**Work Package 4, Activity 4.1**

**Report**

**Sectoral Guidance for Chemicals Management in the Chemical Industry with focus on the production of fertilisers and polymers**

**Draft 28.09.2020**

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**List of Abbreviations**

|  |  |
| --- | --- |
| **AOX** | Adsorbable Organic Halides |
| **BAT** | Best Available Technique |
| **BREF** | Best Available Technique Reference or Reference Document |
| **CAS** | Chemical Abstract System |
| **CE** | Circular Economy |
| **CHEM** | Chemical sector |
| **CLP** | Classification, Labelling and Packaging Regulation |
| **CMS** | Chemical Management System |
| **COD** | Chemical Oxygen Demand |
| **CWW BREF** | BREF about Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector |
| **Deca BDE** | Decabromodiphenyl ether |
| **DU CSR** | Downstream User Chemical Safety Report |
| **ECHA** | European Chemical Agency |
| **EFS BREF** | BREF about Emissions from Storage |
| **ELV** | Emission Limit Value |
| **E-PRTR** | European Pollutant Release and Transfer Register |
| **ES** | Exposure scenario |
| **GHS** | Globally Harmonized System of Classification and Labelling of Chemicals |
| **IED** | Industrial Emissions Directive |
| **IMPEL** | European Union Network for the Implementation and Enforcement of Environmental Law |
| **KEMI** | Swedish Chemical Agency |
| **LVIC-AAF BREF** | BREF about Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilisers |
| **MFA** | Material Flow Analysis |
| **PA** | Polyamide |
| **PAH** | Polycyclic aromatic hydrocarbon |
| **PBT** | Persistent, bio-accumulative and toxic |
| **PE** | Polyethylene |
| **PEC** | Predicted Environmental Concentration |
| **PFOA** | 1. Perfluorooctanoic acid |
| **PFOS** | 1. Perfluorooctanesulfonic acid |
| **PNEC** | Predicted No Effect Concentration |
| **POL BREF** | BREF about Polymers |
| **POP** | Persistent Organic Pollutants |
| **PP** | Polypropylene |
| **PS** | Polystyrene |
| **REACH** | Regulation concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals |
| **SCCP** | Short-chain chlorinated paraffin |
| **SDS** | Safety Data Sheet |
| **SFA** | Substance Flow Analysis |
| **SME** | Small and medium-scale enterprise |
| **SPERC** | Sector Specific Environmental Release Categories |
| **SPIN** | Substances in Preparation in Nordic countries |
| **SRM** | Secondary Raw Materials |
| **SVHC** | Substances of very high concern |
| **TDS** | Technical Data Sheet |
| **UBA** | Federal Environment Agency, Germany |
| **VOC** | Volatile Organic Compound |
| **vPvB** | Very persistent and very bio-accumulative |
| **WFD** | Water Framework Directive |
| **WWTP** | Wastewater treatment plant |

# Preface

This report is a product of the HAZBREF project *“Hazardous industrial chemicals in the IED BREFs”*. HAZBREF is funded by the EU Interreg Baltic Sea Region Programme and the implementation period is three years from October 2017 until September 2020.

The overall aim of HAZBREF is to increase the knowledge base of the industrial sources and the reduction measures of hazardous chemicals. HAZBREF identify relevant chemicals used in industrial sectors, their use patterns, environmental characteristics and measures to prevent and reduce releases to environment.

On the EU level, the main instrument to control industrial releases is the Industrial Emissions Directive (IED), particularly through the publication of BAT Reference documents (BREFs) and their key chapter: the BAT conclusions. However, these BAT conclusions in most cases do not address hazardous substances in a systematic and comprehensive way. HAZBREF aims to develop a systematic approach that will help to exchange and utilize the existing information about hazardous substances between different regulatory frameworks (IED, REACH, Water Framework Directive, Marine Strategy Framework Directive, EU provisions on Circular Economy, Stockholm POP Convention & HELCOM) in the preparation of BREFs.

When the use and risks of chemicals are better addressed in BAT Reference documents, the capacity to manage industrial chemicals will be enhanced among both authorities and operators. The information gathered in BREFs is also useful for the Baltic Marine Environment Protection Commission HELCOM in the development of actions to reduce the inputs of hazardous substances to the Baltic Sea. HAZBREF also promotes the circular economy by finding ways to better include circular economy aspects in BREFs.

HAZBREF outputs target both the policy and the enforcement level. On policy level the outputs will strengthen the links between different regulatory frameworks and their key players. On enforcement level at industrial installations the project will identify and test model solutions for hazardous chemical management.

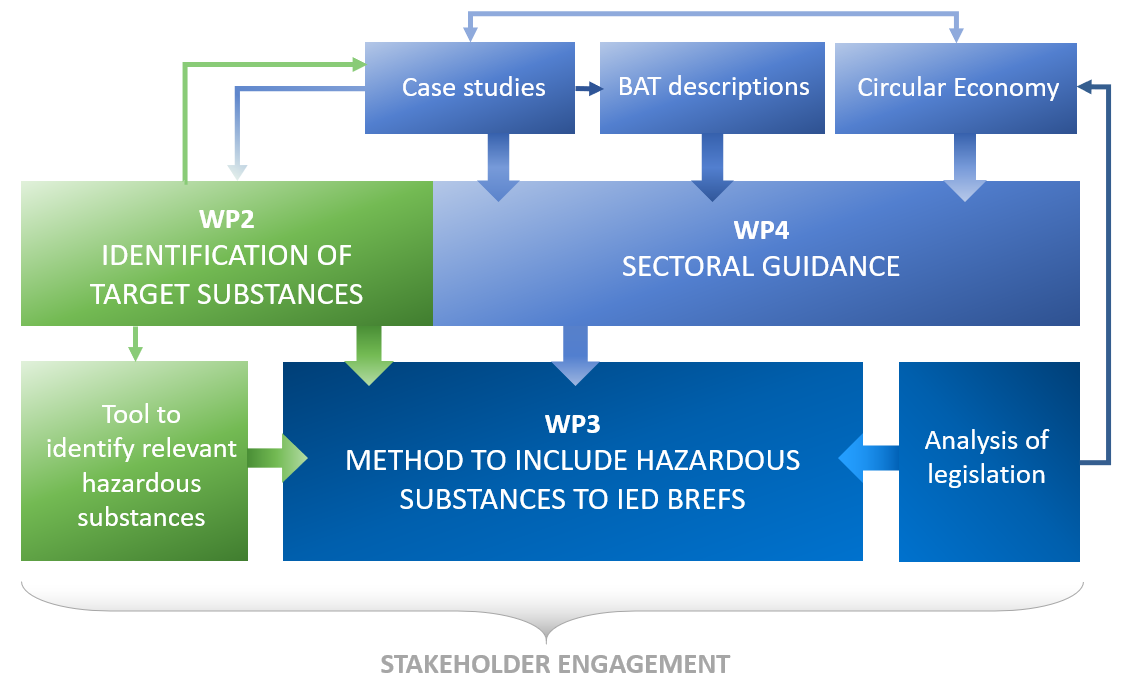
The activities will be carried out in four Work Packages:

* WP1 – Project management and administration (Lead Partner SYKE) including communication and dissemination of results;
* WP2 – Identification of target substances (Lead by UBA) that include:
* 2.1 Identification and selection of target substances
* 2.2 Fate of substances during emission treatment
* WP3 – Policy improvement (Lead by UBA) that include:
* 3.1 Strengthening links between regulatory frameworks on different levels
* 3.2 Developing a method to include substance information into BREFs, improve communication and data flow
* WP4 – Best practices in chemicals management in industry (lead by IETU) that include:
* 4.1 Sectoral guidance for three IED sectors (chemicals, textile, surface treatment of metals and plastics)
* 4.2 Case studies in selected installations
* 4.3 BAT descriptions and model permits
* 4.4 Circular economy aspects.

The HAZBREF partnership includes 5 organizations from the Baltic Sea region: Finnish Environment Institute (SYKE) (Lead partner), German Environment Agency (UBA), Swedish Environmental Protection Agency (SWEPA), Institute for Ecology of Industrial Areas (IETU) and Estonian Environmental Research Centre (KLAB).

In addition, 27 associated organizations and a wide range of other stakeholders are involved in HAZBREF, such as ministries and governmental environmental and chemical agencies from several EU countries, permitting and supervision authorities as well as industries and environmental NGOs.

More information about HAZBREF can be found on our project website ([www.syke.fi/projects/hazbref](http://www.syke.fi/projects/hazbref)).



Overview of the design of the HAZBREF-project with its four work packages

# Executive summary

(To be written after receiving comments on the report from stakeholders)

# Introduction

The main instrument on EU level to control industrial releases is the Industrial Emissions Directive (IED), particularly through the publication of BAT reference documents (BREFs) and related BAT Conclusions for industrial sectors.

Environmental permitting is based on the BREFs. Currently the BREFs do not address all relevant hazardous substances which has led to a situation where the hazardous substances are missing from the environmental permits. If the substances are not addressed in the permits the control of their releases might not be sufficient and this might lead to situations where the effects in the environment are unknown.

Due to the wide range of products the chemical sector in Europe is wide and covers multiple processes. HAZBREF project focuses on the two sub sectors of the chemical industry: fertilisers and polymers. The sub sectors were chosen due to use of chemicals and the upcoming LVIC BREF review.

The lack of knowledge on the use and flow of specific hazardous chemicals in the industrial processes makes chemical control and reduction measures difficult. The problem is that both installations themselves and authorities do not always know which substances are relevant to be addressed and by which management measures. This sectoral guidance contains e.g. information on uses of hazardous chemicals, the best practices in chemical management and recommendations on enhancing the permitting process in CHEM sector.

Production of inorganic fertilizers is in the scope of The Large Volume Inorganic Chemicals - Ammonia, Acids and Fertilizers (LVIC-AAF) BREF document, which was published in 2007. The BREF document covers also production of ammonia, hydrogen fluoride, hydrofluoric acid, phosphoric acid, nitric acid, sulphuric acid, oleum and phosphorus-, nitrogen- or potassium-based fertilizers (simple or compound fertilizers). The BREF review is expected to start in 2020-2021.

Production of polymers is covered by many BREFs. The LVOC BREF covers production of Large Volume Organic Chemicals. The Polymer BREF (European IPPC Bureau 2007) is not a binding document but can be used as an informative guiding document and has still valid BATs for polymer production. Polymer production processes will also be covered by the WGC BREF (Common Waste Gas Treatment in the Chemical Sector), which is currently under preparation. This document sums up the findings from HAZBREF project and is based on case studies, interviews with authorities, expert judgement and input from stakeholders. The aim is to describe good practices in chemical management to be utilized by installations as well as environmental and chemical authorities. The findings of the guidance will feed into in the forthcoming revision of the LVIC BREF. They are also to be used for HELCOM recommendations on how to reduce the discharge of hazardous substances into the Baltic Sea.

# Sector Overview

Chemical Industry is one of Europe’s largest manufacturing sectors and it is crucially important to other sectors as more than half of EU chemicals sold to downstream users go to other industrial sectors[[1]](#footnote-2). The main challenges described by the EC are access to raw materials and energy, coordination between policies and regulatory environment.

The European Chemical Industry Council (CEFIC) has described the European chemical industry in the report “2020 - Facts & Figures of the European chemical industry”. Europe is the second largest chemicals producer in the world after China and USA is the third largest producer. EU chemical sales in 2018 were 565 billion € divided into specialty chemicals (paints & inks, crop protection, dyes & pigments) 27 %, petrochemicals 25 %, polymers (plastics, synthetic rubber & man-made fibers) 21 %, basic inorganic chemicals (other inorganics, industrial gases & fertilisers) 14 %, consumer chemicals 12 % and auxiliaries for industry 1 %, More than half of EU chemicals are supplied to the industry. The largest chemicals producers (based on chemical sales in year 2018) in Europe are Germany 32 %, France 13 % and Italy 9 %.

There are 28 000 companies operating in the chemical sector in EU (CEFIC 2019)[[2]](#footnote-3). Most of the installations are SMEs and below the threshold of Industrial Emissions Directive (IED). In European Pollutant Release and Transfer Register (all reporting states for E-PRTR) there are 2 935 facilities registered under chemical industry sector for year 2017. The amount of IED installations specifically registered under polymers is approx. 400 and fertilisers approx. 100. According to E-PRTR and country specific information (Finland, Poland, Sweden, Estonia and Germany) the amount of IED installations (polymer and fertiliser specific) located in the Baltic Sea catchment area is 71, from which 41 are in the field of polymers and 30 in fertilisers (Table 1).

Table 1: Country specific number of fertiliser and polymer installations in the Baltic Sea catchment area. The number refers only to installations in the catchment area and not to the whole number of installations in the given country.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of Installations | Czech Republic | Estonia | Finland | Germany | Lithuania | Poland | Russia | Sweden | Denmark  Latvia, Slovakia  Norway Belarus, Ukraine |
| Fertiliser | 0 | 1 | 2 | 1 | 2 | 21 | 1 | 2 | Unknown/none |
| Polymer | 3 | 1 | 14 | 3 | 0 | 8 | Unknown/none | 12 | Unknown/none |

The Baltic Sea catchment area extends to 14 countries, but while Estonia, Finland, Latvia, Lithuania, Poland and Sweden are almost entirely within the catchment, only less than half of Denmark, only one eight of Germany and a small fraction of Russia, Belarus, Norway, Ukraine, Czech Republic and Slovakia are situated within the catchment. Russia is an important global player in the chemical sector with approx. 42 billion € (3.5 trillion rubles) production in 2018[[3]](#footnote-4). The chemical companies in Russia are today mainly located outside the Baltic Sea catchment area[[4]](#footnote-5), with at least one exception (EuroChem Phosphorit). There are plans to build more chemical installations in Kaliningrad[[5]](#footnote-6).

The HAZBREF fertiliser case study company is an international company with more than 20 production sites around the world. For the HAZBREF project two sites in Finland were selected as case studies.

## Fertilisers

Production of fertilisers is covered by IED, Annex 1, 4.3. Production of phosphorous-, nitrogen- or potassium-based fertilisers (simple or compound fertilisers).

The Large Volume Inorganic Chemicals - Ammonia, Acids and Fertilisers (LVIC-AAF) BREF document was published in 2007[[6]](#footnote-7). The BREF document covers production of ammonia, hydrogen fluoride, hydrofluoric acid, phosphoric acid, nitric acid, sulphuric acid, oleum and phosphorus-, nitrogen- or potassium-based fertilisers (simple or compound fertilisers). The LVIC BREF review is expected to start in 2020-2021.

The environmental issues are described in the LVIC-AAF BREF as that fertiliser production currently accounts for about 2–3 % of the total global energy consumption. The main pollutants emitted to air are NOx, SO2, HF, NH3 and dust, which are, depending on the source, emitted at high volumes. In the production of HNO3, considerable amounts of the greenhouse gas N2O are generated. Some by-products, e.g. phosphogypsum, are generated in high volumes. According to LVIC-AAF BREF these by-products show potential for valorisation, but transport costs, contamination with impurities and the competition with, e.g. natural resources, restrict the successful marketing. Hence, excess volumes require disposal. The possible contamination of phosphogypsum depends on the raw materials used and thereby contaminants do not always pose problems. According to the HAZBREF case studies, uncontaminated phosphogypsum could be utilised in many applications, also but in addition to aforementioned reasons also product requlations may hinder the use of uncontaminated by-product phosphogypsum.

There are more than 120 manufacturers of fertilisers in Europe[[7]](#footnote-8). The European Fertiliser Product Regulation ((EU) 2019/1009) has been newly updated. The new legislation does not only set conditions on the end product (e.g. allowed levels of contaminants) but also on the raw materials used in manufacturing.

## Polymers

Production of polymers is covered by IED, Annex 1, 4.1. Production of organic chemicals such as h) Plastic materials (polymers, synthetic fibres and cellulose-based fibres).

The key environmental issues of the polymer sector are described in the Polymer BREF as emissions of volatile organic compounds, in some cases waste waters with the potential for high loads of organic compounds, relatively large quantities of spent solvents and non-recyclable waste as well as the energy demand.

The LVOC BREF covers production of Large Volume Organic Chemicals (European IPPC Bureau 2017)[[8]](#footnote-9). The Polymer BREF (European IPPC Bureau 2007)[[9]](#footnote-10) is not a binding document but can be used as an informative guiding document and has still valid BATs for polymer production. Polymer production processes will also be covered by the WGC BREF (Common Waste Gas Treatment in the Chemical Sector), which is currently under preparation[[10]](#footnote-11).

Polymer additives contain many hazardous substances and have been under scrutiny recently[[11]](#footnote-12). Plastics have been under international interest due to environmental problems caused by plastics and microplastic. Polymer industry has great potential to utilise recycled plastic as raw material but there are still many issues to be solved. For these reasons HAZBREF chose polymer subsector as a case sector.

There are close to 60 000 companies operating in plastic industry in Europe. Most of them are small and medium-sized enterprises[[12]](#footnote-13). Around 45 companies in EU-15 produce the large volume thermoplastic materials which are sold to around 30 000 small and medium sized companies which process the polymers into products for end use[[13]](#footnote-14). The world plastics production was 348 million tons in 2017, with Europe having a share of 64.4 million tons. The share of polyethylene in polymer demand was 18 % for low density and linear low density polyethylene (PE-LD and PE-LLD) and 12 % for high density and medium density polyethylene (PE-HD and PE-MD).

**HAZBREF Case Study Installations in chemical sector**

**Fertilisers**

One international fertiliser company participated in HAZBREF project. Two sites in Finland were chosen as case studies.

The two selected IED installations have the following production:

1. Production of phosphoric acid, sulphuric acid, nitric acid, NPK fertilisers and technical ammonium nitrate.
2. Production of nitric acid and NPK fertilisers.

**Polymers**

Three polymer producers in Estonia, Finland and Sweden were selected for compiling voluntary case studies.

The three selected IED installations have the following production:

1. Two kinds of alkyd binders used for production of lacquers and paints – organic solvent (thinner) based and water based. Thinner based binders are usually alkyd resins, and water-based binders alkyd emulsions.
2. Petrochemicals (e.g. phenols, aromatics and acetone), polyethylene and polypropylene. Beside polymers, the company manufacturers fertilisers and has several production units around the world.
3. Water-soluble cellulose derivative, i.e. ethyl hydroxyl ethyl cellulose (EHEC), methyl ethyl hydroxy cellulose (MEHEC) and hydrophobically modified cellulose derivates. The products are mainly used in water-based paints and in various types of construction products.

In addition to the three installations above two polish polymer installations were selected for analysing circular economy issues.

# Relevant hazardous substances

The chemical industry not only uses but also produces chemicals. This means that the installations must be well aware of the chemical legislation and its demands. In the chemical industry as a whole a lot of different chemicals are used and produced. In this report we are focusing on the production of polymers and fertilisers.

Chemicals used for production of different types of polymers are for example surfactants, solvents, emulsifiers, catalysts, modifiers, antioxidants, protective colloids, polymerisation initiators, inhibitors, product stabilisers and extender oils. Some of these contain hazardous substances. In the polymer case studies hazardous substances were found from e.g. catalysts, adsorbents and maintenance chemicals.

Since fertilisers are added to the fields, they can’t contain toxic, bioavailable substances in concentrations which might cause adverse effects in the environment or indirectly to human being. But on the other hand, some essential plant nutrients, such as selenium and copper, are toxic in high concentrations. In the manufacture of fertilisers, hazardous chemicals are used for example as plant micronutrients (copper, zinc, selenium, manganese and boron).

Key references of regulatory frameworks for identification of hazardous substances are provided in the table below. More detailed information on chemical reference list are described in chapter 3.2.

Table 2: Categories of considered substances

|  |
| --- |
| **Hazardous Substances according to regulatory framework** |
| * Substances in CLP Regulation (1272/2008) annex VI * (very) persistent, (very) bioaccumulative and/or toxic – PBT/vPvB -substances * Endocrine disruptors * Substances of Very High Concern (SVHC), such as BPA, Nonylphenols and Cobalt Sulphate * WFD (2000/60/EC) Annex X priority substances, such as cadmium, lead, nickel and its compounds. * Substances covered by the Stockholm Convention on Persistent Organic Pollutants, such as PFOS, PFOA, SCCPs and DecaBDE. * Biocides |

## Identification of chemicals

### Identification of Substances of Very High Concern and Water Framework Directive Priority Substances for polymer and fertiliser industry

HAZBREF project compiled a list of SVHCs and WFD PS relevant for polymer and fertiliser industry (see Annex 6 and 7). The list of SVHCs was downloaded from the ECHA webpage (<https://echa.europa.eu/candidate-list-table>). At the moment (June 2020) the list includes 209 substances or substance groups identified as SVHC. The information on substance uses in EU was compiled from the public ECHA CHEM database (<https://echa.europa.eu/information-on-chemicals>) and in Nordic countries from SPIN register (Substances in Preparation in Nordic countries <http://spin2000.net/>). If the substance had statement ”polymer” or “polymers” or “used in polymers” or “used in polymer processing” or “elastomers” etc. in the section ‘uses at industrial sites’ of the ECHA infocard, the substance was deemed to be used in POL industry (see Annex 6). If the substance had the word ”fertiliser” in the section ‘uses at industrial sites’ of the ECHA infocard, the substance was deemed to be used in fertiliser industry (See Annex 7). In addition, the REACH Annex XV dossiers were used as information sources.

The total use volumes in EU were derived from ECHA infocards (public ECHA CHEM database) as well. The use information from SPIN database was searched from the categories “Industrial Use (NACE)” and “Use (national)”. The use volumes in SPIN database are presented for one particular year.

There are issues concerning the quality of the data in the public ECHA CHEM database. Firstly, the use information in public ECHA CHEM database is provided by the manufacturers or importers of a substance in the registration dossiers. It is possible that the manufacturer/importer has indicated multiple uses for the substance even though the substance might not be used in the sector. This results in false positives in the lists and therefore it should be checked if SVHCs are actually used in the sector. Secondly, the use volumes in ECHA infocards cover all the possible uses of the substance and not only the used amount in i.e. POL sector (i.e. there is no information on amount of use in POL sector). Thirdly, the information on the industrial uses and volumes in public ECHA CHEM might be outdated. For these reasons the results may include substances, which are not used in the sector.

Altogether 66 substances or substance groups were identified to be probably used in POL sector. The identified substances and information e.g. on their uses are presented in the table 4 in Annex 6. For example, different phenols and phthalates, cadmium and lead substances as well as a PFAS substance (PFBS) are most likely used in POL sector. Most substances are SVHCs, but some are both SVHC and WFD substances.

For fertiliser industry, the result was 5 SVHC substances. Three of these are boron compounds. Boron is an essential plant micronutrient and added to SVHC list due to concerns related to human health. Two of the identified substances are cobalt salts. Cobalt is needed in nitrogen fixation reactions in legume plants. The identified substances and information e.g. on their uses are presented in the table 5 in Annex 7.

## Regulatory chemical reference lists

**ECHA database of registered chemicals**

ECHA maintains one of the world's largest regulatory [databases](https://echa.europa.eu/de/advanced-search-for-chemicals?p_p_id=dissadvancedsearch_WAR_disssearchportlet&p_p_lifecycle=0&p_p_col_id=column-1&p_p_col_count=1) on chemicals. The database provides users access to information on over 22 600 chemical substances on the EU market through three layers: (i) infocard, (ii) brief profile and (iii) source data. The Infocard provides the ‘first tier’, the most basic and relevant information (about the substance, properties of concern, how to use it safely etc.). For more detailed information one can easily navigate to the ‘second tier’ – the Brief Profile – (substance identity, classification and labelling, hazardous effects, regulatory activities, Authorisation List, Restriction List, together with generalized information on uses of substance). From the Brief Profile, users can access the ‘third tier’, the source information compiled from the registrations dossier of the substance (registrants/suppliers, phys./chem. properties, environmental fate and pathways, toxicological and ecotoxicological information) on which the summaries of the Infocard and Brief Profile are based.

However, it needs to be mentioned that the level of detail and quality of data might vary considerably between the different chemical datasets.

Complementing the database of registered chemicals, ECHA further provides an inventory of classification and labelling information on notified and registered substances received from manufacturers and importers, covering nearly 152 000 chemicals. The majority of the substances have only undergone a so-called Self Classification process conducted by the companies. The respective rules for this process are provided within the CLP Legislation. Experience shows that this process results in a wide range of different self classifications for the same substance.

**REACH Candidate List of Substances of Very High Concern (SVHC) for Authorisation**

Candidate list of Substances of Very High Concern recommended for authorisation. This list is updated twice per year by ECHA, with the first substances listed on 28th of October 2008. Companies may have immediate legal obligations following the inclusion of a substance in the Candidate List on the ECHA website including in particular Articles 7, 31 and 33 of the REACH Regulation. EU and EEA suppliers of substances on the Candidate List (supplied either on their own or as constituent in mixtures) have to provide their customers with a safety data sheet that includes safe use instructions that consider the specific hazardous behaviour of the substance. Section 15 of pre-existing safety data sheets should be updated to reflect the identification of the substance as an SVHC (Article 31(9)(a)).

Boric acid and disodium tetraborate are identified as Substances of Very High Concern due to the concerns related to human health (toxic for reproduction)[[14]](#footnote-15). Use in fertilisers have been identified in the REACH registration dossiers of these substances. Boron is added to fertiliser products because it is an essential plant nutrient. Boron is not classified as environmentally hazardous according to CLP classification.

**REACH Authorisation List**

A list of substances subject to authorization under REACH. Substances on this list are selected from the REACH SVHC list and cannot be placed on the market or used after a given date ("sunset date"), unless an authorization is granted for their specific use, or the use is exempted from authorization.

**Substances Restricted under REACH**

Annex XVII to REACH includes all the restrictions adopted in the framework of REACH and the previous legislation, Directive 76/769/EEC. Each entry shows a substance, a group of substances or a substance in a mixture, and the consequent restriction conditions. The list is not sector-specific and it is regularly updated so that operators are obliged to keep themselves constantly informed. For example, many phthalates and bisphenols, which have been used in polymers, have been restricted.

**List of Pollutants under Annex II of the IED**

A short list of the most relevant polluting substances as defined under the IED. Many of the listed pollutants are covered by sum parameters (e.g. PAHs, VOCs, AOX, COD) covering a wide range of substances.

**Priority substances under the Water Framework Directive**

In 2018, Directive 2013/39/EU listed 45 substances (or substance groups) to WFD Annex X (Annex of EU priority substances).

