Where are REACH SVHC in Electronic Products and Parts?

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Abstract
The European REACH regulation (Regulation (EC) No 1907/2006) imposes requirements to declare and sometimes restrict the use of Substances of Very High Concern (SVHC). REACH affects all product types and forces the electronics industry to investigate substances that have not commonly been declared down the supply chain. On October 28, 2008, the European Chemicals Agency (ECHA) published the initial Candidate list of 15 SVHC. Non-government Organizations (NGOs) are pushing for rapid introduction of additional SVHC and several EU member states are already preparing their next round of SVHC submissions to the European Chemical Agency. The short time frame in which SVHC are introduced creates a significant challenge for all actors in the electronics industry as many manufacturers will not know if presence of the substance is possible or likely in their products.

This paper summarizes the results of the first year of assessing electronic products and parts for SVHC. The testing involves multiple manufacturers and a variety of product types. Assessment methods based on analytical testing, rule of thumb, and engineering judgment are discussed. Some SVHC are considered to be commonly used in electronic parts and materials while other SVHC are unlikely constituents. We present a summary of results obtained from performing analytical testing for the Candidate list SVHC substances in various types of products and parts. The testing was performed in analytical test labs in North America, Asia, and Europe. A technical understanding of which parts and materials are likely to contain each SVHC and which parts and materials are not likely (or not possible) to contain an SVHC allows manufacturers to perform a risk assessment and focus their effort on the highest risk parts and SVHC.

Introduction
REACH is a European chemicals and substance regulation that applies to nearly all products that are manufactured or imported into the European Union (including European Economic Area (EEA) countries). The acronym REACH stands for: Registration, Evaluation, Authorization and Restriction of Chemicals. It is a complex regulation (Regulation (EC) No 1907/2006) consolidating over 40 previous legislations under one umbrella and adding many new requirements. The regulation was initially over 700 pages in length and is now accompanied by several thousand pages of additional guidance. It is administered by the European Chemical Agency, often abbreviated as ECHA

REACH creates responsibilities for manufacturers, distributers, and other actors in the supply chain. It establishes requirements for nearly all chemicals, mixtures (preparations) and articles that are manufactured or imported into the EU. Requirements came into effect starting 2008 and will continue to come into effect through 2018 and beyond.

So what is REACH? In a nutshell, REACH requires industry to be responsible for the safe manufacture and use of chemicals.

Under REACH,

- Organizations must register substances and mixtures (preparations) manufactured and imported.
- They must create dossiers that assess the effects of substances
- They must provide information on Substances of Very High Concern (SVHC), and
- Chemicals posing an unacceptable risk will be restricted and organizations will need to obtain authorization to continue use after the sunset date

In this paper, we will be discussing only one set of the REACH requirements -- SVHC in articles. In most cases, this is the only requirement that impacts electronic manufacturers that manufacture their products outside of Europe.

The REACH regulation frequently uses the term ‘article’, meaning any product or part whereby the shape or form is more important than the chemical composition. This includes finished products and also parts or components that are still to be manufactured into a product. For example, a sheet of cold rolled steel is not an article; but cut out a piece, bend it, drill some holes and it’s an article. Electronic products, whether a finished product or one that still requires manufacturing steps, would be considered an article.

Substances of Very High Concern (SVHC) include substances that are carcinogenic, mutagenic, toxic to reproduction, persistent, bioaccumulative and/or endocrine disrupting.

Organizations that manufacture or import products containing an SVHC have compliance obligations. If the product is a substance or mixture, the SVHC must be identified in material safety data sheets. For an article with an SVHC present at

greater than 0.1% weight over weight, there are mandatory communication obligations to customers. If manufacture or import of the SVHC is over 1 ton per year there are also 'Notification' obligations to ECHA. Once an SVHC has become restricted, an organization must request and be granted 'Authorization' from ECHA to continue use after the sunset date.

It is important to note that not all SVHC are equal in terms of obligations. There are several different SVHC lists and it's necessary to understand these lists to understand the obligations. Figure 1 illustrates the process that is used by ECHA to create SVHC lists, including consultations to ensure that all stakeholders have an opportunity to provide comments. The amber boxes at the bottom of the figure represent the key SVHC obligations for articles.

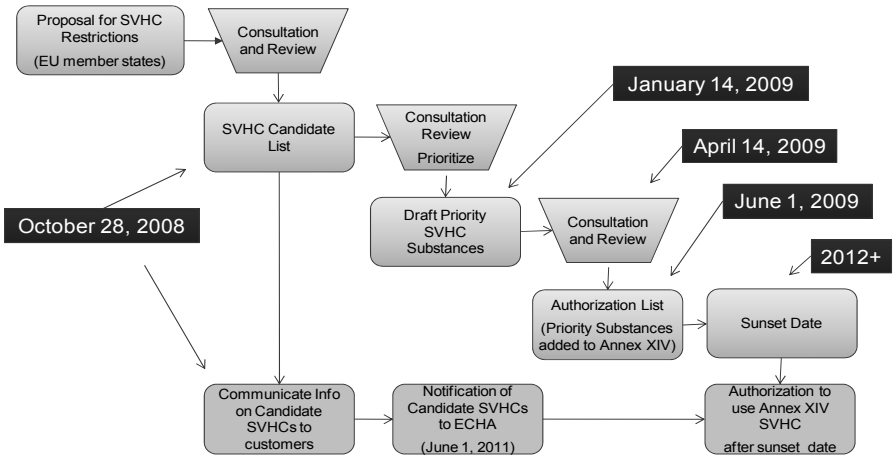

Figure 1: SVHC Candidate Process

In 2008, the European countries (usually the environment ministry) proposed sixteen substances that they would like to see restricted as SVHC. ECHA conducted a public consultation. As a result of the consultation and a subsequent review, the first SVHC Candidate List was officially released by ECHA on October 28, 2008. It included fifteen (15) of the sixteen (16) substances that had been proposed. This particular list is called the candidate list given that these substances are now candidates for restriction. As soon as the candidate list was published, there were immediate communication requirements for manufacturers and importers.

Following the release of the Candidate SVHC List, ECHA prioritized the list to determine which of the 15 candidate substances should be restricted first. After a public consultation, seven (7) of the 15 Candidate SVHC were officially proposed for addition to Annex XIV of the REACH regulation to form what is called the Authorization List. Substances on the Authorization List may not be used in manufacturing without explicit authorization from ECHA.

REACH SVHC Communication Obligations

REACH Article 33 "Duty to communicate information on substances in articles" has been the key obligation driving manufacturers, importers, and distributers to determine whether SVHC exist in their products. If a Candidate list SVHC (that's the list of 15 SVHC) is in the article at greater than 0.1% weight over weight, the manufacturer or importer has communication obligations to recipients.

