Impact of REACH on Military Aircraft Sales and Sustainment – 3/2012

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Summary

- What do European REACH rules have to do with US?
- REACH in short (very short!)
- Recent “deadly” chemicals
- Impact on sustainment in the EU
  - What chemicals are covered?
  - What do you have to do to use them? (SIEF $)
- Impact on EU sales
- Impact on US production and sustainment
What if….?

Suppose you couldn’t use standard processes or even get the chemicals for them

- Chrome and Ni plating
- Chromic acid anodize or anodize sealing
- Brush Cd or Cd passivation
- Alodine on Al prior to paint
- Chromate primer and sealants
- Paint touch-up

How would you sustain a fighter aircraft?

What would happen to foreign sales?
WHAT IS REACH?
REACH in one page
Registration, Evaluation, Authorisation and Restriction of Chemicals

- Registration: Every chemical imported/used > 1 tonne/yr must be registered, and evaluated for toxicity and use
  - Can only be used if registered for that use
- Idea is to substitute SVHCs (Substances of Very High Concern)
  - Carcinogenic, Mutagenic, Reprotoxic (CMR), Persistent Bioaccumulative and Toxic (PBT), very Persistent and very Bioaccumulative (vPvB), other nasty stuff on a case-by-case basis
- Restriction (e.g. Cd, Hg, Pb)
  - Use can be limited, forbidden for certain applications, or forbidden entirely
- Authorization of SVHCs (Annex XIV)
  - You can only use Annex XIV substances if authorized for that use (expensive, limited duration, until a clean substitute found)

The only chemical exempt from REACH is “perfectly safe” water – responsible for a higher human toll than any other (except TNT?)
All right – two pages

- Primarily applies to Substances (elements, compounds) and Preparations (chemical solutions for cleaning, plating, etc., paints)
- Articles (weapons systems, components) are largely exempt, but not from Restriction
  - So in future you may not be able to use chromated primer in EU, but you can import and sell a component with a chromated paint system
  - But you cannot import or use a Cd plated bolt on most vehicles in the EU because Cd plate itself is Restricted
    - Military vehicles neither included nor excluded explicitly
  - But anything “intended to be released” is subject to REACH (e.g. obscurants, tracers, flares)
Some rough statistics

- It is likely to be possible to substitute most organics, but low-volume chemicals will be a problem.
- There are few good alternatives to many inorganics.
- Even fewer for metals such as Cr and Zn.
REACH is a different kettle of fish

- It covers **all** chemicals
- You never know what will be hit tomorrow
- SVHCs can be authorized for use, but authorization is expensive (~$1.5 mm/substance) and of limited duration
- There are lists of SVHCs (SIN List, etc.)
  - Chemicals that contain SVHCs are dropping from world markets, especially low-volume aerospace chemicals
    - Customer deselection
  - But benign chemicals are also dropping from the market, because the market is too small to be worth registering, or nobody registered them for aerospace applications

We think aerospace and defense are pretty darned important.
But we aren’t – at least to major chemical companies who supply plastics, automotive, electronics, etc.
Our contribution to the bottom line is not worth the hassle, cost, liability risk
REACH AND DEFENSE
But Defense is always exempt – right?

- For RoHS, but not for REACH
- Defense Exemptions (DEs) are permitted
  - But only some countries have them – e.g. UK, France, Germany, Poland
  - No requirement to recognize another country’s DE
  - Getting a DE is pretty much the same work as doing Registration
    - Create a detailed Dossier
    - Usually limited time
What about sustainment in EU?

- REACH applies to anything “placed on the market”
  - If you bring in a can of chromate primer through a commercial carrier, or buy locally, or have EU citizens handle it, REACH applies
  - If you bring in chromated primer in a military aircraft, land at a military base, and have only US personnel handle it, REACH does not apply
    - Except still have to inform EU users of SVHC presence
EU countries do not want to have to deal with all the REACH issues because they have much worse sustainment problems

- Want SVHC-free systems that do not require SVHCs to sustain
- This is going to be an important selling point
- Will be a balance between performance, cost, REACH compliance
Bad?

