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Management of Green Chemical Regulations for Electronics Manufacturers

Green chemical regulations have implications for manufacturers of all sizes. Building a foundation of accurate and thorough data is key.

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Preface

We are surrounded by electronics. New electronic gadgets continually enter our lives and we come into personal contact with many of them every day: smart phones, LED televisions, e-readers, kitchen appliances, etc. Most new electronic devices are not seen by the average consumer but are essential in our modern economies: electronics that assist in managing transportation by road, rail and aviation; systems that manage utilities, buildings and telecommunications; medical devices; and systems that manage factories that build the electronic devices that we use every day.

With the proliferation of electronics has come concern over how electronics – their development, use, and disposal – will affect our environment. "Green" can mean many things: whether energy is saved during manufacture of the equipment; whether less energy is consumed during normal operation; whether the electronics contain or release any hazardous chemical substances; whether the equipment can be recycled or reused at end of life. All of these issues have been discussed by many legislative bodies. The result is a large and growing number of Green regulations to address these issues. To electronics manufacturers, the most well known Green chemical regulations are **RoHS** (**R**estriction **o**f **H**azardous **S**ubstances) and **REACH** (**R**egistration, **E**valuation and **A**uthorization of **CH**emicals), both of which restrict the use of chemicals throughout the lifecycle of any electronic or electrical product.

This article is an introduction to the wide variety of RoHS and REACH regulations around the world. It also provides an analysis of the challenges and solutions to manage product compliance for these Green regulations.

Challenges in the Green Era

Green compliance regulations have evolved very quickly. Many businesses are overwhelmed by the demands for Green compliance because the list of regulations continues to grow: EU RoHS, China RoHS, Korean RoHS, REACH/REACH SVHC, Battery Directive, Packaging Directive, Regulation of Ozone Depletion Substances (ODS), Directive of Asbestos, etc. In addition, these regulations often change, which adds to the complexity.

Restriction of Hazardous Substances (RoHS)

In many ways, the European directive on the Restriction of Hazardous Substances (RoHS) is the grandfather of Green regulations that affect manufacturers of electronics and electrical equipment. RoHS requires that electrical and electronic equipment manufacturers selling into the EU are directly responsible for the chemical compliance of their products. In 2003, the directive was adopted and on July 1, 2007 it took effect. A limit was set on 6 chemicals: lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBBs), and polybrominated diphenyl ethers (PBDEs). Companies had to build new strategies to ensure that their products conformed to strict standards and, if required, could provide extensive compliance documentation.

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	EU RoHS restricted substances and maximum concentration values
1	Lead (0.1%)
2	Mercury (0.1%)
3	Cadmium (0.01%)
4	Hexavalent chromium (0.1%)
5	Polybrominated biphenyls (PBB) (0.1%)
6	Polybrominated diphenyl ethers (PBDE) (0.1%)

Table 1: EU RoHS Substances and MCV

This directive was an early step because it only required basic documentation (typically a certificate of compliance stating that a product did not contain any of the substances above the allowable threshold) and many products were exempt from the requirement.

Like many regulations, RoHS has grown. The EU Parliament voted in November of 2010 to amend the directive. The amendment (or Recast) will bring large families of previously excluded products into the scope of the directive. Among these are medical products and monitoring and control equipment. Another change is to add a new category to the directive: "Other electrical and electronic equipment not covered by any of the categories above." This broad categorization means that anything not explicitly exempted will be subject to RoHS under the provisions of the Recast.

RoHS in Other Countries

Other countries have followed the lead of the EU, developing their own sets of restrictions on certain substances:

Regional Regulations	Effective Date and Note
China RoHS	Phase 1 took effect on March 1, 2007
Japan RoHS (J-Moss)	Effective since July 1, 2006 on 8 different categories of electronic and electrical products
Korea RoHS	Effective since April 2, 2007
Norwegian PoHS	Effective since July 10, 2008; restrictions on 18 substances Effective June 2009

Table 2: RoHS in other countries

RoHS in the United States

While the federal government of the United States has not passed any regulation like RoHS, in 2003 California passed SB20, the Electronic Waste Recycling Act, which prohibits the sale of electronic devices that are banned under EU RoHS, but in a narrower scope, restricting only 4 metals. Other states are looking at similar laws.

