

Global restrictions on industrial POPs – developing and implementing

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Stockholm Convention on Persistent Organic Pollutants

- Negotiations ended in December 2001 in response to an urgent need for global action on "POPs"
 - chemicals that are "persistent, bioaccumulate in *fatty tissues* and biomagnify through the food chain"
- Entered into force on 17 May 2004
- 184 Parties, although not all have implemented all restrictions
- Covers 30 chemicals/chemical groups
 - Many chemicals being considered for listing

SC: key provisions

Eliminating production and use	 Legal and administrative measures Import and export controls Exemptions
OR	
Restricting production and use	 Legal and administrative measures Import and export controls Exemptions
Reducing unintentional production with the aim of elimination	 Action Plans Best available techniques Best environmental practices
Ensuring wastes containing POPs are managed safely and in an environmentally sound manner	 Strategies for identifying stockpiles and products and articles in use POPs wastes guidelines
Targeting Additional POPs	POPRC processClearing house mechanism

An example of a global Stockholm Convention restriction



Pretty technical and complicated!

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Chemical	Activity	Specific exemption ²
	Production	As allowed for the Parties listed in the Register
Short-chain chlorinated paraffins (Alkanes, C_{10-13} , chloro) ⁺ : straight-chain chlorinated hydrocarbons with chain lengths ranging from C_{10} to C_{13} and a content of chlorine greater than 48 per cent by weight For example, the substances with the following CAS numbers may contain short-chain		 Additives in the production of transmission belts in the natural and synthetic rubber industry
		 Spare parts of rubber conveyor belts in the mining and forestry industries
	Use	 Leather industry, in particular fatliquoring in leather
		• Lubricant additives, in particular for engines of automobiles, electric generators and wind power facilities, and for drilling in oil and gas exploration, petroleum refinery to produce diesel oil
chlorinated paraffins: CAS No. 85535-84-8; CAS No. 68920-70-7;		 Tubes for outdoor decoration bulbs
CAS No. 71011-12-6; CAS No. 85536-22-7;		 Waterproofing and fire-retardant paints
CAS No. 85681-73-8; CAS No. 108171-26-2.		Adhesives
		Metal processing
		 Secondary plasticizers in flexible

 Secondary plasticizers in flexibl polyvinyl chloride, except in toys and children's products

How does a restriction come together (1)

- A party nominates a chemical for inclusion in the SC
- The POPs Review Committee (POPRC) looks at the proposal, develops a document (Annex E Risk profile) that contains, i.a.:
 - (a) Sources, including as appropriate:
 - (i) Production data, including quantity and location;
 - (ii) Uses; and

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- (iii) Releases, such as discharges, losses and emissions;
- Should the proposal proceed, a Risk Management Evaluation (Annex F) will be developed



COUNTRIES

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How does a restriction come together (2)

• Annex E RME contains, i.a.

- (a) Efficacy and efficiency of possible control measures in meeting risk reduction goals:
 - (i) Technical feasibility; and



- (ii) Costs, including environmental and health costs;
- (b) Alternatives (products and processes):
 - (i) Technical feasibility;
 - (ii) Costs, including environmental and health costs;
 - (iii) Efficacy;
 - (iv) Risk;

- (v) Availability; and
- (vi) Accessibility;



How does a restriction come together (3)

- POPRC develops a recommendation for the deciding body, Conference of the Parties (COP)
- COP negotiates on the basis of the POPRC recommendation on, e.g.
 - What to list?

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- How to restrict?
 - Full prohibition? Continuing uses? Time-tables?
- What to exempt?
 - Transition periods to allow for transition to safer alternatives



Countries implement (1 year)



• Very important to participate in a timely manner, and provide information on national needs to avoid surprises



VIEWS FROM COUNTRIES COLLECTED HERE

Example 1: Short-chain chlorinated paraffins

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Global restriction

- SCCPs were listed in the Convention in 2017 (implementation deadline \rightarrow 2018)
- *Risk profile* prepared by the POPRC identified the following uses:
 - metalworking / metal cutting fluids ("lubricants and coolants in metal cutting and metal forming operations"); polyvinyl chloride (PVC) plastics; paints, adhesives and sealants (e.g. dam sealants, joint sealants); leather fat liquors; plastics and rubber (conveyor belts for mining); flame retardants and textiles and polymeric materials
- Risk management evaluation (RME) prepared by the POPRC discussed alternatives:

• MWF

- Chemical alternatives:
 - environmentally adapted lubricants (EALs): highly biodegradable, have low toxicity and their performance is equal to or better than conventional alternatives (Skerlos et al. 2008)
 - Many other chemical alternatives, including MCCPs and LCCPs
- Alternative techniques have been developed including the use of gas-based system such as supercritical CO₂

• PVC

- Several chemical alternatives to be used as plasticizers and fire retardants
- It was estimated that the total cost for substitution of SCCPs in PVC in the United Kingdom would be approximately 1,000 Euros per tonne replaced (includes one-off costs and operational costs for the entire¹⁰ sector).

