EU REACH and Halogen Reduction in IBM Products

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EU REACH

- REACH is EU's comprehensive chemical management law that entered into force **1 June 2007**
- REACH stands for **R**egistration, **E**valuation, **A**uthorization and Restrictions of **Ch**emical Substances
- Chemical substances regulated under REACH are **general substances** and **substances in articles**
- Individual EU legal entities with REACH obligations:
  - For general substances: manufacturers, importers, downstream users, distributors of chemical substances and preparations
  - For substances in articles: importers, producers, suppliers of articles
- Non-EU entities that do business with EU entities are impacted.
- IBM chemical strategy has been to source in the EU.
- Supplier expectation: track and register substances.

IBM SVHC Strategy / Supplier Expectations

- IBM Hardware strategy for REACH Substances of Very High Concern (SVHCs) is to redesign / stop use of any of those substances (currently 53 substances, see page 5)
  - Listed in 46G3772: Baseline Environmental Requirements for Supplier Deliverables http://www.ibm.com/ibm/environment/products/especs.shtml
  - Track SVHC's using Product Content Declaration: http://www.ibm.com/ibm/environment/products/ecpquest.shtml
- Supplier Expectations:
  - Begin collecting information on whether their products contain any of the identified SVHC's proposed candidates.
  - Prepare information on declaration and gram weights and weight percentage of the identified substances.
  - Be prepared to comply with the updated version of the 46G3772 specification when issued
  - Fill out and return updated PCD when issued by IBM

Current REACH Issues / Updates to REACH Strategy

- Per the European Chemical Agency (ECHA) an article as manufactured is itself an article when given a specific size, shape to meet one function. Multiple articles can be consolidated to build a larger article such as a laptop.
  - Six member states (France etc.) coming forward with a dissenting view; the interpretation of an article to be “once an article always an article” is changed to a “complex article” where an importer must report as multiple articles.
  - Denmark proposal: Ban from placing on the market articles intended for use indoors and articles that may come into direct contact with the skin or mucous membranes containing one or more of these four phthalates DEHP, BBP, DBP and DIBP as a plasticizer / additive .
- Updating IBM Strategy:
  - Pro-actively use the 510 substances Substitute it Now (SIN) list http://www.chemsec.org/list to add substances that have high probability to be in our products as reportable substances to 46G3772 / PCD.
  - Aggressively ensure the 4 phthalates (and any substances found from the analysis of the 457 SIN substances) are removed from products; **46G3772 to be updated to ban DEHP, BBP,DBP and already bans DIBP**.

53 Substances of Very High Concern (SVHC) Candidates

*2,4-Dinitrotoluene	**Sodium dichromate**	**Cobalt dichloride**
4,4'- Diaminodiphenylmethane (MDA)	**Triethyl arsenate**	*Diarsenic pentaoxide
5-tert-butyl-2,4,6-trinitro-m-xylene (musk xylene)	*Tris(2-chloroethyl)phosphate	*Diarsenic trioxide
Acrylamide	**Zirconia Aluminosilicate Refractory Ceramic Fibres**	Dibutyl phthalate (DBP)
Alkanes, C10-13, chloro (Short Chain Chlorinated Paraffins)	**Sodium chromate**	*Diisobutyl phthalate (DIBP)
Aluminosilicate Refractory Ceramic Fibres	**Potassium chromate**	Hexabromocyclododecane (HBCDD)
Anthracene	**Ammonium dichromate**	*Lead chromate
Anthracene oil	**Potassium dichromate**	*Lead chromate molybdate sulphate red (C.I. Pigment Red 104)
Anthracene oil, anthracene paste	**Cobalt (II) dicarbonate**	**Lead hydrogen arsenate**
Anthracene oil, anthracene paste, anthracene fraction	**Cobalt dinitrate**	*Lead sulfochromate yellow (C.I. Pigment Yellow 34)
Anthracene oil, anthracene paste,distn. Lights	**Cobalt (II) sulphate**	**Pitch, coal tar, high temp.**
Anthracene oil, anthracene-low	**Chromium trioxide**	**1,2,3-Trichloropropane**
Benzyl butyl phthalate (BBP)	**2-ethoxyethanol**	**1,2-Benzenedicarboxylic acid, di-C6-8-branched alkyl esters, C7-rich**
Bis (2-ethylhexyl)phthalate (DEHP)	**2-methoxyethanol**	**1,2-Benzenedicarboxylic acid, di-C7-11-branched and linear alkyl esters**
Bis(tributyltin)oxide (TBTO)	**Chromic acid, Oligomers of chromic acid and dichromic acid, Dichromic acid**	**1-Methyl-2-pyrrolidone**
Trichloroethylene	**Cobalt diacetate**	
Boric acid	**2-Ethoxyethyl acetate**	
Disodium tetraborate, anhydrous	**Hydrazine**	
Tetraboron disodium heptaoxide, hydrate	**Strontium chromate**	

