REACH –
Anticipation and Alternatives

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Why worry about coatings and REACH?

- Because coatings have to protect against corrosion they often fall afoul of Legg’s Law

Legg’s Law: “Any material active enough for corrosion control will be a health and environmental hazard”

- Even if the coating is benign, the process chemicals to deposit it may not be
  - Chrome plating uses chromic acid which has recently been proposed for authorization under REACH

- Coating industry critical but small
  - Chemicals for coatings are minor uses not worth the cost and risk for large chemical companies
  - Coating formulators, users have limited funds to bear REACH costs
    - Conversion coatings were only registered at 11th hr as market too small for large producers
Coatings are a problem for ESOH

- Cd and chromates – no longer used in auto
- Organics of all sorts as so many minor and trace constituents critical to performance
  - Paints, sealants, adhesives
- Ni and Co plating
  - Most Ni salts classified as SVHCs by “read-across”
  - Kept off Priority List for now
  - Several Co salts on priority list for Authorization
- Long term we see pressure building on
  - Every corrosion control material
    - Mn, Mo, Zr, Zn, Ce, Cr$^{3+}$
  - Cu and even Ag – gov willing to relieve you of this toxic!
  - Nanoparticle–filled coatings
  - Zn plating (what do we need steel for anyway?)
Effects
Most useful materials are on somebody’s nasties list.

The problem is banning materials based on HAZARD not RISK.
REACH supply chain issue

Chemical
1,000 Tonnes/yr
Defined as SVHC

Minor side product

Liability risk, registration cost
Authorization cost?

Decision: Register as intermediate (internal use only)

Chemical Supplier

Other chemicals

Options:
✓ Find new supply
✓ Register ($$)
✓ Authorization? ($$$)
✓ Reformulate ($$)
✓ Withdraw

After Scott Fetter

Formulator

Chemical Supplier

Options:
✓ Find new supply
✓ Register ($$)
✓ Authorization? ($$$)
✓ Reformulate ($$)
✓ Withdraw

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What are the practical effects of materials regulation?

- Classifying more and more chemicals as SVHCs
  - Chemicals drop from market as soon as put forward as SVHCs
- Many chemicals will no longer be sold as not worth the cost/ risk of registration, even at 1,000 tonne/yr level
  - Many more will be lost as go to 100, 10, 1 tonne levels

<table>
<thead>
<tr>
<th>Chemical</th>
<th>%</th>
<th>Brian Norton, SUR/FIN 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epoxy Resin</td>
<td>31.30</td>
<td></td>
</tr>
<tr>
<td>Strontium Chromate Pigment</td>
<td>20.00</td>
<td>At Risk: SVHC Listing</td>
</tr>
<tr>
<td>Other Colour Pigments</td>
<td>3.38</td>
<td></td>
</tr>
<tr>
<td>Anti-Settlement Agent</td>
<td>1.17</td>
<td>At Risk: Volume/Cost</td>
</tr>
<tr>
<td>Dispersing Agent</td>
<td>0.50</td>
<td>At Risk: Volume/Cost</td>
</tr>
<tr>
<td>Extender</td>
<td>17.30</td>
<td></td>
</tr>
<tr>
<td>Aromatic Hydrocarbon</td>
<td>15.85</td>
<td>At Risk: Solvent Emissions</td>
</tr>
<tr>
<td>Esters</td>
<td>10.50</td>
<td>At Risk: Solvent Emissions</td>
</tr>
</tbody>
</table>

- List of SVHCs will constantly increase
- Even completely benign chemicals are being lost from the market as a result of REACH
- Constant uncertainty, high R&D cost, high qualification and implementation costs

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Applications (MacDermid)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromium trioxide, Acids generated from</td>
<td>Hard chrome plating, chromate conversion (Al, Zn, Cd, etc), chromic acid anodizing –</td>
</tr>
<tr>
<td>chromium trioxide</td>
<td>High priority</td>
</tr>
<tr>
<td>Sodium dichromate</td>
<td>Chromate conversion (Al, Zn, Cd, etc) – High priority</td>
</tr>
<tr>
<td>Sodium chromate</td>
<td>Extensively used in chromates and trivalent chrome passivates – High priority</td>
</tr>
<tr>
<td>Potassium chromate</td>
<td>Used in Al chromates, limited use in other chromates, impacts chromate conversion –</td>
</tr>
<tr>
<td></td>
<td>Medium priority</td>
</tr>
<tr>
<td>Ammonium dichromate</td>
<td>Not commonly used – Low priority</td>
</tr>
<tr>
<td>Potassium dichromate</td>
<td>Not commonly used – Low priority</td>
</tr>
<tr>
<td>Cobalt(II) sulphate</td>
<td>Trivalent passivates for Zn alloys, Co plating – medium priority</td>
</tr>
<tr>
<td>Cobalt dichloride</td>
<td>Trivalent passivates for Zn alloys – medium priority</td>
</tr>
<tr>
<td>Cobalt(II) dinitrate</td>
<td>Trivalent passivates for Zn alloys – medium priority</td>
</tr>
<tr>
<td>Cobalt(II) carbonate</td>
<td>Co plating – medium priority</td>
</tr>
<tr>
<td>Cobalt(II) diacetate</td>
<td>Not commonly used – low priority</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>Vapor degreasing, now seldom used – Low priority</td>
</tr>
</tbody>
</table>