- If the customer is a business to business recipient, the SVHC information must be provided at the time of providing the product.
- If the customer is a consumer, the SVHC information must be provided within 45 days of a request.

Reporting obligations require, at a minimum, identification of the chemical and information on safe use. For organizations that are not in the EU, but whose products may end up in the EU, their customers will need the information for downstream reporting.

SVHC Notification

Starting June 1, 2011, manufacturers and importers must start to notify ECHA of Candidate list SVHC in their products. This is referred to as "Notification". However, notification has a reporting threshold level of 1 tonne per year and various exemptions may apply, thus a detailed assessment should be undertaken. Notification must follow the guidelines outlined in Article 7.4 and include:

- the identity and contact details of the producer or importer
- the registration number(s) if available;
- the identity of the substance
- the classification of the substance(s)
- a brief description of the use(s) of the substance(s) in the article and of the uses of the article(s);

- the tonnage range of the substance(s), such as 1-10 tonnes, 10-100 tonnes and so on.

SVHC Authorization
REACH Annex XIV lists substances that Europe is trying to control and/or eliminate through the authorization process. Manufacturers, importers, and downstream users must receive authorization to continue using these substances after the Sunset Date. Authorization is specific to a company and must be requested at least 18 months before the sunset date. Submitting an Authorization request is expensive and requires details on which use(s) the authorization request covers.

REACH Substances of Very High Concern
ECHA maintains an online "Candidate List of Substances of Very High Concern for authorization" at: http://echa.europa.eu/chem_data/authorisation_process/candidate_list_table_en.asp. Table 1 below provides a list of the fifteen Candidate SVHC that were published on October 28, 2008. SVHC that have been prioritized by ECHA for authorization are noted in the remarks column. Those substances that have known uses in materials used in electrical/electronic products are shown in red text. These substances include the 3 Phthalates DBP, BBP, DEHP; diarsenic pentaoxide, diarsenic trioxide, hexabromocyclododecane, short chain chlorinated paraffins, and tributyl tin oxide.

Table 1: Candidate SVHC List (October 28, 2008)

SVHC Substance	Potential Applications	Remarks
Anthracene	manufacture of dyes, pyrotechnics	
4,4'-Diaminodiphenylmethane (MDA)	hardener for epoxy resins, hardener in adhesives, intermediate in the manufacture of high-performance polymers, preparation of polyurethane	Prioritized substance for authorization
Dibutyl phthalate (DBP)	Plasticizer (softener) in PVC, printing inks, paper and packaging coatings, etc…	Prioritized substance for authorization
Benzyl butyl phthalate (BBP)	Plasticizer (softener) of PVC, acrylics, sealants, adhesives, inks, paints, etc..	Prioritized substance for authorization
Bis (2-ethyl(hexyl)phthalate) (DEHP)	Plasticizer in polymer products, mainly PVC, blister packing	Prioritized substance for authorization
Cobalt dichloride	Gas masks, humidity indicator, dye mordant for glass industry, drying agent in paints, lacquers, varnishes and printing inks, etc…	
Lead hydrogen arsenate	Insecticides	
Diarsenic pentaoxide	Dyeing industry, printing, colored glass, insecticide, metallurgy (to harden copper, lead or gold in alloys), etc…	
Diarsenic trioxide	Decolorizing agent for glass and enamels, oxidizing agent special glass and lead crystal formulations, weed killers	
Sodium dichromate	Metal finishing, aiding corrosion resistance, chrome-tanning of leather, colored glass and ceramic glazes	
5-tert-butyl-2,4,6-trinitro-m-xylene (musk xylene)	Fragrance, cosmetics and soap perfumes	Prioritized substance for authorization
Hexabromocyclododecane (HBCDD)	Flame retardant used in HIPS, PS insulation and textiles	Prioritized substance for authorization
Alkanes, C10-13, chloro (Short Chain Chlorinated Paraffins)	Plasticizers in PVC (cable)and rubber; flame retardant in plastics and textiles;	Prioritized substance for authorization
Bis(tributyltin)oxide	Biocide, antimicrobial – incorporated into polymers -- flooring, tiles and carpeting	
Triethyl arsenate	Intermediate for semiconductors	

SVHCs – Round Two
EU countries proposed in August 2009 a further fifteen (15) substances for addition to the Candidate List. All 15 substances have been approved but had not been officially posted as of writing this paper.

The additional substances are: 2, 4-Dinitrotoluene; Anthracene oil; Anthracene oil, Anthracene paste, distn. Lights; Anthracene oil, Anthracene paste, Anthracene fraction; Anthracene oil, Anthracene-low; Anthracene oil, Anthracene paste; Diisobutyl phthalate; Aluminosilicate, Refractory Ceramic Fibres; Zirconia Aluminosilicate, Refractory Ceramic Fibres; Lead chromate, Lead chromate molybdate sulfate red (C.I. Pigment Red 104); Lead sulfochromate yellow (C.I. Pigment Yellow 34); Acrylamide; Tris(2-chloroethyl)phosphate; and Coal tar pitch, high temperature

Engineering Assessment for SVHC
An engineering assessment can often be performed on an article to determine whether a SVHC is a risk for being present in the article. ECHA has provided guidance that the 0.1% threshold for REACH SVHC communication under Article 33 obligations is based on the mass of the entire article as manufactured or imported; not on the homogeneous material as required under the RoHS Directive. In this way, materials that may contain the SVHC but make up a very small percentage of the product mass may be discounted based on engineering analysis.

Although the mass % of the article can sometimes 'hide' an SVHC from reporting, manufacturers and their downstream operators should note that articles include spare parts or individual pieces that may be shipped unassembled in the same shipping package. For example, a detachable power cable shipped with an electronic product is considered a separate article and must comply with the SVHC communication obligations. A battery or any other part that is not pre-assembled is similarly a separate article.

Typical Applications of REACH SVHC
Table 1 describes some of the potential applications for the first 15 Candidate SVHC. Metals will typically not include any of the 15 SVHC currently listed. Surface coatings could contain these substances BUT these coatings are generally a very small percentage of the base material (usually under 0.1% by mass). Plastics, resins, adhesives, paints, desiccants and flame retardants all pose a fairly significant risk of containing one or more SVHC.

Packaging as an Article
Product packagings are articles that are easily overlooked for REACH SVHC obligations. Packaging was not relevant to the restrictions of the RoHS Directive. However, under REACH, each level of packaging (primary, secondary, tertiary) is considered a separate article and would need to be examined for SVHC content.

