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Selection of hazardous substances for the risk management

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Abstract

The aim of this project has been to develop a national selection mechanism for hazardous substances and make a proposal for the first priority list of hazardous substances in Finland. In this context by hazardous substances is understood substances that are persistent, toxic and tend to bioaccumulate (PBT substances). According to the proposal a substance must fulfil all three PBT criteria to be selected on the Finnish priority list. Persistency has been stressed in the selection profile, since it is considered as a particularly harmful character in the Finnish environmental conditions. The biological and hydrolytical degradation of chemicals is assumed to occur slower in Finland and in the Baltic Sea due to the low temperature. In addition phototransformation of chemicals is considered to be negligible during the winter because of short day conditions and snow and ice cover of soil and waters.

A proposal of priority list of hazardous substances taking into account the environmental conditions of Finland and in the Baltic Sea is made. The selection mechanism has focussed on the environmental hazard, but most of the selected chemicals are of concern for the human health as well. The data on the harmful properties has been obtained from the Nordic Substance Database. The Finnish Register of Chemical Products (KETU) has been used as a pool of chemicals. The serious problem of this method is the lack of data. Only about 900 chemicals registered in KETU have information on persistency, toxicity and bioaccumulation, and can potentially be selected as priority chemicals. More than 4500 chemicals remain outside the selection. In addition, not all chemicals that exist on the Finnish market are included in KETU.

The proposal for priority list contains 54 industrial chemicals, 17 biocides, and 13 pesticides. In addition, separate lists of eight heavy metals and 37 endocrine disrupters are made. The listed endocrine disrupters have been found in KETU and are identified as endocrine disrupters on the basis of EU candidate list. Several substances occur in more than one main category, e.g. several biocides are also used as industrial chemicals. Solvents are most common industrial priority substances, and other typical industrial use patterns are glues, resins, paints, lacquers, varnishes, lubricants and washing agents. Industrial priority chemicals are commonly used in chemical, metal, rubber and plastic industry. Also construction and car service are the fields where several products containing priority chemicals are used. Of the biocidal and pesticidal active substances, the insecticides are the most common. When regarding the number of products, most typical biocidal uses are antifouling paints and wood preservatives.

To be on the list does not necessarily mean a ban or restriction of the chemical. The priority list is intended to be used by all actors involved with manufacture, import or use of chemicals or products containing these chemicals to indicate that special care should be taken to reduce potential risks. The list may help to evaluate the hazard potential of chemicals and also to support the substitution principle. The priority setting mechanism and the proposed list are developed also for a tool to implement the requirements of EU water legislation regarding national identification of priority substances.

The proposed priority list cannot be complete. Therefore this kind of lists should always be considered as an example of particularly hazardous chemicals. As the amount of data on chemical properties is continuously increasing, the prioritisation should be repeated regularly.

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1 Introduction

The aim of this project is to develop a national selection mechanism for hazardous substances and to make a proposal for the first priority list of hazardous substances in Finland. In this context by hazardous substances is understood substances that are persistent, toxic and tend to bioaccumulate (PBT substances). Other hazardous properties are left out of the scope of this study. Furthermore, this project concentrates on intentionally produced and used chemicals leaving unintentionally produced by-products out of the selection.

The total amount of chemicals on the market is large and chemicals are used in all sectors of an industrialised society. The production and use of these chemicals pose risks to the environment. However, risks caused by different substances vary depending on their intrinsic properties and emissions to the environment. Ideally the risk reduction decisions would be based on full scientific risk assessment which takes into account both the effects and exposure. That is, however, in practice unrealistic procedure due to high number of chemicals and amount of work needed to compile a full risk assessment. Hence, more rough selection and prioritisation of substances is needed to focus the risk reduction efforts to substances which are likely to pose the most severe risks. The national priority substances list can be used as one aid when deciding on where risk reduction efforts should be placed. It should be noted that such priority substances lists are always indicative and by no means complete.

2 Selection criteria and prioritisation methods

Selection and prioritisation of chemicals have been carried out for various purposes both within the EU, international organisations and countries. In addition to use pattern, also data availability has had a major impact on selection procedure and results. Different prioritisation methods are described in Annexes 4-10. The selection and prioritisation of hazardous substances usually includes various selection steps. Ideally the initial selection is done among the universe of chemicals. The amount of substances is reduced at each step, and subsequently the demands on the quality of data are increased. The first step has to be for practical reasons automatic and computerised, but at the final selection the expert judgement is often used.