SCCPs had already been restricted in the EU by the time

- Main use, metalworking fluid, was prohibited in 2003
- SCCPs were allowed to be used only as fire retardants for conveyor belts for mining and dam sealants in 2012
 - "In the course of that public consultation, it was suggested by some European companies that a transition to alternatives may not necessarily be smooth and reformulation could take a considerable time."
 - Need for exemption evaluated every 4 years
 - Lack of alternatives in rubber applications

- In addition: "placing on the market and use of <u>substances</u> or <u>preparations</u> containing SCCPs in concentrations lower than 1 % by weight shall be allowed."
 - Allowing the use of alternative, MCCPs, with up to 1% SCCPs as an impurity
- Placing on the market of articles containing SCCPs prohibited as of 2013
 - No specific limit value was set how much SCCPs is allowed?
- Restriction somewhere in the globe leads to discovery of alternatives

European Commission review 2013

• COMMISSION REGULATION (EU) 2015/2030

- In 2013 the Commission consulted with the relevant stakeholders in the mining industry. The consultation indicated that conveyer belts containing SCCPs are no longer used by the industry for mining purposes
- With regard to dam sealants containing SCCPs, they do not appear to be manufactured, placed on the market or used in the Union. Indeed, already in 2008 the relevant stakeholders indicated to the European Chemicals Agency (2) that SCCPs do not appear to be in use or are in the process of being phased out in sealants (including dam sealants) in Europe.

 \rightarrow All use of SCCPs prohibited in 2015



SCCPs regulation became stricter in 2015

- Articles containg SCCPs continued to be imported
 - Concentration limit value for articles added
 - Articles that contain SCCP in concentrations lower than 0,15 % by weight are allowed to be placed on the market and used, as this is the amount of SCCP that may be present as an impurity in an article produced with MCCP.
- Waste issues continue to be significant
 - PVC

- Sealants
- 1. By way of derogation, the manufacturing, placing on the market and use of substances or mixtures containing SCCPs in concentrations lower than 1 % by weight or articles containing SCCPs in concentrations lower than 0,15 % by weight shall be allowed.
 - 2. Use shall be allowed in respect of:
 - (a) conveyor belts in the mining industry and dam sealants containing SCCPs already in use before or on 4 December 2015; and
 - (b) articles containing SCCPs other than those referred to in point (a) already in use before or on 10 July 2012.
 - 3. The third and fourth subparagraphs of Article 4(2) shall apply to the articles referred to in point 2.

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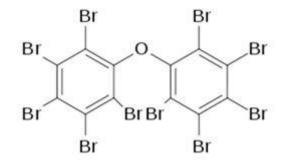
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Decabromodiphenyl ether

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- DecaBDE is an additive flame retardant
- A variety of applications including in plastics/polymers/composites, textiles, adhesives, sealants, coatings and inks.
- DecaBDE containing plastics are used in housings of computers and TVs, wires and cables, pipes and carpets.
- Commercially available decaBDE consumption peaked in the early 2000's, but cdecaBDE is still extensively used worldwide.
- Listed in the Convention in 2017 with several exemptions
- Risk management noted the availability of both chemical (drop-in) alternatives, as well as alternative techniques

US EPA and ECHA studied alternatives in 2014

Table 3

Summary of polymers where c-decaBDE is used as a FR and their end-use application by category

	End-Use Applications								
Polymer Group	Electronics	Wire and Cable	Public Buildings	Construction Materials	Automotive	Aviation	Storage and Distribution Products	Textiles	Waterborne emulsions & coatings
Polyolefins ¹ (PE, PP, EVA)	х	х	х	х	х	х	х	Х	Х
Styrenics ² (PS, HIPS, ABS)	X		х	X	X	Х	х		
Engineering Thermoplastics ³ (Polyesters (PET, PBT), PA, PC, PC-ABS, PEE- HIPS)	Х	Х	Х	Х	X	Х		Х	х
Thermosets ⁴ (UPE, epoxies, melamine-based resins)	Х		х	X	X	х	х	Х	Х
Elastomers ⁵ (EPDM rubber, thermoplastic PUR, EVA)	Х	х	Х	х	Х	х	х	Х	Х
Waterborne emulsions and coatings ⁶	Х	Х	Х	Х	Х			Х	Х

Source: U.S. EPA, 2014a (Table 2.3.1)

¹Polyolefins: polyethylene (PE), polypropylene (PP), ethylene vinyl acetate (EVA).