Packaging includes plastic wrap (e.g. around a CD case), paper or plastic carrier bags, cling wrap, plastic collecting individually packaged products, plastic and wooden pallets, plastic and wooden crates, large shrink wrap, and corrugated carton.

Methodology -- Analytical Testing for REACH SVHC
Products and materials may be tested for SVHC using analytical test methods. Selecting the correct sample preparation and analytical test method is critical for achieving accurate test results. For example, the substance must be fully extracted from the base material otherwise the test results will be inaccurate. But the test strategy must also be cost efficient. This requires the use of clever test strategies to maximize the relevant information with a minimum numbers of tests. Techniques can also be used to eliminate the presence of certain SVHC by using specific tests combined with deductive reasoning.

A variety of test methods are used based on the substance under test and the base material. Two of the most common are gas chromatography - mass spectrometry (GC/MS) and Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). Other methods may be used for specific circumstances.

Sample Preparation
The REACH SVHC reporting threshold is based on the mass of the article, thus grinding of the entire product prior to analytical testing is possible. This is cost effective compared to testing individual parts or materials but makes it difficult to isolate the specific part or material that contains the SVHC. The product is partially disassembled prior to grinding, removing volatile parts (such as batteries) and separating metal pieces from other materials. Each sample to be ground is separately weighed so that percent of article mass can be subsequently calculated. After grinding, the analyte is prepared by solvent extraction or digestion.

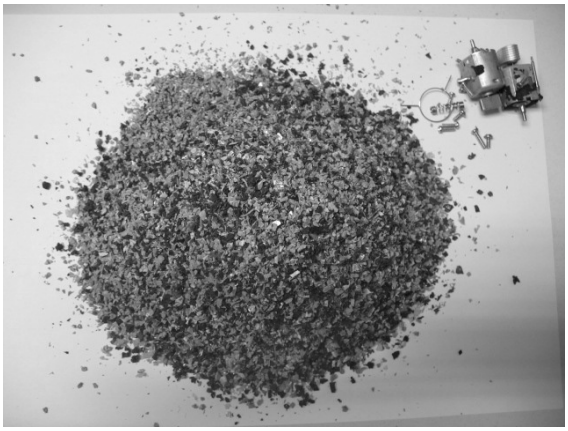

Figure 2: Sample Preparation - Grinding

Testing for Organic Compounds
Organic compounds, which make up more than half of the initial list of 15 SVHC, are usually measured using gas chromatography - mass spectrometry (GC/MS). GC/MS can accurately isolate specific substances and measure their concentration level. However, the extraction method is still critical to the accuracy.

Testing for Inorganic Compounds
Testing for individual inorganic compounds is expensive, but these compounds can be effectively screened by looking for key elements using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). Optical Emission Spectrometry, also called Atomic Emission Spectroscopy (AES) may be used to identify trace metals, such as Arsenic (As) as found in Diarsenic pentaoxide, Diarsenic trioxide, Triethyl arsenate, and Lead hydrogen arsenate. The absence of arsenic rules out the presence of all four SVHC. A compound such as Sodium dichromate can be eliminated if either sodium or chromium is not present. The check for sodium is important given that metallic chromium and trivalent chromium is commonly found in applications similar to where sodium dichromate may be present. When an SVHC cannot be ruled out, additional testing may be required to confirm presence/absence.

Scan and Store
The continuous addition of new SVHC substance to the Candidate List once or twice a year causes serious overhead for manufacturers, suppliers, and downstream operators that are continuously having their products tested for ever more substances.

Scan and store is a technique that allows a product to be tested once and then to reuse the raw data from the test when additional substances need to be considered. The technical consists of:

- Article disassembling, weighting and grinding
- Sample preparation
- GC Mass Scan of a wide range of substances
- ICP Mass Scan of 15/+ elements
- Quantification to ppm level of detected substance from ECHA published List

Results of SVHC Analytical Test Studies
This section summarizes the results of testing for REACH SVHC substances in materials and products that are indicative of electronic products. The testing was conducted at Intertek analytical test labs located in Chalon, France; Taiwan; Hong Kong; and Shenzhen, China. Testing was for the fifteen Candidate list SVHC substances (Oct 28, 2008). In some cases, only the subset of the substances that were deemed to be a high risk in the subject product/material was tested.

SVHC Testing Study – North America
The results from analytical testing of over 500 different product and material samples were reviewed and synthesized into statistical graphs. The test samples were primarily from electronic products or products/materials similar to those used in electronics. Most test samples came from North American manufacturers. Some of the samples were tested for all 15 Candidate List SVHC, while other samples were tested for specific SVHC that were considered to be a high risk. The most prevalent SVHC found in the samples was the phthalate DEHP (Bis (2-ethyl (hexyl) phthalate)). A histogram of the test results is shown in Figure 3. The results show that 64 of 391 samples tested contained the phthalate DEHP at levels above the REACH threshold of 0.1% for reporting. This corresponds to over 16% of the samples that were tested. Of the test samples, 277 came up with DEHP not detected (ND) or below 0.01% (100ppm).

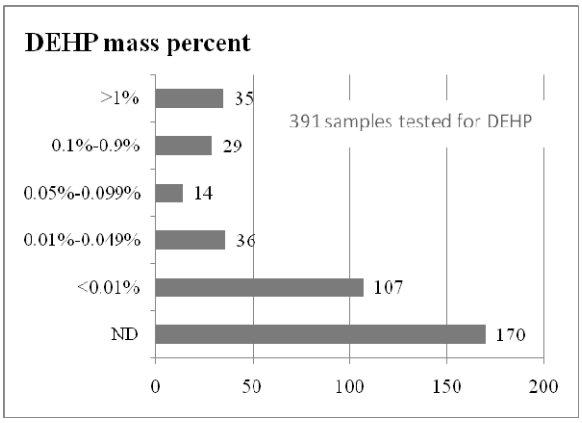

Figure 3: Histogram of samples versus mass percent of DEHP

The phthalate DBP was detected in two samples as shown in Figure 4.

