

# Chapter 12

## Substituting hazardous chemicals

Lothar Lissner and Isabella Banduch

### 1. The SUBSPORT website and the future of substitution information

Substituting hazardous substances at workplaces can be a challenging task. Any alternative chemical or technology should have a similar technical functionality, be readily available, fully tested for toxic properties and technological functionality, and should not create new risks (like new toxins, accidents, carcinogenic chemicals or sensitizing agents). The SUBSPORT website helps people working on substitutions by providing state-of-the-art resources on safer alternatives to hazardous chemicals.

#### SUBSPORT facts

SUBSPORT ([www.subsport.eu](http://www.subsport.eu)) was developed by four organisations:

**Kooperationsstelle Hamburg IFE (KOOP)** is a German consultancy that studies occupational safety, health and environmental protection. KOOP coordinated the SUBSPORT development, managed the initial three-year phase and is currently responsible for maintenance and development. ([www.kooperationsstelle-hh.de](http://www.kooperationsstelle-hh.de))

**The Instituto Sindical de Trabajo Ambiente y Salud (ISTAS)** is a technical foundation supported by the Spanish Trade Union Confederation (CCOO) to promote improved working conditions, occupational health and safety, and environmental protection in Spain. ([www.istas.ccoo.es](http://www.istas.ccoo.es))

**The International Chemical Secretariat (ChemSec)** is a Swedish non-profit organisation that promotes dialogue between business, academic institutions, legislators, investors and NGOs on a toxic-free future. ([www.chemsec.org](http://www.chemsec.org))

**Grontmij A/S** is a Danish consultancy that provides services in the construction, water, occupational health, energy, industry and environment sectors and works towards sustainable development for people's working and private lives. ([www.grontmij.dk](http://www.grontmij.dk))

SUBSPORT was made possible through funding between 2010 and 2013 from:

- the European Union's Life+ Programme;
- the Federal Institute for Occupational Safety and Health (BAuA), Germany;
- the Federal Ministry of Agriculture, Forestry, Environment and Water Management (Ministerium für ein Lebenswertes Österreich), Austria.

## 2. Understanding 'substitution'

Although the term 'substitution' is used in legal documents, it is rarely defined with any precision either practically or politically. Stakeholder perceptions differ widely on whether substitution should be a "fundamental principle", a "duty to both producers and users of chemicals", a "preferred risk reduction strategy" or whether it is "just another tool for managing the same level of risk".

Here are some examples of different interpretations by different stakeholders. CEFIC, the European Chemical Industry Association, sees substitution as "...the replacement of one substance by another with the aim of achieving a lower level of risk." (CEFIC 2011). CEFIC focuses on risk rather than hazard: substitution is not a preferred risk reduction strategy but just one strategy among many technical and organizational options, including the personal protection of people exposed to these substances. Most chemical companies follow this conceptual approach. However, the environmental group Greenpeace has a very different view of substitution to that of the chemical industry: it is much more focused on hazard and the systematic replacement of all hazardous chemicals. Greenpeace says: "The principle of substitution states that hazardous chemicals should be systematically substituted by less hazardous alternatives or preferably alternatives for which no hazards can be identified." This approach shows that NGOs have little trust in risk reduction measures other than replacing hazardous chemicals and that their political goal is risk reduction at source by transition to the safest alternative.

It should be noted that the political and legal definitions combine aspects of both hazard and risk reduction. The European Parliament defines the substitution principle as: "the promotion of safer practices and substances," i.e. both the handling ("practices") and the hazard caused by the substance ("substances") properties shall be reduced.

Scientists emphasise how the process of substitution focuses on hazards or risks and the need to find a functional equivalent for the replaced substance. Lohse/Lissner defined substitution in 2003 as, "the replacement or reduction of hazardous substances in products and processes by less hazardous or non-hazardous substances, or by achieving an equivalent functionality via technological or organisational measures".

The REACH European chemical legislation also uses the term 'concern' and leaves open whether 'the concern' should be reduced by risk- or hazard-related measures. The preamble 12 of REACH says: "An important objective of the new system to be established by this Regulation is to encourage and in certain cases to ensure that substances of high concern are eventually replaced by less dangerous substances or technologies where suitable economically and technically viable alternatives are available."