2.1 PBT properties are used as selection criteria

Persistency, toxicity and bioaccumulation potential are commonly used in the various selection procedures. Different cut-off values for the PBT properties have been used in different prioritisation procedures (Table 1, Annexes 4-10). Persistency and bioaccumulation, however, are not appropriate parameters for the selection of metals and other inorganic compounds. Such substances should be added on the priority list via expert judgement. In addition to PBT characters, properties such as potential for long-range atmospheric transport, hormone disrupting character, ozone depleting potential, and potential to cause greenhouse effect have been used in the prioritisation processes. In addition to harmful properties of the chemicals, their release potential is usually taken into account in prioritising substances. Monitoring data, use patterns, and production volume have been used to estimate exposure of chemicals.

Persistence, toxicity and bioaccumulation potential are considered as inherent properties of chemicals, but also external conditions modify these parameters. Degradation of chemicals is

significantly affected by environmental conditions such as temperature, pH, presence of other chemicals, density and species composition of microbial community. In general, the increase of temperature increases toxicity and bioaccumulation of chemicals, at least in short-term exposure (Braunschweiler & Koivisto 2000). pH greatly affects the toxicity and bioaccumulation of ionic substances such as weak acids and bases.

Persistence

The persistence of a substance reflects the potential for long-term exposure of organisms but also the potential for the substance to be widely distributed in the environment. Biodegradability is not only an intrinsic property of the compound, because the environmental conditions greatly affect the biodegradability. The biodegradation half-life time depends on temperature, the reactivity of the substance, on whether or not the micro-organisms have the ability to degrade the substance, and on the abundance of micro-organisms in the ambient media (DYNAMEC 00/3/1-E). For example, the half-lives in marine surface waters are expected to be longer than in limnic surface waters. The available information on biodegradability of industrial chemicals is dominated by data on ready biodegradability, less data is available from inherent and simulation tests. In the national risk assessment of pesticides and biocides, organic substances are considered as slowly biodegradable (i.e. persistent) when the half-life in soil is three months or more. The half-life less than one week in soil indicates rapid biodegradation, and the half-life 7-30 days in soil indicates moderately rapid biodegradation.

Bioaccumulation

Substances can accumulate in aquatic organisms directly from the water, i.e. bioconcentration or via uptake through the food chain, i.e. biomagnification. Different models are available for evaluation of bioconcentration of organic chemicals, but suitable parameters to evaluate food chain accumulation are not available. The bioconcentration factor, BCF, is used as an indicator for bioconcentration. If no BCF is determined, the *n*-octanol/water partition coefficient, log K_{ow}, can be used. In the national risk assessment of pesticides and biocides, organic substances are considered as bioaccumulating when the BCF for the whole fish is more than 100, highly bioaccumulating substances have BCF more than 1000. Log $K_{ow} > 3$ indicates that the substance is potentially bioaccumulating, whereas log $K_{ow} > 5$ indicates that the substance is potentially highly bioaccumulating.

Toxicity

Toxicity is an inherent property of a chemical although pH and temperature may affect toxicity of several chemicals by changing their bioavailability. Both acute and chronic toxicological and ecotoxicological data are to be taken into account in the selection of toxic substances. In general, chronic effect data are preferred when both acute and chronic data are available. A factor of 10 is proposed to be used between acute and chronic cut-off values, for instance LC50 < 0.1 mg/l corresponds to NOEC < 0.01 mg/l. In the national risk assessment of pesticides and biocides, the substances are considered toxic if the acute LC50 or EC50 is between 1 and 10 mg/l or long-term NOEC is 0.01-0.1 mg/l. The LC50 or EC50 less than 1 mg/l and NOEC less than 0.01 mg/l indicates high toxicity.