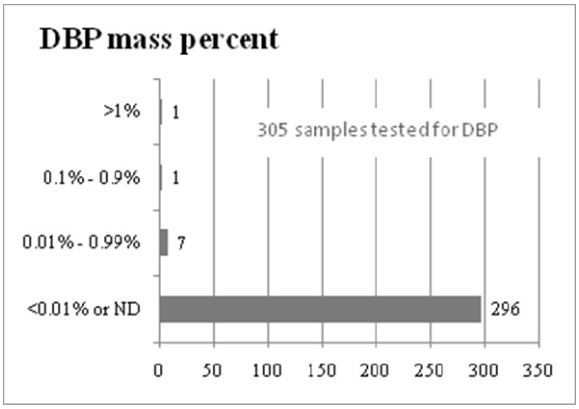

Figure 4: Histogram of samples versus mass percent of BBP

Of the 138 samples that were tested for Alkanes, C10-13, chloro (Short Chain Chlorinated Paraffins), only one sample tested positive above the 0.1% threshold. However, four samples showed between 0.01% (100ppm) and 0.1% (1000ppm) of SCCP, suggesting that some of the constituent materials of the tested product include this SVHC (see Figure 5). If these materials or product parts are imported into Europe as articles, it's possible that the mass percent of SCCP could exceed the reporting threshold.

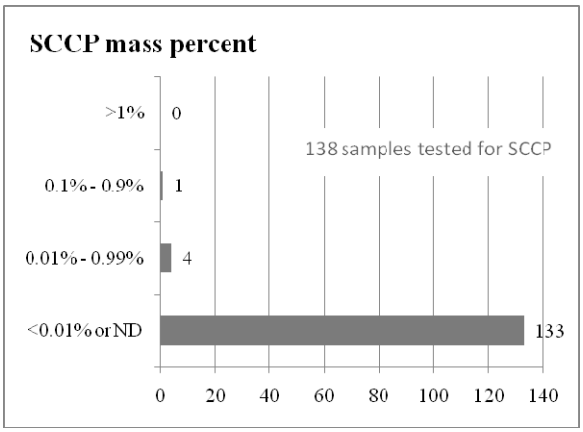

Figure 5: Histogram of samples versus mass percent of Short Chain Chlorinated Paraffins

Sodium dichromate would not usually be expected in electrical/electronic products where compliance to the EU RoHS Directive is required. The chromium in Sodium dichromate is hexavalent chromium which is restricted to no more than 0.1% at the homogeneous material level for all products within scope of the RoHS Directive. However, several fasteners that were tested showed detectable levels of Sodium and Chromium, suggesting that sodium dichromate may have been used for metal finishing and/or corrosion resistance. In most cases the total mass of the fastener overshadowed the mass of the finish such that the SVHC reporting threshold could not have been exceeded; however, one sample showed a sufficiently high level of sodium and chromium whereby the overall mass percent of sodium dichromate may have been as high as 0.2%.

SVHC Testing Study - Asia

The test results summarized in Table 2 are a synthesis of SVHC testing that was performed on electrical/electronic products (and relevant materials) over a four month period in mid 2009 at Intertek laboratories in Taiwan, Hong Kong, and Shenzhen. Total number of test data samples were 1773, composed of the following materials: Plastic, Paint, Paper, "Paper, fabric, glue", PCB, Dye, Glass, Ceramic, Glass, Leather, Synthetic material, Synthetic leather, Textile, Metal, Foam, "Foam, woven", Composition test material, and Electronics.

Table 2: Summary of SVHC Testing at labs in Asia

Summary of Positive Test Results	DEHP	SCCP	DBP	Cobalt dichloride[c]	BBP	Bis(tributyltin)oxide	Anthracene	4,4'-Diaminodiphenylmethane	As[b]	Sodium dichromate[g]	5-tert-butyl-2,4,6-trinitro-m-xylene	HBCDD
Occurrences above 0.1% threshold	137	12	15	2	2	3	0	1	6	1	0	0
Percent of total samples	7.73 %	0.68 %	0.85 %	0.11 %	0.11 %	0.17 %	0.00 %	0.06 %	0.34 %	0.06 %	0.00 %	0.00 %

The following Notes are applicable to Table 2:

a: Plastic are tested separately or mixed with other materials (fabric, leather, coating, glue, paper, wood, fabric, sponge, textile, foam, metal, PCB)

b: "As" includes 4 SVHC compounds Diarsenic pentaoxide, Diarsenic trioxide, Lead hydrogen arsenate, Triethyl arsenate.

c: Co, Cl are detected to confirm whether Cobalt dichloride under threshold, the result can be classified to "pass" & "inconclusive".

e: Organic tin is detected and further testing is needed to confirm whether it comes from Bis(tributyltin)oxide.

g: Cr, Cr6+, Na+ are detected to confirm whether Sodium dichromate under threshold, the result can be classified to "pass" & "inconclusive".

The testing for the inorganic SVHC compounds (highlighted in yellow in Table 2) is based on screening for the metallic element using ICP/OES. This provides a quick and cost effective method to determine if the inorganic SVHC are not present. In the event that a test result is positive, further analytical testing is required to determine if any of the specific SVHC compounds are in fact present and to determine the mass percent level of the SVHC.

The Phthalate DEHP (Bis (2-ethyl (hexyl) phthalate)) was the most frequently detected SVHC. DEHP was most commonly found in plastic materials (122 of the 137 occurrences) but was also detected in paint, paper, synthetic materials, synthetic leather, textiles, foam, and some composite materials.

Plastic was also the base material (matrix) that was found to contain the largest number of different SVHC, including all three phthalates (DEHP, BBP, DBP), Short-chain chlorinated paraffins (SCCP), organic tin, and 4,4'-Diaminodiphenylmethane (MDA).

Summary

Substance regulations have become a significant challenge for manufacturers and their downstream partners. Manufacturers must employ a combination of supply chain information, engineering judgment, and analytical testing to strike an effective balance between compliance assurance and costs.

The REACH regulation imposes a requirement on manufacturers, importers, and distributors to disclose the presence of Candidate List SVHC in their products. Reporting obligations require, at a minimum, identification of the chemical and information on safe use. The reporting requirements apply to each individual article that is manufactured or imported into Europe, including the packaging materials and any consumables or documentation that may be provided. For organizations that are not in the EU, but whose products may end up in the EU, their customers will need the information for downstream reporting.

Several of the SVHC on the Candidate List may be found in electrical/electronic products. The Phthalate DEHP was the most frequently appearing SVHC in the study, although Phthalate DBP and Short Chain Chlorinated Paraffins occurred frequently enough to be a risk. Several of the other SVHC were also detected but in fewer samples. Plastics materials were found most likely to contain an SVHC, including the three phthalates (DEHP, BBP, DBP), Short-chain chlorinated paraffins (SCCP), organic tin, or 4, 4'- Diaminodiphenylmethane (MDA).

Screening and Test methods exist to identify the presence/absence of SVHC, but a good test strategy is needed to optimize the value of the testing performed. Engineering judgment may be used to identify the risks and help narrow the search for SVHC that are reportable under the REACH regulation. An effective test strategy may also be employed to address the requirements of multiple regulations in a single test plan (such as testing packaging materials for REACH SVHC and substance restrictions of the EU Packaging Directive). This optimizes the value of the testing that is performed and reduces operational overhead.