CHEMICALS COVERED BY REACH

Good
Some SVHCs

- Boric acid
- Almost all Ni salts
- Pb salts
- Cd and Cd salts
- Co salts
- Chromates
- Phthalates (plastics)
- Flame retardants
- Large numbers of organics
- Arsenic salts
- Refractory fibers

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Applications (MacDermid)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromium trioxide, Acids generated from chromium trioxide</td>
<td>Hard chrome plating, chromate conversion (Al, Zn, Cd, etc), chromic acid anodizing - 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 – 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:** TCP uses zirconate inhibitor

**This is just the latest batch**
Approximate timeline

If processes are not in the list of Authorized uses by the Application dates you can no longer do them or have them done in the EU after the sunset dates, except on-base with US citizens.
Chromates

- Chromic acid (Alodine 1200) and Na dichromate (Alodine 1600) are primary conversion coatings for aircraft skins, Al components
  - Corrosion control, repaint, touch-up

- Chromic acid used for
  - Hard chrome plating - rebuild, wear resistance
  - Chromic acid anodizing – corrosion resistance and paint adhesion on Al
So what happens if Na$_2$Cr$_2$O$_7$, CrO$_3$ etc. go into Annex XIV?

- **Consortium set up** to pursue Authorization for CrO$_3$
  - $>$2 million and no certainty
  - $>$50,000 to get authorization if not from vendor

- **Will they be authorized?**
  - Probably, as essential for EU aero industry (Al and Mg conversion, chrome plating, probably CAA, sealing and passivation)
  - But Authorization is time-limited (X yrs??)
  - Any user must derive authorization from vendor or other authorization holder, or have own

Will there be Authorization Consortia for the other chromates, Co salts? Je n’ai pas aucune idée

Same for each of the other substances

How long is X?
But wait – there’s more!

- There may not even be a consortium for some of these substances
  - If not, they will be unobtainable in EU
- Authorization is for a substance for a use
- Are all your uses covered for all substances?
  - What about CAA, coating passivation, stainless passivation, fuel tank coatings, all your sealants, Sermetels, every minor use
  - Some might not be covered because nobody in the relevant consortium needed them or remembered them, or they assume they will get rid of that use by May 2016 (CAA for example)
    - At $2mm a pop it had better really be worth it!
Other things to worry about

- Will there be local sources of supply?
  - May have to change sources or formulations
  - May require requal
- Requirement to inform EU users
  - Could be subject to demand for chemical info if used at any EU airport outside base
- Law of Unintended Consequences
  - Co salt Authorization may drive Cr$^{3+}$ alternatives off market

Legg’s Law: “Any material active enough for corrosion control will be a health and environmental hazard”
OTHER RESULTS OF REACH
What’s next?

There are numerous lists of SVHCs that meet REACH requirements for Authorization or Restriction, e.g.

- SIN List 2.0
- List at McKenna and Long

The biggest problems will be chemicals with the smallest markets

- Designation as SVHC, not worth authorizing
- Benign but not worth cost of registration
- Many organics likely to fall into these areas
REACH supply chain issue

Liability risk, registration cost

Authorization cost?

After Scott Fetter

Minor side product

Decision: Register as intermediate (internal use only)

Chemical 1,000 Tonnes/yr

Defined as SVHC

Same thing happens if benign but not worth registering

Chemical Supplier

Other chemicals

Formulator

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

Defined as SVHC

After Scott Fetter

Same thing happens if benign but not worth registering

Formulator

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

Linked data:
http://www.asetdefense.org

http://db.asetdefense.org

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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 – market deselection