2.2 Selection criteria used in prioritisation of hazardous substances

If an exclusive (strict) cut-off value is used more substances are excluded from the selection while inclusive (conservative) cut-off value excludes fewer substances from the selection. In the reviewed prioritisation procedures the selection criteria for persistency varied most, whereas rather similar cut-off values were used for bioaccumulation and toxicity. Bioconcentration factors ranged from $\geq$ 500 to $\geq$ 1000 and log K_{ow} values ranged from $\geq$ 4 to $\geq$ 5. The most inclusive criteria for aquatic toxicity was EC50 or LC50 $\leq$ 1 mg/l or NOEC $\leq$ 0.1 mg/l. The most exclusive criteria used for aquatic toxicity were EC50 or LC50 $\leq$ 0.01 mg/l or NOEC $\leq$ 0.001 mg/l. In DYNAMEC procedure (OSPAR) not readily or not inherently biodegradable substances were selected, whereas in the Dutch selection procedure the biodegradation was solely based on modelling and categories “months” and “more than months” were used in the selection.

In Swedish and Norwegian selection the degradation criteria less than 20% in ready or inherent tests were used. In the Nordic prioritisation processes, the only national element has been the use and production or import volumes of substances in the respective country. Environmental conditions have not been considered in the Danish, Norwegian or Swedish prioritisation procedures.

***Table 1**. The criteria for persistence, bioaccumulation potential and toxicity in different selection procedures adopted from BKH 1998.*

Organisation	Criteria for persistence, toxicity and bioaccumulation potential
UN-ECE 1994 First screening phase	t½ in air > 2 d, vapour pressure < 1000 Pa, t½ in soil, water > 28 d present in remote areas, (use pattern and production volume)
UN-ECE 1996, LRTAP Proposed procedure to add new substances to the Protocol on POPs	log K_{ow} > 5 or BCF > 5000 and t½ in water > 2 months or t½ in soil or sediment > 6 months, potential for long-range atmospheric transport
UNEP-POP Convention 2000[1]	log K_{ow} > 5 or BCF > 5000 and t½ in air > 2 d, t½ in water > 2 months or t½ in soil or sediment > 6 months, potential for long-range environmental transport
PARCOM 1991 PCB-substitutes	biodegradation < 10-30% in all tests, DT50 > 25 d, exp. BCF > 10 000, log K_{ow} > 5, toxicity at the 1 mg/l level
OSPAR pre-screening scheme for off-shore chemicals	Inherent biodegradation < 20% DOC in 28 d, log K_{ow} 3 and Mol < 600
Supplement to IRC-list 1990	t½ > 60 d
US-EPA List of pers. bioacc. subst.	Production volume > 4.5 ton/yr or > 450 ton/yr, t½ (compartment) $\geq$ 30 d (hydrolysis, photolysis, biodegradation)
Canadian candidate substances list for bans and phase-outs	t½ in water, sediment, soil > 50 d (1st PSL); or t½ sediment > 180 d (2nd PSL), BCF > 500, log K_{ow} < 7 (first PSL); or 3 < log K_{ow} < 7 (2nd PSL)
Canadian toxic substances management policy 1994	t½ in air $\geq$ 5 d, t½ in water $\geq$ 182 d, in sediment $\geq$ 730 d, in soil $\geq$ 182 d (both biotic and abiotic), BCF $\geq$ 5000, log K_{ow} $\geq$ 5
Canadian toxic substances management policy 1995	t½ in air $\geq$ 2 d or subject to atmospheric transport to remote areas t½ in water, sediment or soil $\geq$ 182 d, BCF $\geq$ 5000, log K_{ow} $\geq$ 5
OECD test guidelines, EU TGD (Regulation 793/93/EC)	Primary degradation < 20%, mineralisation < 10% in OECD tests for inherent biodegradation, High % of bound residues, < 50%
EU-Uniform principles, Pesticides (Dir. 94/43/EC)	DT50 in soil > 3 month, DT90 > 1 year, bound residue > 50% after 30 d or 70% after 100 d combined with mineralisation < 5% in 100 d
Pesticides legislation in the Netherlands, Sweden	DT50 > 180 d, (S) BCF > 2000 (in fish) and t½ $\geq$ 1 month in soil or water 20 °C
Pesticide legislation, ISA	t½ (hydrolyse) $_{grand}$ > 25 weeks, t½ (photolyse) $_{grand}$ > 1 weeks
UK DOE note 1994	long persistence, t½ in the order of years
CEFIC EuroChlor 1995	t½ in air > 5 d and vapour pressure < 1000 Pa or monitoring evidence in remote regions linked to distant and anthropogenic sources, persistence: t½ in water > 180 d, t½ in soil 180-360 d, t½ in sediment > 360-720 d BCF > 5000 or if data are absent: log K_{ow} > 5 but below 7 and Mol < 600
EU classification criteria	R50: Very toxic to aquatic organisms; LC50 $\leq$ 1 mg/l R51: Toxic to aquatic organisms; 1 mg/l < L50 $\leq$ 10 mg/l R53: May cause long-term adverse effects in the aquatic environment; the substance is not readily degradable or log K_{ow} $\geq$ 3 (unless the experimentally determined BCF $\leq$ 100) combined with R50-51