These definitions show that the term 'substitution' is used in official industry and NGO statements and in legal texts to promote risk reduction by replacing hazardous chemicals. Although there are various interpretations of substitution and different levels of support for the concept among various stakeholders, there is a common understanding that substitution can and should be used to reduce risk by replacing hazardous chemicals.

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### **3. What does SUBSPORT do?**

#### 3.1 Background

SUBSPORT assumes that businesses around the world make many substitutions of hazardous chemicals, if only to avoid problems linked with their use. There might be many reasons for such substitutions: the alternative has a better technological functionality; lower costs for legal compliance and technological risk reduction measures; improving business reputation; reducing the risk of a ‘chemical scandal’; pressure from the public, environmental NGOs and/or trade unions.

However, qualified, easy-to-understand and harmonised descriptions of these substitution activities have been and still are missing. Some businesses might not think it important to promote them, while others might not publish their activities for competitive reasons.

SUBSPORT’s core information portfolio is based on a collection of business reports and similar documents on substitution. Experience shows that employers and workers learn best from good practices in other companies, including those that successfully use substitutes in their processes. SUBSPORT caters for a variety of target groups, and provides specific access points to information, i.e. different levels of detail, adapted language and various navigation options.

#### 3.2 Legal requirements for substitution

This section presents an overview of regulations and international agreements covering substitution issues, whether they refer to substitution directly or closely related issues. Links to the original documents and archived copies are also provided.

#### 3.3 Restricted and Priority Substances database

A typical starting point for website visitors is the SUBSPORT ‘Restricted and Priority Substances Database’. It has 34 lists of hazardous substances that are legally or voluntarily restricted by authorities or companies, or proposed for restrictions by trade unions or NGOs. A specific section provides additional guidance on how to identify substances of concern, by listing the criteria and definitions most commonly used by different stakeholders.

#### 3.4 Substitution Case Stories

A core SUBSPORT offering is the Case Story Database with around 350 substitution ‘case stories’ or practical examples of substitution. Many of these are provided directly by the companies carrying out substitution efforts. The case stories can serve as inspiration and help companies or organisations searching for substitutes to hazardous chemicals.

It can also prove useful, for example, in procurement or in legislative actions like the authorisation process of the EU chemicals regulation REACH. Substances mentioned in the case stories are pre-evaluated for hazards according to the SUBSPORT methodology (Alternative Assessment Methodology, see below). All case stories are available in English. About 100 of the examples are translated into Spanish, German, French or Serbian.

### 3.5 Extensive substitution assessments

More detailed assessments of alternatives are available for nine substances or groups of substances of very high concern (SVHCs).

1. Chloroalkanes
2. Chromium VI and compounds
3. Bisphenol A
4. Lead and its inorganic compounds
5. Nonylphenol and ethoxylates
6. Tetrachloroethylene
7. Formaldehyde
8. Hexabromocyclododecane (HBCDD): a brominated flame retardant
9. Parabens (methylparaben, ethylparaben, propylparaben, butylparaben)

These assessments were made using the SUBSPORT Specific Substances Alternatives Assessments Methodology.

### 3.6 Alternative Assessment Methodology

SUBSPORT has developed a harmonised Alternative Assessment Methodology ([http://www.subsport.eu/wp-content/uploads/data/SUBSPORT\\_methodology.pdf](http://www.subsport.eu/wp-content/uploads/data/SUBSPORT_methodology.pdf)) to guarantee the quality of substitution case stories. All the stories in the Case Story Database are assessed with this methodology. Each substitution case story contains the following sections:

- Substance info
- Hazard assessment
- Description of substitution
- Case/substitution evaluation
- Further info
- Further contacts