The European Commission reviews the list of priority substances every six years according to Art. 1 2013/39/EU. In practice, the list has been reviewed twice (in 2008 (2008/105/EC) and in 2013 (Directive 2013/39/EU)) since it was first compiled in 2001[[15]](#footnote-16). Art. 16 par. 2 of the directive introduces a scientifically based methodology for selecting priority substances based on their significant risk to or via the aquatic environment. Priority substances are required to be minimized, priority hazardous substances have to be phased out. Relevant substances for polymer industry include e.g. 1,2-dichloroethane, nonylphenols, DEHP and some specific lead compounds.

**Regulation on persistent organic pollutants (POP)**

The regulation 2019/1021 (EC) on persistent organic pollutants prohibits or restricts the production and use, as well as the import and export of intentionally produced POPs, listed in Annex I and II to the regulation (Article 3).

Operators are responsible for ensuring that they know the substances listed in the regulation and are not allowed to use them (in accordance with the requirements of the regulation). Competent authorities are required to monitor the implementation of the regulation.

POPs include flame retardants, such as PBDEs and HBCDD, which were used in plastic products (construction materials, electronics, car parts etc.). Now their use has diminished but they might be problematic for the waste treatment sector.

**Biocides**

The European Directive 98/8/EC (Biocidal Product Directive, BPD; EC 1998) on placing biocidal products on the market was adopted in 1998. It was replaced by EU regulation No 528/2012 (Biocidal Products Regulation, BPR; EU 2012) by September 1, 2013. Biocidal active substances have been authorised under the BPD (positive list in Annex I/Ia) or the BPR (list of approved substances; http://echa.europa.eu/information-on-chemicals/biocidal-active-substances), but many biocidal substances are still under assessment.

**Food stuff packaging regulations (polymers)**

The regulation 10/2011 (EU), and its amendments, on plastic materials and articles intended to come into contact with food sets migration limits for specific substances (e.g. tin, boron) in plastic packaging.[[16]](#footnote-17)

**Fertiliser legislation**

The fertiliser products available in the EU market have to comply with the fertiliser product regulation 2019/1009 (EU). The regulation limits the metal (e.g. cadmium, nickel, lead) content in the fertiliser products. The regulation also sets conditions on the raw materials used in manufacturing. The new regulation applies as of 16 July 2022[[17]](#footnote-18).

## Non-regulatory chemical reference lists

**ChemSec – SIN List**

The [SIN List](https://chemsec.org/sin-list/) is a database of hazardous chemicals that are used in a wide variety of articles, products and manufacturing processes around the globe. Some chemicals on the list might be restricted or banned in the EU in the future. The SIN List is publicly available and regularly updated. The list is developed by non-profit organisation ChemSec and available at ChemSec webpages[[18]](#footnote-19).

# Legal Obligations and Management of hazardous chemicals

Operators are obliged to take all necessary measures to prevent major accidents and to limit their consequences for human health and the environment. The requirements of IED for operators include:

* Notification of all concerned establishments (Article 7 IED);
* Deploying a major accident prevention policy (Article 8 IED);
* Producing a safety report (Article 10 IED);
* Producing internal emergency plans (Article 12 IED);
* Providing information in case of accidents (Article 16 IED).

Russian BAT bureau produces and publishes BREF documents in Russia. Russian BREF 32 covers manufacture of polymers and BREF 2 covers manufacture of fertilisers.

Operators are also obliged to follow REACH obligations, see more under chapter 3.2 and chapter 4.1 to 4.5 below.

The Seveso III Directive (2012/18/EU), specifies obligations to prevent major chemical accidents and minimize their effects within and outside establishments where chemicals are present. The obligations apply to establishments han­dling or storing chemicals causing physical, health and environmental hazards in large quantities.[[19]](#footnote-20) Operators are obliged to take all necessary measures to prevent major accidents and to limit their consequences for human health and the environment. The requirements of Seveso for operators include:

* Notification of all concerned establishments (Article 7)
* Deploying a major accident prevention policy (Article 8)
* Producing a safety report (Article 10)
* Producing internal emergency plans (Article 12)
* Providing information in case of accidents (Article 16)

HELCOM Recommendations

Since the HAZBREF project is funded by the European Regional Development Fund Interreg Baltic Sea Region, the guidance includes references to HELCOM recommendations relevant for the Chemical industry regarding discharges, emission and objectives for hazardous substances. The sector specific recommendations do not contain many specific requirements concerning chemical management and the EU and Russian BREFs are the main guiding documents for the Baltic Sea countries

* HELCOM Recommendation 17/6 – Reduction of Pollution from Discharges into Water, Emissions into the Atmosphere and Phosphogypsum out of the Production of Fertilizer
* HELCOM Recommendation 23/11 – Requirements for discharging of waste water from the chemical industry
* HELCOM Recommendation 25/2 – Reduction of emissions and discharges from industry by effective use of BAT;
* HELCOM Recommendation 31E/1 – Implementing HELCOM’s objective for hazardous substances; **https://helcom.fi/wp-content/uploads/2019/06/Rec-31E-1.pdf**

This chapter also contains description about how to use substance flow analysis in chapter 4.6 and interactive schemes in chapter 4.7.

## Using safety data sheets

Safety Data Sheets (SDS) are a method for the provision of information on chemical substances and mixtures to their recipients in the EU. SDS are designed to provide comprehensive safety information on substances and mixtures where[[20]](#footnote-21) a substance or a mixture meets the criteria for classification as hazardous according to CLP

a substance is persistent, bio-accumulative and toxic (PBT) or very persistent and very bio-accumulative (vPvB), according to the criteria given in Annex XIII of REACH

a substance is included in the candidate list for eventual authorisation according to Article 59 (1) of REACH for any other reason (See Article 31(1) of REACH).

Article 31 of the REACH Regulation describes the specific requirements for SDS under REACH in conjunction with Annex II of REACH. All SDS are divided in 16 sections, which must contain e.g. information on possible hazards, composition/information on components of mixtures. The SDS sections with the highest relevance for good chemical management are 1, 2, 3, 9, 11 and 12 (see Annex 3 to this report). Chemical suppliers are obliged to provide end users with SDS for all relevant chemical substances or chemical products (formulation of different chemicals on chemical products) in such a way that they meet the formal requirements according to the corresponding ECHA guidelines.

SDS provide information on:

* correct handling and storage
* measures for the protection of human health and safety at the workplace (occupational health)
* measures for the protection of the environment
* correct responses in case of substance related emergencies
* correct disposal of the respective substances.

Additional information on the content and appropriate use of SDS is provided in the ECHA “[Guide on Safety data sheets and Exposure scenarios](https://www.reach-compliance.ch/downloads/sds_es_guide_en.pdf)”.

Findings from the case studies:

* SDSs are kept up to date and checked regularly in some of the plants.
* SDSs are used to make short, easy-to-read safety cards to the plant operators. ECHA database is not utilised by the company but all the information is derived from the SDSs.
* The quality of SDS supplied by European chemical companies is usually at a high level. This quality is not always guaranteed by smaller scale suppliers.
* Frequently commercially competitive chemicals from outside the community provide very general SDSs to the EU market. This may result from the lack of such data from the manufacturer, or not putting full information may be intentional action.
* Sometimes the translations to other languages than English are insufficient in quality.
* Beyond the supply chain communication requirements, as stated in the REACH regulation, detailed data about the impurities or intentionally added constituents is challenging to get from the suppliers. This concerns both impurities and ingredient substances in minor concentrations, which remain below thresholds (levels of concern) triggering their presence in section 3 of SDS. Even though the concentrations of impurities might be low, the load might become significant when the used volumes of raw materials are high.

## Producing safety data sheets

ECHA have a guidance on the compilation of safety data sheets (version 3.1, November 2015) available on their website[[21]](#footnote-22).

The aim of the guidance is to assist industry in determining which tasks and requirements have to be complied with in order to fulfil their obligations under Article 31 of REACH (Requirements for safety data sheets) and Annex II of REACH, as replaced by two Commission Regulations:

* Commission (EU) No 453/2010: alignment of the SDS with the applicable requirements arising from implementation of the changes in classification and labelling of substances and mixtures according to the CLP Regulation from 1 December 2010 and 1 June 2015 respectively.
* Commission Regulation (EU) 2015/830: adaptation to the 5th revision of the GHS and avoidance of confusion generated by two potentially conflicting amendments entering into force on the 1 June 2015.

This guidance provides information especially on:

* issues to consider when compiling an SDS;
* details of the requirements for information to be included in each Section of an SDS;
* who should compile the SDS and what competences the author should have.

There is also a shorter version available on ECHAs website (version 2.0, December 2015, Guidance in a nutshell).

The guideline is currently being updated. A draft (version 4.0, April 2020) is available on the ECHA website.

## Using exposure scenarios

In the case that a hazardous substance (according to REACH) is registered in a quantity above 10 tonnes per year and registrant, an extended safety data sheet, with exposure scenarios (ES) attached, must be provided. ES are intended to provide information on the sources, use patterns and release pathways of chemicals used and to assist in the estimation of releases of chemicals to the environment. In contrast to SDS, the format of the exposure scenario is not specified by REACH. On the one hand this gives the suppliers the flexibility to present the information in different ways, on the other hand the different formats can lead to difficulties in identifying the relevant information for the recipients. To address this problem, ECHA and various stakeholders recommend a harmonised format comprising the following four sections:

* Title section
* Conditions of use affecting exposure
* Exposure estimation
* Guidance to downstream users to evaluate if their use is within the boundaries of the exposure scenario

Key points to be included in the format as well as additional information on the use of exposure scenarios are provided in the ECHA “[Guide on Safety data sheets and Exposure scenarios](https://www.reach-compliance.ch/downloads/sds_es_guide_en.pdf)”. Specific annotated formats can be downloaded from the website section “[Formats and templates](https://echa.europa.eu/support/guidance-on-reach-and-clp-implementation/formats)”.

**Obligations of downstream users with regard to Exposure Scenarios**

When receiving ES as part of the extended safety data sheet, downstream users must fulfil certain obligations. As a first step they must determine whether the particular use and/or conditions of use in the installation is covered in the ES. If the respective use is covered in the ES, no further action is required in this respect. Downstream users are instead only obliged to document how the conclusion was reached (This information shall be made available to enforcement authorities on request). In case use/use conditions are not covered by the exposure scenarios received from the suppliers, downstream users can – depending on their situation - choose between the following options:

* Ask the supplier to include the relevant conditions of use in his chemical safety report and to submit an appropriate exposure scenario. Enough information must be made available to the supplier to enable him to carry out such an assessment.
* Implement the operating conditions described in the exposure scenario you have received. This option may require changes in the processes and/or products.
* Eliminate or substitute the substance or the activity with a safer alternative.
* Find another supplier who can provide the substance with SDS and exposure scenario covering your use.
* Carry out a chemical safety assessment and prepare a downstream user chemical safety report (DU CSR) for their uses and conditions of use, unless exemptions apply. The ECHA Guide 176 “[How to prepare a downstream user chemical safety report](https://echa.europa.eu/de/view-article/-/journal_content/title/how-to-prepare-a-downstream-user-chemical-safety-report)” provides further details regarding this approach.

Further practical guidance for the procedure described above is provided in the ECHA Practical Guide Nr. 13 “[How downstream users can handle exposure scenarios](https://echa.europa.eu/documents/10162/13655/du_practical_guide_13_en.pdf/2c3bc624-fb3c-4515-a581-87b79d460d38)”.

The operator should be aware of the potential risks involved when using hazardous substances. This means that even when PEC is below PNEC a generic risk assessment should be done. If the PEC exceeds the PNEC, a more detailed risk assessment is needed.

**SDS exposure scenarios** are one source of information for hazardous chemicals risk assessment. But detailed exposure scenarios are not yet available from all suppliers. It is also possible that key information like PNECs are missing. Further, the exposure scenarios are often all too generic, based on modelling with default emission ratios and overestimated use volumes in the sites. Exposure scenarios represent the worst-case situation. Exposure Scenarios aren´t thus usually directly usable for the operators. Sector specific environmental release categories (SPERCs), based on measurements and info about the typical environmental fate of substances in the sites could help but they have not yet been developed for many industrial uses.

In one of the case studies, the exposure scenario of a substance for fertiliser formulation indicated that based on modelling there is a risk that the emissions from fertiliser production exceed the PNEC values (PEC/PNEC>1) in water, sediment and soil and in addition in sewage treatment plant. This estimate however does not fit well in the production process of the case installation since the wastewater from the installation is treated in its own treatment plant and the sludge is landfilled. This will decrease the emissions to water and no emissions to WWTP or to soil are generated. Also, the use volumes in the exposure scenarios were overestimations.

Therefore, the risk should be estimated by using site’s own measured data and calculating the flow of the substance over the process to estimate emissions to the environment. For example, available tools are STAN tool[[22]](#footnote-23) (see annex 2) and the EUSES model[[23]](#footnote-24). If the exposure scenario in the SDS estimates that the PEC>PNEC then the installation should make a more detailed evaluation whether the risk is real. If the risk is real, then the emission abatement measures are needed. However, this modelling requires quite a lot of monitoring data (inputs and outputs). Further, the more there are uncertainties the more unreliable the result is.

Findings from the case studies:

* The companies use the exposure scenarios even though they are not directly usable but need to be refined to specific uses of the substances.
* The exposure scenarios are difficult to read and too generic to apply and thus not directly usable for the production units. Specific environmental release categories (SPERCs) could be helpful.
* The exposure scenarios and data on environmental hazards should be improved in the SDSs.
* Exposure scenarios are utilized and adapted to the specific uses at the installation. But all SDSs do not yet have exposure scenarios and in some the data is of poor quality, especially concerning mixtures. Sometimes the information in the SDSs is in contradiction between different suppliers of same chemical. Thus, the information is not harmonized.

## Producing exposure scenarios

ECHAs guidance on the compilation of safety data sheets (version 3.1, November 2015) contains information on:

* when attachment of Exposure Scenarios to the SDS is required (section 2.22)
* alternative ways to include the Exposure Scenario information into the SDS for substance and mixtures (section 2.23)
* how to include relevant Exposure Scenario information into the SDS (appendix 1).

The guideline is currently being updated. A draft (version 4.0, April 2020) is available on the ECHA website[[24]](#footnote-25).

## Developing chemical inventories

To allow for an effective chemical management, it is necessary to clearly identify which chemicals are used, how they should be used, and how they can be substituted if risks are identified. This requires that established inventories are continuously updated and archived. Chemical Inventories allow among other things for a targeted compilation and assessment of chemical related information, which can serve the specific information requirements of different organizational units within the industrial installation. They can also serve as an important reference and information tool for stakeholders such as IED permitting authorities (e.g. to assess compliance with lists of restricted substances or other chemical related regulations), thus going beyond the mere purpose of fulfilling storage or stock-keeping requirements.

In order to ensure the availability and completeness of all information necessary for a responsible chemical management that can be used for both internal and external requirements, the inventory should include all chemical substances and products (including by-products, intermediates, residual raw materials and solvents) present throughout the production cycle.

The main and commonly used sources of data with respect to the different chemical products are the SDS[[25]](#footnote-26) and - to a certain extent - the Technical Data Sheets (TDS)[[26]](#footnote-27). Other sources of relevant chemical information such as type, chemical (containing) waste, production process involving chemicals as well quantities of inputs and non-product outputs include eco-maps and process flow diagrams. Further reference on how to establish and maintain a chemical inventory is provided in section 5.2.1. The chemical inventory could be improved if detailed data about the impurities or intentionally added constituents would be available in SDS.

Some of the case study companies take part in Responsible care program[[27]](#footnote-28). The internal company rules and practices are often stricter than legislation or requirements of authorities. The processes which include hazardous chemicals have the most detailed rules. These rules are part of the process safety requirements: if any unknown and unwanted substance enters the sensitive process there is even a risk for explosion. Therefore, all new chemicals are assessed in detail before taking them into use in the production process. The installations are not allowed to use any chemicals before they have been tested and approved by the company.

See more about chemical and raw material inventory and chemical handling system in chapter 5.2.

**Information requirements for chemical inventories**

According to the assessment of IED permitting authority representatives and experts from HAZBREF, it is recommended to include the following information on substances and mixtures in a chemical inventory:

The commercial name of the products used

Chemical characterisation of the products used, if possible, with single chemical compounds

Identifiers, CAS / EC number of chemical substances contained

Characterisation / description of use (input material, solvent, product, intermediate, by-product)

Details of use / details about the process

Annual consumption of the chemical products/substances

The total quantity of the chemical products or substances that may be present within the total installation/operational area

Physical / chemical / toxicological / eco-toxicological properties of the chemical products/substances

Biodegradability/bioeliminability in [%], including information on the testing method

The lower content (as % by weight) of components in chemical formulations

The highest content (as % by weight) of the component in chemical formulations

Information about possible emissions or possible reactions (e.g. decomposition) of substances in case of an incident or accident in the production process.

## Substance flow analysis

One of the challenges in managing hazardous substances in the installation is understanding the flows of the substances in the processes and in the discharges outside of the installation. For that purpose, Substance Flow Analysis (SFA) and Material Flow Analysis (MFA) can be used. These are studies of physical flows of substances or materials into, through and out of a given system such as installation. Conduction of SFA or MFA could help in the management of wastewater and wastes as well as in improving material efficiency. Substance and Material flow analyses contain the following main steps:

* Identification of the key parameters such as the material or substance, flow related issues
* System analysis (selection of the relevant matter, production processes, indicator substances, and system boundaries)
* Quantification of mass flows of matter and indicator substances
* Identification of weak points in the system
* Development and evaluation of scenarios and schematic representation, interpretation of the results

Tools for assessing transformations of the substances can be used in the estimations of substance mass balances. The mass of the substance in each of the media (including process media, product, wastewater, air emissions, waste) can be estimated as a result. It can be done by using tools such as STAN, which is focused especially on waste management.

STAN (short for subSTance flow ANalysis) is a freeware that helps to perform material flow analysis according to the Austrian standard ÖNorm S 2096 (Material flow analysis – Application in waste management).

After building a graphical model with predefined components (processes, flows, system boundary, text fields) you can enter or import known data (mass flows, stocks, concentrations, transfer coefficients) for different layers (good, substance, energy) and periods to calculate unknown quantities. All flows can be displayed in Sankey-style, i.e. the width of a flow is proportional to its value. The graphical picture of the model can be printed or exported. For data import and export Microsoft Excel is used as an interface.

A material flow analysis (MFA) was concluded in one of the case sites to assess the possible releases of the substance to environment from the production process. STAN tool was used to conduct this MFA. More information about how the analysis was done is available in Annex 8.

## **Interactive scheme for the identification of relevant target substances**[[28]](#footnote-29)

The objective of the HAZBREF Project is among others to improve the "best available technology" (BAT) for the elimination of substances from waste water discharges (currently disregarding other waste streams). It is the intention of WP 2 of HAZBREF to characterise substances with regard to the properties which determine their fate and behavior in wastewater treatment (currently disregarding other waste streams), i.e. water solubility, biodegradability and persistence, adsorptivity/mobility, and volatility. This characterises the “potential to be released” from the installation wastewater treatment into the environment. In addition, substances with an ecotoxicological or human toxicological concern should be flagged for additional risk reduction measures. This characterises the relevance of target substances for BAT conclusions.

The procedures to identify the relevant target chemicals will be provided by WP 2 in form of an interactive scheme for decision-making. The interactive tool assists identification of substances or chemical groups with specific concerns that are relevant to be included in the respective BREF review. This improvement is achieved by providing information on substance properties, which will enable installation managers to characterise the substances used in the respective installation with regard to various concerns and to choose appropriate risk reduction measures and abatement techniques. In addition, there will be a guidance that allows operators to identify substances of very high concern or other prioritised substances in use with the purpose that hazardous substances with defined features can be more easily detected and assigned for substitution or for further action (prevention or reduction release). The overall guidance and interactive tool also supports operators in the access and handling of the available substance related information, contained e.g. in the safety data sheets and the ECHA database of registered substances, and also contains recommended generalised end-of-pipe measures (substance or group specific standard phrases for elimination during wastewater treatment).

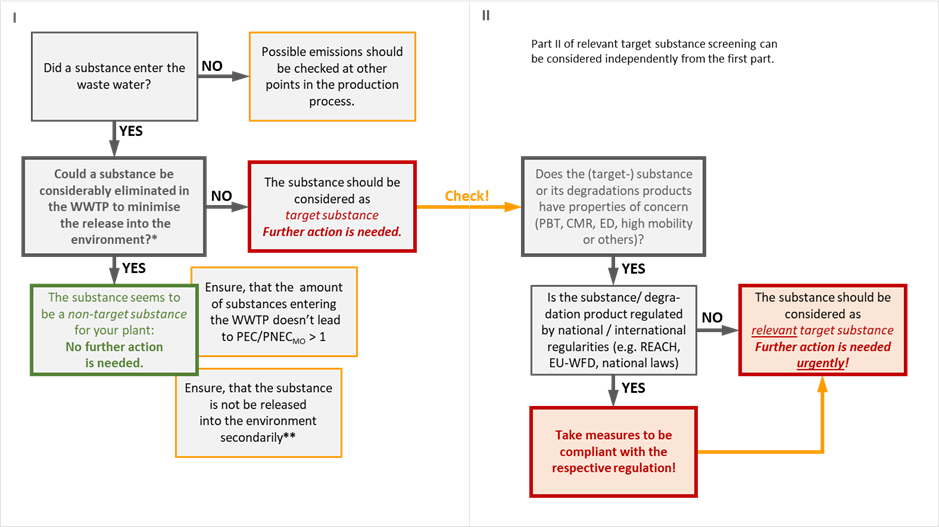


Figure 1: General interactive scheme (draft) on whether the substance is considered as a “target substance” or as a “relevant target substance”.

Using the schemes prepared by WP2 together with the substance-specific information available at the REACH databases and in the SDS clearly shows that there is a lack of useful data on (eco)toxicology and also degradation products for many chemicals. This will in some cases lead to the classification of substance as “relevant target substances” or substances of concern leading to action although a complete set of data would suggest the opposite. At this point the support of chemical experts is needed for decision making.

# Best Practice in Chemical Management and identification of BAT candidates

To avoid or reduce emissions of hazardous substances a number of approaches should be used. These approaches cover the choice of production process with raw materials and chemicals, measures within an existing production process, to the end of pipe abatement techniques. These approaches can be grouped within three main categories:

* Preventive
* Process related
* End of pipe

**PREVENTIVE**

Preventive measures should be the measures taken in the first place. They address new processes, chemicals or raw materials to be introduced at the facility. To achieve this, it is necessary to obtain and keep enough relevant knowledge and capacity covering the key aspects:

* development of new products and production processes
* the relevant hazardous substances, approval and management of new chemicals
* chemical and raw material inventory
* control systems
* maintenance and regular inspections of operations and equipment

continuous training of staff

**PROCESS INTEGRATED/RELATED**

Process related measures mainly focus on improvement of existing production process, with support systems, within the facility. Some of these process related measures could also be used as preventive measures as described above. If preventive measures cannot be taken, process related measures should be considered as the second option. Recommended process related measures are:

* process mapping of hazardous substances
* improvements in the existing process
* substitution chemical storage and transportation and
* closed cycle processes

**END OF PIPE**

End of pipe measures are the last option in avoiding emissions of hazardous substances. Key end-of-pipe measures are waste stream management, waste and hazardous waste management, pre-treatment of waste streams, gas and water treatment and emergency preparedness.

In the HAZBREF project, best practices regarding management of hazardous substances were identified and recommendations and BAT candidates were prepared for the chemical sector. They were developed based on information from:

* HAZBREF case studies
* Information from the industries and organisations
* Expertise of the HAZBREF project team
* Information available in the current BREF-documents and other descriptions of BAT available.

This chapter contains both general applicable practices and recommendations on BAT candidates. Most of the BAT candidates are applicable to all installations. BAT candidate 5 are applicable for installations producing or handling with plastic pellets. All the BAT candidates are described in detail in Annex 1.

## Chemical Management System

A Chemical Management System (CMS) is a systematic approach regarding chemicals and substances covering several integrated administrative and practical measures. A CMS should not be equated with an Environmental Management System (such as ISO 14001 or EMS according to BAT 1 in CWW) but it can be a part of an EMS. The systematic approach (PDCA) is the same in both CMS and EMS but in a CMS the focus is on the chemicals with the aim to improve management and reduce risks.

The purpose of the CMS is to control the chemicals and hazardous substances at the site, increase knowledge of the characteristics, risks and impact and improve the processes to reduce emissions of hazardous substances.

**CMS proposal developed in HAZBREF project as input to BREF review for textile sector and accepted for the revised draft TXT BREF by EIPPCB (2020)**

In order to improve the overall environmental performance, BAT is to elaborate and implement a chemicals management system (CMS) as part of the EMS (see BAT1) that incorporates all of the following features:

1. process chemical procurements policy to select process chemicals and their supplier with the aim to minimize the use of hazardous chemicals such as substances of very high concern and to avoid the procurement of excess amount of process chemicals
2. anticipatory monitoring of regulatory changes related to hazardous chemicals and safeguarding compliance with applicable legal requirements
3. chemicals inventory
4. identification of the process chemicals pathways through the plant (from procured process chemicals to products, waste and emissions)
5. assessment of the risks associated to the chemicals, based on the chemicals’ hazards, concentrations and amounts. This may include an estimation of their emissions to the environment
6. regular (e.g. annual) check aiming at identifying potentially new available and safer alternatives to the use of hazardous chemicals (e.g changes of process(es) or use of other chemicals with no or lower environmental impacts such as enzymes)
7. goals and action plans to avoid or reduce the use of hazardous chemicals
8. development and implementation of procedures for the handling, storage, use and return of process chemicals

A general Chemical Management System follows the PDCA-cycle: Plan, Do, Check, Act.

It is important to have an established plan for the chemical work.

When objectives and plans are established <<plan>>, the planned measures are taken <<do>>. These measures could cover update of routines, improvements of knowledge of substances and their use and flow within the production process, monitoring of emissions etc. The outcomes of the measures are then <<checked and studied>>, to be a basis for identifying the actions needed <<act>> to improve the process when returning to a new planning phase.

The Chemical Management System is described in more detail as BAT candidate 1 in Annex 1.

## Chemical and raw material inventory and chemical handling system

In order to know which hazardous substances are used or generated at the site, a chemical inventory is needed. See more about chemical inventories in chapter 4.5. It is important to include all types of chemicals and raw materials used in all processes and activities at the site. That is to include chemicals used for example in maintenance, cleaning, firefighting in all parts of the site including chemicals used by contractors and others conducting activities at the site.

In a chemical inventory, there must be information regarding product name, information about ingredients, CAS numbers, a hazard statement, quantity stored and where the chemical is stored. The information in the chemical list must be searchable and there must be routines in place to update the information in the chemical list regularly.