²Styrenics: polystyrene (PS), high-impact polystyrene (HIPS), acrylonitrile butadiene styrene (ABS).

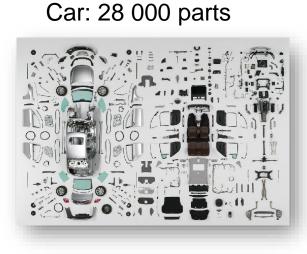
³Engineering Thermoplastics: polyesters (polybutylene terepthalate (PBT), polyethylene terephthalate (PET)), polyamides (PA,

nylons), polycarbonate (PC) and PC-ABS, polyphenylene ether- high-impact polystyrene (PE-HD), PE ether HIPS.

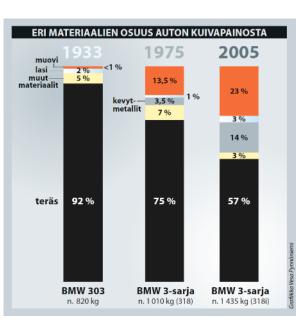
⁴Thermoset plastics: unsaturated polyesters (UPE), epoxies, melamine-based resins.

A very specific challenge

- Product specifications (e.g. fire-safety requirements) used in automotive and aviation industry
 - Changing the chemical content would require re-certification of the part, which may not always be possible
- Light materials, including plastics, are increasingly used to reduce fuel consumption



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Boeing 747: 6 000 000 parts



The outcome of SC negotiations (1)

Activity	Specific exemption
Production	As allowed for the Parties listed in the Register
Use	In accordance with Part IX of this Annex:
	 Parts for use in vehicles specified in paragraph 2 of Part IX of this Annex
	• Aircraft for which type approval has been applied for before December 2018 and has been received before December 2022 and spare parts for those aircraft
	 Textile products that require anti-flammable characteristics, excluding clothing and toys
	• Additives in plastic housings and parts used for heating home appliances, irons, fans, immersion heaters that contain or are in direct contact with electrical parts or are required to comply with fire retardancy standards, at concentrations lower than 10 per cent by weight of the part
	Polyurethane foam for building insulation

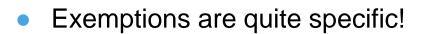
The outcome of SC negotiations (2)

2. Specific exemptions for parts for use in vehicles may be available for the production and use of commercial decabromodiphenyl ether limited to the following:

- (a) Parts for use in legacy vehicles, defined as vehicles that have ceased mass production, and with such parts falling into one or more of the following categories:
 - Powertrain and under-hood applications such as battery mass wires, battery interconnection wires, mobile air-conditioning (MAC) pipes, powertrains, exhaust manifold bushings, under-hood insulation, wiring and harness under hood (engine wiring, etc.), speed sensors, hoses, fan modules and knock sensors;
 - (ii) Fuel system applications such as fuel hoses, fuel tanks and fuel tanks under body;
 - Pyrotechnical devices and applications affected by pyrotechnical devices such as air bag ignition cables, seat covers/fabrics (only if airbag relevant) and airbags (front and side);
 - (iv) Suspension and interior applications such as trim components, acoustic material and seat belts.

The outcome of SC negotiations (3)

- (b) Parts in vehicles specified in paragraphs 2 (a) (i)–(iv) above and those falling into one or more of the following categories:
 - (i) Reinforced plastics (instrument panels and interior trim);
 - (ii) Under the hood or dash (terminal/fuse blocks, higher-amperage wires and cable jacketing (spark plug wires));
 - Electric and electronic equipment (battery cases and battery trays, engine control electrical connectors, components of radio disks, navigation satellite systems, global positioning systems and computer systems);
 - (iv) Fabric such as rear decks, upholstery, headliners, automobile seats, head rests, sun visors, trim panels, carpets.





Domestic implementation



- Automotive spare parts and aviation industry were granted a long exemption
 - Auto industry needs to ensure supply of spare parts for old car models
 - Manufacture sufficient amount of parts when you discontinue production of a model
 - Sell the equipment to SME who will continue supplying parts to the market
 - SMEs do not have the resources for the product development, nor access to new cars
- All PBDEs already regulated in electrical and electronic equipment



How many parts a vehicle contains?

