Overview of fire retardants solutions
PIN Flame Retardants in PVC cables

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Content

- **Who is Pinfa**
- PIN Flame Retardants
- Fire Safety and Flame retardants efficacy
- PIN FR’s in Cables : Overview of fire retardants solutions
- Conclusions
Pinfa, mission, vision, raison d’être

- the **Phosphorus, Inorganic and Nitrogen** Flame Retardants Association
- established in 2009 as a Sector Group within **Cefic**, the European Chemical Industry Council
- 29 members

- Pinfa members are **committed to sustainable fire safety via environmentally-friendly flame retardants**
Pinfa members’ shared vision:

- **Vision**: continuously improving the environmental and health profile of their flame retardant products, offering innovative solutions for sustainable fire safety

- **Concept** of an ideal flame retardant:
  - fit for purpose, not toxic, risk and hazard controlled
  - does not migrate out of finished products
  - does not contribute to release additional toxic or corrosive gases in case of fire
  - does not impede the recycling of finished materials
  - degradable in the environment or remains neutral as naturally occurring substances

- **Commitment**: providing safe and none hazardous products to enable high fire safety standards which minimize the risk of fire to the general public

www.pinfa.org and @pinfa_eu
Content

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• Conclusions
Flame Retardants

Bromine
Chlorine
Antimony

Phosphorus
Inorganic compounds
Nitrogen
Content

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Fire Safety and Flame retardants efficacy

• Several questions are asked about flame retardants:
  • - Why Flame retardants ?
    - What do they do for the fire safety ?
    - Are they useful ?
    - Are they sustainable chemicals?

• This short video is aimed at providing some answers.
Content

- Who is Pinfa
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- Fire Safety and Flame retardants efficacy
- **PIN FR’s in Cables : Quick overview of fire retardants solutions**
- Conclusions
PIN FR’s in Cables : Overview of fire retardants solutions

- Mostly from the following starting chemicals:
  - Aluminium
  - Magnesium
  - Phosphate
  - Zinc

- “Product selector”: Showing regulatory status and possible applications.
PIN FR’s in Cables: Metal hydrates of Al and Mg

- Energy consumption
- Formation of oxide layer
- Cooling of surface
- Thinning of burnable gases

\[ 2 \text{Al(OH)}_3 \xrightarrow{>200\,^\circ\text{C}} \text{Al}_2\text{O}_3 + 3\,\text{H}_2\text{O} \]
\[ \text{Mg(OH)}_2 \xrightarrow{>320\,^\circ\text{C}} \text{MgO} + \text{H}_2\text{O} \]
\[ 2\,\text{AlOOH} \xrightarrow{>340\,^\circ\text{C}} \text{Al}_2\text{O}_3 + \text{H}_2\text{O} \]

\[ \begin{align*}
\text{2 Al(OH)}_3 & \rightarrow 200\,^\circ\text{C} & 1075\,\text{kJ/kg} \\
\text{Mg(OH)}_2 & \rightarrow 320\,^\circ\text{C} & 1220\,\text{kJ/kg} \\
\text{2 AlOOH} & \rightarrow 340\,^\circ\text{C} & 700\,\text{kJ/kg}
\end{align*} \]
PIN FR’s in Cables: Flammability and FR loading

LOI = Limiting Oxygen Index

**Graph:**
- **Y-axis:** LOI (%O₂)
- **X-axis:** FR filler in phr

<table>
<thead>
<tr>
<th>FR Filler</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC</td>
<td>100</td>
</tr>
<tr>
<td>DINP</td>
<td>50</td>
</tr>
<tr>
<td>Ca/Zn-Stabilizer</td>
<td>5</td>
</tr>
<tr>
<td>PE-Wax</td>
<td>0.5</td>
</tr>
<tr>
<td>ATH / AOH / MDH</td>
<td>0 - 80</td>
</tr>
</tbody>
</table>

**Graph (Another Scenario):**
- **Y-axis:** LOI (%O₂)
- **X-axis:** DINP

<table>
<thead>
<tr>
<th>DINP (phr)</th>
<th>LOI (%O₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>38</td>
</tr>
<tr>
<td>45</td>
<td>36</td>
</tr>
<tr>
<td>55</td>
<td>32</td>
</tr>
</tbody>
</table>

**Formulas:**
- PVC = 100
- DINP = 50
- Ca/Zn-Stabilizer = 5
- PE-Wax = 0.5
- ATH / AOH / MDH = 0 - 80
PIN FR’s in Cables: Smoke reduction

**ATO - reduced**

- PVC: 100
- DINP: 50
- Ca/Zn-Stabilizer: 5
- PE-Wax: 0.5
- ATO + ATH: 5 - 33

**ATO - free**

- PVC: 100
- DINP: 50
- Ca/Zn-Stabilizer: 5
- PE-Wax: 0.5
- ATH: 0 - 80

**Cone Calorimetry**

- 5.0 phr ATO
- 3.0 phr ATO + 30 phr ATH
- 2.4 phr ATO + 30 phr ATH
- 2.4 phr ATO + 40 phr ATH

- PVC - no FR
- PVC + 30 phr ATH
- PVC + 50 phr ATH
- PVC + 80 phr ATH

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PIN FR’s in Cables : Overview of FR solutions

• Other Chemistries not covered in this presentation
• Zn- Borate (Smoke suppression synergist)
• Sn derivatives

• On going developments....

• “Product selector”: Showing regulatory status and possible applications.
Conclusions

• PIN Flame Retardants are effective solutions to combat fire
• PIN Fr’s nicely couple with PVC and act as smoke reducer in case of fire
• Generally no restrictions on pin FR’s

Thank you for your attention
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More info visit: www.pinfa.org