[1] The proposed criteria were accepted on 4-9 December 2000.

3 Finnish environmental conditions relevant for the selection of priority chemicals

3.1 Climate

The most crucial climatic factors influencing the fate and behaviour of chemicals in Finland are temperature and solar irradiation. The mean annual temperature is less than 2 °C and winter is the longest season lasting about 100 and 200 days in south and north Finland, respectively (Heino 1999). The mean temperature remains below 0 °C in winter. The growing season, when the average daily temperature is higher than 5 °C, lasts about 140 days. Low temperature delays the degradation of organic compounds, and it is assumed that biodegradation of organic compounds is significant only during the growing season. No biodegradation is expected to occur in winter. Also hydrolytical degradation occur slowly at low temperature.

Short day conditions decrease photodegradation of organic compounds during late autumn and winter in Finland. North of the Arctic Circle, the sun does not rise above horizon at all for several weeks and in south Finland the shortest day is only six hours long (Heino 1999). In winter snow and ice cover on soil and waters prevent the penetration of light into soil surface and water minimizing the photodegradation to zero. The Finnish lakes are ice covered about five to eight months per year depending on latitude (Heino 1999). Despite long days in summer, photodegradation is not significantly higher in Finland compared to central and south Europe. Due to the adsorption of UV-B radiation (280-320 nm) by ozone, the latitudinal variation in UV-B radiation is minimal during summer (OECD 93). The UV-B light is responsible for the direct photolysis of many organic chemicals, including most commonly used pesticides (Braunchweiler & Koivisto 2000).

3.2 Soil

Acid gneisses, granodiorites and granites dominate the Finnish bedrock (Braunchweiler & Koivisto 2000). A large part of Finland is covered with a peat layer. The dominating soil type is podzol, which is typically acid, sandy, non-sorted and covered by an organic horizon (Greve 98). The acid minerals cause the natural acidity of soils and waters in Finland. Temperature, organic matter content, pH and particle size are essential factors affecting fate and behaviour of chemicals in soils. High content of organic matter is typical for Finnish soils. The organic matter content is typically 5-7%, but it can be over 50% in the podzol of coniferous forests (Kähäri 87, Martikainen 98). The agricultural soils are usually acid. Low pH and temperature of Finnish soils inhibits the microbial activity reducing the degradation rate of organic compounds. The soil is frozen from three to six months every year in Finland. Frost causes structural cracks and holes in clay soil, which enhances leaching of chemicals (Al-Soufi 99). In spring melting snow increases desorption and leaching of chemicals from soil surface (Seppälä 97). Thin soil layer above the bedrock and the coarse texture further increase the risk for groundwater contamination by chemicals.

3.3 Lakes

Inland waters cover about 10% of Finnish area. Most of the lakes are small and shallow. The mean retention time of water is estimated to be two years and in large lakes up to 10 years (FEI). A typical feature of many Finnish lakes is the brown colour caused by humic substances

(Kortelainen 93). The humic lakes naturally have pH below 7. Many lakes are naturally acid, and only 9% are considered to be very acid sensitive (Mannio et al. 2000). There is also relatively soft water in majority of Finnish lakes (Kemira Kemi Ab 1996). The physical and chemical characters of inland waters affect the bioavailability and toxicity of chemicals. The humic substances may increase the toxicity of metals and some organic compounds (Oikari 92, Kukkonen 95). On the other hand, humic substances decrease the bioconcentration of organic compounds to aquatic organisms (Landrum et al. 85, Black & McCarthy 88, Kukkonen et al. 89). Heavy metals are more toxic to aquatic organisms in soft waters.

