Lead Paint Reformulation
Technical Guidelines

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1. Technical Guidelines

Content

• Information on hazardous properties of lead compounds
• Substitution processes
• Color theory and color index
• Dispersion process
• Alternative pigments and additives
• Assessment of alternative pigments and additives
• General information on reformulation processes
• The Technical Guidelines are developed to help address both capacity constraints and technical barriers to the substitution of lead compounds in paints

• Focus is on SMEs needs for the effective and efficient reformulation
2. Colors and Paint Function
Paint Functions: Protection
Paint Functions: Signal/Camouflage
Paint Functions: Aesthetics & Other Properties

• Decorative
• Insulation
• Conductivity
• Antibacterial
• Fire retardant
Paint Functions: Usage

• Paint is also formulated to adapt to a variety of substrates and methods of application
• Since there are many different initial lead-containing formulations for color and other paint properties, the Technical Guidelines may only provide general information about reformulation processes.

• In-depth analyses and more specific data will be provided through the pilot demonstrations in the SAICM GEF Lead Paint Project to participating companies according to their specific needs.
3. Paint Raw Materials

- **Resins**
  - Vehicles
  - Binders

- **Pigments**

- **Extenders**
  - Fillers

- **Additives**
  - Driers
  - Plasticizers

- **Solvents**
  - Oil-based
  - Water-based
4. Lead Compounds in Paints

- Paint Raw Materials that may Contain Lead Compounds

<table>
<thead>
<tr>
<th>Type of Paint</th>
<th>Pigments</th>
<th>Extenders</th>
<th>Driers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air-drying primers and topcoats</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Primers, other bases</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Primer surfacers, other bases</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Topcoats, other bases</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Natural extenders or pigments (e.g., ferro oxides) may contain lead compounds, and by using them, lead compounds may be added unintentionally.
Hazardous Properties of Lead Compounds in Paints

<table>
<thead>
<tr>
<th>Pigment Chemicals</th>
<th>Hazard statements according to GHS</th>
</tr>
</thead>
</table>
| Lead chromate molybdate sulphate red (PR 104)           | H350 – may cause cancer  
H360 – may damage fertility or the unborn child  
H373 – may cause damage to organs through prolonged or repeated exposure |
| Lead chromate (PY 34)                                  | H400 – very toxic to aquatic life  
H410 – very toxic to aquatic life with long lasting effects |
5. Substitution Processes

Identifying lead compound used in paint

Identifying possible alternative

Consultation within and outside the supply chain

Assessment of potential alternatives
- Technical feasibility
- Environment and human health hazards
- Economic feasibility
- Availability

Suitable alternative(s) found

Reformulation in the lab

Definition of HSE measures

Scale-up

For industrial paints – on site testing
Lead Compounds Substitution

• Anticorrosive “red lead” pigment
  • Zinc chromate – contains Cr$^{6+}$
  • Zinc phosphate – free of Pb and Cr$^{6+}$; performance not good
  • Calcium (poly)phosphate – Zn-free

• Pigments for red molybdate, lead chromate topcoats
  • Wide choice of possible, non-hazardous alternatives (bismuth vanadates, iron oxides, mixed metal oxides, etc.)

• Lead additives (driers)
  • Zirconium or Strontium Octoate – octoate acids hazardous to unborn child
  • Zr or Sr neodecanoate
6. Assessment of Alternative Pigments and Additives

- Alternatives to anticorrosive red lead pigment
- Alternatives to molybdate orange and lead chromate yellow (PY 34) pigments

<table>
<thead>
<tr>
<th>Pigment</th>
<th>Possible Alternative to</th>
<th>Colour comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bismuth Vanadate PY 184</td>
<td>PY 34</td>
<td>Pigments have similar chroma, but PY 184 has lighter shade than PY 34 which leads to difficulty in obtaining a deeper yellow colour. These colours can be obtained by addition of other pigments.</td>
</tr>
</tbody>
</table>
6. Assessment of Alternative Pigments and Additives

<table>
<thead>
<tr>
<th>Request</th>
<th>Lead chromate yellow PY 34</th>
<th>Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PY 184</td>
</tr>
<tr>
<td><strong>Function</strong></td>
<td>Excellent hiding power. Excellent bleeding properties and gloss retention, the vibrant and deep colours of PY 34 and PR 104 do not fade or become dull.</td>
<td>Durable paints, the same colour range cannot be achieved without other pigments Excellent bleeding properties</td>
</tr>
<tr>
<td><strong>Production process</strong></td>
<td></td>
<td>There is no need for changes in the production process</td>
</tr>
<tr>
<td><strong>Environmental and human health hazard</strong></td>
<td>H350 – may cause cancer H360 - May damage fertility or the unborn child H373 - May cause damage to organs through prolonged or repeated exposure H400 - Very toxic to aquatic life H410 - Very toxic to aquatic life with long lasting effects</td>
<td>Not classified as hazardous to human health and the environment</td>
</tr>
<tr>
<td><strong>Economic feasibility</strong></td>
<td></td>
<td>The best alternative for PY 34, but 5 to 6 times more expansive (22 to 35 EUR per kg)</td>
</tr>
<tr>
<td><strong>Availability</strong></td>
<td></td>
<td>Somewhat limited; due to limited sources of raw materials (Bi, V)</td>
</tr>
</tbody>
</table>
7. Reformulation Processes

- The main practical problem in (re)formulation is the large number of components present in a paint.
Reformulation – Anticorrosive Pigments, Driers

- Lead driers and anticorrosive pigments substitution do not require complex reformulation
- Parallel paints testing is necessary to check if reformulation is effective
Reformulation – Pigments for Topcoats

• Molybdate orange and lead chromate cannot be substituted by a single pigment
• Substitution by combination of the organic and the inorganic pigments is necessary
• Pigments choice depend on desired performance properties of a paint
Conclusion

• Lead is classically a chronic or cumulative toxin and exposure to lead is a major public health concern

• Lead compounds are intentionally added to paint as pigments, anticorrosive, driers, and should have priority in substitution

• Cost-effective reformulation alternatives are available on the market for all lead-containing paint ingredients

• Lead Paint Reformulation Technical Guidelines provide information on alternatives, their assessments and reformulation processes, which helps companies to effectively substitute lead compounds

• We will work with participating SMEs on specific reformulations, according to their needs
THANK YOU!
Terima kasih!

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