Test strategies such as "Scan and Store" can also help manufacturer's reduce their test requirements when additional SVHC are added to the Candidate List.

Where are REACH SVHC in Electronic Products and Parts?

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Agenda

- Brief Introduction to REACH
- Substances of Very High Concern (SVHC)
- Test Methodology
- Statistical Analysis of SVHC Test Results
- Summary

What is REACH?
Quick overview of the Regulation

- Registration, Evaluation, Authorization and Restriction of Chemicals
  - Regulation (EC) No 1907/2006
  - Directive 2006/121/EC

- Requires industry to be responsible for the safe manufacture and use of chemical substances
  - Manufacturers/Importers must Register all substances manufactured/imported in quantities of 1 tonne or more per manufacturer/importer
  - Evaluation of dossiers for completeness and exposure
  - Authorization required for substances of very high concern (SVHC)
    - Includes specifically listed carcinogens, mutagens, reproductive toxins (CMRs), persistent bio-accumulative toxins (PBTs), and very persistent, very bio-accumulative substances (vPvBs)
  - Restrictions on chemicals posing unacceptable risk
    - Either on certain uses of the substance or a complete ban

Substances of Very High Concern

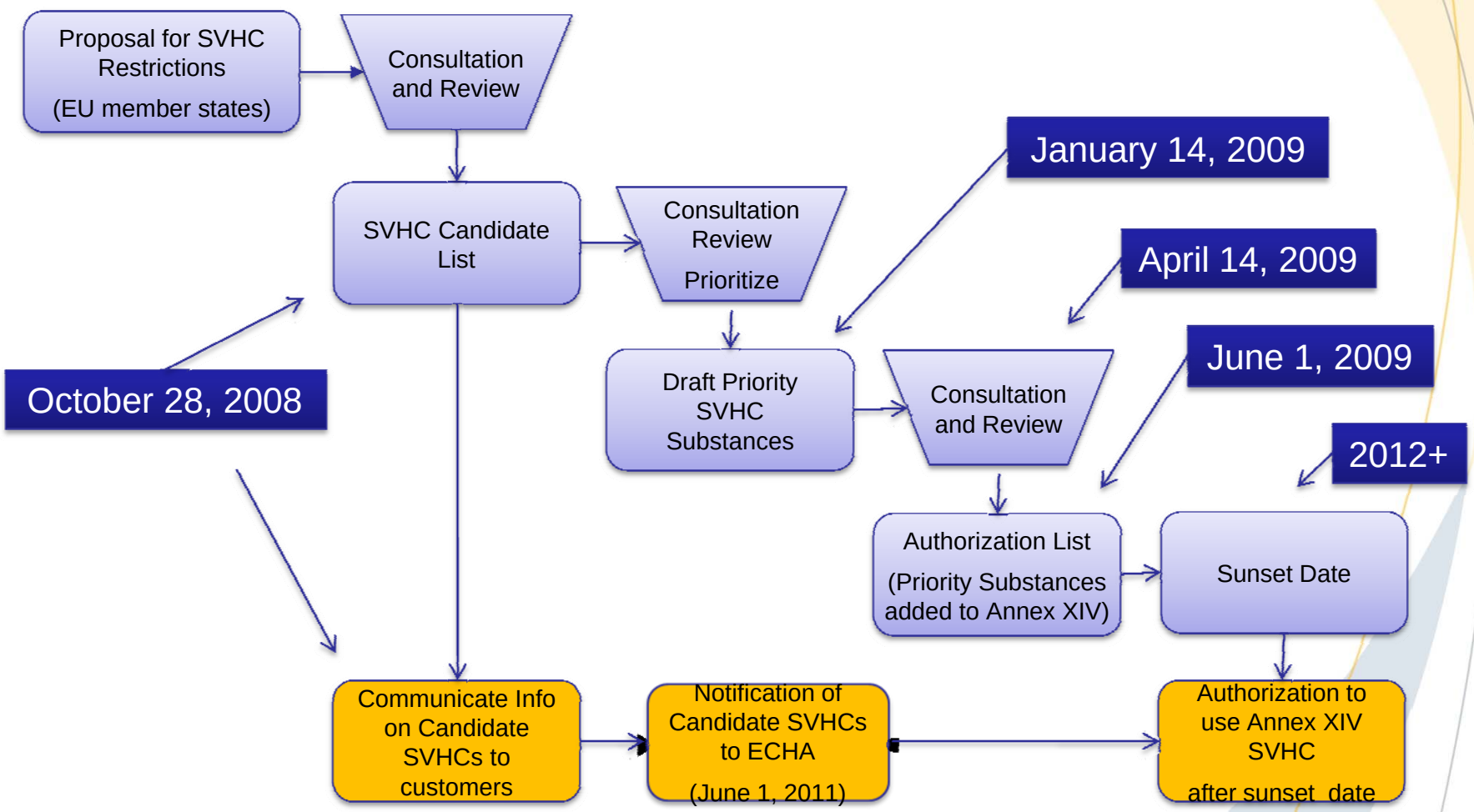
SVHC Basics

C = Carcinogenic
M= Mutagenic
R = Reproductive Toxin
P = Persistent
B = Bioaccumulative
T = Toxic
vP = very Persistent
vB = very Bioaccumulative

- SVHC = Substance of Very High Concern
- REACH Definition
  - Substances such as CMRs, PBTs, vPvBs and endocrine disruptors
  - Responsibilities for products containing an SVHC:
    - Identification in MSDS documents
    - Communication obligations to customers (articles w/ >0.1%)
    - Notification obligations to ECHA
      - w/ >0.1%, over 1 tonne per year
    - Authorizations required to continue using after sunset date

REACH SVHCs

How are the SVHC Candidate and Authorization Lists Created?



Current SVHC Candidate List

Anthracene – manufacture of dyes, pyrotechnics

* **4,4'- Diaminodiphenylmethane (MDA)** – hardener for epoxy resins (possible use in PCBs), hardener in adhesives, intermediate in the manufacture of high-performance polymers, preparation of polyurethane

* **Dibutyl phthalate (DBP)** - plasticizer (softener) in PVC, printing inks, paper and packaging coatings, etc…

* **Benzyl butyl phthalate (BBP)** - plasticizer (softener) of PVC, acrylics, sealants, adhesives, inks, paints, etc..