- 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>
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<tbody>
<tr>
<td>Epoxy Resin</td>
<td>31.30</td>
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<tr>
<td>Strontium Chromate Pigment</td>
<td>20.00</td>
<td>At Risk: SVHC Listing</td>
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<tr>
<td>Other Colour Pigments</td>
<td>3.38</td>
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<tr>
<td>Anti-Settlement Agent</td>
<td>1.17</td>
<td>At Risk: Volume/Cost</td>
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<tr>
<td>Dispersing Agent</td>
<td>0.50</td>
<td>At Risk: Volume/Cost</td>
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<tr>
<td>Extender</td>
<td>17.30</td>
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<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</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

http://www.asetdefense.org  Database: http://db.asetdefense.org  Keith Legg 847-680-9420 klegg@rowantechnology.com
Never-ending story

Note what is happening here:

- Ni electro and electroless plates, Ni alloys, Ni composites, nCo-P, Ni-W electroplate have all been developed/qual’d used in place of hard chrome
  - Co alloy electroplates no longer usable in EU
  - Most Ni salts have also been declared SVHCs under REACH and will eventually be Authorizable or Restricted
  - **Result – no electroplating alternatives**

- Chromate conversion becoming authorizable, so will eventually be replaced
  - But some compounds used for trivalent alternatives going same way, with more expected because of Legg’s Law (p 21)

**Never-ending cycle of substitution**

- Inevitable, since there is a huge bureaucracy set up for it
WHAT TO DO?
Norwegian Air Force

- Successful Norwegian Air Force F-16 Application
  - Complete Cr-Free system (Initial Qual Anticipated)
What can we do about it?

Minimize risk, cost by better test and design methods

Use databases to identify alternatives

Plan on how/when to change

Keep on top of technology/material developments

Keep on top of technology/material developments

Anticipate from lists, databases, suppliers

Be aware of chemicals used to make them

Be aware what is in your products
<table>
<thead>
<tr>
<th>Document Title</th>
<th>Systems</th>
<th>Coatings, Processes</th>
<th>Test Names</th>
<th>Contact Names</th>
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<tbody>
<tr>
<td>Technical Report, Doc-001: Non-Chromate Aluminum Pretreatments - Phase 1 Report</td>
<td>Solid rocket booster</td>
<td>Conversion: Heavent catapult However</td>
<td>Adhesion</td>
<td>Craig Marzor</td>
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<td>F-16</td>
<td>Conversion: Trilaterally coated (TCL) LIC Conversion: Non-chrome Precoat</td>
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<td>Navy Aircraft Division (301) 342-9972 Authors: William Nickerson Craig Marzodt</td>
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<td>LCAC</td>
<td>Conversion: TCP-license (TCL) LIC Conversion: Adhesion promoter</td>
<td>Material properties</td>
<td>Navy Aircraft Division (301) 342-9972 Authors: William Nickerson Craig Marzodt</td>
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<td>S-3</td>
<td>Conversion: TCP-license (TCL) LIC Conversion: Adhesion promoter</td>
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<td>Navy Aircraft Division (301) 342-9972 Authors: William Nickerson Craig Marzodt</td>
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<td>C-46</td>
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<td></td>
<td>AAAV</td>
<td>Conversion: TCP-license (TCL) LIC Conversion: Adhesion promoter</td>
<td>Weathering</td>
<td>Navy Aircraft Division (301) 342-9972 Authors: William Nickerson Craig Marzodt</td>
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<td></td>
<td>All Systems</td>
<td>All Coatings</td>
<td>All Tests</td>
<td>Craig Marzodt</td>
</tr>
</tbody>
</table>

http://db.asetsdefense.org/Custom/customsearch.aspx
Department of Defense

Managing Chemicals, Materials, and Impacts to Readiness from REACH: A Strategic Plan

The European Union’s Registration, Evaluation, Authorisation and Restriction of Chemical Substances

Limitations:
This document is a strategic plan; it does not provide authority to take specific actions. Such authorization must be obtained through normal delegations found in other Department of Defense issuances and policy memoranda. All international agreements must comply with Department of Defense Directive (DoDD) 5530.03, International Agreements, and any other applicable issuance.
We are updating this doc since a lot has happened since 2008. Hope to get done by mid-year. Will probably issue as Dist C.