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Hyundai Motor Europe Tech. Center

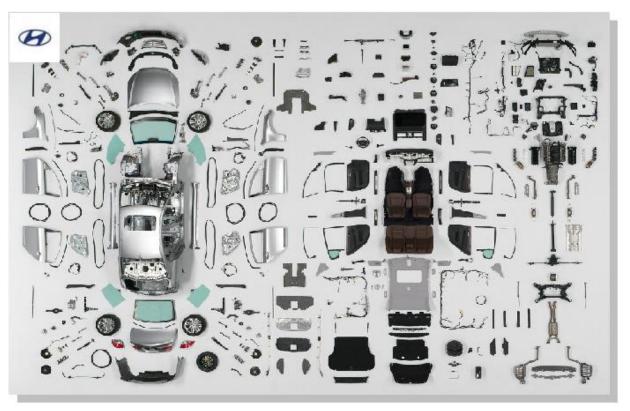
 Depending on the complexity, there are between 4.000 & 9.000 different main components contained in a vehicle platform

(without multiple entries for one specific part).

- e.g. The vehicle platform of one OEM contains
 8.400 components
 (=28.000 incl. common parts) from 1.800 suppliers!
- Up to 75% of a car are pre-manufactured by supply chain

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Total number of components assembled to one vehicle: up to 28.000 (example: 1 tire = 1 part reference number; number of tires per vehicle = 4)



Products from other industries may be even more complex! (e.g. aerospace, engineering industry)

State of play

- Automotive industry phasing out the use of decaBDE in new models
- Legacy spare part production possible in both automotive and aviation industry
 - Not so much because of lack of alternatives, but because of product specifications and the need to re-certify parts
- Placing articles on the market at concentrations at or above 10 mg/kg (0.001% by weight) is prohibited
 - Import control and market surveillance
 - E.g. China has not ratified decaBDE provisions



Hexabromocyclododecane

- Flame-retardant mainly in EPS & XPS insulation and packaging, some electronics (HIPS in VCR casings) and textiles (back-coated textiles for public transportation etc)
- Alternatives discussed in Risk Management evaluation:
 - "Technically feasible alternatives are commercially available for most of the applications in which HBCD is used. Chemical drop-in alternatives for onestep EPS and XPS production are becoming available in short term."
- Listing in Stockholm Convention in 2013
 - Continued manufacture and use allowed for insulation materials in buildings
 - Fire-safety issues: national building code and fire-safety requirements in many countries required the use of self-extinguishing PS insulation

HBCD in EPS- ja XPS plastics in Finland

• Large scale use since 1980's

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- Use ended by 2017 (in the whole EU)
- There is both FR and non-FR on the market
 - 10% of the EPS insulation is flame retardant in Finland
 - Source: Finnish insulation industry association
 - Ground frost insulation has traditionally been the biggest EPS application – no need for FR
 - EPS for walls and and floors must be flame-retardant
- Alternative was phased in in a timely manner and transition was smooth

This will go on for the next 100 years





Perfluorooctanoic acid (PFOA), its salts and PFOArelated compounds

- Belongs to PFAS chemicals
- Risk profile noted uses:
 - widely used as processing aids in the production of fluoroelastomers and fluoropolymers (e.g. polytetrafluoroethylene PTFE);
 - used as surfactants and surface treatment agents (e.g. in textiles, paper and paints, fire-fighting foams);
 - for the manufacture of side-chain fluorinated polymers. Due to their physicochemical properties, PFOA, its salts and PFOA-related compounds are used in a wide variety of applications and consumer products across many sectors.
 - \rightarrow Complicated industrial uses

DCouncil member companies voluntarily committed to a global phase-out of long-chain fluorochemistries by the end of 2015, resulting in the transition ternatives, such as short-chain fluorochemistries that offer the same high-performance benefits, but with improved environmental and health profiles.

ELECTRONICS Improves insulation.

weather-ability, transparency and water-resistance. Provides smooth and smudge-resistant touch screens.

AEROSPACE/ DEFENSE

Enables chemical-resistant tubes, hoses and fluid seals; high and low temperature brake and hydraulic fluids used in aircraft control systems and brakes; and ultra-high frequency wire and cable insulation necessary for navigation, fly-by-wire control and aircraft

> BUILDING/ CONSTRUCTION Enhances durability, UV resistance and anti-corrosive properties to lengthen the lifetime of

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FIRST RESPONDERS Offers life-saving protection in safety gear and firefighting foams used to fight flammable liquid fires.

AUTOMOTIVE

Provides every automotive system with durability, heat and chemical resistance and vapor barriers. Increases reliability of engine compartment wirings and gauges and improves auto safety by reducing engine compartment fires. Protects carpets and seats against stains, soil, oil and water.

ALTERNATIVE ENERGY

Enables lithium batteries, fuel cells and solar panels, which contribute to reduced emissions and energy costs.