* **Bis (2-ethyl(hexyl)phthalate) (DEHP)** - plasticiser in polymer products, mainly PVC, blister packing

Cobalt dichloride - gas masks, humidity indicator, dye mordant for glass industry, drying agent in paints, lacquers, varnishes and printing inks, etc…

Lead hydrogen arsenate – Insecticides

Diarsenic pentaoxide - dyeing industry, printing, coloured glass, insecticide, metallurgy (to harden copper, lead or gold in alloys), etc…

Diarsenic trioxide - decolorizing agent for glass and enamels, oxidizing agent special glass and lead crystal formulations, weed killers

Sodium dichromate - metal finishing, aiding corrosion resistance, chrome-tanning of leather, coloured glass and ceramic glazes

* 5-tert-butyl-2,4,6-trinitro-m-xylene (musk xylene) – fragrance, cosmetics and soap perfumes

* Hexabromocyclododecane (HBCDD) – Flame retardant used in HIPS, PS insultation and textiles

* Alkanes, C10-13, chloro (Short Chain Chlorinated Paraffins) - plasticisers in PVC (cable)and rubber; flame retardant in plastics and textiles;

Bis(tributyltin)oxide –biocide, antimicrobial – incorporated into polymers -- flooring, tiles and carpeting

Triethyl arsenate – intermediate for semiconductors

* Prioritized substance (authorization)

Fulfilling SVHC obligations?

Communication – REACH Article 33

Applies to ALL articles

manufactured/imported to the EU

If SVHC present >0.1%

Manufacturers/Importers - Inform customers of (minimum):

- Chemical Name
- Information on safe use

Consumers may request information about the presence of SVHC in articles

(must reply within 45 days)

Additional 15 SVHC Approved in 2009

- 2,4-Dinitrotoluene
- Anthracene oil
- Anthracene oil, anthracene paste, distn. Lights
- Anthracene oil, anthracene paste, anthracene fraction
- Anthracene oil, anthracene-low
- Anthracene oil, anthracene paste
- Diisobutyl phthalate
- Aluminosilicate, Refractory Ceramic Fibres
- Zirconia Aluminosilicate, Refractory Ceramic Fibres
- Lead chromate
- Lead chromate molybdate sulfate red (C.I. Pigment Red 104)
- Lead sulfochromate yellow (C.I. Pigment Yellow 34)
- Acrylamide
- Tris(2-chloroethyl)phosphate
- Coal tar pitch, high temperature

Several of these substance may be used in Electrical/Electronic products

Risk Analysis

Metals, Plastics and other risk areas

- Metals will not include any of the first 15 SVHCs listed
- Surface coatings could contain these substances BUT these coatings are generally a very small percentage of the base material (well under 0.1% by mass)

- Plastics, resins, adhesives, paints, desiccants and flame retardants all pose a fairly significant risk of containing one or more SVHCs

Possible SVHC	Part/Substance/ Material
Phthalates (DEHP, DBP, BBP)	PVC, Plastics
4,4'-Diaminophenylmethane	Resins and Adhesives Polymers - Plastics
DBP, Cobalt Dichloride	Inks, adhesives, grouting agents, paints, moisture indicator in dessicants
Hexabromocyclododecane	Polystyrene – Packaging and possibly of a higher risk in products (as these products would need to be more fire retardant.)

Packaging as an Article

* Each level of packaging (primary, secondary, tertiary) is considered a separate article and would need to be examined for SVHC content.

Packaging Categories - The EU Packaging Directive defines 3 specific classes of packaging (it is useful to continue to refer to packaging in this manner):

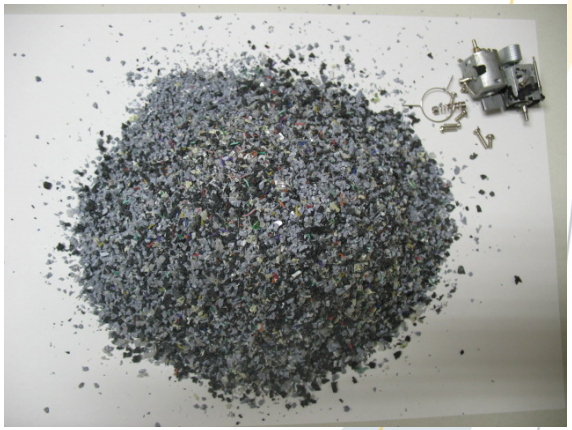
- Primary Packaging or Sales Packaging
  - sweet boxes
  - plastic wrap around a CD case
  - paper or plastic carrier bags
  - disposable plates and cups
  - cling wrap
  - sandwich bags
  - aluminum foil
  - labels hung directly on or attached to a product
- Secondary Packaging or Grouped Packaging
  - case for beverage receptacles
  - plastic collecting individually packaged bars of soap together
  - shrink wrap
- Tertiary Packaging or Transport Packaging
  - plastic and wooden pallets
  - plastic and wooden crates
  - large shrink wrap
  - corrugated carton

Analytical Test Methods

- Various analytical test methods for measuring SVHC substances
- Sample preparation and analytical test method is critical for achieving accurate test results.
  - Fully extract/dissolve substance from the base material
- Large number of substances so test strategy must be cost efficient.
  - Clever test strategies to maximize relevant information with minimum number of tests.
  - Techniques can also be used to eliminate the presence of certain SVHCs with the use of specific tests combined with deductive reasoning.

Sample Preparation

- REACH SVHC reporting threshold is based on the mass of the entire article
  - allows for grinding of the entire product
  - cost effective compared to testing individual parts or materials but
  - makes it difficult to isolate the specific part or material that contains the SVHC
- The product is partially disassembled prior to grinding
  - Removing volatile parts (such as batteries)
  - Separating metal pieces from other materials.
  - Each sample to be ground is separately weighted so that % of article can be subsequently calculated.
- After grinding, the material is prepared by solvent extraction, or digestion.



Organic compounds

- Organic compounds make up more than half of the initial list of 15 SVHCs, are measured using gas chromatography - mass spectrometry (GC/MS).
  - GC/MS can accurately isolate specific substances and measure their concentration level.
- Gas chromatography - mass spectrometry (GC/MS)
- Extraction method is still critical to the accuracy.