REACH SVHC

Another regulation of note comes from the European Community Regulation on chemicals and their safe use, dealing with the **R**egistration, **E**valuation, and **A**uthorization of **Ch**emical substances. REACH became law in June of 2007 and requires manufacturers to gather information on the substances used in their products and provide safety information.

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A subset of REACH is the SVHC Candidate List. SVHC stands for **S**ubstances of **V**ery **H**igh **C**oncern, chemicals that are carcinogenic, mutagenic, toxic for reproduction, persistent and bioaccumulative, and there is ""scientific evidence of probable serious effects to human health or the environment which give rise to an equivalent level of concern."

Complying with REACH SVHC is different than RoHS because REACH demands that substances be aggregated across the entire product (or "Article" in REACH lingo). For example, the total weight of DBP or DEHP (which can occur in plastics) in an Article must be less than 0.1% of the total weight of the Article, even if the DBP in an individual component is less than 0.1% of the individual component's total weight.

REACH SVHC-15 Substance Name	CAS Number	Possible Applications
4,4'-Methylendianilin	101-77-9	Curing agent for epoxy resin inPCB, preparation of PU, azo dyes ingarments
bis(tributyltin)oxide,hexabutyldistannoxane	56-35-9	Pesticide, fungicide in paint
Benzylbutylphthalate (BBP)	85-68-7	Plasticizer for resin, PVC, acrylics
anthracene	120-12-7	Source of dye stuff
triethyl arsenate	15606-95-8	Intermediates for semi-conductor
Hexabromocyclododecane (HBCDD) and all major diastereoisomers identified (α–HBCDD, β-BCDD, γ-HBCDD)	25637-99-4 and 3194-55-6 (134237-51-7, 134237-50-6, 134237-52-8)	Flame retardant used in HIPS and textiles
Cyclododecane	294-62-2	
5-tert-butyl-2,4,6-trinitro-m xylene	81-15-2	Cosmetics and soap perfumes
Alkanes, C10-13, chloro (Short chain chlorinated paraffins)	85535-84-8	Leather coating, plasticizer in PVC and chlorinated rubber, flame retardant in plastic & textiles
cobalt(2+) dichloride	7646-79-9	Moisture indicator in silica gel, absorbent
sodium dichromate, dihydrate	7789-12-0, 10588-01-9	Chome-tanning of Leather, corrosion inhibitor in paints, mordant in textile dyeing process
Di(2-ethylhexyl)phthalate DEHP	117-81-7	Plasticizer for resin, PVC, blister
lead hydrogen arsenate	7784-40-9	Insectides
Diarsenic pentoxide	1303-28-2	Insecticides, week killer, wood preservatives, coloured glass, dyeing and printing
diarsenic trioxide	1327-53-3	Weed killers, timber preservatives, manufacture of special glass
Dibutylphthalate	84-74-2	Plasticizer, in adhesives and paper coatings; insect replellent for textiles

Table 3: REACH SVHC-1

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Like RoHS, the REACH SVHC regulation changes, but much more frequently (see table below).

REACH SVHC Sequence Number	Published Date	Number of Substances in Candidate List	Effective Date
SVHC-1	October 28, 2008	15	April 28, 2009
SVHC-2	January 13, 2010	29	July 13, 2010
SVHC-3	March 30, 2010	30	September 30, 2010
SVHC-4	June 18, 2010	38	December 18, 2010
SVHC-5	December 15, 2010	46	June 15, 2011
SVHC-6	June 20, 2011	53	December 20, 2011
SVHC-7 (proposed)	August 29, 2011	71	-

Table 4: The Evolution of the SVHC Candidate List

REACH in Other Countries

Other countries have their own versions of REACH:

Regional Regulations	Effective Date and Note
EU REACH	Regulation was published on Dec 18, 2006 and various due dates are listed for each stage of substance control. For example, starting from June 1, 2011, notification of SVHC is required 6 months after the SVHC is added to the Candidate List
China REACH	Effective since October 15, 2010
Canada CEPA 1999	Similar to EU REACH SVHC, Canada has the PSL (Priority Substance List) substances which covers 69 substances currently

Table 5: REACH in Other Countries

REACH in the United States

In September of 2008, California signed into law the California Green Chemistry Initiative, sometimes called California REACH. Other states are considering similar legislation.