> FLUORINE CARBON

OIL AND GAS Provides reliable equipment to help improve the safety and affordability of oil-field and pipeline operations. Improves the reliability and safety of fuel system seals and hoses, O-rings and downhole and field equipment gaskets.



SEMICONDUCTORS

Creates the ultra-pure manufacturing environments necessary for micro-electronics Used for plasma machinery, etching materials, cleaning fluids and wetting surfactants for chemical etchants

MILITARY Enables apparel and equipment to provide high-barrier skin protection in extreme environments and against chemical warfare agents.





CHEMICAL/ PHARMACEUTICAL MANUFACTURING Provides sterile, corrosion-resistant

coatings, linings and equipment.



HEALTHCARE

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OUTDOOR APPAREL/ EQUIPMENT



Creates breathable membranes and long-lasting finishes that provide water repellency, oil repellency, stain resistance and soil release with abrasion-resistant finishes for apparel and equipment.

PFOA

- Risk management evaluation (2017) on alternatives:
 - appropriate alternatives may currently not be available for several uses, namely: (1) equipment used to manufacture semiconductors and related infrastructure; (2) latex printing inks; (3) textiles for the protection of workers from risks to their health and safety; (4) membranes intended for use in medical textiles, filtration in water treatment, production processes and effluent treatment; (5) plasma nano-coatings; (6) medical devices; (7) production of implantable medical devices; (8) photographic coatings applied to films, papers or printing plates; (9) photo-lithography processes for semiconductors or in etching processes for compound semiconductors; (10) certain pharmaceutical chemicals; and (11) use of sulfluramid.
- Listed in the Convention in 2019

Use for everything else is prohibited, but: (1)

- In accordance with the provisions of part X of this Annex:
 - Photolithography or etch processes in semiconductor manufacturing
 - Photographic coatings applied to films
 - Textiles for oil and water repellency for the protection of workers from dangerous liquids that comprise risks to their health and safety
 - Invasive and implantable medical devices
 - Fire-fighting foam for liquid fuel vapour suppression and liquid fuel fires (Class B fires) in installed systems, including both mobile and fixed systems, in accordance with paragraph 2 of part X of this Annex
 - Use of perfluorooctyl iodide for the production of perfluorooctyl bromide for the purpose of producing pharmaceutical products, in accordance with the provisions of paragraph 3 of part X of this Annex

Use for everything else is prohibited, but: (2)

- Manufacture of polytetrafluoroethylene (PTFE) and polyvinylidene fluoride (PVDF) for the production of:
 - High-performance, corrosion-resistant gas filter membranes,
 - water filter membranes and
 - · membranes for medical textiles
- Industrial waste heat exchanger equipment
- Industrial sealants capable of preventing leakage of volatile organic compounds and PM2.5 particulates
- Manufacture of polyfluoroethylene propylene (FEP) for the production of high-voltage electrical wire and cables for power transmission
- Manufacture of fluoroelastomers for the production of O-rings, v-belts and plastic accessories for car interiors

Experiences on PFOA restriction

- The exemptions are complicated and require expertise
 - Surprise uses have come up
 - Plastic products, ski waxes, clothing that contains PFOA or precursors
 - Informing the industry and the supply chain is critical
 - PFOA may be contained even relatively simple articles, such as outdoor clothing
- Enforcement difficulties
 - A comprehensive list of substances that the restriction covers is still in the making
 - Analytical challenges
 - Import control of articles and mixtures
- Largest point sources are fire-fighting foams
 - Foam concentrate shelf-life 20-30 years
 - Trade name does not necessarily reveal illegal foams
 - Restrictions quite complicated



Project on phase out of AFFF

- Focus on all fluorinated foams
 - Suitable alternatives are available
 - PFAS foams are not a sustainable solution
- Not a drop-in substitution
 - Compatibility with and/or changes to application systems and equipment
- Environmental impact

- Procedures for cleaning out the residues from the equipment and extinguishing systems
- Disposal methods for old foam
- Preplanning for and training in the use of new foams



Conclusions

- Complicated chemicals have complicated restrictions
 - Timely contact with the industry is critical
 - The industry must in turn inform its supply chain about the restrictions
- Downstream users (e.g. metal working and chromium plating workshops) use those chemicals that are available
 - Availability of alternatives important for enforcement of restrictions
- Lack of analytical capacity (techniques and quantification in low concentrations) hinders implementation
- Imported articles require control
 - Use of restricted chemicals may continue in other countries under exemptions or complete lack of ratification
- There could be other (socio-economic) reasons for exemptions than lack of technically feasible alternative
 - Need to know early and justify the case well to make the case for a transition period or continued use