SUBSPORT has developed its Specific Substances Alternatives Assessments Methodology ([www.subsport.eu/wp-content/uploads/data/SUBSPORT\\_spec\\_subst\\_alt\\_ass\\_method.pdf](http://www.subsport.eu/wp-content/uploads/data/SUBSPORT_spec_subst_alt_ass_method.pdf)) in cooperation with a recognised institute from the US - the Toxics Use Reduction Institute (TURI) in Massachusetts - to design consistent and comparable assessments of substitutes for the selected chemicals. This SUBSPORT methodology

should be applied when conducting an alternatives assessment for the Specific Section of the Case Story Database. It can also be used by businesses for assessing alternatives. The protocol contains the following steps:

- Profiling chemicals
- Identifying functions and uses
- Identifying potential substitutes
- Screening out regrettable substitutions
- Characterizing alternatives
- Comparing alternatives

### 3.7 The Substance Database according to Screening Criteria (SDSC)

The SDSC ([www.subsport.eu/listofflists?listid=31](http://www.subsport.eu/listofflists?listid=31)) was set up to prevent situations where one hazardous chemical is replaced with another hazardous chemical. It provides a basic assessment of alternatives.

SUBSPORT developed the SDSC to pre-assess chemical hazards in its substitution Case Story Database as well as to assess alternatives for specific substances. All substances and alternatives are checked for hazards with the following sources:

- The European Chemical Substances Information System database (ESIS-CLP) and, from 2015 onwards, the European Chemicals Agency (ECHA, C&L Inventory database) for substances included in the EU harmonized classification.
- The Substance Database, using SUBSPORT Screening Criteria SDSC to check for hazards of equivalent concern that are not in the EU harmonized classification, as well as IARC carcinogens.

Table 1 SUBSPORT screening criteria

Criteria	Definition
CMR	CLP Regulation cat. 1A, 1B (Dir. 67/548, cat. 1 and 2) IARC cat. 1, 2A, 2B
(v)P(v)BT	REACH Regulation – Annex XIII EC PBT Working Group OSPAR List of substances of possible concern
Endocrine disruptors	OECD Report EU Endocrine disruptors database cat. 1, 2 SIN list database
Neurotoxicants	Vela, Laborda, Garcia Study, 2003, cat. 2-4
Sensitisation agents	CLP Regulation for H334, H317 (Dir. 67/548, for R42, R43)

### 3.8 Other assessment tools for substitutes and alternatives

The SUBSPORT website also lists common methods and tools for assessing alternatives, as well as guidance on the most useful tools, and the level of knowledge they require.

The following assessment tools are explained on the SUBSPORT website:

1. Column Model for Chemical Substitutes Assessment
2. COSHH Essentials
3. Technical Rules for Hazardous Substances (TRGS) 600
4. Substitution Green Screen for Safer Chemicals
5. Determination and work with code numbered products (MAL Code)
6. Pollution Prevention Options Analysis System (P2OASys)
7. Priority-Setting Guide (PRIO)
8. Quick Scan
9. Stockholm Convention Alternatives Guidance
10. Stoffenmanager

The OECD released a ‘Substitution and Alternatives Assessment’ toolbox in January 2015. This compiles resources linked to chemical substitution and alternatives assessments. It lists a range of resources, including SUBSPORT. KOOP used the experience from SUBSPORT to develop the toolbox.

### 3.9 Training and seminars

SUBSPORT continues to offer training sessions in different languages on substitution and alternatives assessment. These sessions are discussion-based and focus on participant experiences, with short introductions and practical exercises in working groups.

The Alternatives Identification and Assessment training aims to provide basic concepts and tools to help participants start the substitution processes, understand the different stakeholders, which substances are of most concern, how and where to look for new ideas and alternatives, and introduce existing tools to assess alternatives. The training session targets national and local authorities, industry, trade unions, NGOs and other interested parties dealing with the substitution of hazardous chemicals in products and processes. Training materials are available in Danish, English, French, German and Spanish.

## 4. Extending SUBSPORT

### 4.1 Textile sector

KOOP developed a sector specific extension to provide substitution information for the textile sector (funded by the German Environmental Foundation DBU). The following items have been added to the SUBSPORT portfolio:

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- textile-specific case stories from enterprises and descriptions of alternative substances and technologies in the textile sector;
  - detailed alternatives assessment for chromium VI and compounds;
  - incorporation of textile-specific restricted substances lists into the Restricted and Priority Substances Database;
  - sector-related alternatives identification and assessment training sessions.