Corporate Regulations

In addition to regional Green compliance regulations, many companies also have to comply with OEM Green requirements, such as those from IBM, HP or SONY. (See Tables 6-8 below.) These global OEMs have created standards that address environmental laws globally, instead of trying to customize product to each region that has these laws. Some OEM Green requirements change every year; some change twice a year, reflecting the growth in global regulations. No matter how often they are revised, each change increases the amount of restricted substances. Exemptions expire and new exemptions appear. Managing Green compliance with such frequent changes is a challenge for companies who supply to these OEMs.

IBM Spec Name	Published Date
ES 46G3772	February 19, 2008
ES 46G3772	August 8, 2008
ES 46G3772	February 25, 2009
ES 46G3772	October 2, 2009
ES 46G3772	February 22, 2010
ES 46G3772	September 22, 2010
ES 46G3772	April 27, 2011
ES 46G3772	September 6, 2011

Table 6: The Evolution of IBM Green Requirements

HP Spec Name	Published Date
GSE-011 Rev L	August 1, 2008
GSE-011 Rev M	August 7, 2009
GSE-011 Rev N	August 4, 2010
GSE-011 Rev O	August 1, 2011

Table 7: The Evolution of HP Green Requirements

SONY Spec Name	Published Date	Enforcement Date
SS-00259 8th Edition	March 2, 2009	April 1, 2009
SS-00259 9th Edition	March 1, 2010	April 1, 2010
SS-00259 10th Edition	March 1, 2011	April 1, 2011

Table 8: The Evolution of SONY Green Requirements

The Implications of Green Regulations

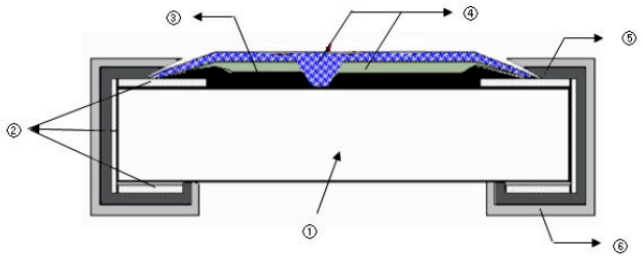
Clearly, manufacturers of electronics and electrical devices face big challenges. First, their products often contain 1000 or more unique components; components are swapped out or change for a variety of reasons. Second, the number of regulations that affect them, or may affect them, is growing. Third, the regulations themselves constantly change. This combination is especially acute for manufacturers who are not large and cannot devote significant resources to environmental compliance.

In the past, one solution was to physically test every product that could fall under RoHS. This was possible because RoHS only had 6 substances and testing was feasible. But under REACH SVHC, physical testing is not financially viable for most products. There are too many substances to test for and the cost of testing one product could reach tens of thousands of dollars.

More recently, suppliers of electronic components and other materials used in products would issue a certificate of compliance attesting that their product did not contain any substances of very high concern. But as the number of substances grows, suppliers have grown weary of physically testing their products for these substances.

The result is that many suppliers are now releasing full material disclosure of their products, that is, a list of every chemical that makes up the product. (Sometimes a substance is listed as proprietary, but the supplier knows what the substance is and whether it is allowable under SVHC restrictions.) Full material disclosure makes it possible to solve the problem of the growth and change of regulations much more efficiently (see example below).