Most of the information needed is addressed using the safety data sheet (SDS). See more about SDSs in chapter 4.1. If some information is missing from the SDS, the supplier should be asked to provide this. Good routines to handle new and updated SDS are crucial to have an up to date and reliable chemical database. These routines should involve on-site handling and updates as well as communication with suppliers on how SDS are delivered. One scenario is paper distribution along with the physical product. However, manual handling increases the risk of information being lost on site and never reaching the responsible person. A more efficient way is through established automatically processed digital distribution of SDS connected to the sales/purchase systems.

An example of a chemical and raw material inventory is described in more detail as BAT candidate 2 in Annex 1.

## Chemical storage and transportation

**Storage in tanks**

The first example is double-walled tanks (see EFS BREF section 4.1.6.1.13.). A double-walled tank can have different designs. The double wall can be placed on the outside of the tank with a distance to the inner wall, adjacent to the inner wall or inside the tank. The double wall is normally applied in combination with a double tank bottom and leak detection for the storage of flammable substances or substances hazardous in contact with water.

Single-walled tanks is another option if they are combined with tank bunds (see EFS BREF section 4.1.6.1.14.). The tank bund shall be designed for large spills and must contain the volume of the tank in case of e.g. shell rupture or a large overfill. The bund consists of a wall around the outside of the tank (or tanks) to contain any product in the event of a spill. The wall must be fully impermeable to avoid leakage to the ground.

All IBCs, small tanks and drums should be placed on a secondary containment (see EFS BREF section 3.1.13.1.). Secondary containment refers to additional protection against storage tank releases over and above the inherent protection provided by the tank container itself.

**Storage based on the substance**

For storage of hazardous substances, it is important to consider the physio-chemical properties. For instance, hazardous materials that could react with other substances, potentially leading to dangerous gases or fumes, should be stored separately. Storage cells is one option for separate storage (see EFS BREF section 3.1.13.1). In Figure 2, there is one example of a storage-class-compatibility check used in Germany containing a list of storage classes and how they should be stored (joint or separate).

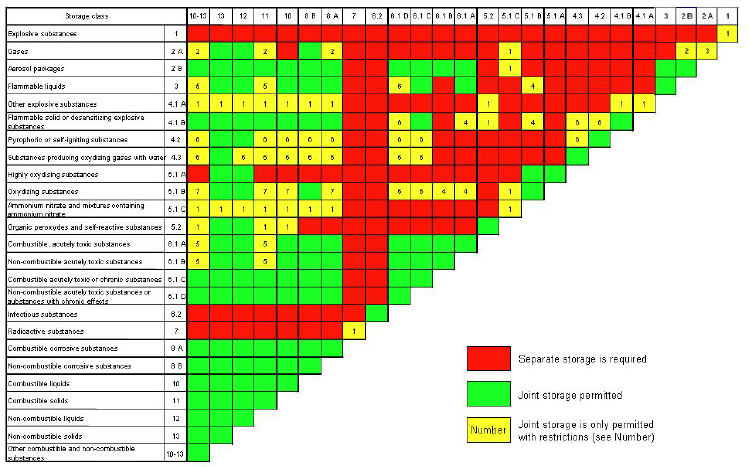


Figure 2: Storage-class-combatibility check containing a list of storage classes and if they should be stored joint or separately (Source: Technical rules for hazardous substances, TRGS 510)

There could also be dedicated systems for tanks and equipment where these are only used for one group of products. This makes it possible to install and use technologies specifically tailored to the products stored (and handled), thereby preventing and abating emissions efficiently and effectively (see EFS BREF section 4.1.4.4.).

**Transfer**

The transfer of hazardous substances is another potential environmental issue where emissions can occur. To reduce the emissions and the risk of leakage, there should be risk-based inspection plans and proactive maintenance plans as well as leak detections and repair programmes. For valves, a diaphragm, bellows or double-walled valves should be used (see BREF document Section 4.2.9.).

Additionally, there should be a dedicated unloading area for trucks with precautionary measures in case of spills. These precautionary measures could be for instance a valve or a tank underground, to catch accidental releases of chemicals during unloading.

## Optimization of process integrated recycling

Establishing recirculation in one process step could lead to big savings in resource use as smaller amounts of new materials have to be added in the process. By recirculating chemicals that are not needed in the final product and that would otherwise go to waste, both the chemical input and the unwanted output could be reduced.

One example of a recirculating process step is from one of the case studies and its production of polyethylene. The process is based on the operation of loop and gas-phase reactors in series. The output from the second loop is a polymer powder containing residual hydrocarbons that have the potential for material recovery.

In a separation step, the residual hydrocarbons are separated from the powder by nitrogen purging and fed to distillation columns where light and heavy compounds are separated. Various hydrocarbon fractions are separated in several distillation units for different purposes. Oligomers are used for energy production; light hydrocarbons are recycled for use in another process for olefin production as feedstock and unreacted hydrocarbons are recycled back to the loop and gas-phase reactors as an input to the process.

A recirculation will result in environmental benefits such as decreased emissions to air due to efficient use of hydrocarbons, a minimised use of hazardous chemicals and hence reduced emissions of hazardous substances to the environment.

An example of an optimization of process integrated recycling is described in more detail as BAT candidate 3 in Annex 1.

## Substitution

A successful substitution work can be performed in four stages;

Stage 1: Identification of hazardous substances

Stage 2: Screening for possible alternatives

Stage 3: Evaluation and choice of alternatives

Stage 4: Development of new alternatives

*1. Identification of hazardous substances*

Strategical decisions on what to screen for and creating a control over the products used in the production processes. An effective tool to manage the identification is to use a structured inventory for all chemicals as mentioned in section 5.2.1. Such a system can help to identify hazardous substances and some of them also have screening methods for substances that are structurally similar to the identified hazardous substance.

*2. Screening for possible alternatives*

The screening process starts with the understanding of the function of the identified hazardous substance with help of three main questions;

* Why is this product/substance used?
* What is the function of the identified hazardous substance?
* Is that function needed? If yes, can the function be achieved through a substitute?

When the function of the identified hazardous substance and the actual need for the product/process is established the screening process can focus on finding solutions with an equivalent function. The new solution does not need to be identical, but it must solve the requested function. This means searching for chemicals but also non-chemical alternatives, materials or other technical solutions.

*3. Evaluation and choice of alternatives*

This process requires both chemical and toxicological knowledge combined with knowledge regarding the production site where the substitute is going to be used. Key considerations are the hazardous properties of the substitute, relative exposure (compare the difference in total exposure between the current substance and the substitute), technical performance, and long-term cost at full production (not at pilot scale). The new solution often brings new questions to light, or alternative production methods that must be taken into the equation during the evaluation.

*4. Development of new alternatives*

The fourth step of the substitution process involves developing new sustainable substances or techniques. In the absence of available alternatives, new innovations and/or techniques may be necessary.

It is important that the needs of certain functions are communicated within the supply chain all the way from the manufacturers down to the end users. Depending of the role of the production facility in the supply chain, this step involves different tasks. Transparency in the supply chain is one of the key issues for a successful development.

## Process mapping of hazardous substances

To be able to take actions for reducing emissions of hazardous substances, good knowledge of the production processes is needed. One example of how to do this is by working with process mapping of hazardous substances. The purpose of the working method is to reduce the emissions of hazardous substances to the process wastewater and finally to the recipient, to avoid investments in a very complex and expensive process and treatment plant for wastewater treatment that would have been the alternative option.

The process mapping of hazardous substances includes different steps; identification, calculation of mass balances, sampling and analysis, implementation of actions and verification and is described in more detail as BAT candidate 4 in Annex 1.

## Management of hazardous waste

Hazardous waste management can pose a risk when it comes to the discharge of hazardous substances. The following aspects are important to manage by implementing routines for safe handling, training for employees and contractors and environmental requirements on waste transporters and waste vendors in order to produce safe and secure handling of the hazardous waste from the production site and until the waste is finally disposed. Examples of routines to have in place for collection, storage, classification-labelling-packaging, transport and final disposal follow below.



*Routines for collection*

* Separating hazardous waste from other waste and
* Training for employees handling hazardous waste, with focus on the different types of hazardous waste, the characteristics and risk with different hazardous waste fractions, how to handle them and use of necessary Personal Protective Equipment (PPE).

*Routines for storage*

* Hazardous wastes should be stored protected from precipitation and on a surface impermeable to water
* Liquid hazardous waste should be stored in a secondary containment
* Acids, bases, solvents and other chemicals should be stored separated from each other
* Regular inspections of the storage area

*Routines for classification, labelling, packaging*

* Classification, packaging and labelling must be performed by a trained waste chemist
* Documentation of hazardous waste fraction (type, amounts, classification) in a transportation document that will follow the transport of the waste to final disposal

*Routines for transport and final disposal*

* According to national and local regulations
* Requirements on contracted waste vendors
* Regular auditing of waste vendors to check compliance with requirements

## Wastewater treatment

An example of a wastewater treatment process is described in more detail as BAT candidate 5 in   
Annex 1.

# Permitting Process and Management

The IED stipulates that IED installation may not be operated without a valid permit that meets the IED requirements. Such a permit must contain emission limit values (for emissions to air, water and soil), which are based on BAT listed in the sector-specific BREF. Furthermore, the permit must contain all relevant conditions and stipulations (also based on BAT) on: (1) integrated pollution prevention measures (such as the prevention of applying certain chemicals, not to carry out certain processes, establishment of wastewater, waste and chemicals inventories); (2) self-monitoring, storage and handling of chemicals; (3) health and safety aspects, especially concerning the application of hazardous toxic chemicals; (4) the right of the competent authorities to carry out inspections any time, to take wastewater samples any time and (5) measurements of emissions to air by certified third-party institutions at a certain frequency etc.

In addition to the sector-specific BREF, other relevant BREFs should be taken into account in the permit application. In chemical industry there might be several relevant BREFs for one site. These complementary and relevant BREFs are listed in the scope of the BREF document.

The HAZBREF case studies and interviews with representatives from permitting authorities in five countries[[29]](#footnote-30) indicate significant differences between the respective permitting procedures regarding detail as well as frequency of information on substances to be submitted. Furthermore, while some countries apply BREFs and BAT conclusions directly (e.g. Sweden), others transpose it into national law (e.g. Germany).

Differences in the permitting requirements are also visible within countries. For example, while in one German federal state IED installations are required to submit a list of chemicals products used on an annual basis, in other federal states no such requirements are in place.

## Environmental permitting and inspection cycle

In the following, the steps of the IED permitting and inspection cycle will be addressed with special consideration of available tools and references as well as common challenges for permit writers, competent permitting authorities and operators. The figure below provides an overview of the steps, inputs, links between the steps and how they work together.

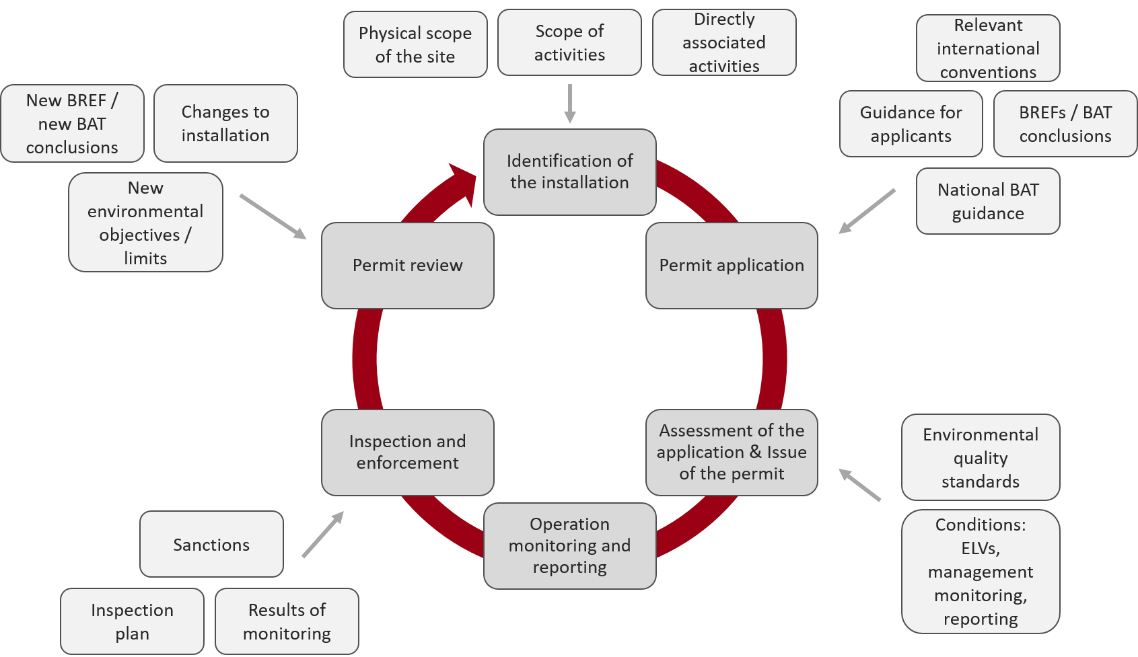


Figure 3:IED permitting and inspection cycle[[30]](#footnote-31)

According to Finland's environmental protection legislation, permits are needed for all activities involving the risk of pollution of the air and water or contaminating the soil. One important condition for permits is that emissions are limited to the levels obtainable by using Best Available Techniques (BAT). Applications must be made to the relevant authority, as defined in the Environmental Protection Act and Decree. The authority will then make the application public as appropriate, giving the relevant authorities and anyone affected by the plans time to comment and make proposals concerning the requirements for the permit. Complaints against permit decisions may be made to the Administrative Court, then to the Supreme Administrative Court (Figure 4).

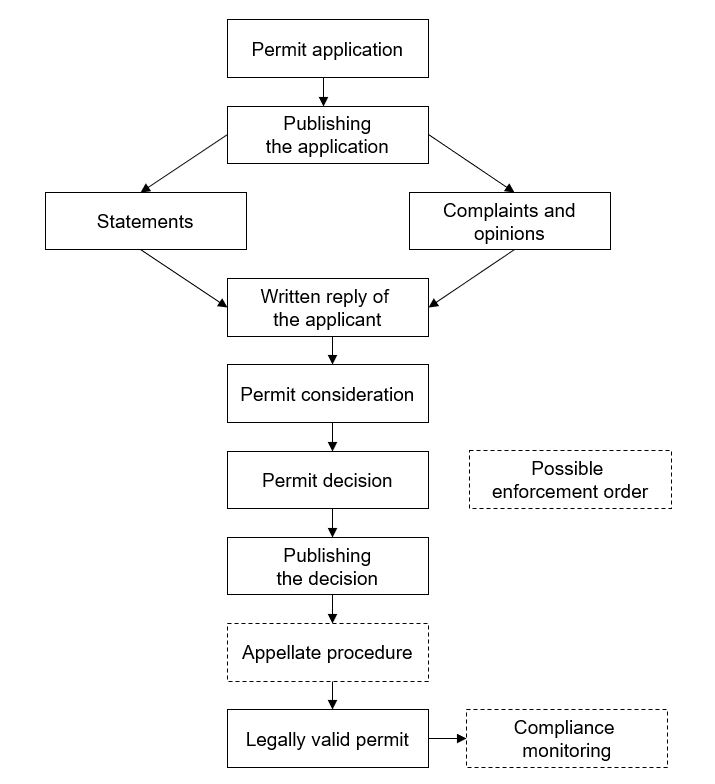


Figure 4: General flow chart of the permitting procedure in Finland

According to Estonian legislation obligations for applying permit depend of emission type. For air emission permit requirement depends on emission values and/or facility size (e.g. power of combustion engines). For water emission permit is needed regardless of quantities of pollutants discharged (even if background values are higher than those in discharged water). If facility size is above IED threshold values all emissions must be described in application. Before issuing, the IED permit is published.

### Permit Application

Before starting to prepare a permit application, it is recommended that operators contact the competent authority and get an overview of the available templates and guidance materials. A list of available reference documents and tools is provided in Annex 2. It is the duty of the operator to submit sufficient data according to both REACH[[31]](#footnote-32) and IED[[32]](#footnote-33) to competent authority. The competent authority is responsible to inform the operator about the extent and format of required chemical information.

According to Article 12 of the IED, the permit application must include descriptions of the following aspects related to chemical management:

* the installation and its activities;
* the raw and auxiliary materials, other substances and the energy used in or generated by the installation;
* the sources of emissions from the installation;
* the conditions of the site of the installation;
* where applicable, a baseline report in accordance with Article 22(2);
* the nature and quantities of foreseeable emissions from the installation into each medium as well as identification of significant effects of the emissions on the environment;
* the proposed technology and other techniques for preventing or, where this is not possible, reducing emissions from the installation;
* measures for the prevention, preparation for re-use, recycling and recovery of waste generated by the installation;
* measures planned to monitor emissions into the environment;

An important source of information are the SDSs. If they don´t contain sufficient information additional information sources are needed, such as information published by ECHA or information provided by other databases (see section 3.2 and 3.3).

It is the competent authority’s duty to ensure that the operator submits the chemical inventory (see section 5.2.1 and BAT candidate 2 in Annex 1) as complete as possible. Using the data provided in the chemical inventory the competent authority can:

* identify chemical products containing hazardous and non-biodegradable substances,
* develop permit conditions such as emission limit values for certain compounds,
* develop recommendations to substitute certain chemical products or at least to reduce their consumption and
* set requirements for monitoring and abatement techniques.

The same applies to requirements for handling and storage of chemicals at the installations. For example, chemical products, which can spontaneously decompose resulting in explosions (e.g. hydrogen peroxide) or fires (e.g. sodium dithionite) have to be stored separately with adequate security measures (see also section 5.3.1).

Although the IED does not address compliance with REACH duties as such, several European member states, which were interviewed for the IMPEL Report on “Linking the Directive on Industrial Emissions (IED) and the REACH Regulation”, stated that IED and REACH are already linked directly or indirectly in their legislation (e.g. through reference on REACH in legislation and guidance documents or supporting tools). In the electronic IED application software (ELiA) REACH duties are for instance checked in the Template “Chemical Safety”. In many other countries, REACH duties are not systematically checked during the IED permitting process.

**Good Practices:**

**Electronic tool for submission of applications (ELiA, Germany)**

[ELiA](https://www.gewerbeaufsicht.niedersachsen.de/umweltschutz/genehmigungsverfahren_nach_bundesimmissionsschutzgesetz/elia_elektronische_antragstellungsprogramm_version_21/elektronisches-genehmigungsverfahren-72382.html) is an IT solution designed for the application and approval of installations under the IED resp. the German Clean Air Act (BImSchG). With this tool, companies or the engineering offices commissioned, can electronically prepare IED permit applications and send them to the competent permitting authority in encrypted form. The aim is to ensure that even extensive permitting procedures for the erection and operation of installations (or for their substantial change) are carried out more uniformly, effectively, efficiently and in accordance with the BImSchG. ELiA is currently used by 8 of the 16 German federal states and can be downloaded free of charge from the websites of the respective state governments.

**Electronic chemical database (KemiDigi, Finland)**

KemiDigi is a national chemical information resource and service which pulls together national chemical data. Suppliers or importers of chemicals will upload the chemical notices to KemiDigi. Companies (users of the chemicals) can use the KemiDigi system to compile their lists of chemicals used in production. Chemical, environmental and safety authorities are able to see the chemical lists in KemiDigi and use them for their supervision or permitting activities.

**Electronic tool for submission of applications (Estonia)**

In Estonia all environmental permits are applied and managed in electronic platform (https://kotkas.envir.ee/). Applicant fills the forms. System makes preliminary logic tests (e.g. if given working hours are equal or less to total hours of entire year). Details are so far checked by authority specialist. Permits are issued in the same system. Permit owner receives reminders from system to provide monitoring data. Monitoring data is also entered to e-system. Now, application evaluation is mostly done by human, but in future it is planned to shift quality and compliance check as much as possible to automation.

More open communication during the permitting process would make the whole process more effective and faster. Also, more communication between the environmental and chemical authorities would be valuable, for example the information regarding the use amounts of chemicals must be reported to many different authorities. It is extremely difficult for the applicant (=installation) to receive information during the process. More open communication and involvement of all stakeholders during the application stage could lead to less complaints and overall faster and more streamlined process.

### Assessment of the application documents and permit decision

The competent authority must assess the environmental performance of the installation. Chemical-related data are evaluated on the basis of the chemical inventory (see section 5.2.1 and BAT candidate 2 in Annex 1). A major challenge for an efficient assessment of chemical-related information is the lack of systematic evaluation approaches and the lack of comprehensive and accessible information sources. The most important sources of information regarding relevant substances are the SDSs (see section 4.1.1). Other sources include chemical databases such as those made available by ECHA or national organisations (see section 3.2 and 3.3), as well as various checklists or reference tools. SDS exposure scenarios can serve as an additional valuable source of information (see section 4.1.3) if they are available. An exemplary compilation of suitable tools and references for hazardous substances is presented in Annex 2.

**Good Practice: Norway**

The Norwegian Environmental Agency has developed a flow chart which is mainly used as a working tool by permit writers. The flowchart gives an overview of the different chemical regulations that apply when working with IED approvals and further contains a link to the [Norwegian Chemicals Database](http://miljodirektoratet.no/kjemikaliesok/). Searching by substance name, CAS or EC this database provides results which include the respective provisions of the National Priority List, the REACH Candidate List, the REACH Authorisation List, the REACH Restriction List, CLP and possible other provisions (e.g. related to biocides).

**Good Practice: Germany (Schleswig-Holstein)**

In Schleswig-Holstein, an interdepartmental team of experts was formed to pool expertise on IED applications and chemicals legislation and to make the relevant information more easily accessible. Consisting of experts in chemical law enforcement and environmental inspectors, the experts can advise both applicants and competent authorities on questions relating to chemical law aspects in the field of IED permitting and plant monitoring. Their work includes the evaluation of chemical inventories, the reference to obligations under chemicals law (in particular REACH obligations), the formulation of ancillary provisions for permitting, as well as the monitoring of chemicals law (general, implementation of actions, participation in monitoring of plants with regard to issues of chemicals law).

**Good practice: Finland**

KemiDigi is a national chemical information resource and service which pulls together national chemical data. Suppliers or importers of chemicals will upload the chemical notices to KemiDigi. Companies (users of the chemicals) can use the KemiDigi system to compile their lists of chemicals used in production. Chemical, environmental and safety authorities are able to see the chemical lists in KemiDigi and use them for their supervision or permitting activities. <https://www.kemidigi.fi/>

### Monitoring, reporting and inspections

To ensure compliance with the emission limit values (ELVs) for the pollutants listed under Annex II IED and specified on the basis of the chemical inventory (see section 5.2.1 above), installations should be subject to regular monitoring. The monitoring should address the nature of the pollutants as well as the possible cross-media effects (e.g. in case of scrubbers using water). In German federal states and in Sweden the operators are further obliged to establish and maintain a chemical inventory as part of the self-monitoring. In Finland chemical inventory should be done as part of the permit application. According to the frequency defined in the permit, the operator has to update the chemical inventory, including:

* the major changes in the past year (new chemical products applied, recently identified/classified hazardous chemicals)
* measures taken or foreseen to prevent and abate emissions of hazardous chemicals
* a compilation of all monitoring results of emissions to water and to air
* the type and quantity of hazardous waste listed together with the disposal route.

BAT conclusions shall be the reference point for setting the monitoring scheme (e.g. parameters to be monitored, test method to be applied, required frequency of reporting). The detailed monitoring program should be then done based on the chemical inventory at each installation.

According to Article 23 IED the competent authority should regularly carry out environmental inspections. The inspections should be based on an individual inspection plan and monitoring programme. The determination of the period between site visits should be based on a systematic assessment of the environmental risks of the installation concerned (between 1 and 3 years). The characteristics of the chemicals processed or produced in the installation concerned play an important role in the risk assessment. However, as presented above, the chemicals management is also subject of the annual reporting.

If the inspection reveals non-compliance with the permit conditions, an additional on-site visit must be carried out within 6 months after the first inspection according to Article 23 IED. Article 23 also states that non-routine inspections shall be carried out in order to investigate serious environmental damage, serious chemical and environmental accidents or incidents of non-compliance. The inspections should be carried out as soon as possible and, where appropriate, before the permit is granted, reviewed or updated.

Findings from the case studies:

* Some companies use consultants to carry out monitoring, environmental auditing and to help with securing that legal requirements are followed.
* In addition to monitoring program, company’s own surveillance is carried out and certificates and audits are utilized. Company internal standards and requirements for chemicals are often stricter than permit conditions.
* In many cases the monitoring program can be updated even if the environmental permit is not updated with the approval of the supervisor.
* Monitoring needs resources and measurement and analysis of some parameters are more challenging and expensive than others. Therefore, the term “technically and economically feasible” would need more clarification also in relation to monitoring.
* The personnel at case installation would like that the monitoring is based on chemical inventory so that the amount of substances monitored would be reasonable and justified based on environmental fate of the substances and significant releases.
* There have also been some misunderstandings in the way the monitoring should be done. Therefore, the permit conditions and the monitoring program should be clear for all parties so that the authorities would not argue among themselves how the requirements should be fulfilled.
* The personnel at some installation criticize the setting of different emission limits values in the environmental permits for the same parameters in different sites. It is not always clear for the operator what the limit values are based on. Therefore, a clear justification (e.g. lower emission limit values based on local conditions) is recommended from the authority.

### Review of the permit

Competent authorities should regularly check whether substances manufactured or used in the installation are included in the SVHC list or whether they are subject to REACH authorisation or restrictions. Changes should be considered when evaluating new measures and reviewing the permit. Furthermore, Art. 21 (1) of IED requires the competent authorities to ensure that, no later than four years after publication of the BAT conclusions, all permit conditions have been reviewed and, if necessary, updated to ensure compliance with the relevant provisions and that the operators of the installation have taken appropriate measures.

To improve the permit review process, it is recommended to include a stipulation in the permit that requires installations to submit a chemical inventory (as described under section 5.2.1 and in BAT candidate 2 in Annex 1) on an annual basis. This would allow for a regular screening of the applied chemicals/ chemical products and thus minimise the risk of hazardous chemicals being used.

In Sweden IED and BAT conclusions are implemented as general binding rules. Therefore, instead of reviewing the permit after the publication of new BAT conclusions, operators are required to prepare an annual environmental report including a summary of all measures taken to ensure compliance with the general rules of consideration, the permit conditions and the BAT conclusions. A review of the permit is only required in case the installation is upgraded in response to the new regulations.

## Challenges & Recommendations with regard to environmental permitting

A common challenge for both the operators of IED installations and competent permitting authorities is the access to and evaluation of information on hazardous substances.

A lot of expertise on chemicals is needed among the authorities. One solution could be establishment of chemical units (example from Germany[[33]](#footnote-34)) or specific groups focusing on chemicals among authorities. Another solution could be a database where chemical lists and SDS are available for all relevant authorities, which is done for example in Finland[[34]](#footnote-35). Good practice is also to arrange regular meetings and trainings together with environmental and chemical authorities where the participants can share knowledge. Another good practice is to have continuous co-operation between chemical and environmental authorities. It would be good to also exchange information on identified problems and solutions between MS authorities on regular basis.  
  