## 4.2 Extension to Serbia

Serbia is hoping to join the EU and its chemical laws are being harmonized with relevant EU legislation. If the government effectively implements chemical legislation and policies, it should enhance the knowledge and capacities of relevant industry sectors and other stakeholders such as NGOs, associations, authorities and academia. It should raise awareness with both industry and the general public about the possible impact of hazardous chemicals as well as global and EU practices in sound chemicals management.

There are tools at EU level aimed at encouraging and supporting industry as it speeds up the transition to safer alternatives. These tools are not available in Serbia. The ‘Serbia Substitutes’ project, funded by the Norwegian Embassy in Belgrade, made sure the results of the SUBSPORT and SIN List (Chemsec) were available in Serbia, and raised Serbian industry awareness about substituting hazardous chemicals with safer alternatives.

## 5. The future of SUBSPORT and substitution information

Health and safety consultants Kooperationsstelle Hamburg IFE, an organisation belonging to the Hamburg public sector until 2010, has worked with substitution for over 20 years, starting in 1992 with SUBSPRINT (SUBStitution of organic solvents in the PRINtIng industry). SUBSPORT is one of the most recent and successful initiatives on support substitution.

One of the biggest challenges is deciding what kind of information stakeholders actually need. This depends on the sector, their basic knowledge, their motivation, the surrounding supply chain, legislation etc. One possible route to developing SUBSPORT is to provide more sector-specific information. Limiting substitution information to certain processes means more specific questions from potential users. That means not just questions about chemistry or toxic properties but also questions about technology, process results, the environmental impact, other OSH concerns and the costs of different cleaning technologies.

The popularity of CLEANTOOL ([www.cleantool.org](http://www.cleantool.org)) seems to support this argument: the website, which has been online for ten years, focuses on just one process, metal surface cleaning.

The first European Chemicals Agency (ECHA) public consultation also showed how sector-specific information is important. Rolls-Royce asked ECHA for authorisation to use the phthalate DEHP in the welding process for aircraft turbines. One supplier of aircraft turbines had already replaced DEHP years before, thus offering a safer alternative. However, this supplier was a competitor to Rolls-Royce, so it did not turn up in the public ECHA consultation. That led the ECHA to conclude that no alternative was available, and Rolls-Royce was eventually granted a seven-year exemption to use DEHP. Had the substitute been picked up during the consultation, Rolls-Royce would not have been granted authorisation to use DEHP.

Substitution support works best if it comes with technical expertise. The information should include broad support taking account of the problems often connected to substitution. This would echo the work of Sweden's KEMI and its centre of excellence for substitution. However even a large centre like KEMI cannot cover all the different technological sectors. Rather, a global networking institution is needed to gather such information, collecting available data for the different stakeholders, and offering it in a digestible format.

It should be possible to create an international, non-profit foundation to maintain, update and extend both practical and reference information on substitution and alternative assessments. KOOP and the other active substitution promoters are too small to initiate such a process, which would require investment to create and build such an institution. It would also have to provide neutral expertise, be free from industry or government influence and be driven by scientific principles. KOOP would actively support such an institution and offer it access to its own databases.

## References

- CEFIC (2005) Paper on Substitution and Authorisation under REACH, 23 May 2005, Brussels, European Chemical Industry.
- Greenpeace (2005) Safer chemicals within REACH: using the substitution principle to drive green chemistry, Brussels, Greenpeace European Unit.
- European Parliament (2001) European Parliament resolution on the Commission White Paper on Strategy for a future Chemicals Policy (COM(2001) 88 - C5-0258/2001 - 2001/2118(COS)).
- European Parliament and Council (2006) Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC, Official Journal of the European Union, L 396, 30 décembre 2006.
- Lohse J. and Lissner L. (eds.) (2003) Substitution of hazardous chemicals in products and processes, Report compiled for the Directorate General Environment of the Commission of the European Communities. <https://pdfs.semanticscholar.org/0402/63f2f5e1276445d632bb2fbf6b260450ae1c.pdf>