1210 Resistor Material Composition



Part Name	Material	% of total Wt.	Substance Name	% of total Wt.	CAS No.	wt%	Mass mg
CR1210	① Substrate	88.6	Aluminium oxide	96.79	1344-28-1	85.734	13.438
			Silicon dioxide	3.21	7631-86-9	2.842	0.445
	② Conductor layer	5.6	Silver	61.14	7440-22-4	3.445	0.540
			Palladium	3.30	7440-05-3	0.186	0.029
			Lead oxide	27.36	1317-36-8	1.542	0.242
			Silicon dioxide	4.49	7631-86-9	0.253	0.040
			Boron trioxide	3.71	1303-86-2	0.209	0.033
	③ Resistive layer	0.6	Ruthenium oxide	38.33	12036-10-1	0.248	0.039
			Lead oxide	42.04	1317-36-8	0.272	0.043
			Silicon dioxide	13.45	7631-86-9	0.087	0.014
			Boron trioxide	2.78	1303-86-2	0.018	0.003
			Aluminium oxide	3.40	1344-28-1	0.022	0.003
	④ Coating layer	1.9	Lead oxide	44.62	1317-36-8	0.846	0.133
			Silicon dioxide	39.19	7631-86-9	0.743	0.116
			Boron trioxide	7.81	1303-86-2	0.148	0.023
			Aluminium oxide	8.39	1344-28-1	0.159	0.025
	⑤ Plating Ni	1.6	Nickel	100.00	7440-02-0	1.560	0.245
	⑥ Plating Sn	1.7	Tin	100.00	7440-31-5	1.686	0.264
‡ All the above are approximate values calculated by the component parts of the material.						100.000	15.674

Green Chemical Regulations Compliance for Electronics OEMs

Data Collection. As stated above, the biggest challenge for electronics OEMs in managing compliance of Green chemical regulations is to discover the chemical composition of all components and materials used in their products. With full knowledge of the chemicals used, OEMs can create a compliance plan that will work short and long-term. However, collecting chemical substance information from suppliers is a tedious and resource-intensive job. It takes numerous phone calls or

emails; suppliers often do not understand aspects of regulations such as SVHCs; and suppliers sometimes demand a rationale for sharing information.

Manufacturers should ask for full-disclosure substance data whenever possible. If the SVHC list changes, for example, that means they don't have to ask for more data in the future. If full-disclosure data is not available from a supplier, at the very least, manufacturers should try to obtain a non-use SVHC statement or certificate. Ideally, suppliers should inform manufacturers about their use of an SVHC when it exceeds 0.1% in concentration. In reality, it is risky not to pursue this data and to rely only on suppliers to provide notification.

Data Validation and Consolidation. The second challenge starts after chemical substance data begins to arrive from suppliers. The data may not be clean and it needs to be validated. Here are some common problems: (1) the chemical substance name does not match the CAS (Chemical Abstracts Service) Registry number; (2) the CAS number is incomplete or missing; (3) two different substances use the same CAS number; (4) different suppliers refer to identical substances with different names and different CAS numbers. In cases where data cleansing and consolidation have not taken place, it is not possible to generate an accurate rollup of the total weight of chemicals used in the product. Resolving these issues is necessary before conducting substance analysis for REACH compliance.

Conclusion

Compliance with Green chemical regulations demands thorough and accurate data and an efficient way to analyze and manage the data. Companies throughout the supply chain are or will be feeling the impact of REACH or other similar regulations, and need to develop strategies to ensure that disruptions are minimized. These strategies include:

1. Manufacturers must clean the data they already have by scrubbing the BOMs (Bills of Materials). There are several third party solution providers should validate manufacturer names and part numbers first because almost every BOM contains errors.
2. Manufacturers must try to collect full-disclosure chemical data for all components if available. A third-party solution provider can save time and money. As we have seen, the number of regulations increases and their requirements change; data collection is not a one-time task.
3. Manufacturers need a software tool to manage REACH compliance, including reporting on data collection, and chemical analysis at the component, subassembly, and product level. There are several software providers that provide a solution to manage this chemical compliance task.
4. Manufacturers must be rigorous in finding replacements for problem components.

Applying these strategies will help prevent product delays, redesigns, and supply chain disruptions.

Larry Yen is president and CEO of GreenSoft Technology, Inc., a data services provider and developer of software solutions for environmental compliance regulations such as RoHS and REACH. GreenSoft's unique value proposition of providing both data services and compliance management software has made GreenSoft the solution provider of choice for many electronic manufacturers.