One recommendation from HAZBREF is that there would be more discussion between the applicant and authorities during the permitting process. Open communication would clarify issues before the permit is issued and make the whole process more effective and faster.

It is the duty of the operator to submit sufficient data according to both REACH[[35]](#footnote-36) and IED[[36]](#footnote-37) to competent authority. The competent authority is responsible to inform the operator about the extent and format of required chemical information. For example, in Finland there is a specific table to be filled in for the permit application (See Annex 5). Usually operators simply compile chemical information from the SDS and send a list together with the SDS for all chemical products used. The evaluation of this chemical data is often too time consuming and difficult for the competent authority.

The format for a chemical inventory should be standardised. An example is given in Annex 5. It is the duty of the operator to provide information in a way that it can be quickly assessed and that conclusions in the form of permit requirements, stipulations and conditions can be drawn more easily.

There are first approaches to standardise the IED permit application requirements regarding information on chemicals used (e.g. ELiA Germany), but most IED requirements regarding the provision of information on used (hazardous) substances are by no means standardised at both international and national levels. Therefore, section 6.1.2 and 6.1.3 and Annex 5 of this Report provide an overview of chemical information requirements that should be available during environmental permitting.

In case a chemical supplier fails to provide SDS with sufficient quality, it is the duty of both the operator and the competent authority to ask for the missing information.

Availability of staff and expertise on chemicals pose a challenge for competent authorities. Short-staffed authorities are not able to dedicate enough time to each IED installation, hampering their ability to carry out extensive and in-depth evaluations of chemical inventories. Analysing measurement results and mass flows also requires a lot of time. Ideally, the staff composition of relevant authorities would bring together expertise in the areas of chemical and environmental engineering, legal requirements and sectoral process technology.

# Circular Economy issues in polymer sector

The aim of circular economy (CE) is to eliminate waste and to use resources sustainably. For polymer manufacturers implementation of CE priorities means finding a reliable source of secondary raw materials and the method of its processing due to obtain basic product of high-quality (monomer). Environmental requirements of waste processing and the respective costs are key factors which determine waste management in the companies. Taking into account the merits of virgin raw materials as crude oil or gas, efficient processing of polymer waste or polymers in close loop systems is a big challenge.

Hazardous substances may hamper polymer processing when SRM is used as raw material for polymer production. This issue has been discussed in numerous papers (an example of multithreaded analysis is the study conducted by Stenmarck Å et al [[37]](#footnote-38)).

For the industrial and market applications the polymer manufacturer usually provides the polymer in its basic form (e.g. PE, PP, PA, PS). The final composition of the plastic product is determined by the so-called “compounding” process, usually run by another entity further down in the value chain. In the POL BREF these processes are briefly characterized for polyamides as processes for changing polymer formulations with a wide range of molecular weight, mostly compounding grades[[38]](#footnote-39). In the compounding process, the polymers are modified according to the product requirements. Numerous chemicals (including hazardous substances), may be used in this process. The desired product properties are obtained through modifications of key parameters such as mechanical strength, heat resistance or flame retardation. Moreover, during the polymers production the risk of synthesis of hazardous substances during the process, must be considered.

Accessibility of information on polymer composition significantly determines the opportunities of efficient processing of plastic waste. Hence, the most valuable waste stream for recycling is production waste from polymer manufacturing industry, with known composition and high purity (i.e. not contaminated with other polymers or other components). The risk of hazardous substances is identified and characterized in the SDS and relates to specific substances. For the polyamides these substances can be both the polymer components themselves - i.e. monomers (e.g. caprolactam), and additives (e.g. flame retardants as melamine cyanurate or antimony trioxide). Customer requirements plays important role in the final composition of plastic products due to use of process additives, which may include hazardous substances.

**Findings from the case studies:**

Each industry has a number of technical and legal standards for raw materials and products, which has to be fulfilled. The use of recycled plastics does not exempt from meeting the quality requirements. Therefore, the use of secondary raw materials is challenging for many polymer producers and some plastics are not usable for reuse in polymer production.

Plastics can be recycled mechanically or chemically (chemical processing is also called feedstock recycling). Mechanical recycling is widely used, but at the moment there is no economically viable method to chemically recover polymers back to monomers.

In feedstock recycling the polymers are broken down to monomers and other basic chemical elements (by depolymerization process). This is an option for polymers that are difficult to recycle mechanically due to low quality, composite nature or low economic value. These monomers can be used as virgin material alternatives in manufacturing new polymers[[39]](#footnote-40).

There are commercial applications for depolymerization processes already on the market, however the wide use is still limited and the whole technology is still under development and there are many economic and technical challenges to be solved. The challenges are confirmed by experiences of polyamide producers in Polish case installations. Despite the challenges, chemical recycling, where the raw material is produced by depolymerisation, appears to be the way forward for implementing Circular Economy issues in the polymer production sector.

**Findings from the Polish case studies:**

* One of the Polish case study operators has carried out depolymerization of solid waste to recover the monomer caprolactam, to produce polyamide. Due to economic reasons, the installation was shut down in 1996.
* The most valuable secondary raw material for polymer manufacturers are, due to the quality requirements, own post-production waste or well characterized waste from compounding processes.
* If secondary raw materials from external suppliers is considered, the raw material must meet high quality requirements.
* Good practice is to sort waste, taking into account possible contaminated materials.
* Good practice is direct pumping of liquid waste into tank trucks. An example from a Polish case installation producing polystyrene is direct pumping of waste liquid mixture of styrene and ethylbenzene into tank trucks of a waste treatment company. The liquid waste is reused by external operator.

# Concluding remarks

Chemical industry covers many different processes and installations. There are many legislations which concern the installation, and this leads to challenges in chemical management for both operators and authorities. The requirements from authorities are based on law but often the companies have their own programs and rules which are stricter than the requirements based on current law. The authorities need a lot of knowledge on chemical issues, but this information is not always easily available.

Based on HAZBREF project findings, the following conclusions can be drawn:

**Improvement of chemical management system**

A Chemical Management System (CMS) provides a systematic way of managing chemicals. The CMS can be integrated with the Environmental Management System (EMS). The purpose of the CMS is to control the chemicals and hazardous substances at the site, increase knowledge of the characteristics, risks and impact and improve the processes to reduce emissions of hazardous substances.

The HAZBREF project recommends the use of a CMS following the principles described as BAT candidate 1 in Annex 1.

**Development of Inventories and databases**

In order to know which hazardous substances are used or generated at the site, a chemical inventory is needed. It is important to list all types of chemicals and raw materials used in all processes and activities at the site in a database. The chemical list or database is a key part of chemical management allowing for systematic risk assessment, management of chemicals flows and their storage. It is useful in the permitting processes by providing easy access to data for chemicals used in the installations.

The information in the chemical list / database must be searchable and the list should be updated regularly. Most of the information needed is available in the safety data sheets (SDS). If some information is missing from the SDS, the supplier should be asked to provide this.

The HAZBREF project recommends development and use of a chemical and raw material inventory following the principles described as BAT candidate 2 in Annex 1.

**Quality and use of Safety data sheets (SDS)**

To allow for efficient chemicals management, it must be assured that all SDS comply with a certain quality level. In case a chemical supplier fails to provide SDS with sufficient quality, it is the duty of both the operator and the competent authority to demand the missing information.

Better SDSs, including improved data on environmental hazards, and exposure scenarios would make risk assessment of individual chemicals in specific process easier. This would lead to more efficient monitoring and help to focus on problematic substances. The SDSs of raw materials should be better concerning information on impurities. Also the chemical inventory could be improved if detailed data about the impurities or intentionally added constituents would be available in SDS.

Exposure Scenarios are not usually directly usable for the operators. Sector specific environmental release categories (SPERCs), based on measurements and info about the typical environmental fate of substances in the sites could help but they have not yet been developed for many industrial uses.

**Process mapping of hazardous substances**

To be able to take actions for reducing emissions of hazardous substances, good knowledge of the production processes is needed. One example of how to do this is by applying process mapping of hazardous substances. The purpose of the method is to identify the releases and reduce the emissions of hazardous substances to the wastewater and finally to the recipient. The purpose is also to optimise monitoring and identify cost efficient ways to reduce emissions.

The HAZBREF project recommends mapping of hazardous substances following the principles described as BAT candidate 4 in Annex 1.

**Substitution**

Substitution is an important tool to minimise chemical risks at the installation. A successful substitution work can be performed in four stages; Identification of hazardous substances - Screening for possible alternatives - Evaluation and choice of alternatives and Development of new alternatives. Regrettable substitution should be avoided.

**Permitting process**

Permit process could be streamlined with more communication during the application phase between the applicant and permitting authority. More co-operation between chemical, environmental and occupational health authorities is suggested to achieve smooth information flow and reduce double work. More exchange of information and good experiences between Member States would also contribute in the long run to more harmonised and better practices on European level.

The format for a chemical inventory should be standardised. An appropriate approach is given in Annex 5. It is the duty of the operator to provide information in a way that it can be quickly assessed and that conclusions in the form of permit requirements, stipulations and conditions can be drawn more easily.

# Annexes

Annex 1 – Recommendations on BAT candidates

### 1. Chemical Management System

In order to reduce emissions of hazardous substances in the chemical industry, it is important to introduce a systematic approach for handling chemicals. It is possible to start by implementing individual actions and sub-measures and when it is fully implemented it can be called a Chemical Management System (CMS). A CMS should not be equated with an Environmental Management System (such as ISO 14001 or EMS according to BAT 1 in CWW) but it can be a part of an EMS. The systematic approach (PDCA) is the same in both CMS and EMS but in a CMS the focus is on the chemicals with the aim to improve management and reduce risks.

The purpose of the CMS is to get good control of chemicals and hazardous substances at the site, increase the knowledge of the characteristics, risks and impact and improve the processes to reduce emissions of hazardous substances, in a systematic way. As an example, through the chemical management system, a routine is established on how to minimize the use of hazardous chemicals and releases of hazardous substances.

The CMS is useful for handling obligations in different legislations like IED, REACH and SEVESO. Read more about obligations in chapter 4.

A general Chemical Management System follows the classical PDCA-cycle as any management system: Plan, Do, Check, Act. See figure below.

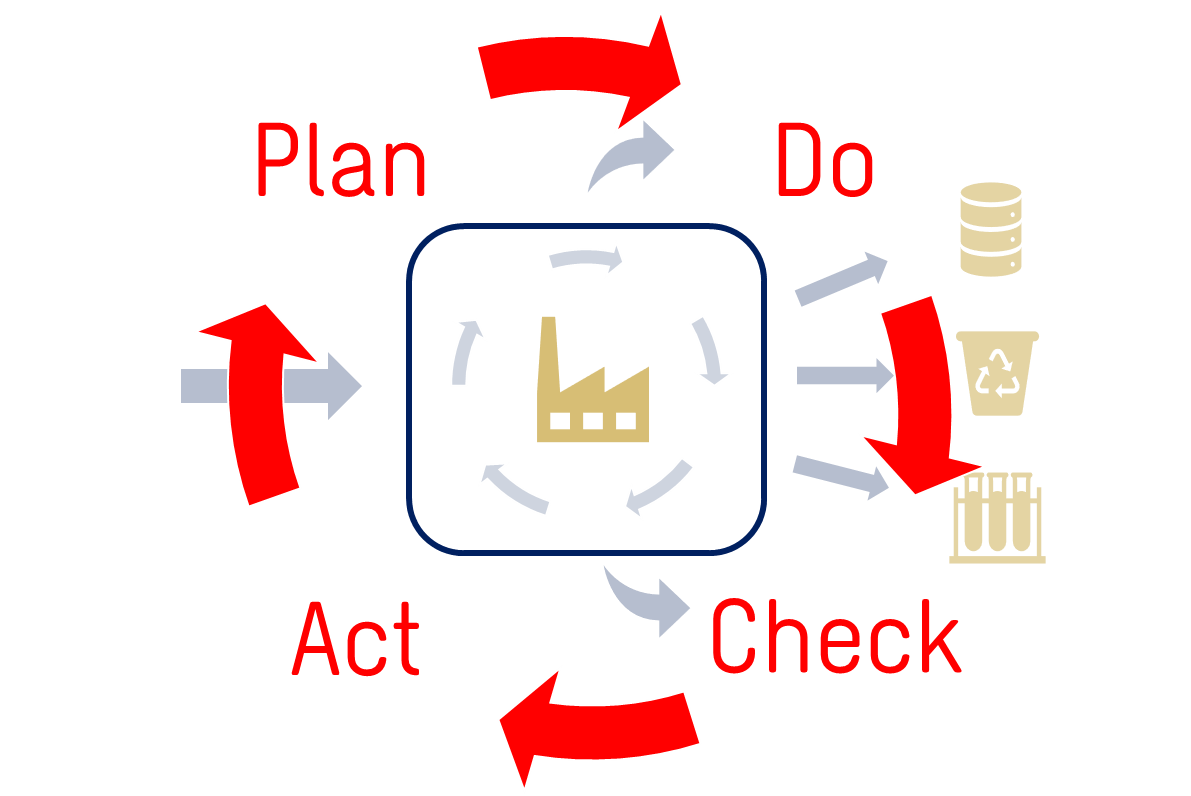


Figure 5: The PDCA-cycle related to chemical management

Plan

To allow for an effective chemical management, it is necessary to clearly identify which chemicals are used, how they should be used, and how the risks can be minimized. This requires that inventories established are continuously updated. Chemical inventories allow, for example, for a targeted compilation and assessment of chemical related information, which can serve the specific information requirements of different organizational units within the industrial facility.

1. Process chemicals procurement policy to select process chemicals and their suppliers with the aim to minimize the use of hazardous chemicals and to avoid the procurement of excess amounts of process chemicals. This is to reduce total releases to water and air.
2. Set goals and action plans to avoid or reduce the use of hazardous chemicals.

As for all management systems, it is important to have a statement from the top management in the company, including:

* What Chemicals or substances are approved/not approved to use on the site.
* How to ensure compliance with relevant legislation.
* How reduction of hazardous substances can be reached.
* How many undesirable chemicals can be substituted.

Do

Actions are taken according to the plan. For example, improvement of chemical and raw material inventory, conduct training to raise awareness, changing production procedures, etc.

1. Monitoring of regulatory changes related to hazardous chemicals and safeguarding compliance with applicable legal requirements
2. Identification of the process chemicals pathways through the plant (from procured process chemicals to products, waste, wastewater and emissions to air)
3. Assessment of the risks associated with the chemicals, based on the chemicals’ hazards, concentrations and amounts. This may include an estimation of their emissions to water and air.

Check

The result of the actions and implementation work are evaluated and analysed. The result must be reported so that current decision-makers are able to take action and establish new plans.

1. Regular (e.g. annual) checks aiming at identifying any newly available and safer alternatives rather than continuing to use the same hazardous chemicals (e.g. process integrated techniques and measures or use of other chemicals with no or lower environmental impacts).

Act

Decisions on new changes for improvements, which then go into the planning phase again.

1. Development and implementation of procedures for the handling, storage and use to prevent or reduce the emission to water and air.

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| ***Name of the technique*** | **Chemical Management System (CMS)** |
| Description of the technique | See the description above. Chemical Management System (CMS) is a way of working that will affect the organization in many ways. There is a need for commitment from the management and communication that these issues are of high importance for the company. |
| Technical description | A CMS is not a technical solution, more an organizational solution that demands leadership, communication, routines and systematic approach. |
| Achieved environmental benefits | With an implemented CMS in place there are prerequisites to set the right focus on chemical handling and work with continuous improvements. The aim of the CMS is to achieve an improved handling of chemicals with a reduced risk of discharging hazardous substances to the environment. Targets are set by management and the resources allocated by the management. |
| Environmental performance with regard to hazardous substances and operational data | N/A |
| Cross-media effects | No cross-media effects are expected from this implementation. |
| Technical considerations relevant to applicability | A CMS can be implemented within the whole chemical sector and it can be adapted to each type of industry with the focus needed. |
| Economics | Above all, it is about appointing an organization with a team that can lead the changes. First, in the form of a project, but when the appointed actions are in place and implemented in the operations it will be a natural part in the ordinary procedures at the site. |
| Driving force for implementation | Costumer-specific requirements, requirements from insurance companies or other stakeholders can be a driving force for implementing a CMS. |
| Example plants | The chemical industry in Sweden working with production of organic chemicals (polymers) used in pharmaceutical industries. |
| Reference literature | Framework and certification from internationally recognized management systems such as ISO 9001 or ISO 140001 may be referenced and/or utilized in developing a chemicals management system.  <https://www.iso.org/standards.html> |

### 2. Chemical and raw material inventory

The main purpose with a chemical inventory is to gain control and acquire a good overview of all chemicals, including raw materials/products for production, maintenance- and cleaning products. A structured inventory is a key factor for further actions and work to maintain a successful chemical management. This type of system can be built up in different ways and include small or large amounts of data that can be used for screening of hazardous substances used at a specific site. Depending on the size of the company and the amount and variation of chemicals/products that are used, different datasets should be included in the system. The basic information, besides the product names, is some type of material identification. If available, the CAS or EC numbers should be added to the inventory.

This type of basic inventory can be built up in a simple Excel list with the ability to evolve and stretch out the information added during the work process. Basic information extracted from an SDS should be included in the inventory;

* Product name
* Producer
* Type of product (Chemical categorization)
* CAS number (Raw material and substances)
* Content of hazardous substances in weight-% for individual substances in mixtures
* CLP hazards
* SDS date
* If available, information from the exposure scenario.

The purpose of this basic data is to provide a possibility to track and pinpoint hazardous substances and to identify products in the facilities that contain these substances. The CAS numbers gives an identification commonly used in legislative and customers band and restriction listings. There are no given legal applications on how old an SDS can be, so the SDS date is added to evaluate how old the given information is and to monitor the need for a review. The operator should ask the chemical supplier for updated information when needed.

The quality of the SDS can be a risk factor for inaccurate safety information. Since not all classifications are harmonized, different manufacturers can provide contradictory information on the same substance. For monitoring and evaluating information of hazardous chemicals, there are many tools on the ECHA webpage and industry sector NGOs that can assist in conducting a high-quality-risk assessment for substances of concern.

For a complex system, toxicological, and physical data can be added to the inventory for further advanced evaluations and screenings in the CMS process, both for approval evaluations and substitution, but also physical parameters useful for the process mapping of hazardous chemicals and handling and storage processes.

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| **Basic information** | | | | | | **Advanced tox data used for evaluation and approvals** | | | | | | | **Storage** | | |
| Commercial Name | Producer | Process application | CAS | CLP hazard | SDS date | Cont. haz. Substances in [weight-%] for indiv. subst. | Biolog. degradation/ testing method | BOD/COD value | Toxicity to bacteria EC50 | Toxicity to algae EC50 | Toxicity to daphnia EC50 | Toxicity to fish LC50 | flashpoint | Annual consumption (kg) | Max quantity stored |
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Depending on the number of chemicals used at the site, there can be different solutions for a chemical inventory. In the simplest case with handling up to 200 chemicals, an Excel file with the setup described above can be suitable.

But if the number of chemicals is greater or used in facilities with different units, a commercial chemical handling system that can be business-integrated or as a stand-alone system is preferred. Beside the fact that such a system can handle and structure a larger number of products, such systems also provide good support functions such as; access to safety data sheets, risk assessment functions, direct contact and update to legislative, classification and labelling changes.

The main advantage with a digital chemical database in the aspect of hazardous substances is the possibility of screening through all products used in a company against various substance lists, governmentally and customer integrated. Keeping the register up to date is crucial for all further work with detecting, monitoring and actions for prevention and reduction of hazardous substances.

Following is a list of important functions to request in a chemical handling tool;

* List of all chemical products used
* Identification of chemical products with high acute or chronic aquatic toxicity (CLP classification)
* Identification of WFD PS and SVHC substances (CMRs 1A/1B)
* Identification of national authority databases e.g., Swedish Chemical Agency PRIO-list
* Identification of chemical products that are non-biodegradable
* Identification of VOC, and any other environmentally relevant properties (PBT,vPvB), which are not based on CLP hazard classification
* Identification of all combustible/flammable products and those that can decompose (thermally or by reaction with other chemicals)
* Compilation of relevant data required for planning and implementing adequate storage and handling
* Assessing compatibility of substances and preparing according storage layout plan and allowable storage volumes
* Compilation of data relevant for communication, reporting and/or certification purposes such as for authorities or customers
* Cross-referencing with manufacturing restricted substances lists (e.g. ECHA authorized and restricted substances) or specific customer’s substance lists

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| **Name of the technique** | **Chemical and raw material inventory** |
| Description of the technique | A Chemical inventory brings structure and a solid handling tool for revue and further preventive and safety work with chemical products. It is the first step for an organized ad structured work and a key to a successful chemical management system. |
| Technical description | Specific data for all the chemical products used are entered in a database from where targeted information can be searched. The main sources of information used for the different chemical products are the safety data sheets (SDS). A commercial inventory can also provide tools for updated substance lists e.g. REACH (SVHC, ANNEX XIV and ANNEX XVII), RoHS, POP or WFD PS. The digital lists can be implemented in the system and used for scanning to identify products or substances that contain listed substances or targeted classifications. |
| Achieved environmental benefits | A well-arranged and up to date chemical inventory is the key tool for further preventive work with reduction of hazardous substances. Combined with different filtering and evaluation methods the system helps identifying substances with undesired characteristics. |
| Environmental performance with regard to hazardous substances and operational data | A procedure on how to bring in new chemicals aligned with an approval process can ensure that all chemicals get evaluated and brought into the inventory. Besides this approval process that can ensure the registration of a new product, a good maintenance system has to be implemented to ensure the information in the system being up to date. Communication and good routines should be implemented with the suppliers. |
| Cross-media effects | SDS quality and information not harmonized can be an issue. Different suppliers can present contractually data on the same substance. |
| Technical considerations relevant to applicability | This technique is applicable to any industry as a key part of a chemicals management system. The necessary software application for the establishment of such an inventory and search and evaluation tools can either be obtained by a range of commercial software systems available on the market (as part of an integrated business system or stand-alone application) or developed in-house. |
| Economics | The investment and operating costs for a chemical data base depend on the intended use and need of advanced searching systems and integrations with other systems. Commercial software is available as simple lists up to advanced systems that can be integrated into other business systems. Savings usually arise from being able to streamline stocks, manage surplus chemicals, simplify or automate the procedures/process as well as indirectly from reducing environmental management costs. |
| Driving force for implementation | Companies may be required/recommended by authorities to maintain a chemical inventory, for example: German Hazardous Substances Ordinance (GefStoffV), Finnish National Chemical Register (KemiDigi) and Swedish Chemical Agency Product Register on Chemical Products and Biotechnical Organisms (Products Register).  A chemical inventory is also required in the environmental permit application in Finland, Estonia and Sweden. The minimum requested information meets the example on base set information given above. |
| Example plants | Examples of commercial systems for chemical inventories:  Ichemistry <https://intersolia.com/en/ichemistry/>  EcoOnline <https://www.ecoonline.com/>  Yordas <https://www.yordasgroup.com/hive/software>  Sphera <https://sphera.com/spheracloud/> |
| Reference literature | REACH: <https://echa.europa.eu/information-on-chemicals>  SCIP: Substances of Concern In articles as such or in complex objects (Products) <https://echa.europa.eu/sv/scip-database>  Swedish law: Regulation (2008:245) on chemical products and biotechnological organisms. <https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/forordning-2008245-om-kemiska-produkter-och_sfs-2008-245>  Finnish law on chemical information notification 553/2008 <https://www.finlex.fi/fi/laki/alkup/2008/20080553> |

### 3. Optimization of process integrated recycling

Establishing recirculation in one process step could lead to big savings in resource use as smaller amounts of new materials have to be added in the process. By recirculating chemicals that are not needed in the final product and that would otherwise go to waste, both the chemical input and the unwanted output could be reduced.

One example of a recirculating process step is from the Case Study No1 and the production of polyethylene. The process consists of the steps pre-treatment, loop and gas-phase reactors in series, gas recycling and processing.

The output from the loop reactors is a polymer powder that is lead through a flash tank where residual unreacted hydrocarbons that have the potential for material recovery are separated. The residual hydrocarbons are separated from the powder by nitrogen purging and fed to distillation columns where light and heavy compounds are separated. Various hydrocarbon fractions are separated in several distillation units for different purposes. Oligomers are used for energy production; light hydrocarbons are recycled to another process for olefin production as feedstock and unreacted hydrocarbons are recycled back to the loop and gas-phase reactors as an input to the process.

Recirculation will result in environmental benefits such as decreased air emissions due to efficient use of hydrocarbons, a minimised use of hazardous chemicals and hence reduced emissions of hazardous substances to the environment.

The technique can be used in different types of polymer production where monomer recycling is possible. However, there might be a need for modifications in the recycling process.