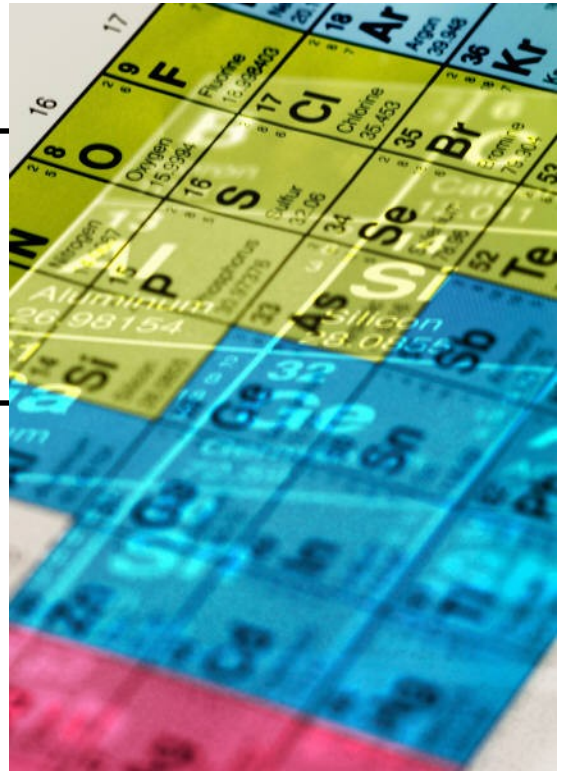
20 Proposed SVHC Candidates and their Potential Uses According to Annex XV Dossier Information

Substance name	Potential uses
Dichromium tris(chromate)	Mainly used in mixtures for metal surface treatment in the aeronautic/aerospace, steel and aluminium coating sectors.
Potassium hydroxyoctaoxodizincatedi-chromate	Mainly used in coatings in the aeronautic/ aerospace, steel and aluminium coil coating and vehicle coating sectors.
Pentazinc chromate octahydroxide	Mainly used in coatings in the vehicle coating and aeronautic / aerospace sectors.
Aluminosilicate Refractory Ceramic Fibres (RCF)	Refractory ceramic fibres are used for high-temperature insulation, almost exclusively in industrial applications (insulation of industrial furnaces and equipment, equipment for the automotive and aircraft/aerospace industry) and in fire protection (buildings and industrial process equipment).
Zirconia Aluminosilicate Refractory Ceramic Fibres (Zr-RCF)	Refractory ceramic fibres are used for high-temperature insulation, almost exclusively in industrial applications (insulation of industrial furnaces and equipment, equipment for the automotive and aircraft/aerospace industry) and in fire protection (buildings and industrial process equipment).
Formaldehyde, oligomeric reaction products with aniline (technical MDA)	Mainly used for manufacture of other substances. Minor uses are as hardener for epoxy resins, e.g. for the production of rolls, pipes and moulds, and as well for adhesives.
Bis(2-methoxyethyl) phthalate	No registration for this phthalate compound has been submitted to ECHA. Hence, the substance seems not to be manufactured in or imported to the EU in quantities above 1 t/y. Main uses in the past were as plasticiser in polymeric materials and paints, lacquers and varnishes, including printing inks.
2-Methoxyaniline; o-Anisidine	Mainly used in the manufacture of dyes for tattooing and coloration of paper, polymers and aluminium foil.
4-(1,1,3,3-tetramethylbutyl)phenol, (4-tert-Octylphenol)	Mainly used in the manufacture of polymer preparations and of ethoxylates. Further used as a component in adhesives, coatings, inks and rubber articles.
1,2-Dichloroethane	Mainly used for manufacture of other substances. Minor uses as solvent in the chemical and pharmaceutical industry.
Bis(2-methoxyethyl) ether	Used primarily as a reaction solvent or process chemical in a wide variety of applications. Used also as solvent for battery electrolytes, and possibly in other products such as sealants, adhesives, fuels and automotive care products.
Arsenic acid	Mainly used to remove gas bubbles from ceramic glass melt and for improving adhesion between copper foil and resin in the production of laminated printed circuit boards
Calcium arsenate	Calcium arsenate is present in complex raw materials imported for manufacture of copper, lead and a range of precious metals. It appears mainly to be used in metallurgical refinement processes to precipitate nickel from molten copper and to manufacture diarsenic trioxide. However, most of the substance seems to be disposed of as waste.
Trilead diarsenate	Trilead diarsenate is present in complex raw materials imported for manufacture of copper, lead and a range of precious metals. The trilead diarsenate contained in the raw materials is in the metallurgical refinement process transformed to calcium arsenate and diarsenic trioxide. Whereas most of the calcium arsenate appears to be disposed of as waste the diarsenic trioxide is used further.
N,N-dimethylacetamide (DMAC)	Used as solvent, mainly in the manufacture of various substances and in the production of fibres for clothing and other applications. Also used as reagent, and in products such as industrial coatings, polyimide films, paint strippers and ink removers.
2,2'-dichloro-4,4'-methylenedianiline (MOCA)	Mainly used as curing agent in resins and in the production of polymer articles and also for manufacture of other substances. The substance may further be used in construction and arts.
Phenolphthalein	Mainly used as laboratory agent (in pH indicator solutions), for the production of pH-indicator paper and in medicinal products.
Lead azide Lead diazide	Mainly used as initiator or booster in detonators for both civilian and military uses and as initiator in pyrotechnic devices.
Lead styphnate	Mainly used as a primer for small calibre and rifle ammunition. Other common uses are in munition pyrotechnics, powder actuated devices and detonators for civilian use.
Lead dipicrate	No registration for this substance has been submitted to ECHA. Lead dipicrate is an explosive like lead diazide and lead styphnate. It may be used in low amounts in detonator mixtures together with the two other mentioned lead compounds.