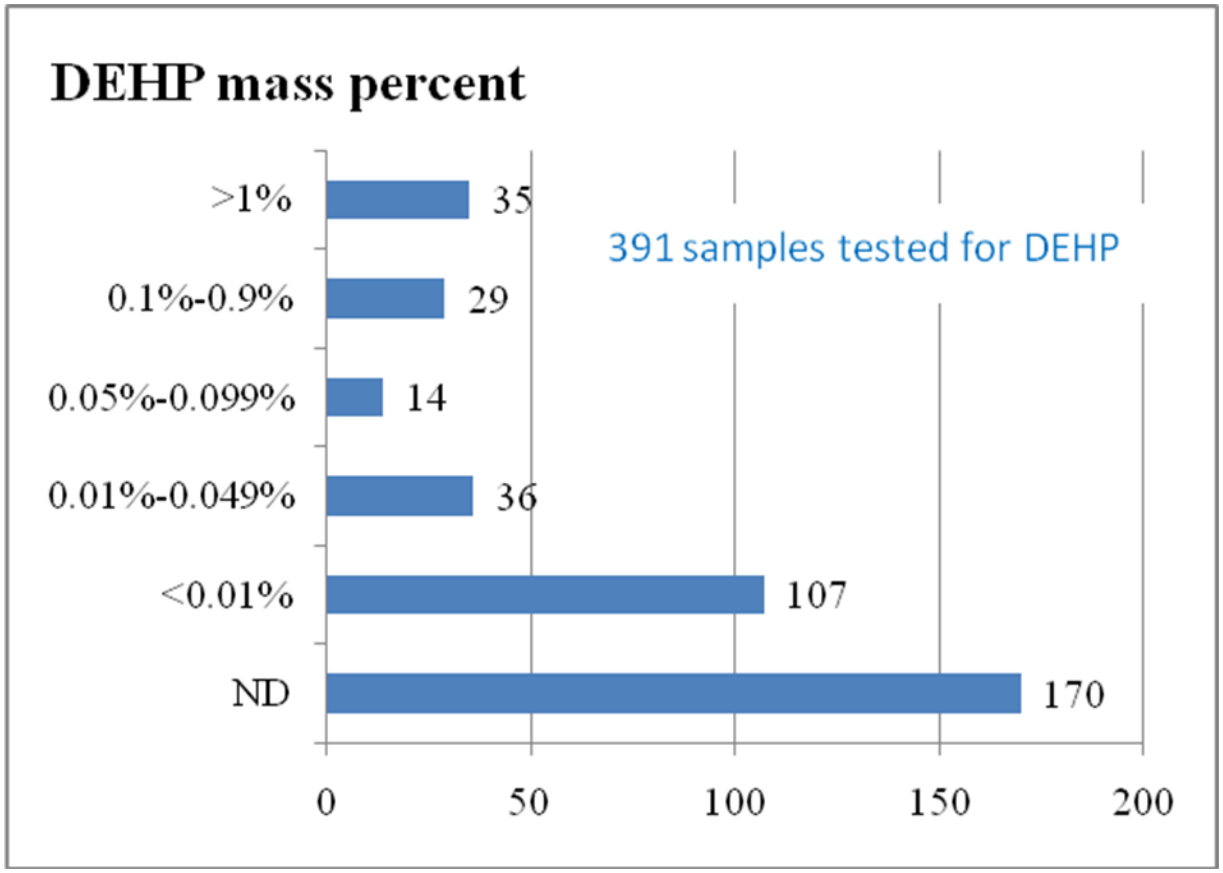
Inorganic compounds

- Specific inorganic compounds are expensive to test for, but can be effectively screened by looking for key elements using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES).
- Optical Emission Spectrometry, also called Atomic Emission Spectroscopy (AES) may be used to identify trace metals, such as Arsenic (As) as found in Lead hydrogen arsenate, Diarsenic pentaoxide, Diarsenic trioxide, and Triethyl arsenate. The absence of arsenic rules out the presence of all four SVHCs.
- A compound such as Sodium dichromate can be eliminated if both sodium and chromium are not present. The check for sodium is important given that elemental or trivalent chromium is commonly found in applications similar to where sodium dichromate may be present.

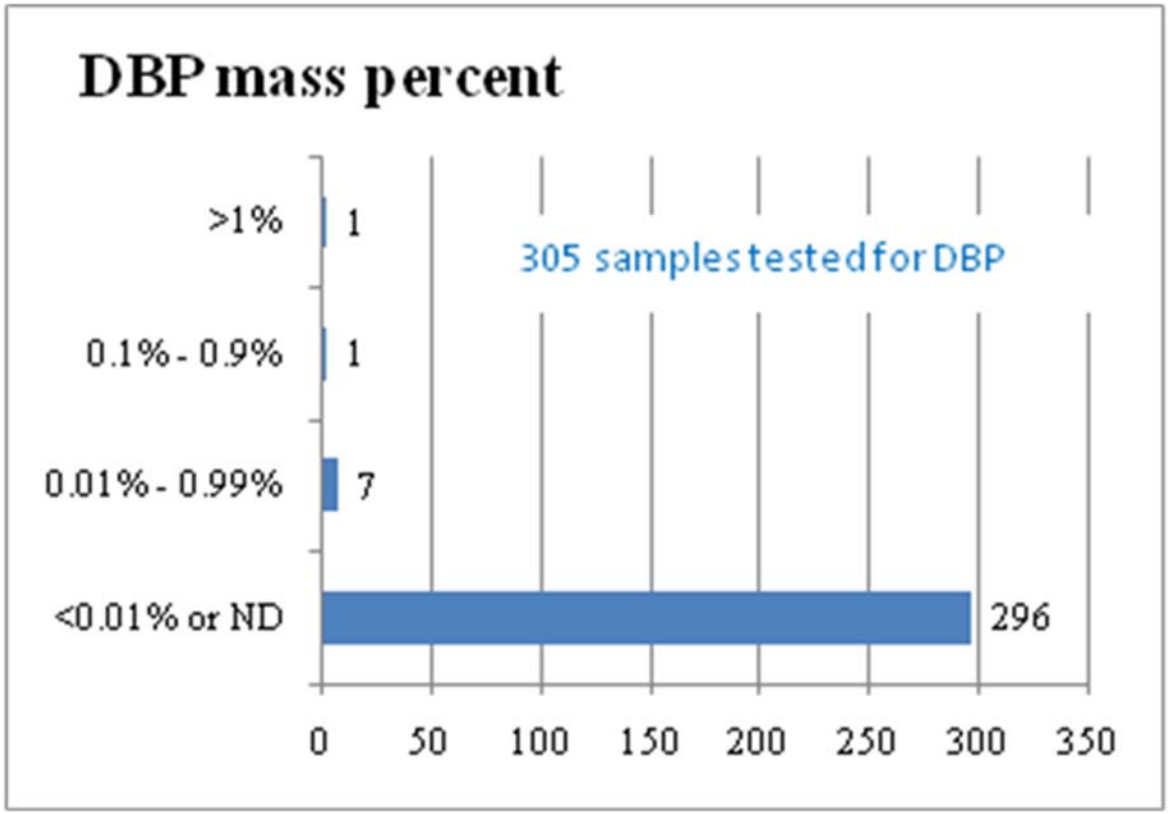
Scan and Store

- SCAN
  - Article disassembly, weighing and grinding
  - Sample preparation
  - GC Mass Scan of a wide range of substances
  - ICP Mass Scan of 15/+ elements
  - Quantification to ppm level of detected substance from ECHA published List
- STORE
  - Storage of raw data
  - Storage of representative samples (powders)