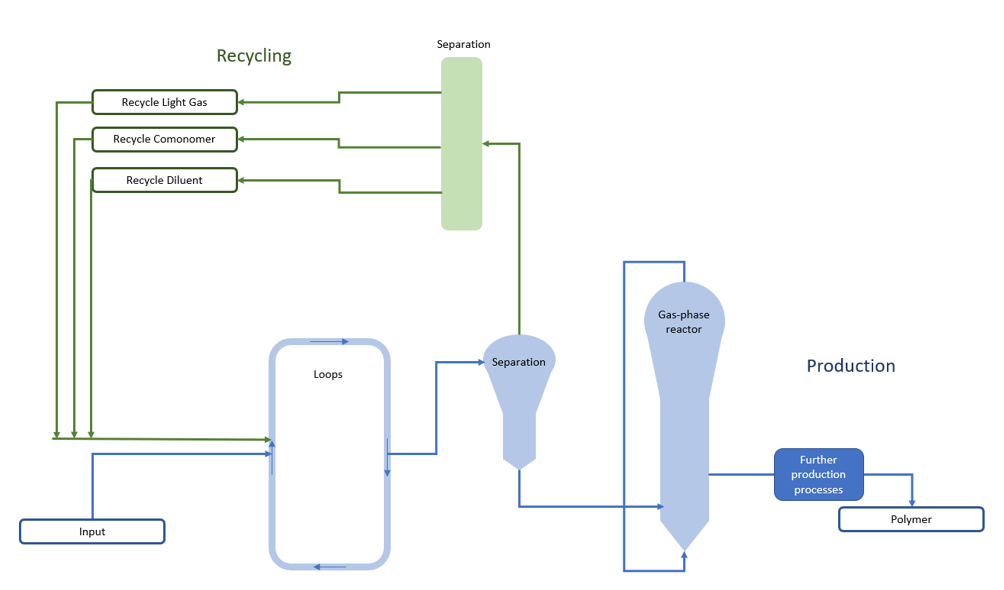


Figure 6: Simplification of process steps in the polymer production

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| **Name of the technique** | **Optimization of recirculation process** |
| Description of the technique | The polymer powder contains still a lot of hydrocarbon gases before pelletizing. The hydrocarbon gases must be cleaned from the powder prior to pelletizing, to eliminate the risk of explosion. Hydrocarbons can be recycled if they are cleaned and separated. |
| Technical description | Optimization of intermediate gas flows through automatic process control (APC system, advanced process control) to enhance material recovery and to minimize flaring. Residual hydrocarbons are separated from polymer powder by nitrogen purging. Hydrocarbons are fed to the distillation columns where light and heavy compounds are first separated. Oligomers are removed and used for energy production. Various hydrocarbon fractions are separated in several distillation units. Unreacted hydrocarbons are fed back to the loop and gas phase reactors. Light hydrocarbon fractions are recycled to the olefin production as feedstock. |
| Achieved environmental benefits | Emissions to air are minimized due to the efficient use of hydrocarbons. The use of nitrogen is optimized and the use of additional/booster fuel for the flare is minimized. |
| Environmental performance with regard to hazardous substances and operational data | With efficient process control, good chemical management and process integrated techniques, a good level of environmental performance is achieved without end-of-pipe abatement techniques. |
| This also minimizes the use of hazardous chemicals and reduces the emissions of hazardous substances into the environment. |
| Cross-media effects | Efficient use of raw materials  Energy efficiency  The known trade-offs of the process exist between the use of nitrogen and use of fuel: too much nitrogen will cause dilution of flare gas stream possibly causing incomplete combustion and flame out of the flare, too little will not remove all hydrocarbons. The used amount of nitrogen also affects the NOx emissions. The optimal use of nitrogen is enough to **replace** all hydrocarbons but is not too much to cause excessive NOx emissions and excessive use of fuel in the flare. |
| Technical considerations relevant to applicability | Automatic process control system is required  A receiving facility is needed for the return gases. Preferably the gases shall end up in material recovery, secondly in energy recovery. In this sight the return gases are fed to steam cracker as feedstock. |
| Economics | After investment, savings in raw material, energy and CO2-emission allowance costs. |
| Driving force for implementation | Financial reasons, minimized flaring and CO2-emissions. |
| Example plants | Case Study No1 (and 2 other sites in Europe) |
| Reference literature | Case Study No1 |

### 4. Process mapping of hazardous substances

To be able to take actions for reducing emissions of hazardous substances, it is necessary to gain good knowledge of the production processes. An example of how to do this is process mapping of hazardous substances. The process mapping includes six different steps; identification, mass balances, sampling and analysis, implementation of actions and verification. See the project process below.

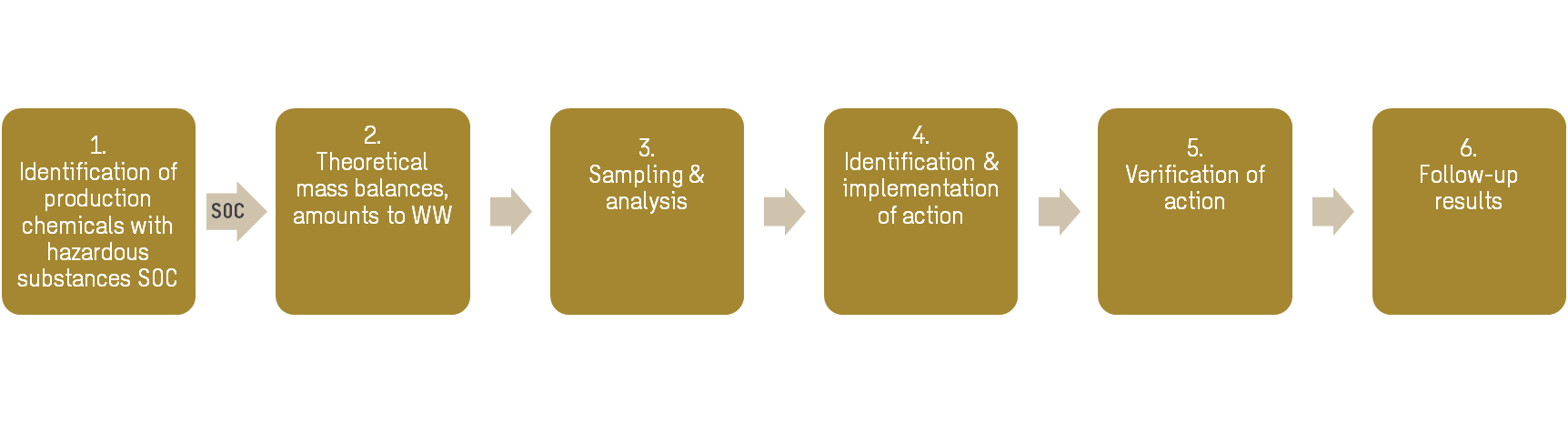


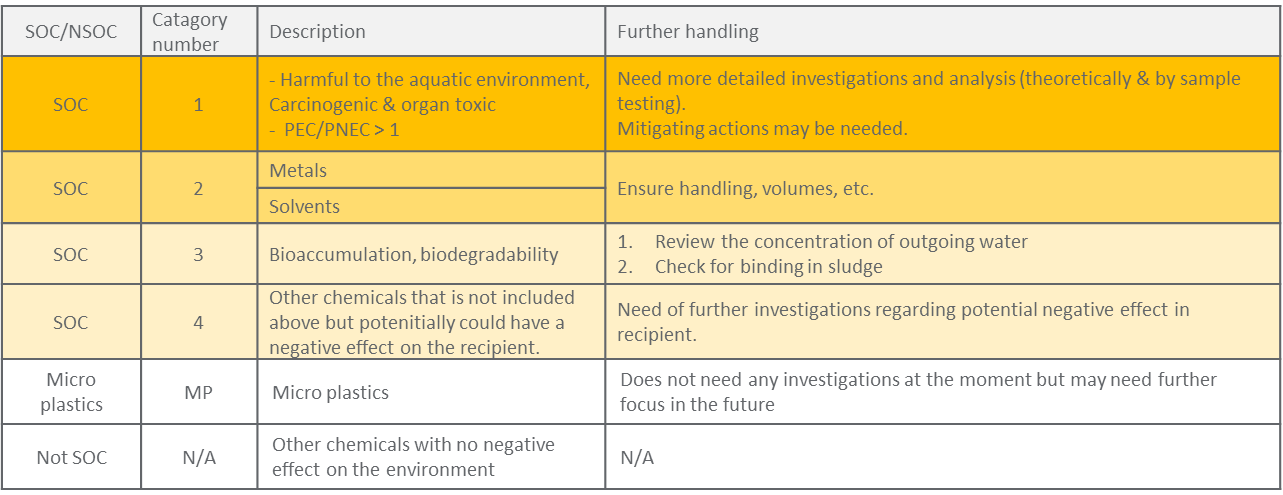
Figure 7: Six steps of process mapping of hazardous substances

1. The first step of the process mapping is to review all the chemicals that are part of the production processes at the site and sort these into the category SOC (Substances of Concern) or as Not SOC, defined by the company.

In addition, the SOC category is divided into subcategories based on the inherent properties of the chemicals (such as harmful to the aquatic environment, toxicity, bioaccumulation, biodegradability, etc.). The different subcategories then have different strategies for further investigation.

To acquire a manageable number of substances to focus on, there is a need to prioritize. Table 3 below presents an example about how to prioritize. In this example, substances classified as harmful to the aquatic environment and substances with a PEC/PNEC >1 are prioritized (Category no. 1). Prioritization can be performed in other ways, depending on the number and types of substances.

Table 3: Example of prioritizing substances of concern (SOC)



2. Step two concerns initiating the mapping work itself, the scope of which depends on the nature of the chemical, i.e. subcategory in the SOC classification. The most hazardous chemicals require in-depth examination with theoretical mass balances, sampling and discussion of possible measures. The goal is for all chemicals to have a minimal negative impact on the recipient.

3. In step three, depending on the results from the theoretical mass balances of each substance, it may be necessary with sampling and analysis to verify the theoretical mass balances.

4. Step four involves identification of necessary actions and implementation of such. The actions depend on the processes but can be abatement measures, such as separation of waste streams or residual process water for waste handling or pre-treatment or changes in the production methods to obtain a higher yield and minimize the emissions, etc.

5. In step five, when a new procedure is implemented, it is important to verify the results of the action.

6. The final step, step six, is to follow up the entire process, mapping progress to make sure that the goal of the project has been achieved.

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| **Name of the technique** | **Process mapping of hazardous substances** |
| Description of the technique | See the description above. Process mapping of hazardous substances is a type of inventory of the hazardous substances at the site. This can be implemented as a project or as a part of the normal procedures. |
| Technical description | Process mapping of hazardous substances is not a technical solution. It is a procedure or a project, as described above.  The output of the process mapping can be different technical measures. |
| Achieved environmental benefits | These can be many: -in-depth knowledge of chemicals and substances in  the processes  -higher yield and reduction of chemicals used -substitution of hazardous substances -development of abatement techniques -when working with measures closer to the source, there will be less volumes to be addressed The environmental benefits are all aimed at reducing emissions of hazardous substances. |
| Environmental performance with regard to hazardous substances and operational data | The purpose of the process mapping is to achieve a reduction of the emissions of hazardous substances. The measures can range from simple process adjustments to extensive pre-treatments, depending on the outcome of steps 1-4. This will affect the environmental performance. |
| Cross-media effects | No cross-media effects are expected from this implementation. |
| Technical considerations relevant to applicability | A project for process mapping of hazardous substances can be implemented within the whole chemical sector and it can be adapted to each type of industry with focus on relevant substances. |
| Economics | To achieve the desired results the organization must manage the work. In addition to a project leader, there must be representatives from the production department, development department (R&D-function), the environmental department, as well as analytical competence within the organization. Depending on how many substances are prioritized, the project can last for many years. |
| Driving force for implementation | Instead of a large investment in a new wastewater treatment plant with very complex treatment techniques, the solution is to reduce the hazardous substances at source, which is less expensive.  In addition, it is more efficient to introduce measures at source, see comment above regarding volumes. |
| Example plants | Chemical industry in Sweden working with production of organic chemicals (polymers). |
| Reference literature | - |

Another example of process mapping follows, from Case Study No. 4., where the use of the information in the exposure scenarios in the extended SDS is utilized in EUSES models or in the STAN tool, to indicate need of measurements for different substances in the production processes.

Challenges for these types of modelling is the lack of specific and process adjusted data. This modelling requires quite a lot of monitoring data (inputs and outputs). In addition, the more there are uncertainties, the more unreliable the result is.

| **Name of the technique** | **Application of SDS exposure scenarios** |
| --- | --- |
| Description of the technique | The exposure scenario in the SDS indicates where the substance ends up in various processes. These are made with the EUSES model, which gives an estimate whether the PNEC values in environmental compartments might be exceeded. The model uses default values, which leads to “worst case scenarios”. This means that the exposure scenario produces rather vague risk ratios for a specific industrial process. Due to the numerous different industrial processes, it is not possible to calculate accurate risk ratios for all of them. Therefore, the exposure scenario’s risk ratios should be refined and recalculated to the specific process in each facility. |
| Technical description | When the exposure scenario in the supplier’s SDS does not cover the use even after scaling:   * either because of larger than assessed amounts used or * the usage conditions differ from the description of the exposure scenario   Or when the use in the exposure scenario indicates a risk as the PEC/PNEC ratio in the ES >1  A site-specific risk ratio calculation should be done for the hazardous chemicals used in the processes: WFD priority substances, SVHC substances and substances labelled as hazardous to the environment (GHS hazards H400, H410, H411, H412 and H413).  The risk ratio can be based either for sector spERCs if available or estimated by using measured data and by calculating substance flow over the process to estimate emissions to the environment. For example, available tools are STAN tool and the EUSES model. For the modelling data inputs and outputs to/from the process are needed. |
| Achieved environmental benefits | Once the relevant substances are identified, monitoring and abatement measures can be focused. |
| Environmental performance with regard to hazardous substances and operational data |  |
| Cross-media effects | No cross-media effects identified |
| Technical considerations relevant to applicability | Generally applicable.  Modelling requires quite a lot of monitoring data (inputs and outputs) and the more there are uncertainties, the more unreliable the result is. Another challenge is that these detailed exposure scenarios are often missing from the SDSs. Despite missing exposure scenarios, the modelling exercise should be performed for all necessary chemicals indicated in point “Technical description”. |
| Economics | The modelling tools are freely available but require specific competence to apply. |
| Driving force for implementation | Modelling techniques and measures can be used as supporting tools in identifying relevant emissions to the environment. |
| Example plants |  |
| Reference literature | STAN tool  [**http://www.stan2web.net/**](http://www.stan2web.net/)  EUSES model  <https://ec.europa.eu/jrc/en/scientific-tool/european-union-system-evaluation-substances> |

### 5. Wastewater Treatment in polymer production site

A drum filter is an added technique for wastewater treatment to prevent pollutions of plastic particles form a LD/HD-production plant (Sweden). This added wastewater treatment is part of the plant’s project “Zero pellets lost”. The filter is a technical solution that can be added in wastewater treatment of all polymer producing plastic pellets.

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| **Name of the technique** | **Additional treatment step in wastewater treatment plant** |
| Description of the technique | As part of the plants work program for zero pellets lost, the plant has installed an additional treatment step with removal of micro particles down to 10 µm in water leaving the site. There is treatment both for process water and storm water in separate flows. |
| Technical description | Drum filter with removal of particles down to 10 µm. Capacity to treat water flows up to 250 m3/h.  The process water filter is placed after oil separation and before final equalisation pond. The storm water filter is placed before the equalization pond. |
| Achieved environmental benefits | Reduce plastic particles down to 10 µm in water discharged from the production unit, even rainwater is filtrated. The water is finally discharged to the sea. |
| Cross-media effects | No cross-media effects are expected from this implementation. |
| Technical considerations relevant to applicability | This technique is applicable in facilities producing polymer pellets.  The example plant has operational issues with dewatering the residues from back flushing of the drum filter treating the storm water. Project on-going for finding solutions for these issues. |
| Economics | The example plant has not provided information on the financial investment for this installation. |
| Driving force for implementation | As a plastic producer, the example plant is doing everything possible to minimize the risk for plastic particles ending up outside of the production plant - “zero pellet loss”. They identified three risk areas for spreading of pellets; via transports, water effluents and snow. Therefore, they have implemented measures connected to all these risks and the filtration of all water flows is one of them. |
| Example plants | LD/HD-production plant (Sweden) |

Annex 2 – Overview of selected references and tools

The following list provides an overview of available, sector specific tools for good chemical management of substances and mixtures (general and textile). The list does not claim to be an exhaustive list of references and tools which could be applied in the sector. Other tools may exist, or may be developed, which could also be considered for good chemicals management.

| **Name of source** | **Address/location** | **Description** | **Languages** | **Sector specific scope** | **Relevant Permitting Steps[[40]](#footnote-41)** |
| --- | --- | --- | --- | --- | --- |
| **CHEmical Safety Assessment and Reporting tool**  **(CHESAR)** | <https://chesar.echa.europa.eu/home> | Chesar is an application developed by the European Chemicals Agency (ECHA) to help companies to carry out their chemical safety assessments (CSAs) and to prepare their chemical safety reports (CSRs) and exposure scenarios (ESs) for communication in the supply chain. Chesar enables registrants to carry out their safety assessments in a structured, harmonised, transparent and efficient way. This includes the importing of substance-related data directly from IUCLID, describing the uses of the substance, carrying out exposure assessment including identifying conditions of safe use, related exposure estimates and demonstrating control of risks. Based on this, Chesar automatically generates the CSR and exposure scenarios for communication as a text document, and export information on use and exposure to IUCLID. Chesar also facilitates the re-use (or update) of assessment elements generated in a single Chesar instance or imported from external sources. |  | general | PA, M |
| **Database of the C+L directory at ECHA** | <http://echa.europa.eu/de/information-on-chemicals/cl-inventory-database> | This database contains information on classification and labelling (C&L) of notified and registered substances submitted to ECHA during substance registration under REACH or notification under CLP, including harmonised classifications (Table 3.1 in Annex VI of CLP). ECHA maintains the list but does not check the validity of this information. | All European languages |  | PA, AA, R, M |
| **Database on REACH-registered substances at ECHA** | <https://echa.europa.eu/information-on-chemicals/registered-substances> | The data contained here are taken from the registration dossiers submitted to ECHA. In addition to the classification, this database also contains other information on the substances, such as physical data or study summaries. | All European languages | Yes, see findings of HAZBREF, WP2 | PA, AA, R |
| **ECETOC’s Targeted Risk Assessment (TRA) tool** | <http://www.ecetoc.org/tools/targeted-risk-assessment-tra/> | ECETOC TRA ("Targeted Risk Assessment") is a tool for exposure assessment, developed by the ECETOC research group. The instrument will be used as preferred level 1 model for workplace exposure estimation. | English |  | AA |
| **eChemPortal by OECD** | <http://www.echemportal.org> | The eChemPortal enables the search for reports and data sets of chemicals by substance name, CAS number and the like. It contains links to hazard and risk analyses and national and regional classifications. Information on exposure and use of the substances is also available. | English |  | PA, AA |
| **ES Modifier** | Not available | This tool, jointly developed by TNO (Netherlands), Confederation of Danish Industry was meant to support end users in checking and modifying suppliers’ exposure scenarios (ES) to fit their own conditions, formulators in preparing ES for preparations as well as support preparation of Downstream user Chemical Safety Reports (CSR). |  | Current status unknown |  |
| ***European Union System for the Evaluation of Substances (EUSES)*** | <https://ec.europa.eu/jrc/en/scientific-tool/european-union-system-evaluation-substances> | EUSES was developed to enable government authorities, research institutes and chemical companies to carry out rapid and efficient assessments of the general risks posed by chemical substances | Various |  | AA |
| **GESTIS Substance Database** | [www.dguv.de/ifa/stoffdatenbank](http://www.dguv.de/ifa/stoffdatenbank) | The GESTIS substance database contains information on more than 8700 substances with regard to identification, physical, toxicological and eco-toxicological properties, occupational medicine, first aid and safe handling as well as relevant regulations. Information on classification and labelling is partly taken from SDS from manufacturers or distributors. | German, English |  | PA, AA, R |
| **GisChem Hazardous Substance Information System of the German Employers' Liability Insurance Association for Raw Materials and Chemical Industries (BG RCI) and the German Employers' Liability Insurance Association for Wood and Metal (BGHM)** | <http://www.gischem.de/suche/index.htm> | The database contains data sheets and draft operating instructions. The search for hazardous substances can be carried out by name, CAS no., branches of industry or procedure. In addition, selection is also possible via a complete list. Under the GisChem Interactive the site also offers free-of-charge assessment tools such the “mixture calculator” which provide assistance in finding the correct classification and labelling for any substance mixtures whatsoever in the GHS system | German, with sections in English |  | PA, AA, R |
| **GSBL - Common Substance Data Pool Federation/States** | <http://www.gsbl.de/> | In the data pool of the BMU and the environment ministries of the German states, up-to-date, comprehensive information on environmentally relevant properties of chemical substances and mixtures is available for all areas of environmental protection and hazard prevention. Access to the complete GSBL database is reserved for representatives of the authorities. | German |  | PA, AA, R |
| **Hazardous substance database of the Federal states in Germany (GDL):** | <https://www.gefahrstoff-info.de/> | The common hazardous substance database of the authorities of all federal states responsible for the state monitoring of hazardous substance legislation in the field of occupational health and safety (GDL) contains information on hazards and protective measures as well as legal regulations/limit values of individual substances and substance groups. Important aspects from relevant national and EU legislation are integrated into the database on a substance or substance group basis. | German |  | AA, M, R |
| **IGS - Information system for hazardous substances:** | <http://igsvtu.lanuv.nrw.de> | IGS is provided by the State Office for Nature, Environment and Consumer Protection of North Rhine-Westphalia. In IGS-Public, the publicly accessible part of the substance data information system, the focus is on the substance-related mapping of legal sources. | German, English |  | PA, AA, R |
| **Information about Chemicals** | <https://echa.europa.eu/information-on-chemicals> | Important and comprehensive source of information on chemicals produced in or imported into Europe. It covers hazardous properties, classification, labelling and information on their safe use. Since 20 January 2016, information on some 120,000 chemicals has been available in complex form. It is divided into three levels: an information map, a short profile and detailed source data. Statistical evaluations of the different classifications from the C&L inventory are also available for many substances. | All European languages |  | PA, AA |
| **KemiDigi** | <https://www.kemidigi.fi/> | KemiDigi is a national chemical information resource and service which pulls together national chemical data. KemiDigi aims to create a streamlined electronic service for companies managing their reporting obligations related to chemicals. The core elements of KemiDigi comprises (i) a chemical register of the dangerous chemicals on the market; (ii) a substance register of substances and the groups comprising the substances; and (iii) lists of chemicals by companies, which utilise information from the chemical and substance registers. | Finnish, Swedish, English | no | PA, AA |
| **Norwegian Chemical database** | <http://miljodirektoratet.no/kjemikaliesok/> | This database is a search tool for substances, by name or CAS- and EC-numbers. The search results in which chemical regulations a substance is covered by the national priority list, REACH candidate list, REACH authorisation list, REACH restricted substance list, CLP and possible other regulations like for biocides. | Norwegian |  | PA, AA, R |
| ***OECD Substitution and Alternatives Assessment Tool Selector*** | <http://www.oecdsaatoolbox.org/Home/Tools> | This website allows the user to identify and link to various tools designed for providing information on online resources and software that can be used in conducting chemical substitutions or alternatives assessments. The Tool Selector is divided into two categories: (i) Tools, which provide users with the ability to evaluate a chemical, material, process, product and/or technology for attribute analysis with an alternatives assessment, and (ii) data sources, which contain a repository of organized information but no mechanism for data manipulation for outside users. |  |  | PA, AA, R, M |
| ***Chemsec SIN list*** | https://sinlist.chemsec.org/ | The [SIN List](https://chemsec.org/sin-list/) is a database of hazardous chemicals that are used in a wide variety of articles, products and manufacturing processes around the globe. Some chemicals on the list might be restricted or banned in the EU in the future. The SIN List is publicly available and regularly updated. | English | No |  |
| ***ChemSec Market place*** | https://marketplace.chemsec.org/ | Marketplace is a platform where companies can find safer alternatives to hazardous chemicals, enabling buyers and suppliers to start substituting chemicals of concern. | English | No |  |
| **Other tools** |  |  |  |  |  |
| **PRIO (Sweden)** | <https://www.kemi.se/en/prio-start> | PRIO was developed by the Swedish Chemical Inspectorate (KEMI) to help eliminate high hazard chemicals from products to meet the Swedish government's goal of a "non-toxic environment" by 2020. PRIO contains a database of chemicals of high concern to human health and the environment, which are divided into "phase-out" or "priority risk reduction" chemicals. “Phase-out” chemicals should be avoided or substituted, and the tool provides a seven step process for identifying safer alternatives. For “priority risk reduction” chemicals, further assessments are recommended to ensure risk minimization. Users search databases based on authoritative lists by specific substance, hazard properties, chemical category, or specific database. If a specific substance is not in the database, users can research substance properties and compare against PRIO criteria. | Swedish |  | AA, M, R |
| ***Rigoletto (UBA)*** | <https://webrigoletto.uba.de/rigoletto/public/language.do;jsessionid=A3C82B85A5DC7C9949C6472AAFE1ECDD?language=english> | This web-based information tool has been established by the Umweltbundesamt, Germany to support users in determining the water hazard classes (WGK) of substances and mixtures (e.g. 1: slightly hazardous to water, 2: obviously hazardous to water, 3: highly hazardous to water.) on the basis of the Ordinance on Facilities for Handling Substances that are Hazardous to Water (Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen (AwSV)) of 18 April 2017 | German/ English |  | PA, AA, R |
| **SPIN - Substances in Preparations in Nordic Countries** | <http://spin2000.net/> | SPIN is a database on the use of Substances in Products in the Nordic Countries. It is a public accessible database, which can be used free of charge. The user can find information on the chemicals that are used in the Nordic countries. The information includes quantities, industries in which it is used (NACE and national) and the function it is used for (USE Category). | English |  | AA |
| ***Stoffenmanager*** | <https://gestis.stoffenmanager.com> | Developed by TNO (Netherlands, Arbo Unie and BECO (EY) in 2003, this online instrument helps users identify the chemical hazards, control the exposure at workplaces and communicate in an understandable, transparent manner to managers, employees and external stakeholders, thus helping them to comply with the regulatory and broader ethical and sustainability requirements. | German, English | General comment: Paid and free version | PA |
| **SubSelect (UBA)** | <https://www.umweltbundesamt.de/en/document/subselect-guide-for-the-selection-of-sustainable> | This guide helps you to select more sustainable chemicals. The selection of sustainable chemicals has beneficial effects for occupational safety, consumer and environmental protection. In the medium run, sustainability leads to more innovative uses of chemicals, and is therefore also economically attractive. More sustainable products mean: fewer pollutants, greater acceptance, less adverse impacts on the environment and to society, with simultaneous success in the market. SubSelect help you as a manufacturer, formulators or end users of substances to put a greater emphasis on sustainability aspects: in the selection of substances and use of chemicals in the company. | German, English, Baltic languages |  | R |
| **EUSES** | <https://ec.europa.eu/jrc/sites/jrcsh/files/EUSES_2.1.2_installation_and_docs.zip> | Estimate Predicted Environmental Concentrations (PEC) - The European Union System for the Evaluation of Substances (EUSES) is a free tool developed by the European Commission to assist authorities, research institutes and companies to estimate environmental exposure levels of industrial chemicals and biocides. EUSES is easy to use. Only a few data on substance properties are needed to calculate PECs for tier 1 assessment. If the use of default exposure estimates and tier 1 assessment do not lead to PEC/PNEC<1, a refined assessment is possible in EUSES by including more specific information on releases. |  |  |  |

Annex 3 – Safety Data Sheets – Good example

The following table includes examples and description of good practice for selected SDS sections. The selection of the sections covered is based on a technical assessment of their relevance for good chemical management. Where appropriate, the sections also include a brief explanation of the contents and recommendations for operators and competent IED authorities on how to use the information contained. Further guidance on the assessment and correct use of SDS is provided in the ECHA “[Guide on Safety data sheets and Exposure scenarios](https://echa.europa.eu/documents/10162/22786913/sds_es_guide_en.pdf)”.

