Acrylic systems wrong specified
Oil & Gas

Chartek fire Protection
Heritage

Leaders in safety for over 40 years
When astronauts first set foot on the moon we led the way providing cutting edge technology to ensure their safe return

There was no room for error, lives were at risk
Since then, fire protection performance has remained critical to the lives of those working in the most hazardous locations on earth.
Bringing these individuals home safely has been the sole mission underpinning the 50 year history of Chartek development.
Hydrocarbon product offer

Greater choice, more competitive

2015
Chartek 7
Protecting lives, protecting assets

- UL1709
- Jet Fire capability
- Up to 4 hours fire protection
- Sphere & Sphere legs
Chartek 7E

Protecting lives, protecting assets

- UL1709
- Jet Fire capability
- Chartek 7 self reinforced
- Mesh function placed within the formulation
Chartek 8E

- Operating temperature up to 120ºC in continuous
- Jet Fire capability when using HK2 mesh
- Ideal for process vessels
Chartek 1709
Protecting lives, protecting assets

- UL1709
- Operating temperature up to 120°C in continuous
- Jet Fire capability when using HK2 mesh
- Up to 4 hours fire protection
Chartek 2218

Protecting lives, protecting assets

- UL1709 up to 4 hours
- Two hours fire requirements achievable in one coat
- Fast application / curing
- Reduced installation cost
Reinforcement methods

- Advanced carbon fibre mesh for clients who prefer proven in-service performance

- Charlok clip-on reinforcement

- No reinforcement

- Mesh function placed within the formulation
Enhancing Productivity – Charlok clip-on

- Reduced schedules with 2 hour (UL1709) application in a single coat
- Assured durability
- Challenges the use of cementitious PFP
- Reduction in installed cost
Proven Chartek 7 Technology

Market leading solution for all areas of an asset in every region of the world

Customer partnerships have made Chartek 7 the most specified epoxy PFP

Over 6 million square metres protected with Chartek 7
CHARTEK 1709 at a glance

- 12 years in the market: + 1,500,000 sqm protected

- **Recent Megaprojects:**
  - IMPEX ICHTHYS 513,000 M2 (2013 – 2014)
  - GORGON 327,000 M2 (2011 – 2012)

- **Recent Projects**
  - JEDDAH SOUTH POWER PLANT 40,000 M2 (2013)
  - SADARA LIQUIDS WAREHOUSE 10,000 M2 (2013)
  - FILANOVSKAYA CENTRAL PROCESSING PLATFORM 13,800 M2 (2014)
  - TOTAL NORMANDY: 2,000 M2 (2012)
  - TOTAL OPTARA: 21,000 M2 (2014)
  - KHABAROVSK / NK ALLIANCE: 9,000 M2 (2013)
Chartek Fire Design

Solutions delivered by chartered or licensed structural fire engineers

- Professional
- Tailored
- Specific
KEY REQUIREMENTS OF A PFP SYSTEM

- Certification
- Problem solving – full project solutions
- Application _ meeting project schedules
- Durability and retention of fire protection properties
- Track record
- Full life costs
Just like space exploration, you need to get it right first time.

40 year History of Reliability – Next generation of products need to Evolve without compromise.
Thank you