Note: Co salt rules will prevent use of nCo-P chrome plate alternative, and Cr3+ passivates for Zn, and ZnNi (i.e. Cd alternatives)
All these are transition elements, so have enough chemical similarities to allow some substitutions among them. Is there an escape from this circle? Yes, but not with plating.

If all these materials are removed from practical use, we will no longer have any wear-resistant or corrosion-resistant electroplates left.
Alternatives
Hex Cr alternatives

**Hard Cr and CAA**
- Electroless Ni and composite plating
- Co–P and Co composite plating
- HVOF (line–of–sight)
- PVD (expensive)
- SAA, TFSAA, BSAA
- High voltage anodize (Keronite, Tagnite, etc)

**Chromates**
- Trivalent Cr passivates
- Non–Cr passivates
- Sol–gel and other adhesion promoters
- Rare earth primers
- Mg–rich, Zn–rich primers
Cd alternatives

- Zn for less demanding applications
  - But increasing concern over Zn – the most widely used corrosion prevention coating in the world
- Electroplated Al and IVD for more demanding
- LHE Zn14wt%Ni without brighteners
  - Available from Dipsol, Atotech, Coventya
  - This chemistry is single-phase material
- Qualified by USAF Hill AFB for landing gear
  - Being implemented component by component
- Close to qual by Boeing for components and fasteners
  - Seattle and St Louis not yet decided whether to spec by chemistry supplier or performance
  - Discussion of this at ASETSSDefense 2012
What about Co?

- Electroless Ni used as hard Cr alternative
- HVOF WC–Co, WC–CoCr and pulse plated nCo–P developed as non–Ni alternatives to hard chrome (also Co–P+SiC, Ni–W)
  - Co salts now priority chemicals under REACH
  - WC–Co “hard metal disease” rising concern
- ZnNi developed as alternative to Cd
  - Uses Ni
  - BUT needs Co–based passivate
Ni alternatives

- Ni coatings are alternatives to hard Cr
- ZnNi is alternative to Cd
- Ni is essential for aircraft MRO
- Ni salts added to CLP list as SVHCs
  - Will be Restricted or Authorizable at some point
- Thus far Ni Institute in Brussels has kept them off the Priority List
  - Hope is to keep them off until the EU realizes that they are losing all their manufacturing
What can we do about it?
Anticipate change

- Lists
  - 67/548/EEC, List of Lists, SIN
  - REACH Annex XIV Candidates
  - Suppliers
- Similarity to existing SVHCs
- Database
  - Shows current restrictions
  - Potential for future restrictions
- Some changes unanticipated
  - Especially as register smaller quantities (so far only 1,000 tonne)

I’ve got them on the list, They’d none of them be missed
Often the problems will not be the major constituents, but the essential minor or even trace chemicals
NASF (National Association for Surface Finishing)
- Coating technologies
- Environmental regulations US, EU

Trade magazines

ASETSDefense covers alternatives to Cd, Cr\textsuperscript{6+}, VOCs for military and aerospace [www.asetsdefense.org](http://www.asetsdefense.org)
- Most useful for aerospace and defense
- Not very useful for high-volume commercial products

Coatings database for comparisons

Granta and Rowan are considering whether there is enough of a market to provide service for keeping up with regulations and materials alternatives
But it isn’t all technology!

- Helping companies through all this is good for my business
- But it is critical that technical people get involved, to ensure that materials engineering for manufacturing is not dictated by people with knowledge of neither materials, nor engineering, nor manufacturing
  - I see no future for manufacturing in Europe under REACH
  - We must not allow that same damage to our economy
- That is why NASF works to make sure that regulators and politicians understand the issues, their costs and consequences