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| **SDS Section** | **Explanation and Recommendations for Use** |
| Section 1 – Identification |  |
| 1.1 Product Identifier  Trade Name: […]  Product No: […] | The product identifier shall be provided in accordance with Article 18(2) of Regulation (EC) No 1272/2008 in the case of a substance and in accordance with Article 18 (3) (a) of Regulation /(EC) No 1272/2008 in the case of a mixture, and as provided on the label in the official language(s) of the Member State(s) where the substance or mixture is placed on the market, unless the Member States(s) concerned provide(s) otherwise.  For substances subject to registration, the product identifier shall be consistent with that provided in the registration and the registration number assigned under Article 30(3) of this Regulation shall also be indicated |
| 1.2 Relevant identified uses of the substance or mixture and uses advised against  Use of the substance/mixture:   * textile auxiliaries * Detergents and cleaning agents | At least the identified uses relevant for the recipient(s) of the substance or mixture shall be indicated. This shall be a brief description of what the substance or mixture is intended to do.  Where applicable the uses which the supplier advises against and the reasons why shall be stated (Example: Do not use for injecting and spraying  In many cases, information in the registration dossiers about uses of substances is limited because downstream users do not have an incentive to provide sufficient information about their uses to the upstream provider of chemicals |
| 1.3 Details of the supplier providing the safety data sheet  Manufacturer / Supplier:   |  |  | | --- | --- | | Name  Address  Information Contact  Email (competent person) | Name  Address  Information Contact  Email (competent person) |   Importer:  -  Information-providing department: | Contact details of manufacturer need to be available and shall match with the information provided on the respective chemical containers.  In case of non-EU supplier of chemicals, the contact details of the local importer or distributor need to be indicator. In view of the fact that the majority of chemicals used in the textile sector are manufactured outside the EU, special attention should be paid to the availability of information regarding importers and distributors. |
| 1.4 Emergency contact:   * +49 7071 154 0 (Germany, 24h) * +41 71 763 88 11 (Switzerland, 24h) | A 24-hour emergency contact number of the manufacturer, importer and/or distributor needs to be indicated in the SDS (as well as on the chemical container).  Most EU Member States, with exception of Germany, Poland, Italy, and France, have appointed an official emergency response center, whose contact information must be listed in Section 1.4 of the SDS. In Germany, manufacturers and importers may optionally notify one of several poison centers in the country, or they may provide their own number, given certain conditions. France now lists the National Research and Safety Institute for the Prevention of Occupational Accidents and Diseases (INRS) as its official emergency contact to be listed in Section 1.4 of the SDS.  For further information about the contact points, refer to the downloadable list of emergency telephone numbers available from the ECHA website <https://echa.europa.eu/support/helpdesks> |
| Section 2 – Possible Hazards |  |
| 2.1 Classification of the substance or mixture:  Classification (REGULATION (EC) No 1272/2008):  Irritant effect on the skin, category 2   * H315: Causes skin irritation.   Severe eye damage, Category 1   * H318: Causes severe eye damage.   Long-term (chronic) water hazard, category 3   * H412: Harmful to aquatic organisms, having long term effects. | The classification of the substance or the mixture which results from the application of the classification criteria in Regulation (EC) No 1272/2008 shall be given in the SDS.  The classification provided here should be consistent with the information provided in the SDS Sections 9 to 12, covering the most important adverse physical, human health and environmental health and environmental effect. The information needs to be presented in a way that allows non-experts to identify the hazards of the substance or mixture. |
| 2.2 Labelling elements  Labelling (Regulation (EC) No 1272/2008):  Hazard pictograms    Signal word   * Danger   Hazard Statements   * H315 Causes skin irritation * H318 Causes severe eye damage * H412 Harmful to aquatic organisms, with long-term effects   Safety instructions - Prevention:   * P264 Wash skin thoroughly after use. * P273 Avoid release into the environment. * P280 Wear protective gloves/ eye/ face protection.   Safety instructions – Reaction:   * P305 + P351 + P338 + P310 IN EYE CONTACT: Rinse gently with water for several minutes. Remove contact lenses if possible. Continue rinsing. Call the POISON CENTER/physician immediately. * P332 + P313 In case of skin irritation: seek medical advice.   Safety instructions - Disposal:   * P501 Contents/ container to be disposed of in an approved waste disposal facility   Hazard-determining component(s) for labelling:   * Isotridecanolethoxylate * Alcohols, C12-15 branched and linear, ethoxylated propoxylated * 2-[2-(2-Butoxyethoxy)ethoxy]ethanol * Acrylic acid polyethylene-polypropylene glycol monoallyl ether copolymer | This section of the SDS should show how the substance or mixture should be labelled. For both substances and mixtures the label elements are to be indicated according to the CLP Regulation.  If a substance on its own or in a mixture is subject to REACH authorisation, the authorisation number (see the ECHA-term (<https://echa-term.echa.europa.eu/>) for a definition) must be included here. In such case, more information regarding authorization should be available in SDS Section 15.  The label elements indicated here need to correspond to those on the product (container, packaging). |
| 2.3 Other hazards  This substance/mixture does not contain components at concentrations of 0,1 % or higher that are either persistent, bioaccumulative and toxic (PBT) or very persistent and very bioaccumulative (vPvB). | In case the substance is a PBT or vPVB, this needs to be indicated in form of a statement here. |
| Section 3 - Composition/Information on Components |  |
| 3.2 Mixtures  Chemical characterization:   * Mixture of fatty alcohol alkoxylates   Hazardous components   |  |  |  |  | | --- | --- | --- | --- | | Substance name | CAS-No. EG-No. Registration number | Classification | Concentration (% w/w) | | Isotridecanolethoxylat | 69011-36-5  Polymer | Eye Dam. 1; H318  Aquatic Chronic 3; H412 | >= 20 - < 25 | | Alkohole, C12-15-verzweigt und linear, ethoxyliert propoxyliert | 120313-48-6  Polymer | Skin Irrit. 2; H315  Eye Dam. 1; H318  Aquatic Acute 1; H400  Aquatic Chronic 3; H412 | >= 10 - < 20 | | 2-[2-(2-Butoxyethoxy)ethoxy]ethanol | 143-22-6  205-592-6  01-2119475107-38 | Eye Dam. 1; H318 | >= 3 - < 10 | | Isotridecanolethoxylat | 69011-36-5  Polymer | Eye Irrit. 2; H319  Aquatic Chronic 3; H412 | >= 2,5 - < 10 | | Acrylsäure-Polyethylen-Polypropylenglykolmonoal-lylether Copolymer | 205327-92-0  Polymer | Skin Corr. 1B; H314 | >= 3 - < 5 | | Alkohole, C16-18, ethoxyliert | 68439-49-6  Polymer | Eye Irrit. 2; H319 | >= 1 - < 10 | | 3,6,9,12 Tetraoxahexadecan-1-ol | 1559-34-8  216-322-1 | Eye Irrit. 2; H319 | >= 1 - < 10 | | 2-(2-Butoxyethoxy)ethanol | 112-34-5  203-961-6  01-2119475104-44 | Eye Irrit. 2; H319 | >= 1 - < 10 | | Section 3 provides information on the composition of the chemical product. If it is a substance, the information is provided in Section 3.1. If the chemical is a mixture, the information is in Section 3.2, usually in form of a table.  This table should include (i) the name and/or trade name, and (ii) other identifiers (such as CAS number, registration number, etc.) of the substances, ingredients or impurities, which   * contribute to the overall hazard classification; or * are present at concentrations above certain levels of concern; or * have occupational exposure limits.   Usually an ingredient must be disclosed, if it meets GHS classification criteria as a hazardous substance and its content exceeds relevant cut-off value (usually 0.1 % or 1 % depending on hazards). For example, a carcinogen must be disclosed in SDSs, if its concentration is above or equal to 0.1 %.  In the EU, disclosure of non-hazardous substances is required, if there are union workplace exposure limits for them or if they belong to PBT and vPvB substances.  Chemical suppliers may like to withhold exact substance name and exact concentration or concentration ranges in this section 3 claiming these are confidential business information. In the EU, this requires with prior approval according to CLP, article 4. |

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| Section 9 - Physical and chemical properties |  |
| 9.1 Information on the basic physical and chemical properties:  Appearance: fluid  Colour: Colourless, light, yellowish  Odour: Characteristic  pH: 3,5 - 4,1 (20 °C)  Concentration: 100 g/l  Melting point/Melting range: No data available  Boiling point/Boiling range: No data available  Ignition point: 100 °C  Evaporation speed: Not applicable  Upper explosive limit: Not applicable  Lower explosion limit: Not applicable  Vapour pressure: No data available  Relative vapour density: Not applicable  Density: - 1.03 g/cm3 (20 °C)  **Solubility(s)**  Water solubility: miscible  Distribution coefficient: n-octane/water - Not applicable  **Viscosity**  Viscosity, dynamic   * 90 - 150 mPa.s (20 °C) * Brookfield LVT * 50 rpm * Spindle 2   Oxidizing properties: Not applicable | This section contains information about the basic physical and chemical properties of the chemical substance or mixture (such as appearance, odour, pH, boiling point etc.) which are relevant to the classification and the hazards.  Information of this SDS section is relates to further characteristics as described in SDS section 10 (stability and reactivity). The latter section informs about the stability of the substance or mixture, hazardous reactions that could occur under certain conditions of use or if released into the environment, conditions to avoid, incompatible materials, hazardous decomposition products.  No sections should be kept blank. If data is not available, it should be clearly indicated in form of a corresponding statement (“no data available”) |
| 9.2 Other disclosures  Conductivity: not determined  Spontaneous ignition: not self-igniting |  |

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| Section 11 - Toxicological information |  |
| **11.1 Information on toxicological effects**  **Acute toxicity**  Product:  Acute oral toxicity:   * LD50 (rat): > 2 000 mg/kg * conclusion by analogy   Acute inhalative toxicity:   * On the basis of the available data, the classification criteria are not met.   Acute dermal toxicity:   * On the basis of the available data, the classification criteria are not met.   Ingredients:  Isotridecanolethoxylate:  Acute oral toxicity:   * LD50 (rat): > 5 000 mg/kg * literature value   Acute dermal toxicity:   * LD50 (rat): > 2 000 mg/kg * Method: OECD test guideline 402 * literature value   Alcohols, C12-15 branched and linear, ethoxylated propoxylated:  Acute oral toxicity:   * LD50 (rat): > 2 000 mg/kg * conclusion by analogy   2-[2-(2-Butoxyethoxy)ethoxy]ethanol:  Acute oral toxicity:   * LD50 (rat): 5 170 mg/kg   Acute dermal toxicity:   * LD50 (rabbit): 3 480 mg/kg * Isotridecanolethoxylate:   Acute oral toxicity:   * LD50 (rat): > 5 000 mg/kg * Method: OECD test guideline 401 * literature value   Acute dermal toxicity:   * LD50 (rat): > 5 000 mg/kg * literature value   2-(2-Butoxyethoxy)ethanol:  Acute oral toxicity:   * LD50 (rat): > 2 000 mg/kg * Method: OECD test guideline 401   Acute dermal toxicity:   * LD50 (rabbit): > 2 000 mg/kg * Method: OECD test guideline 402   **Etching/irritant effect on the skin**   * […]   **Eye damage/irritation**   * […]   **Sensitization of the respiratory tract/skin**   * […]   **Germ cell mutagenicity**   * […]   **Carcinogenicity**   * […]   **Reproductive toxicity**   * […]   **Specific target organ toxicity at single exposure**   * […]   **Specific target organ toxicity for repeated exposure**   * […]   **Aspiration toxicity**   * […] | Section 11 of a GHS-SDS contains detailed information about the adverse health effects that result from exposure to the product, as well as data about how these effects are influenced by dosage and route of exposure.  While all SDS sections are important for user health & safety, the information contained in this section is vital should an employee or other user ever experience uncontrolled, accidental exposure to a product. It is of utmost importance to medical professionals and toxicologists and is used primarily in emergency situations during medical treatment. The information will help medical professionals and emergency responders evaluate long-term and short-term health risks.  Accordingly, this SDS section should provide following information for the substance and/or components as identified in SMDS section 3.2:   * Relevant health hazards and corresponding toxicological data * Likely routes of exposure * Potential adverse health effects that may occur upon exposure * Delayed and immediate effects, due to both short-term and long-term exposure * Numerical measures of toxicity * Relevant interactions with other substances * Information about other adverse health effects that do not fall into GHS classification   With regard to the health hazard references should cover at least   * Acute toxicity * Skin corrosion/irritation * Serious eye damage/irritation * Respiratory and skin sensitization * Germ cell mutagenicity * Carcinogenicity * Reproductive toxicity * Single target organ toxicity/single exposure * Single target organ toxicity/repeated exposure * Aspiration hazards   It may not always be able to obtain information on the hazards of a substance or mixture. In cases where data on the specific substance or mixture are not available, data on similar substances or mixture, if appropriate, may be used, provided the relevant similar substance or mixture is identified. In case data is not available, this shall be clearly indicated rather than leaving blanks.  It is important to make sure that results as well as testing guidelines applied are clearly indicated. |

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| Section 12 - Environmental disclosures |  |
| **12.1 Toxicity**  **Product**:  Toxicity to fish:   * No data available for the product itself.   Toxicity to daphnia and other aquatic invertebrates:   * EC50 (Daphnia magna (large water flea)): 5,8 mg/l * exposure time: 48 h * Method: OECD test guideline 202   Toxicity to algae:   * No data available for the product itself.   Toxicity to microorganisms:   * EC50 (activated sludge): > 1 000 mg/l * exposure time: 3 h * Method: OECD test guideline 209   **Ingredients**:  **Isotridecanolethoxylate**:  Toxicity to fish:   * LC50 (Oncorhynchus mykiss (rainbow trout)): > 1 - 10 mg/l * exposure time: 96 h * (Classified according to CESIO recommendations)   Toxicity to daphnia and other aquatic invertebrates:   * EC50 (Daphnia magna (Great Water Flea)): > 1 - 10 mg/l * exposure time: 48 h * (Classified according to CESIO recommendations)   Toxicity to algae:   * EC50 (algae): > 1 - 10 mg/l * Exposure time: 72 h * Method: OECD test guideline 201 * (Classified according to CESIO recommendations) * EC10 (algae): > 1 - 10 mg/l * Exposure time: 72 h * Method: OECD test guideline 201 * (Classified according to CESIO recommendations)   Toxicity to microorganisms:   * EC50 (activated sludge): > 1 000 mg/l * exposure time: 16 h * Method: DIN 38412, part 8 * conclusion by analogy   Toxicity to daphnia and other aquatic invertebrates (chronic toxicity):   * NOEC: 1 mg/l * Species: Daphnia magna (Great Water Flea) * literature value   Assessment of ecotoxicity  Long-term (chronic) water endangering:   * Harmful to aquatic organisms with long-term effects (classified according to CESIO recommendations).   **Alcohols, C12-15 branched and linear, ethoxylated propoxylated:**   * […]   **2-[2-(2-Butoxyethoxy)ethoxy]ethanol:**   * […]   **Isotridecanolethoxylate**:   * […]   **2-(2-Butoxyethoxy)ethanol:**   * […] | Section 12 contains ecological and eco-toxicological data for both terrestrial and aquatic environments. The information shall describe on the effects of the chemical on the environment if released as well as its environmental fate (What happens to the chemical after its release into the environment?).  This section is designed to assist environmental stewardship, prevent harmful effects to the health of local ecosystems, as well as help businesses evaluate one product against another. This information forms the basis for deciding on waste and wastewater treatment practices, how to handle spills and control of releases.  The content of this section provides the basis for the classification and risk management measures given in the safety data sheet. The information in Sections 2, 3, 4, 6, 7, 8, 9, 13, 14, and 15 should be consistent with the ecological information provided here.  This SDS section, with its subsections on (i) eco-toxicity, (ii) persistence and degradability, (iii) bioaccumulation potential, (iv) mobility in ground, and (v) results of the PBT and vPvB assessment, should also outline how the chemical was tested for toxicity, persistence and degradability, bioaccumulative potential, and mobility in soil, together with the test results. It should also contain the results of a PBT and vPvB assessment, if one has been carried out as part of a chemical safety assessment.  The eco-toxicological test data for aquatic organisms used to determine GHS classifications should be provided, such as   * Fish: 96 hours, Lethal concentration (LC) 50, chronic No Observed Effect Level (NOEC) or Effective Concentration (ECx) * Crustaceans: 48 hours, Lethal concentration (LC) 50, chronic No Observed Effect Level (NOEC) or Effective Concentration (ECx) * Algae & aquatic plants: 72 or 96 hours, effectice reduction of growth rate concentration (ErC50), chronic No Observed Effect Level (NOEC) or Effective Concentration (ECx)   Important details to include throughout this section include species, media, test duration and test conditions.  The information in this section 12 should be consistent with the other sections of the SDS. The eco-toxicological (EC50, NOEC) endpoints should be consistent with the aquatic toxicity categories, respectively.  Since some components in a mixture may behave very differently from the mixture as a whole when released to the environment, eco-toxicological information should be given for all relevant ingredients.  Any information that indicates possible impact on wastewater treatment plants, like degradability and inhibitory effects on microorganisms, should be mentioned. |
| **12.2 Persistence and degradability**  **Product**:  Biodegradability:   * Type of test: DOC-CO2 measurement * Biological degradation: 68%. * Method: OECD 302 B with CO2 (mineralisation) * Type of test: DOC measurement * Biological degradation: 95%. * Method: OECD 302 B with CO2 (elimination) * The product is inherently bio-degradable according to OECD criteria. * Type of test: O2 measurement * Biological degradation: 76%. * Method: OECD 301 F (mineralisation) * The product is readily biodegradable according to OECD criteria. The surfactant contained in this mixture fulfils the conditions of biodegradability as laid down in Regulation (EC) No. 648/2004 on detergents. Documents confirming this will be kept available for the competent authorities of the Member States and will only be made available to them at their direct request or at the request of a detergent manufacturer.   Biochemical oxygen demand (BOD):   * 180 mg/g * Incubation time: 5 d * Method: DIN EN 1899-1 (H 55)   Chemical oxygen demand (COD):   * 1 240 mg/g * Method: DIN 38409-H-41   **Compounds**:  **Isotridecanolethoxylate:**  Biodegradability:   * Type of test: CO2 measurement * Result: Easily biodegradable. * Biological degradation: > 60%. * exposure time: 28 d * Method: OECD 301 B (mineralisation) * (Classified according to CESIO recommendations) * Type of test: DOC measurement * Result: Easily biodegradable. * Biological degradation: > 90%. * exposure time: 28 d * Method: OECD 301 E (elimination)   **Alcohols, C12-15 branched and linear, ethoxylated propoxylated:**  Biodegradability:   * Type of test: CO2 measurement * Result: Easily biodegradable. * Biological degradation: > 60%. * exposure time: 28 d * Method: OECD 301 B (mineralisation) * conclusion by analogy   **2-[2-(2-Butoxyethoxy)ethoxy]ethanol:**   * […]   **Isotridecanolethoxylate:**   * […]   **2-(2-Butoxyethoxy)ethanol:**   * […] | Biodegradation is the process by which organic substances are broken down by living organisms such as bacteria and fungi. Biodegradation can happen in surface water, sediment and soil.  With regard to expressing the biodegradability of a substance, it is important the type of test, methods, circumstances and results are specifically outlined to allow for a proper interpretation of the information.  For example, common methods for determining the biodegradability include OECD 301 A-F (Ready biodegradability), OECD 302 A-C (inherent biodegradability).  The pass levels for ready biodegradability are 70 % removal of Dissolved organic carbon (DOC) and 60 % of theoretical oxygen demand (ThOD) or theoretical carbon dioxide (ThCO2) production for respirometric methods (OECD 301). |
| **12.3 Bioaccumulation potential**  **Product**:  Bioaccumulation:   * There is no data available for the product itself.   Distribution coefficient: n-octanol/water:   * Not applicable   **Ingredients:**  **2-(2-Butoxyethoxy)ethanol:**   * Coefficient of partition: n-octane/water: * log Pow: 1 (20 °C) * pH value: 7 * Method: OECD 117 | Information on bioaccumulation is vital for understanding the environmental behaviour of a substance. The information on bioaccumulation is used in 1) PBT assessment, 2) hazard classification, and 3) chemical safety assessment. The information on bioaccumulation is also a factor in deciding whether long-term ecotoxicity testing might be necessary  Bioconcentration Factor (BCF) is an indicator of a chemical substance’s tendency to accumulate in the living organism. It can be obtained by calculation method based on logKow/logPow or bio-accumulation test. Calculated BCF values are unitless and generally range from one to a million.  If an aquatic bioconcentration test (usually on fish) is conducted, BCF will be the concentration of test substance in/on the fish or specified tissues thereof (as mg/kg) divided by the concentration of the chemical substance in the surrounding medium (BCF = Concentration of the substance in fish (mg/kg)/Concentration of the substance in water (in mg/L)).  n-octanol/water partition coefficient (Kow) is used as a screening test for bio-accumulation test. The assumption behind this is that the uptake of an organic substance is driven by its hydrophobicity.  A chemical substance with high BCF will generally have low water solubility, a large Kow (octanol/water partition coefficient), and a large Koc (soil adsorption coefficient). As per EU REACH, a substance with a BCF>2000 will be regarded as bio-accumulative (B). A substance with a BCF>5000 will be regarded as very bio-accumulative (vB).  For organic substances with a logKow value below 4.5 it is assumed that the affinity for the lipids of an organism is insufficient to exceed the bio-accumulation criterion i.e. a BCF value of 2000. Substances with very high logKow values (i.e, >4.5) are of greater concern because they may have the potential to bio-concentrate in living organisms.  It is important that the specific testing guidelines for measuring Bioaccumulation in Fish (i.e. OECD 305) and for Kow/logKowis or log POW (e.g. OECD 117) are mentioned in the SDS. |
| 12.4 Mobility in the ground or soil  **Product**:  Mobility:   * No data available | This subsection should indicate the soil Adsorption Coefficient (Kd/Koc) of a substance, measuring the mobility of a substance in soil. Koc is a very important input parameter for estimating environmental distribution and environmental exposure level of a chemical substance.  A very high value (e.g. Koc > 100,000 or log Koc >5) indicate that the substance is strongly adsorbed onto soil and organic matter and does not move throughout the soil. In such case, additional terrestrial toxicology tests may be conducted to confirm the toxicity of a substance to soil organisms. A very low value (Koc >10 or log KOC <1) means it is highly mobile in soil.  It is important that the testing guideline (e.g. OECD 106 or OECD 121) is indicate as well. |
| 12.5 Results of the PBT and vPvB assessment  **Product**:  Rating:   * This substance/mixture does not contain components at concentrations of 0,1 % or higher classified as either per-sistent, bioaccumulative and toxic (PBT) or very persistent and very bioaccumulative (vPvB). |  |
| 12.6 Other adverse effects  **Product**:  Adsorb. org. bound halogen (AOX):   * Due to the fact that it does not contain organically bound halogens, this product cannot contribute to the AOX contamination of waste water.   Other ecological information:   * According to our current state of knowledge, the product does not contain any heavy metals or compounds of the EC Directive 2000/60/EC. |  |

Annex 4 – BAT of interest in existing BREFs

There are some BREF documents of interest concerning handling of chemicals for the sub sectors polymers and fertilisers. The BREF documents are Emissions from storage, EFS (2006), Production of polymers, POL (2007), Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilisers,   
LVIC-AAF (2007) and Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector, CWW (2016). BAT conclusions concerning handling of chemicals are listed below. The BREF documents with BAT conclusions are available on the European IPPC Bureau´s webpage[[41]](#footnote-42)

**Emissions from storage, EFS (2006)**

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| **Section** | **Comments** |
| 5.1 Storage of liquids and liquefied gases | BAT conclusions on tanks, storage of packaged dangerous substances, basins and lagoons, atmospheric mined caverns, pressurised mined caverns, salt leached caverns and floating storage. |
| 5.2 Transfer and handling of liquids and liquefied gases | BAT conclusions on general principles to prevent and reduce emissions and considerations on transfer and handling techniques. |
| 5.3 Storage of solids | BAT conclusions on open storage, enclosed storage, storage of packaged dangerous solids and preventing incidents and (major) accidents. |
| 5.4 Transfer and handling of solids | BAT conclusions on general approaches to minimise dust from transfer and  handling and considerations on transfer techniques. |

**Production of polymers, POL (2007)**

|  |  |
| --- | --- |
| **Generic BAT conclusion under section 13.1** | **Comments** |
| BAT 1 | BAT is to implement and adhere to an Environmental Management System |
| BAT 2-4 | Fugitive emissions |
| BAT 5 | Dust emissions |
| BAT 6 | Start ups and stops |
| BAT 9 | Prevent water pollution |
| BAT 10 | Separate different water and gas streams |
| BAT 11 | Treatment of air purge |
| BAT 15 | Re-use of waste |
| BAT 17 | Buffer for waste water |
| BAT 18 | Waste water treatment |

**Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilisers, LVIC-AAF (2007)**

|  |  |
| --- | --- |
| **Common BAT conclusion in section 1.5** | **Comments** |
| section 1.5.1 | BAT on monitoring of key performance parameters and to establish and maintain mass balances |
| section 1.5.1 | BAT on recycling or re-routing mass streams |
| section 1.5.1 | BAT on reducing waste water volumes and loads by recycling condensates, process and scrubbing waters |
| section 1.5.2 | BAT is to implement and adhere to an Environmental Management System. |

**Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector, CWW (2016)**

|  |  |
| --- | --- |
| **BAT conclusions** | **Comments** |
| BAT 1 | BAT is to implement and adhere to an environmental management system |
| BAT 2-4 | BAT on inventories of waste water and waste gas streams and monitoring |
| BAT 5 | BAT on diffuse VOC emissions |
| BAT 7-11 | BAT on handling of waste water |
| BAT 12 | BAT on waste water treatment |
| BAT 13-14 | BAT on handling of waste |
| BAT 15 | BAT on recovery of compounds and reduction of emissions to air |
| BAT 16, 19 | BAT on emissions to air |

Annex 5 – Examples of Information how to take chemicals better into consideration in the environment permit applications.