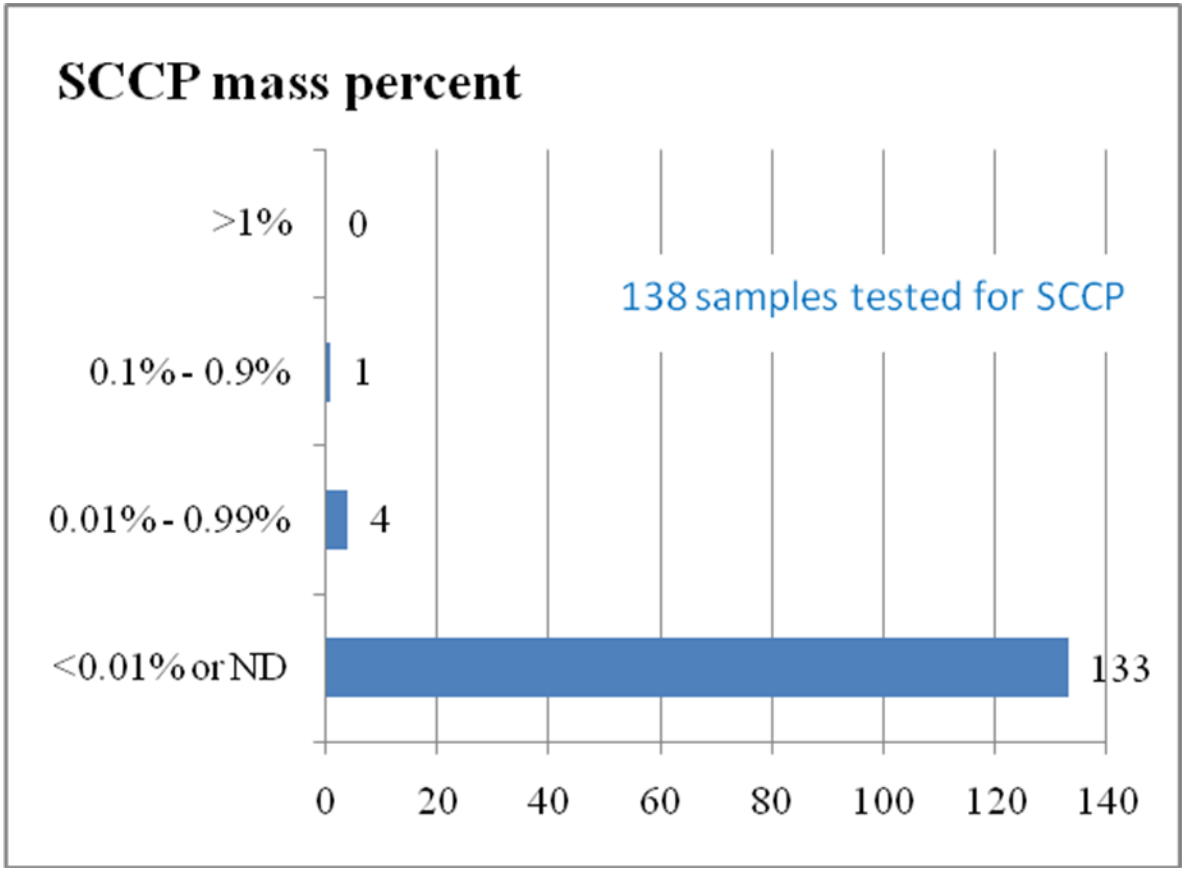
DEHP Detection



Phthalate DBP Detection



Short Chain Chlorinated Paraffins



SVHC Testing in Asia

Number of Test Data Samples = 1773

Summary of Positive Test Results	DEHP	SCCP	DBP	Cobalt dichloride[c]	BBP	Bis(tributyltin)oxide	Anthracene	4,4'-Diaminodiphenylmethane	As[b]	Sodium dichromate[g]	5-tert-butyl-2,4,6-trinitro-m-xylene	HBCDD
Occurrences above 0.1% threshold	137	12	15	2	2	3	0	1	6	1	0	0
Percent of total samples	7.73%	0.68%	0.85%	0.11%	0.11%	0.17%	0.00%	0.06%	0.34%	0.06%	0.00%	0.00%

Notes
a: Plastic are tested separately or mixed with other materials (fabric, leather, coating, glue, paper, wood, fabric, sponge, textile, foam, metal, PCB)
b: "As" includes 4 SVHC compounds Diarsenic pentaoxide, Diarsenic trioxide, Lead hydrogen arsenate, Triethyl arsenate.
c: Co, Cl are detected to confirm whether Cobalt dichloride under threshold, the result can be classified to "pass" & “inconclusive”.
e: Organic tin is detected and further testing is needed to confirm whether it comes from Bis(tributyltin)oxide.
g: Cr, Cr6+, Na+ are detected to confirm whether Sodium dichromate under threshold, the result can be classified to "pass" & “inconclusive”.

Summary

- REACH SVHC reporting requirement for each article manufactured or imported into the EU
  - Packaging materials
- Several of the first 15 SVHCs on the Candidate List are found in electrical/electronic products.
  - Phthalate DEHP most frequent,
  - Phthalate DBP and Short Chain Chlorinated Paraffins occurred frequently enough to be of concern.
  - Several of the other SVHCs were also detected but in fewer samples.
- Plastics are material most likely to contain an SVHC,
  - including all three phthalates (DEHP, BBP, DBP), Short-chain chlorinated paraffins (SCCP), organic tin, and 4,4'- Diaminodiphenylmethane (MDA). Phthalates in particular are a high risk.
- There is a significant risk of SVHCs in specific parts and materials.
  - Engineering judgement may be used to identify the risk
  - Screening and Test methods exist to identify substances.
- Combination of supply chain information, engineering judgment, and analytical testing
  - strike an effective balance between compliance assurance and costs.
- Effective test strategy to combine the requirements of multiple regulations in a single test.
- Test strategies such as “Scan and Store” can help manufacturer’s reduce their test requirements when additional SVHC are added to the Candidate List.

Questions

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