Halogen Reduction

In IBM Products

Anne Brinkley
IBM Corporate Environmental Affairs



Focus Areas for Halogen Reduction Activities

- *Brominated* and *chlorinated* compounds in electronic materials
- Key applications
  - Flame retardants in polymers
  - Polyvinyl chloride: Cl as well as plasticizers, pigments, etc.
  - Board laminates
  - Electronic components
- Standardized definitions and scope: halogen free, low halogen
- Alternatives research with various consortia
- Specification → Availability → Transition

Significant Steps in Halogenated Flame Retardant and Polyvinyl Chloride Reduction

- 2007: IBM banned PVC and Tetrabromobisphenol A (TBBPA) as an additive flame retardant in new system enclosures
- 2008: Participated in HDPUG study on reduction of PVC for cables and power cords
- 2009: Focused IBM's Roadmap
  - Understand industry capability, increase external collaboration
  - Defined a team of commodity experts or supplier interface teams
  - Agreement with the Product Environmental Stewards for hardware brands
  - Identified a flagship product
  - Established baseline BFR/CFR and PVC- containing commodities/costs
  - Began working on consortia projects across multiple commodities
  - Engaged with standards development (JEDEC, IPC)
- 2010 through 2011: Execution
  - Released IBM's Materials Specification for BFR/CFR and PVC reduction
  - Co-developed a webinar hosted by iNEMI on materials, specifications, standards, connectors, power cords – supply chain enablement
  - Developed the tracking mechanism for parts, subassemblies that IBM has successfully transitioned to halogen-reduced

Low-Halogen Standards and Specifications

Document Type	Document Reference
IBM Halogenated Flame Retardants and Polyvinylchloride Material Substances Specification (All using commodities, adopted the JS-709 restriction)	**IBM Engineering Specification 46M2586 EC N28742, Dec 20, 2010**
Standards (for PCB Material Only)	**IEC 61249-2-21 JPCA-ES-01-1999 IPC – 4101C**
JEDEC Publication (rescinded) (Solid State Devices Only)	**JEP-709**
JEDEC/ECA Standard (Passives and Solid State Devices)	**JS-709 Defining "Low-Halogen" Passives and Solid State Devices (Removal of BFR/CFR/PVC)"** http://www.jedec.org/sites/default/files/docs/JS709.pdf

IBM's specification is publically available at

http://www-03.ibm.com/procurement/proweb.nsf/ContentDocsByTitle/United+States~Information+for+suppliers

Regulatory Responses for Halogenated Flame Retardants, PVC and Phthalates

- Limited legislation exists today supports halogenated flame retardant reduction
  - PBDE and PBB in EU RoHS (2002/95/EC) and similar laws
  - Halogenated compounds as a generic group were considered for the RoHS substance review and recast (2011/65/EU). Expect to revisit this proposal.
  - Phthalates in PVC impacted by EU REACH SVHC requirements

- DEHP, DBP, BBP and DIBP phthalates are already banned in IBM ES 46G3772, “Baseline Environmental Requirements for Supplier Deliverables to IBM”
  - Impetus for PVC alternatives
- The November 2011 version of IBM’s Product Content Declaration will require TBBPA as a separate reportable.