The table below is an annex for the environmental permit application to be filled in by the applicant in Finland.[[42]](#footnote-43) It has been used since 2002 in Finland and it has increased significantly the consideration of chemicals in the environment permit process (Mehtonen & Knuutila 2014).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Chemical list | | | | | VOCs | |  | | | Chemical fate | | | | |
| Chemical or mixture | Constituents (individual substances) | Percentage (%) | CAS number | Classifi-cation  (CLP) | Vapour pressure at 20°C (kPa) | Boiling point at 101,3 kPa (°C) | Use volume (max, t/a) | Average use  (t/a) | Function in the process | Ends up to product (%) | Ends up to water (%) | Ends up to air (%) | Ends up to waste (%) | Intermediate etc use |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Annex 6 – SVHC and WFD PS relevant for polymer industry

The list of SVHC substances was downloaded from the ECHA webpage (<https://echa.europa.eu/candidate-list-table>). At the moment (April 2020) the list includes 205 substances or substance groups identified as SVHC. The information on substance uses in EU was compiled from the public ECHA CHEM database (<https://echa.europa.eu/information-on-chemicals>) and in Nordic countries from SPIN register (Substances in Preparation in Nordic countries <http://spin2000.net/>). If the substance had statement ‘”polymer” or “polymers” or “used in polymers” or “used in polymer processing” or “elastomers” etc. in the section ‘uses at industrial sites’ of the ECHA infocard, the substance was deemed to be used in POL industry. The total use volumes in EU were derived from ECHA infocards (public ECHA CHEM database) as well. The use information from SPIN database was searched from the categories “Industrial Use (NACE)” and “Use (national)”. The use volumes in SPIN database are presented for one particular year. If the use volume value in SPIN database is “0” it means that the volume is below the limit of accuracy, which is 100 kg.

There are issues concerning the quality of the data in the public ECHA CHEM database. Firstly, the use information in public ECHA CHEM database is provided by the manufacturers or importers of a substance in the registration dossiers. It is possible that the manufacturer/importer has indicated multiple uses for the substance even though the substance might not be used in POL sector. This results in false positives in the lists and therefore more it should be checked if SVHCs are actually used in POL sector. Secondly, the use volumes in ECHA infocards cover all the possible uses of the substance and not only the used amount in POL sector (i.e. there is no information on amount of use in POL sector). Thirdly, the information on the industrial uses and volumes in public ECHA CHEM might be outdated (the year information is originating/based on is unknown). For these reasons the table 4 may include substances, which are not used in POL sector. Additionally, the use information on PFAS substances identified as SVHC in ECHA CHEM is very scarce. It is possible that they really are not used or that the public ECHA CHEM database is not good information source for use of PFAS. Due to lack of data most PFAS were left out of the table.

Additionally, the utilization of chemical use information in polymer sector from SPIN database turned out to be very difficult, because the polymer sector (or term polymer production or even term polymer) is not available and therefore can not be searched from SPIN database. The only available possibly POL related terms in SPIN register category “Industrial Use (NACE)” are related to manufacture of rubber and plastics. More precise information, e.g., “raw materials for production of rubber products and plastics“ was found from category “Use (national)” in SPIN register, but only for few substances.

Altogether 66 substances or substance groups were identified to be probably used in POL sector. The identified substances and information e.g. on their uses are presented in the table 4. For example, different phenols and phthalates, cadmium and lead substances as well as a PFAS substance (PFBS) are most likely used in POL sector. Most substances are SVHCs but some are both SVHC and WFD substances.

SVHC substances are regulated under REACH with the intention to phase out their use and to reduce exposure. Note that the SVHC substance list is updated twice a year. Substances with the following hazard properties may be identified as SVHCs:

* Substances meeting the criteria for classification as carcinogenic, mutagenic or toxic for reproduction (CMR) category 1A or 1B in accordance with the CLP Regulation.
* Substances which are persistent, bioaccumulative and toxic (PBT) or very persistent and very bioaccumulative (vPvB) according to REACH Annex XIII.
* Substances on a case-by-case basis, that cause an equivalent level of concern as CMR or PBT/vPvB substances.

Table 4: REACH substances of very high concern (SVHC) and WFD priority substances (PS) / priority hazardous substances (PHS) which have registered uses in POL industry based on REACH registration information in the public ECHA chemical database. Annex XV = substance specific dossiers on “Proposal for identification of a substance as a category 1A or 1B CMR, PBT, vPvB or a substance of an equivalent level of concern” under REACH Annex XV, available in the ECHA chemical database separately from the REACH registration information.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Substance**  **(SVHC / WFD substance)** | **CAS** | **Use in POL sector (ECHA/SPIN)** | **Total imported or manufactured for all uses in EU (public ECHA CHEM database) / for POL in Nordic countries (SPIN database) (tons/a) 1** | **“Fate” in wastewater treatment plant 2** | **Other information** |
| 1,2,3-trichloropropane  SVHC | 96-18-4 | ECHA: rubber products and plastic products  Annex XV: manufacture of polymers  SPIN: no data | ECHA: 1 000 – 10 000 tons/a  SPIN: no data | not evaluated in HAZBREF |  |
| 1,2-Benzenedicarboxylic acid, di-C6-10-alkyl esters  SVHC | 68515-51-5 | ECHA: polymers, manufacture of plastic and rubber products  Annex XV: used in polymer processing, preparations and compounds, manufacture of plastic products, including compounding and conversion  SPIN: no POL related uses | ECHA: 0 – 10 tons/a  No POL related uses in SPIN. | not evaluated in HAZBREF | Manufacture ceased in 2018.  This substance may still be used because there is still time to apply for authorization (Latest application date 27/08/2021; Sunset Date 27/02/2023). Thus, the use of substance without authorization is possible in EU until 27.2.23. And use is possible also after sunset date if authorization has been applied. |
| 1,2-dichloroethane  SVHC  WFD PS | 107-06-2 | ECHA: polymers  Annex XV: production of vinyl chloride, manufacture of ethylene amines and vinylidene chloride  SPIN: no POL related uses | ECHA:  1 000 000 – 10 000 000 tons/a  No POL related uses in SPIN. | 66% to surface water  1% to sludge  0% biodegradation  33% volatilization  (Simple Treat – model, Mannio et al. 2011) |  |
| 1,6,7,8,9,14,15,16,17,17,18,18-Dodecachloropentacyclo[12.2.1.16,9.02,13.05,10]octadeca-7,15-diene (“Dechlorane Plus”™)  SVHC | 13560-89-9 | ECHA: polymers, manufacture of plastic products  Annex XV: manufacture of plastics products (including compounding and conversion), formulation of polymers, non-plasticizing flame retardant in polymers  SPIN: no POL related uses | ECHA: 100 – 1 000 tons/a  No POL related uses in SPIN. | not evaluated in HAZBREF |  |
| 1-Methyl-2-pyrrolidone (NMP)  SVHC | 872-50-4 | ECHA: no POL-related uses  Annex XV: acrylic and styrene latexes  SPIN: raw materials for production of plastics\*, manufacture of rubber and plastic products\*\* | ECHA: 10 000 – 100 000 tons/a  SPIN: 0 tons/a (2015)\*,   11 tons/a (2017)\*\* | 8,0% to surface water  0% to sludge  92% biodegradation  0% volatilization |  |
| 2-(2H-benzotriazol-2-yl)-4,6-ditertpentylphenol (UV-328)  SVHC | 25973-55-1 | ECHA: polymers, manufacture of plastic products  Annex XV: UV-stabilisers, UV-protection agents for plastics, rubber and polyurethanes  SPIN: raw materials for production of plastics | ECHA: 100 – 1 000 tons/a  SPIN (2017): 0,3 tons/a | not evaluated in HAZBREF |  |
| 2,2'-dichloro-4,4'-methylenedianiline (MOCA)  SVHC | 101-14-4 | ECHA: polymers, manufacture of plastic products  Annex XV: used primarily to produce polyurethane articles  SPIN: manufacture of rubber and plastic products | ECHA: 100 – 1 000 tons/a  SPIN (2017): 1,5 tons/a | not evaluated in HAZBREF |  |
| 2-benzyl-2-dimethylamino-4'-morpholinobutyrophenone  SVHC | 119313-12-1 | ECHA: polymers, manufacture of plastic products  Annex XV: photoinitiator in polymer production  SPIN: manufacture of plastic and rubber products | ECHA: 100+ tons/a  SPIN (2013): 0 tons/a,  no POL related uses after 2013. | not evaluated in HAZBREF |  |
| 2-ethylhexyl 10-ethyl-4,4-dioctyl-7-oxo-8-oxa-3,5-dithia-4-stannatetradecanoate (DOTE)  SVHC | 15571-58-1 | ECHA: polymers, manufacture of plastic products  Annex XV: processing of polymers, manufacture of plastics products, including compounding and conversion  SPIN: raw materials for production of plastics\*, manufacture of rubber and plastic products\*\* | ECHA: 1 000 – 10 000 tons/a  SPIN: 2 tons/a (2015)\*,  12 tons/a (2017)\*\* | not evaluated in HAZBREF |  |
| 2-methyl-1-(4-methylthiophenyl)-2-morpholinopropan-1-one  SVHC | 71868-10-5 | ECHA: manufacture of plastic products  Annex XV: photoinitiator in polymer production  SPIN: manufacture of rubber and plastic products | ECHA: 1 000+ tons/a  SPIN (2012): 0 tons/a,  no POL related uses after 2012. | not evaluated in HAZBREF |  |
| 4-(1,1,3,3-tetramethylbutyl) phenol  SVHC WFD PS | 140-66-9 | ECHA: polymers  Annex XV: a monomer for polymer preparations, intermediate for manufacture of ethoxylates, component in coatings and tackifier in the production of rubber products  SPIN: raw materials for production of rubber products | ECHA: 10 000 – 100 000 tons/a  SPIN (2017): 0,1 tons/a | not evaluated in HAZBREF |  |
| [4-[[4-anilino-1-naphthyl][4-(dimethylamino)phenyl]methylene]cyclohexa-2,5-dien-1-ylidene] dimethylammonium chloride (C.I. Basic Blue 26)  SVHC | 2580-56-5 | ECHA: polymers, manufacture of plastic products  Annex XV: dyeing of plastic products  SPIN: no POL related uses | ECHA: 0 – 10 tons/a  No POL related uses in SPIN. | not evaluated in HAZBREF | Manufacture ceased in 2020.  This substance may still be used in polymer sector. |
| 4,4'- Diaminodiphenylmethane (MDA)  SVHC | 101-77-9 | ECHA: polymers  Annex XV: Processed to methylenediphenyl diisocyanate (MDI). MDI is further used for polyurethane production.  SPIN: manufacture of rubber and plastic products | ECHA: 10 000 – 100 000 tons/a  SPIN (2012): 0 tons/a,  no POL related uses after 2012. | 50,7% to surface water  49,3% to sludge  0% biodegradation  0% volatilization |  |
| 4,4'-isopropylidenediphenol (bisphenol A; BPA)  SVHC | 80-05-7 | ECHA: polymers, manufacture of plastic products  Annex XV: manufacture of polymers  SPIN: raw materials for production of plastics | ECHA: 100 000 – 1 000 000 tons/a  SPIN (2017): 0,5 tons/a | 7,5% to surface water  6,4% to sludge  86,1% biodegradation  0% volatilization |  |
| 4,4'-oxydianiline  + its salts  SVHC | 101-80-4 | ECHA: polymers, manufacture of chemicals and plastic products  Annex XV: no information on use\*  SPIN: no data | ECHA: 10 – 100 tons/a  SPIN: no data | not evaluated in HAZBREF | **\****The available use information is provided in the registration dossiers (authorities with access rights only) or on ECHA’s dissemination website.* |
| 4-Nonylphenol, branched and linear (incl. ethoxylated NPE)  SVHC WFD PHS | Substance group, no CAS number presented in ECHA database.  84852-15-3 (branched), 26027-38-3 (ethoxylated), 127087-87-0 (branched, ethoxylated)  68412-54-4 (Nonylphenol, branched, ethoxylated) | ECHA: polymers (CAS 84852-15-3)  Annex XV: polymer industry  SPIN: manufacture of rubber and plastic products, industry for plastics in primary forms | ECHA:  CAS 84852-15-3  10 000 – 100 000 tons/a  CAS 26027-38-3  1 – 10 tons/a  CAS 127087-87-0  0 – 10 tons/a or no data  (inconsistent data in ECHA CHEM)  CAS 68412-54-4  100+ tons/a or 1 000+ tons/a  (inconsistent data in ECHA CHEM)  SPIN (2017): 0 tons/a | p-nonylphenol (NP):  3,4% to surface water  62% to sludge  34,3% biodegradation  0,3% volatilization | Certain uses are Restricted under REACH at EU level but not polymer use.  NP is formed due to the degradation of NPE. |
| 4-tert-butylphenol  SVHC | 98-54-4 | ECHA: polymers  Annex XV: polymers  SPIN: raw materials for production of rubber products and plastics | ECHA: 10 000 – 100 000 tons/a  SPIN (2017): 0,2 tons/a | not evaluated in HAZBREF |  |
| Benzene-1,2,4-tricarboxylic acid 1,2 anhydride (trimellitic anhydride) (TMA)  SVHC | 552-30-7 | ECHA: polymers  Annex XV: manufacture of polymers and esters  SPIN: no POL related uses | ECHA: 10 000 – 100 000 tons  No POL related uses in SPIN | not evaluated in HAZBREF |  |
| Benzyl butyl phthalate (BBP)  SVHC | 85-68-7 | ECHA: no data  Annex XV\*: plasticiser for PVC or other polymers  SPIN: manufacture of rubber and plastic products | ECHA: 1– 10 tons/a  SPIN (2015): 0,3 tons/a,  no POL related uses after 2015. | 8% to surface water  42% to sludge  50% biodegradation  0% volatilization  (Simple Treat – model, ECB 2007) | **\*** Annex XV Restriction report – four phthalates |
| Bis (2-ethylhexyl) phthalate (DEHP)  SVHC WFD PHS | 117-81-7 | ECHA: polymers, manufacture of chemicals and plastic products  Annex XV: plasticiser in polymers  SPIN: raw materials for production of rubber products and plastics\*, manufacture of rubber and plastic products\*\* | ECHA: 10 000 – 100 000 tons/a  SPIN: 91 tons/a (2011)\*,  126 tons/a (2017)\*\* | 2,6% to surface water  78,6% to sludge  18,8% biodegradation  0% volatilization |  |
| Bis(2-methoxyethyl) ether (Diglyme)  SVHC | 111-96-6 | ECHA: polymers, manufacture of chemicals and plastic products  Annex XV: production of magnetic polystyrene beads and manufacture of rubber and plastic products  SPIN: manufacture of rubber and plastic products | ECHA: 100 – 1 000 tons/a  SPIN (2007): 0 tons/a,  no use after 2007. | not evaluated in HAZBREF |  |
| Boric acid  SVHC | 10043-35-3 | ECHA: no POL related uses  Annex XV: preservatives for rubber and polymerised materials, raw materials for production of rubber, flame retardants etc.  SPIN: raw materials for production of rubber products | ECHA: 10 000 – 100 000 tons/a  SPIN (2017): 0,1 tons/a | not evaluated in HAZBREF |  |
| Cadmium carbonate  SVHC WFD PHS | 513-78-0 | ECHA: polymers, manufacture of chemicals and plastic products  Annex XV: polymers  SPIN: no data | ECHA: 10 – 100 tons/a  SPIN: no data | Cadmium:  19% to surface water  81% to sludge  0% biodegradation  0% volatilization  (modelling + measured data; Vieno 2014) |  |
| Chromium trioxide  SVHC | 1333-82-0 | ECHA: manufacture of plastic products  Annex XV: catalyst in production of polyethylene and other plastics  SPIN: no POL related uses | ECHA: 10 000 – 100 000 tons/a  No POL related uses in SPIN. | not evaluated in HAZBREF |  |
| Cobalt (II) diacetate  SVHC | 71-48-7 | ECHA: polymers, manufacture of chemicals and plastic products  Annex XV: production of other chemicals and polymers (intermediate), cobalt salts are used to improve the adhesion of rubber to steel  SPIN: manufacture of rubber and plastic products | ECHA: 100 – 1 000 tons/a  SPIN (2011): 0 tons/a,  no POL related uses after 2011. | not evaluated in HAZBREF |  |
| Cyclohexane-1,2-dicarboxylic anhydride (HHPA) and all possible combinations of the cis- and trans-isomers  SVHC | 85-42-7 (HHPA), 14166-21-3 (trans-HHPA), 13149-00-3 (cis-HHPA) | ECHA: polymers  Annex XV: manufacture of alkyd resins, plasticizers and as hardener in epoxy resins. Industrial use as monomer in the manufacture of resins.  SPIN: manufacture of rubber and plastic products | ECHA: 10 000 – 100 000 tons/a  SPIN (2016): 0 tons/a,  no POL related uses after 2016. | not evaluated in HAZBREF |  |
| Decamethylcyclopentasiloxane (D5)  SVHC | 541-02-6 | ECHA: polymers, intermediate  Annex XV: used as a monomer in the production of silicone polymers, resins and other organosilicon substances, used as a feedstock for the production of silicone polymers  SPIN: manufacture of rubber and plastic products | ECHA: 10 000 – 100 000 tons/a  SPIN (2017): 1,2 tons/a | 2,0% to surface water  74,9% to sludge  0% biodegradation  23,1% volatilization |  |
| Diazene-1,2-dicarboxamide (C,C'-azodi(formamide)) (ADCA)  SVHC | 123-77-3 | ECHA: polymers and laboratory chemicals, manufacture of plastic products and rubber products  Annex XV: manufacture of plastics products, including compounding and conversion, a blowing agent in the rubber and plastics industry  SPIN: raw materials for production of rubber products and plastics | ECHA: 10 000 – 100 000 tons/a  SPIN (2017): 116,8 tons/a | 99,8% to surface water  0,2% to sludge  0% biodegradation  0% volatilization |  |
| Diboron trioxide  SVHC | 1303-86-2 | ECHA: intermediate, manufacture of chemicals  Annex XV: borates polymer production  SPIN: no POL related uses | ECHA: 1 000 – 10 000 tons/a  No POL related uses in SPIN. | not evaluated in HAZBREF |  |
| Dibutyl phthalate (DBP)  SVHC | 84-74-2 | ECHA: manufacture of plastic products, intermediate  Annex XV: polymer industry: softener (plasticizer in PVC)  SPIN: raw materials for production of plastics\*, manufacture of rubber and plastic products\*\* | ECHA: 1 000 – 10 000 tons/a  SPIN: 3 tons/a (2009)\*,  0 tons/a (2013)\*\*,  no POL related uses after 2013. | 9% to surface water  33% to sludge  58% biodegradation  0% volatilization  (Simple Treat model, ECB 2003) |  |
| Dicyclohexyl phthalate (DCHP)  SVHC | 84-61-7 | ECHA: polymers  Annex XV: manufacturing of compounds for PVC, rubber and plastic compounds (use as co-plasticizers)  SPIN: manufacture of plastics in primary forms | ECHA: 1 000 – 10 000 tons/a  SPIN (2017): 0,2 tons/a | not evaluated in HAZBREF |  |
| Diethyl sulphate  SVHC | 64-67-5 | ECHA: polymers, manufacture of chemicals  Annex XV: no information on use\*  SPIN: no data | ECHA: 1 – 10 tons/a  SPIN: no data | not evaluated in HAZBREF | **\****The available use information is provided in the registration dossiers (authorities with access rights only) or on ECHA’s dissemination website.* |
| Diisobutyl phthalate  SVHC | 84-69-5 | ECHA: polymers, manufacture of plastic products and chemicals  Annex XV: specialist plasticizer, gelling aid in combination with other plasticizers  SPIN: manufacture of rubber and plastic products | ECHA: 1 – 10 tons/a  SPIN (2017): 1,2 tons/a | 5,3% to surface water  9,2% to sludge  70,1% biodegradation  15,4% volatilization |  |
| Diisopentyl phthalate (DIPP)  SVHC | 605-50-5 | ECHA: no data  Annex XV: May be used as plasticiser for PVC products and other polymers.  SPIN: no data | ECHA: 1 – 10 tons/a or 10 – 100 tons/a (inconsistent data in ECHA CHEM)  SPIN: no data | not evaluated in HAZBREF |  |
| Dimethyl sulphate  SVHC | 77-78-1 | ECHA: polymers, manufacture of chemicals  Annex XV: no information on use\*  SPIN: no POL related uses | ECHA: no data\*  No POL related uses in SPIN. | not evaluated in HAZBREF | This substance may still be used in polymer sector.  **\****The available use information is provided in the registration dossiers (authorities with access rights only) or on ECHA’s dissemination website.* |
| Dinoseb (6-sec-butyl-2,4-dinitrophenol)  SVHC | 88-85-7 | ECHA: polymers, manufacture of chemicals and plastic products, production of resins, rubbers, polymers  Annex XV: no information on use\*  SPIN: no data | ECHA: 1 000 – 10 000 tons/a  SPIN: no data | not evaluated in HAZBREF | Also used as herbicide.  **\****The available use information is provided in the registration dossiers (authorities with access rights only) or on ECHA’s dissemination website.* |
| Dioxobis(stearato)trilead  SVHC | 12578-12-0 | ECHA: polymers, manufacture of plastic products  Annex XV: no information on use\*  SPIN: manufacture of plastic products | ECHA: 1+ tons/a or 1 000+ tons/a (inconsistent data in ECHA CHEM)  SPIN (2009): 0 tons/a,  no use after 2009. | not evaluated in HAZBREF | **\****The available use information is provided in the registration dossiers (authorities with access rights only) or on ECHA’s dissemination website.* |
| Disodium tetraborate, anhydrous  SVHC | 1330-43-4,  1303-96-4 (Borax),  12179-04-3 (pentahydrate) | ECHA: manufacture of chemicals, intermediate  Annex XV: production of plastics, resins, rubbers, nylon, elastomers, used as: industrial fluids, adhesives, flame retardants, reagent chemicals  SPIN: manufacture of rubber and plastic products | ECHA: 100 000 – 1 000 000 tons/a  SPIN (2017): 0 tons/a | 7,9% to surface water  0% to sludge  91,6% biodegradation  0,5% volatilization |  |
| Dodecamethylcyclohexasiloxane (D6)  SVHC | 540-97-6 | ECHA: intermediate  Annex XV: Use as a monomer in the production of polysiloxane polymers and resins. Use as intermediate.  SPIN: no POL related uses | ECHA: 10 000 – 100 000 tons/a  No POL-related uses in SPIN. | 1,9% to surface water  89,4% to sludge  0% biodegradation  8,7% volatilization |  |
| Ethyldiamine (EDA)  SVHC | 107-15-3 | ECHA: adhesives and sealants, manufacture of chemicals  Annex XV: monomer use in epoxy, PU, adhesives, coatings and other polymers, use of polymer - residual monomer  SPIN: manufacture of rubber and plastic products | ECHA: 10 000+ tons/a  SPIN (2017): 0 tons/a | not evaluated in HAZBREF |  |
| Fatty acids, C16-18, lead salts  SVHC  WFD PS | 91031-62-8 | ECHA: polymers, manufacture of plastic products  Annex XV: no information on use\*  SPIN: no data | ECHA: 1 000 – 10 000 tons/a  SPIN: no data | not evaluated in HAZBREF | **\****The available use information is provided in the registration dossiers (authorities with access rights only) or on ECHA’s dissemination website.* |
| Formaldehyde, oligomeric reaction products with aniline  SVHC  WFD PS | 25214-70-4 | ECHA: intermediate  Annex XV: intermediate in MDI and high performance polymer production, hardener in epoxy resins and in adhesives  SPIN: manufacture of rubber and plastic products | ECHA: 100 – 1 000 tons/a  SPIN (2017): 0 tons/a | not evaluated in HAZBREF |  |
| Hexahydro-4-methylphthalic anhydride  SVHC | 19438-60-9 | ECHA: polymers  Annex XV: manufacture of polyester and alkyd resins, plasticizers for thermoplastic polymers, as hardeners for epoxy resins and chain cross-linkers for thermoplastic polymers  SPIN: manufacture of rubber and plastic products | ECHA: 1 000 – 10 000 tons/a  SPIN (2016): 142 tons/a | not evaluated in HAZBREF |  |
| Hexahydromethylphthalic anhydride  SVHC | 25550-51-0 | ECHA: used in in formulation or re-packing and at industrial sites  Annex XV: manufacture of polyester and alkyl resins and plasticizers for thermoplastic polymers, hardeners for epoxy resins and chain cross-linkers for thermoplastic polymers  SPIN: manufacture of rubber and plastic products | ECHA: 1 000 – 10 000 tons/a  SPIN (2010): 0 tons/a,  no POL related uses after 2010. | not evaluated in HAZBREF |  |
| Hydrazine  SVHC | 302-01-2, 7803-57-8 | ECHA: polymers, manufacture of chemicals and plastic products  Annex XV: wide use as an intermediate, use as a monomer in polymerisations (mostly for polyurethane coatings and adhesives)  SPIN: no POL related uses | ECHA: 1 000 – 10 000 tons/a  No POL related uses in SPIN. | not evaluated in HAZBREF |  |
| Imidazolidine-2-thione (2-imidazoline-2-thiol)  SVHC | 96-45-7 | ECHA: manufacture of rubber products  Annex XV: polymer preparations and compounds, process regulators for polymerisation processes in production of resins, rubbers, polymers  SPIN: raw materials for production of rubber\*, manufacture of rubber and plastic products\*\* | ECHA: 1 000 – 10 000 tons/a  SPIN: 10 tons/a (2011)\*,  0 tons/a (2012)\*\*,  no POL related uses after 2012. | 99,9% to surface water  0% to sludge  0% biodegradation  0,1% volatilization |  |
| Lead  SVHC  WFD PS | 7439-92-1 | ECHA: polymers  Annex XV: formulation or repacking etc.  SPIN: raw materials for production of plastics | ECHA:  1 000 000 – 10 000 000 tons/a  SPIN (2017): 0 tons/a | 11% to surface water  89% to sludge  0% biodegradation  0% volatilization  (modelling + measured data; Vieno 2014) |  |
| Lead chromate molybdate sulphate red (C.I. Pigment Red 104)  SVHC  WFD PS | 12656-85-8 | ECHA: polymers, manufacture of plastic products  Annex XV: vinyl and cellulose acetate plastics, rubber and plastic formulation for commercial applications and export  SPIN: manufacture of rubber and plastic products | ECHA: 1 000 – 10 000 tons/a  SPIN (2015): 6,3 tons/a  No POL related uses after 2015. | not evaluated in HAZBREF |  |
| Lead monoxide (lead oxide)  SVHC WFD PS | 1317-36-8 | ECHA: polymers and adsorbents  Annex XV: no information on use\*  SPIN: manufacture of rubber and plastic products | ECHA:  100 000 – 1 000 000 tons/a  SPIN (2017): 0 tons/a | Lead:  11% to surface water  89% to sludge  0% biodegradation  0% volatilization  (modelling + measured data; Vieno 2014) | **\****The available use information is provided in the registration dossiers (authorities with access rights only) or on ECHA’s dissemination website.* |
| Lead oxide sulfate  SVHC  WFD PS | 12036-76-9 | ECHA: polymers  Annex XV: no information on use\*  SPIN: no data | ECHA:  1 – 10 tons/a or 100 – 1 000 tons/a (inconsistent data in ECHA CHEM)  SPIN: no data | Lead:  11% to surface water  89% to sludge  0% biodegradation  0% volatilization  (modelling + measured data; Vieno 2014) | **\****The available use information is provided in the registration dossiers (authorities with access rights only) or on ECHA’s dissemination website.* |
| Lead sulfochromate yellow (C.I. Pigment Yellow 34)  SVHC  WFD PS | 1344-37-2 | ECHA: polymers, manufacture of plastic products  Annex XV: coloration of plastics, coating of plastic material  SPIN: manufacture of rubber and plastic products | ECHA: 1 000 – 10 000 tons/a  SPIN (2015): 0 tons/a,  no POL related uses after 2015. | not evaluated in HAZBREF |  |
| Methyloxirane (Propylene oxide)  SVHC | 75-56-9 | ECHA: polymers  Annex XV: no information on use\*  SPIN: raw materials for production of plastics | ECHA:  1 000 000 – 10 000 000 tons/a  SPIN (2017): 1 885 tons/a | 4,0% to surface water  0% to sludge  16,7% biodegradation  79,3% volatilization | **\****The available use information is provided in the registration dossiers (authorities with access rights only) or on ECHA’s dissemination website.* |
| N,N-dimethylacetamide (DMAC)  SVHC | 127-19-5 | ECHA: intermediate  Annex XV: Spinning solvent in the production of fibres of various polymers including acrylic, polyurethanepolyurea copolymer and meta-aramid. Also used as a solvent for production of films of polyimide.  SPIN: no POL related uses | ECHA: 1 000+ tons/a  No POL related uses in SPIN. | 22,5% to surface water  0,1% to sludge  77,4% biodegradation  0% volatilization |  |
| N,N-dimethylformamide  SVHC | 68-12-2 | ECHA: used in laboratory chemicals, intermediate  Annex XV: use as a process solvent for the manufacture of substances including polymers used e.g. in plastics, artificial leathers, coatings, resins, use as a cleaning solvent, e.g. in textile and plastics industries and laboratories  SPIN: manufacture of rubber and plastic products | ECHA: 10 000 – 100 000 tons/a  SPIN (2011): 0 tons/a,  no POL related uses after 2011. | not evaluated in HAZBREF |  |
| Octamethylcyclo siloxane (D4)  SVHC | 556-67-2 | ECHA: manufacture of chemicals, rubber and plastic products  Annex XV: feedstock for the production of silicone polymers  SPIN: industry for plastics in primary forms, raw materials for production of rubber products and plastics | ECHA: 100 000 – 1 000 000 tons/a  SPIN (2017): 2,5 tons/a | 2,6% to surface water  48,4% to sludge  0% biodegradation  49% volatilization |  |
| Orange lead (lead tetroxide)  SVHC  WFD PS | 1314-41-6 | ECHA: polymers and adsorbents, manufacture of chemicals and plastic products  Annex XV: no information on use\*  SPIN: manufacture of rubber and plastic products | ECHA: 10 000 – 100 000 tons/a  SPIN (2010): 0 tons/a,  no POL related uses after 2010. | Lead:  11% to surface water  89% to sludge  0% biodegradation  0% volatilization  (modelling + measured data; Vieno 2014) | **\****The available use information is provided in the registration dossiers (authorities with access rights only) or on ECHA’s dissemination website.* |
| p-(1,1-dimethylpropyl) phenol  SVHC | 80-46-6 | ECHA: polymers, manufacture of chemicals and plastic products  Annex XV: not found  SPIN: no POL related uses | ECHA: 100 – 1 000 tons/a  No POL related uses in SPIN. | not evaluated in HAZBREF |  |
| Pentalead tetraoxide sulphate  SVHC | 12065-90-6 | ECHA: polymers, manufacture of plastic products and chemicals  Annex XV: no information on use\*  SPIN: manufacture of plastic and rubber products | ECHA: 10 000 – 100 000 tons/a  SPIN (2006): 0 tons/a,  no use after 2006. | not evaluated in HAZBREF | **\****The available use information is provided in the registration dossiers (authorities with access rights only) or on ECHA’s dissemination website.* |
| Perfluorobutane sulfonic acid (PFBS) and its salts  SVHC | 375-73-5 | ECHA: polymers, manufacture of plastic products  Annex XV: catalyst in polymer manufacture and as catalyst in chemical synthesis, additive/reactant in polymerisation processes in e.g. polycarbonate production  SPIN: no data | ECHA: 0 – 10 tons/a  SPIN: no data | not evaluated in HAZBREF |  |
| [Phthalato(2-)] dioxotrilead  SVHC  WFD PS | 69011-06-9 | ECHA: polymers, manufacture of plastic products  Annex XV: no information on use\*  SPIN: manufacture of rubber and plastic products | ECHA: 0 – 10 tons/a  SPIN (2007): 0 tons/an  no use after 2007. | not evaluated in HAZBREF | **\****The available use information is provided in the registration dossiers (authorities with access rights only) or on ECHA’s dissemination website.* |
| Sulfurous acid, lead salt, dibasic  SVHC  WFD PS | 62229-08-7 | ECHA: polymers, manufacture of plastic products  Annex XV: no information on use\*  SPIN: manufacture of rubber and plastic products | ECHA: 0 – 10 tons/a  SPIN (2009): 0 tons/a,  no use after 2009. | not evaluated in HAZBREF | **\****The available use information is provided in the registration dossiers (authorities with access rights only) or on ECHA’s dissemination website.* |
| Terphenyl hydrogenated  SVHC | 61788-32-7 | ECHA: polymers, manufacture of chemicals and plastic products  Annex XV: additive in plastic applications  SPIN: manufacture of rubber and plastic products | ECHA: 10 000 – 100 000 tons/a  SPIN (2017): 0 tons/a | not evaluated in HAZBREF |  |
| Trilead dioxide phosphonate  SVHC  WFD PS | 12141-20-7 | ECHA: polymers, adhesives and sealants, manufacture of plastic products, chemicals and rubber products  Annex XV: no information on use\*  SPIN: manufacture of rubber and plastic products | ECHA: 1 000 – 10 000 tons/a  SPIN (2017): 0 tons/a | not evaluated in HAZBREF | **\****The available use information is provided in the registration dossiers (authorities with access rights only) or on ECHA’s dissemination website.* |
| Tris(4-nonylphenyl, branched and linear) phosphite (TNPP) with = 0.1% w/w of 4-nonylphenol, branched and linear (4-NP)  SVHC | Mixture of two substances, no CAS number presented in ECHA database  26523-78-4  [Tris(nonylphenyl) phosphite] | ECHA: polymers, manufacture of rubber and plastic products  Annex XV: used as an antioxidant to stabilise polymers, use of formulated polymer in manufacturing, coatings and adhesives  SPIN: industry for plastics in primary forms, raw materials for production of plastics | ECHA: 10 000 – 100 000 tons/a  SPIN (2017): 0,2 tons/a | not evaluated in HAZBREF |  |
| Trixylyl phosphate  SVHC | 25155-23-1 | ECHA: polymers, manufacture of plastic products  Annex XV: starting material for polymer foam production, manufacturing and use of plastic products  SPIN: no POL related uses | ECHA:  100+ tons/a or 1 000+ tons/a (inconsistent data in ECHA CHEM)  No POL related uses in SPIN. | not evaluated in HAZBREF |  |

1) Information taken from ECHA chemical database (<https://echa.europa.eu/fi/information-on-chemicals>) 1.4.2020, indicates total imported/manufactured amount in EU (tons per year) in all uses, no information on use specifically in POL sector. The years information is based on is unknown.

Information taken from SPIN database (<http://spin2000.net/>) 1.4.2020, indicates total imported/produced volume in POL sector in the Nordic Countries in one particular year (tons per year).

2) GoA2.2 mini-report

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* Annex XV dossier 1,2-dichloroethane
* Annex XV dossier 1-methyl-2-pyrrolidone
* Annex XV dossier 2-(2H-benzotriazol-2-yl)-4,6-ditertpentylphenol (UV-328)
* Annex XV dossier 2,2'-dichloro-4,4'-methylenedianiline
* Annex XV dossier 4-(1,1,3,3-tetramethylbutyl)phenol
* Annex XV dossier [4-[[4-anilino-1-naphthyl][4- (dimethylamino)phenyl]methylene]cyclohexa-2,5-dien-1-ylidene] dimethylammonium chloride (C.I. Basic Blue 26)
* Annex XV dossier 4,4-Oxydianiline
* Annex XV dossier 4-Nonylphenol, branched and linear, ethoxylated
* Annex XV dossier Bis(2-ethylhexyl)phthalate
* Annex XV dossier bis(2-methoxyethyl) ether (Diglyme)
* Annex XV dossier Boric acid
* Annex XV dossier C,C'-azodi(formamide) (ADCA)
* Annex XV dossier Dibutyl phthalate
* Annex XV dossier Diisobutyl phthalate
* Annex XV dossier Diethyl sulphate
* Annex Xv dossier Diisopentylphthalate (DIPP)
* Annex XV dossier Dimethyl sulphate
* Annex XV dossier Dinoseb(ISO); 6-sec-butyl-2,4-dinitrophenol
* Annex XV dossier Dioxobis(stearato)trilead
* Annex XV dossier Disodium tetraborate, anhydrous
* Annex XV dossier Fatty acids, C16-18, lead salts
* Annex XV dossier Formaldehyde, oligomeric reaction products with aniline
* Annex XV dossier Hexahydromethylphthalic anhydride Hexahydro-4-methylphthalic anhydride Hexahydro-1-methylphthalic anhydride Hexahydro-3-methylphthalic anhydride
* Annex XV dossier Hydrazine
* Annex XV dossier Imidazolidine-2-thione (2-imidazoline-2-thiol)
* Annex XV dossier Lead chromate molybdate sulfate red (C.I. Pigment Red 104)
* Annex XV dossier Lead monoxide [Lead oxide]
* Annex XV dossier Lead oxide sulfate
* Annex XV dossier Lead sulfochromate yellow (C.I. Pigment Yellow 34)
* Annex XV dossier Methyloxirane [Propylene oxide]
* Annex XV dossier N,N-Dimethylacetamide (DMAC)
* Annex XV dossier N,N-dimethylformamide
* Annex XV dossier Orange lead [Lead tetroxide]
* Annex XV dossier Pentalead tetraoxide sulphate
* Annex XV dossier [Phthalato(2-)]dioxotrilead
* Annex XV dossier Sulfurous acid, lead salt, dibasic
* Annex XV dossier Trilead dioxide phosphonate
* Annex XV dossier Trixylyl phosphate
* Annex XV report 1,6,7,8,9,14,15,16,17,17,18,18- Dodecachloropentacyclo[12.2.1.16,9.02,13.05,10]octadeca-7,15-diene (“Dechlorane Plus”TM) [covering any of its individual anti- and syn-isomers or any combination thereof]
* Annex XV report 1,2-Benzenedicarboxylic acid, di-C6-10-alkyl esters;
* Annex XV report 2-methyl-1-(4-methylthiophenyl)-2-morpholinopropan-1-one
* Annex XV report 2-ethylhexyl 10-ethyl-4,4-dioctyl-7-oxo-8-oxa-3,5- dithia-4-stannatetradecanoate (DOTE)
* Annex XV report 4,4’-Diaminodiphenylmethane (MDA)
* Annex XV report 4,4'-isopropylidenediphenol (Bisphenol A)
* Annex XV report 4-tert-butylphenol
* Annex XV report Benzene-1,2,4-tricarboxylic acid 1,2-anhydride
* Annex XV report Cadmium carbonate
* Annex XV report Chromium trioxide
* Annex XV report Cobalt(II) diacetate
* Annex XV report Decamethylcyclopentasiloxane; D5
* Annex XV report Dicyclohexyl phthalate (DCHP)
* Annex XV report Dodecamethylcyclohexasiloxane
* Annex XV report Ethylenediamine (ethane-1,2-diamine)
* Annex XV report Lead (lead powder and lead massive)
* Annex XV report Octamethylcyclotetrasiloxane, D4
* Annex XV report Perfluorobutane sulfonic acid (PFBS) and its salts
* Annex XV report Terphenyl, hydrogenated
* Annex XV report Tris(4-nonylphenyl, branched and linear) phosphite (TNPP) with ≥ 0.1% w/w of 4-nonylphenol, branched and linear (4-NP)1
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Annex 7 – SVHC and WFD PS relevant for fertiliser industry

The list of SVHC substances was downloaded from the ECHA webpage (<https://echa.europa.eu/candidate-list-table>). At the moment (April 2020) the list includes 205 substances or substance groups identified as SVHC. The information on substance uses in EU was compiled from the public ECHA CHEM database (<https://echa.europa.eu/information-on-chemicals>) and in Nordic countries from SPIN register (Substances in Preparation in Nordic countries <http://spin2000.net/>). If the substance had word ‘”fertiliser” in the section ‘uses at industrial sites’ of the ECHA infocard, the substance was deemed to be used in fertiliser industry. The total use volumes in EU were derived from ECHA infocards (public ECHA CHEM database) as well. The use information from SPIN database was searched from the categories “Industrial Use (NACE)” and “Use (national)”. The use volumes in SPIN database are presented for one particular year. If the use volume value in SPIN database is “0” it means that the volume is below the limit of accuracy, which is 100 kg.

There are issues concerning the quality of the data in the public ECHA CHEM database. Firstly, the use information in public ECHA CHEM database is provided by the manufacturers or importers of a substance in the registration dossiers. It is possible that the manufacturer/importer has indicated multiple uses for the substance even though the substance might not be used in the fertiliser sector. This results in false positives in the lists and therefore more it should be checked if SVHCs are actually used in fertiliser sector. Secondly, the use volumes in ECHA infocards cover all the possible uses of the substance and not only the used amount in fertiliser sector (i.e. there is no information on amount of use in fertiliser sector). Thirdly, the information on the industrial uses and volumes in public ECHA CHEM might be outdated (the year information is originating/based on is unknown). For these reasons the table 5 may include substances, which are not used in fertiliser sector.

Altogether 5 substances or substance groups were identified to fertiliser sector. Three of these are boron compounds. Boron is an essential plant micronutrient and added to SVHC list due to concerns related to human health. Two of the identified substances are cobalt salts. Cobalt is needed in nitrogen fixation reactions in legume plants. The identified substances and information e.g. on their uses are presented in the table 5.

SVHC substances are regulated under REACH with the intention to phase out their use and to reduce exposure. Note that the SVHC substance list is updated twice a year. Substances with the following hazard properties may be identified as SVHCs:

* Substances meeting the criteria for classification as carcinogenic, mutagenic or toxic for reproduction (CMR) category 1A or 1B in accordance with the CLP Regulation.
* Substances which are persistent, bioaccumulative and toxic (PBT) or very persistent and very bioaccumulative (vPvB) according to REACH Annex XIII.

Substances on a case-by-case basis, that cause an equivalent level of concern as CMR or PBT/vPvB substances

Table 5: REACH substances of very high concern (SVHC) and WFD priority substances (PS) / priority hazardous substances (PHS) which have registered uses in fertiliser industry based on REACH registration information in the ECHA chemical database. Annex XV = substance specific dossiers on “Proposal for identification of a substance as a category 1A or 1B CMR, PBT, vPvB or a substance of an equivalent level of concern” under REACH Annex XV, available in the ECHA chemical database separately from the REACH registration information.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Substance**  **(SVHC / WFD substance)** | **CAS** | **Use in Fertiliser sector (ECHA/SPIN)** | **Total imported or manufactured for all uses in EU (ECHA database) / for STM in Nordic countries (SPIN database) (tons/a)1** | **“Fate” in wastewater treatment plant2** | **Other information** |
| Boric acid  SVHC | 10043-35-3 | ECHA: fertilisers  Annex XV: non-electrolytic metal coatings, metal surface treatment agents, corrosion inhibitors, rust preventive agents  SPIN: crop and animal production, agriculture, fertilisers | ECHA:  100 000 – 1 000 000 tons/a  SPIN (2017): 42,2 tons/a | not evaluated in HAZBREF |  |
| Cobalt dichloride  SVHC | 7646-79-9 | ECHA: metal surface treatment products, manufacture of chemicals and fabricated metal products  Annex XV: nitrate fertilisers  SPIN: no fertiliser related uses | ECHA:  1 000 – 10 000 tons/a  No fertilisers related uses in SPIN. | not evaluated in HAZBREF |  |
| Cobalt (II) carbonate  SVHC | 513-79-1 | ECHA: fertilisers  Annex XV: adhesion: ground coat frit, production of other chemicals (intermediate)  SPIN: manufacture of food products, nutrients, fertilisers | ECHA:  1 000 – 10 000 tons/a  SPIN (2017): 0 tons/a | not evaluated in HAZBREF |  |
| Disodium octaborate  SVHC | 12008-41-2 | ECHA: fertilisers  Annex XV: micronutrient fertilisers  SPIN: no fertilisers related use | ECHA:  1 000 – 10 000 tons/a  No fertilisers related use in SPIN. | not evaluated in HAZBREF |  |
| Disodium tetraborate, anhydrous  SVHC | 1330-43-4,  1303-96-4 (Borax),  12179-04-3 (pentahydrate) | ECHA: fertilisers  Annex XV: metal production, metal surface refining (pentahydrate)  SPIN: crop and animal production, agriculture, fertilisers | ECHA:  100 000 – 1 000 000 tons/a  SPIN (2017): 0 tons/a  343,5 tons/a (Borax)  159,2 tons/a (pentahydrate) | 7,9% to surface water  0% to sludge  91,6% biodegradation  0,5% volatilization |  |

References:

Annex XV reports of boric acid, cobalt dichloride, cobalt (II) carbonate, disodium octaborate, disodium tetraborate

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Annex 8 – Substance flow analysis

In the HAZBREF case study the exposure scenario of a substance for fertiliser formulation indicated that based on modelling there is a risk that the emissions from fertiliser production exceed the PNEC values (PEC/PNEC>1) in water, sediment and soil and in addition in sewage treatment plant. This estimate however does not fit well in the NPK production process of the case installation since the wastewater from the installation is treated in its own treatment plant and the sludge is landfilled. This will decrease the emissions to water and no emissions to STP or to soil are generated. Also, the use volumes in the exposure scenarios were overestimated.

A material flow analysis (MFA) was concluded in one of the case sites to assess the possible releases of the substance to environment from the production process. STAN tool was used to conduct this MFA and this annex explains the method in brief.

Material flow analysis is a method for assessing flows of materials during a given time period and within a defined system boundary (1). The material can be a good or a substance, and if it is a substance the method is referred to as a substance flow analysis. The basic principle, which material and substance flow analysis relies on, is the law of mass conservation, which implies that the sum of all inputs of the material to the system must be equal to the sum of outputs from the system. See Brunner & Rechenberger (2) for a detailed overview of the MFA method.

In this analysis a material and substance flow analysis software, STAN 2.6 version was used. STAN has built-in computation algorithms for error propagation and data reconciliation, securing a viable system without gross errors while balancing the flows, thereby satisfying the law of mass conservation.

These steps to follow when executing the analysis with STAN:

1. Choosing the substance to analyze.
2. Defining the system boundary in space and time.
3. Identifying goods containing the chosen substance in step 1).
4. Identifying processes and flows related to the identified goods in step 1).
5. Building the graphical model in STAN based on the processes and flows in step 4).
6. Defining the layers of goods and substances.
7. Entering data regarding the mass flows and mass fractions for the layers defined in step 6).
8. Performing the calculation with STAN.

The STAN-software relies on error propagation, which means that all data used in STAN should also have standard errors. It is recommended in the STAN manuals that if no error is known, an assumption or estimate is better than no (or 0) error. The standard sample error is computed by the formula

Equation I

where s is the sample standard deviation (the sample-based estimate of the standard deviation of the population) and n is the number of observations in the sample.

The substance was chosen (referred here as substance X) (step 1). The system boundary was set to be the production plant and its immediate surrounding area, including the area for unloading the raw-materials and packing the product (step 2), as well as the water treatment plant in connection with the production plant. The timeline for the model was chosen to be one year. The material flows containing substance X were identified (step 3). The identification of processes and flows was done by combining information about the plant infrastructure and its waste water treatment plant (step 4), and a graphical model was built in STAN based on this information (step 5). Two layers were defined, a layer of goods containing the substance X and the substance layer (step 6).

The analysis of the flow of X started with identifying which substances may contain substance X and understanding if or when these flows may be in contact with the surroundings of the plant. The flows were drawn and the masses of substance X were calculated or estimated, when data was not available. Standard errors were computed for the values where there was more than 1 measurement on the mass or mass fraction. To estimate the standard errors of the input values without comprehensive measurement data, the mean of the relative standard errors were computed (32,33 %). This estimate was used for the rest of the input data, except for the amount of substance X in the products, which can be assumed to be more controlled since the product composition should be known. in the products, which can be assumed to be more controlled since the product composition should be known.

The results were computed with STAN (step 8). Since not all import and export flows were known, the software can not apply the method of data reconciliation.

STAN is a suitable tool for evaluating the outflow of a substance into the environment, provided that the data is comprehensive enough. An analysis similar to this one can be difficult to conduct with other substances if the data basis is limited compared to the data used in this analysis, or if there are more or larger uncertainties than in this analysis. Therefore, the method is only suitable for calculating substance flows if there is enough measured data on the substances and the substance is relatively inert in the process.

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3. The Russian Chemists Union [↑](#footnote-ref-4)
4. <http://vestkhimprom.ru/posts/khimicheskij-kompleks-segodnya> [↑](#footnote-ref-5)
5. The Russian Chemists Union [↑](#footnote-ref-6)
6. https://eippcb.jrc.ec.europa.eu/reference/large-volume-inorganic-chemicals-ammonia-acids-and-fertilisers [↑](#footnote-ref-7)
7. Fertilisers Europe Annual Overview 2018-2019 [↑](#footnote-ref-8)
8. https://eippcb.jrc.ec.europa.eu/reference/production-large-volume-organic-chemicals-0 [↑](#footnote-ref-9)
9. https://eippcb.jrc.ec.europa.eu/reference/production-polymers [↑](#footnote-ref-10)
10. https://eippcb.jrc.ec.europa.eu/reference/common-waste-gas-treatment-chemical-sector [↑](#footnote-ref-11)
11. https://echa.europa.eu/fi/-/high-volume-plastic-additives-mapped [↑](#footnote-ref-12)
12. Plastics Europe. Plastics - the Facts 2018. https://www.plasticseurope.org/en/resources/publications/619-plastics-facts-2018 [↑](#footnote-ref-13)
13. Polymer BREF 2007 [↑](#footnote-ref-14)
14. https://echa.europa.eu/fi/substance-information/-/substanceinfo/100.030.114 And https://echa.europa.eu/fi/substance-information/-/substanceinfo/100.014.129 [↑](#footnote-ref-15)
15. Decision No 2455/2001/EC of the European Parliament and of the Council of 20 November 2001 establishing the list of priority substances in the field of water policy and amending Directive 2000/60/EC (Text with EEA relevance), OJ L 331/1. [↑](#footnote-ref-16)
16. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32011R0010>, <https://ec.europa.eu/food/safety/chemical_safety/food_contact_materials/legislation_en> [↑](#footnote-ref-17)
17. <https://ec.europa.eu/growth/sectors/chemicals/specific-chemicals_en> [↑](#footnote-ref-18)
18. <https://sinlist.chemsec.org/>https://sinlist.chemsec.org/ [↑](#footnote-ref-19)
19. <https://ec.europa.eu/environment/seveso/legislation.htm> [↑](#footnote-ref-20)
20. Under certain conditions some chemical formulations which do not meet the criteria for classification as hazardous according to CLP also require an SDS to be prepared or be made available on request (See Article 31(3) of REACH and notes to tables 3.4.6, 3.6.2, 3.7.2, 3.8.3and 3.9.4of Annex I of CLP). [↑](#footnote-ref-21)
21. https://echa.europa.eu/ [↑](#footnote-ref-22)
22. http://www.stan2web.net/ [↑](#footnote-ref-23)
23. https://ec.europa.eu/jrc/en/scientific-tool/european-union-system-evaluation-substances [↑](#footnote-ref-24)
24. https://echa.europa.eu/ [↑](#footnote-ref-25)
25. The short-comings of SDS in terms of their comprehensiveness and quality of information need to be taken into account and may require further inquiries with the chemical supplier, particularly as far as the complete disclosure of chemical product compositions is concerned. [↑](#footnote-ref-26)
26. Technical data sheets contain information on the application of the product and instructions for its use. This may include the correct dilution range, the correct temperature as well as other information of use for the process engineer. [↑](#footnote-ref-27)
27. <https://cefic.org/our-industry/responsible-care/> [↑](#footnote-ref-28)
28. This section contains unmarked text which is taken from the final report of WP 2. The authorship is with WP 2 of HAZBREF [↑](#footnote-ref-29)
29. [Analysis of the interfaces, possible synergies or gaps between Industrial Emission Directive, REACH Regulation, Water Framework Directive, Marine Strategy Framework Directive and the POP Regulation concerning hazardous substances](https://www.syke.fi/download/noname/%7BE565D8ED-8AB4-47AA-BAB5-369B9D905B05%7D/160790) [↑](#footnote-ref-30)
30. Based on: IMPEL, Linking the Directive on Industrial Emissions (IED) and the REACH Regulation, 2013) [↑](#footnote-ref-31)
31. Art. 36 of REACH [↑](#footnote-ref-32)
32. Art 12 of IED [↑](#footnote-ref-33)
33. Schleswig-Holstein, see chapter 5.1.3 [↑](#footnote-ref-34)
34. KemiDigi [↑](#footnote-ref-35)
35. Art. 36 of REACH [↑](#footnote-ref-36)
36. Art 12 of IED [↑](#footnote-ref-37)
37. Stenmarck Å et al, Hazardous substances in plastics – ways to increase recycling, TemaNord 2017 [↑](#footnote-ref-38)
38. https://eippcb.jrc.ec.europa.eu/reference/production-polymers [↑](#footnote-ref-39)
39. https://www.ceguide.org/Strategies-and-examples/Dispose/Feedstock-recycling [↑](#footnote-ref-40)
40. I (Identification of the installation); PA (Permit Application); AA (Assessment of the application documents); PI (Involvement of the Public); PD (Permit Decision) M (Monitoring, reporting and inspections), R (Review of the Permit) [↑](#footnote-ref-41)
41. https://eippcb.jrc.ec.europa.eu/reference/ [↑](#footnote-ref-42)
42. <https://www.ymparisto.fi/fi-fi/asiointi_luvat_ja_ymparistovaikutusten_arviointi/luvat_ilmoitukset_ja_rekisterointi/ymparistolupa/Miten_ymparistolupa_haetaan__ohjeet_ja_lomakkeet> [↑](#footnote-ref-43)