Alternatives for Epoxy Resins for PCB Technology

- Reactive nitrogen and phosphorous compounds and additive inorganic alternatives, mainly aluminum hydroxide are used on a commercial basis as flame retardant alternatives to TBBPA in epoxy resins.
- Smaller, thinner card assemblies have had increased success with alternatives to TBBPA and can be found on the market NIC cards, memory cards, including devices such as HDDs, DVD/ROMs, and other devices using thinner board technologies
- Need for defined test standards vs. reliability
  - iNEMI Hi Reliability study (Server Market Segment Application) is on going to assess 8 BFR-free phenolic-based PCB materials
    - http://thor.inemi.org/webdownload/Pres/APEX2011/HFR-Free_041411.pdf
- Drawbacks remain
  - brittleness, warpage, loss of dielectric properties

Considerations for Low Halogen Alternatives for Flame Retardants in Various Polymers

- Meet all mandatory fire and safety requirements
- Be compatible with the polymer
- Maintain mechanical properties of the polymer
- Have good UV (ultra violet) stability
- Be resistant towards ageing and hydrolysis
- Match thermal behavior of the polymer
- Be non-corrosive
- Cannot emit toxic compounds when burned
- Cannot have harmful physiological and environmental effects
- Be commercially available and cost efficient
- Meet IBM's quality and reliability standards in final the application

Electronic Components
(Memory, Logic, Actives, Optics, Passives, Switches)

BFRs are widely used in

- IC molding compounds,
- organic substrates used in BGA (ball grid array) packages, and
- PCBs (printed circuit boards) used in memory, hybrid, and optical modules.

CFRs are not widely used. Very slight use in

- solder mask materials for PCB laminates and
- once used in an underfill material for a FC-BGA (flipchip BGA)

PVC has slight usage in

- Active fiber optic cables
- Sleeve material for some PTH aluminum (electrolytic) capacitors

Electronic Components
(Memory, Logic, Actives, Optics, Passives, Switches)

- Over 20,000 IBM p/ns managed in this commodity
  - of which 9500 are recommended for use in new designs
- Component team updated the Product Content Declarations for the 9500 p/ns in order to identify which p/ns still use BFRs, CFRs, and PVC today
- Flagship BoM was re-evaluated once all of the PCDs were updated
  - Only **8** IBM p/ns managed by component team currently use a BFR
  - No p/ns on the BoM referenced a CFR or PVC

Halogen-Reduced FR in Electronics

HF (Low Hal)	Mechanical	Electrical	Effectiveness	Cost	Availability
PCB Laminates Thicker board/condensed landscape	Lower thermal expansion (CTE) values	Lower loss	UL94-V0 – reliability TBD	~10% cost adder (FPCB: ~3%)	<10%
PCB Laminates Thinner NIC Card/I/O technology	Comparable to halogenated	Comparable to halogenated	UL94-V0	cost parity	<20% market growth forecast
BGA substrate / Mold compounds	Comparable to halogenated	Comparable to halogenated	UL 94-V0	cost parity	<30% of market today, growth forecast
Cords, Cables & Wires	Elasticity and sometimes order issues	Comparable to halogenated	UL VW-01, CSA FTI	DC: ~50-70% AC: ~140%-170%	Growing number of solutions
Enclosures	Comparable to halogenated	Comparable to halogenated	UL 94-V0	N.A.	No issue
Connectors	Comparable to halogenated		Lower flow, corrosion ,out gassing, lower surface quality, lower mechanical strength, no drop-in	~10-20% cost adder	Solutions available

Summary

- Heightened awareness to improve/ implement “halogen reduced” materials
- Halogen reduced and PVC alternatives are major undertakings for the electronics supply chain and strides continue to be made in available technology at decreasing cost
  - Most replacement materials are not “drop-in”
  - Industry needs to play a proactive role in developing solutions that are
    - based on science and engineering, delivering value to customers
    - available in advance of new regulations
- The cost gap is closing and we will continue to monitor and work with supply chain
  - Consumer and communications customers are executing plans/initiatives to move to low halogen technologies – Volumes for commercial systems still low
  - Some commodities ready such as DVDs, HDDs, memory cards, some connectors, power cords, some “off the shelf” cables and flex cables.
  - Where the viable technology exists it is important for the electronic supply chain to use it whenever applicable
  - IBM’s new programs are utilizing “halogen reduced ” materials whenever feasible

Thank You

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