3.4 The Baltic Sea

The Baltic Sea is one of the largest brackish water sea in the world. The salinity varies from 2% in the Bothnian Bay to 20% in the Danish Straits. The present salinity has persisted about three thousand years which is a short time in the evolutionary time perspective. Only a few species are truly adapted to live in brackish water and consequently the biodiversity is low in the Baltic Sea compared to sea and lakes. The large, densely populated catchment area and slow exchange of water makes the Baltic Sea particularly exposed to man-made chemicals. Small water volume compared to seas as well as the permanent stratification of water because of salinity (halocline) contributes to the concentration of chemicals. Low temperature delays the hydrolytic and microbiological degradation of chemicals. In winter the ice cover prevents photolysis and volatilization of chemicals. Living in brackish water may increase the sensitivity of marine invertebrates to some hazardous substances (McLusky et al. 1986, Tedengren & Kautsky 1987, Tedengren et al. 1988).

The main concern for substances, which could reach the marine environment, is that they are persistent. Persistency leads to long-term exposure to marine organisms, dispersion to large regions and transportation to remote areas. Furthermore, if persistent substances cause an effect, the exposure will continue for a long period, even if all uses of substance are banned and all releases are strictly controlled. Biodegradation in the marine environment is assumed to be relatively slow due to low density of micro-organisms, small diversity of micro-organisms, lack of adaptation and low concentrations of chemicals. The half-life under marine conditions is by large unknown. Therefore, the extrapolation of the biodegradation potential from freshwater data should be performed in a very cautious manner. In the marine environment substances will be present at low concentrations in water due to dilution. Depending on the inherent properties a chemical may be accumulated in the sediment or bioconcentrated in the organisms.

4 Proposal for the selection of Finnish priority chemicals

4.1 Chemicals covered in the selection

Ideally the Finnish priority chemicals should be selected among all chemicals intentionally used in Finland, i.e. chemicals produced in or imported to Finland including chemicals imported in articles containing or treated with chemicals. In practise, the pool of chemicals among which the national priority chemicals are selected is the chemicals in the Finnish register of chemical products, KETU see 4.2.1).

It is proposed that several types of substances posing environmentally adverse effects are excluded from the selection. Effects on the atmosphere, such as depletion of ozone in the stratosphere or

contribution to the greenhouse effect, are not considered in the selection due to their different adverse effect mechanism compared to the PBT substances. Substances that are only unintentionally produced in industrial processes or waste incineration are outside the selection procedure. Further, radioactive substances, cosmetics, human and veterinary medicines, as well as food and feed additives are not included in the selection procedure. The reason for the exclusion is purely administrative. The substances mentioned before are not covered by the Chemicals Act, and consequently they are not included in the KETU either.

The priority list may include some endocrine disrupters, but these have not been selected systematically, since no testing battery is available to recognise the endocrine disrupters. However, a separate list of endocrine disrupters identified by European Commission and registered in the KETU is attached to this report.

4.2 Databases

4.2.1 The Finnish register of chemical products

The Finnish register of chemical products (KETU) contains data on professionally used chemicals imported or produced in Finland and which are classified as dangerous to the human health or the environment or which may otherwise cause hazard (http://www.sttv.fi/kemo/kemikaali_tuoterek.htm). In practise KETU contains mainly data on chemicals officially classified in the EU, although the companies should also send data on chemicals not yet classified in the EU but fulfilling the classification criteria or being otherwise hazardous. Furthermore, chemicals included in articles imported to Finland are not registered in the KETU. Even though the KETU does not contain all chemicals on the Finnish market, it is he best available data source for the prioritisation purpose.

The manufacturers and importers of the chemicals submit the information to the KETU. The data are checked and the register is maintained by the National Product Control Agency for Welfare and Health (STTV). Information shall be provided on all chemicals for which a safety data sheet must be compiled. Such are chemicals that are classified in the EU as dangerous to health or to the environment or as involving fire or explosion hazards. Furthermore, chemicals must be registered if their chemical properties or handling, use or storage may cause risk to health or to the environment. It is, however, not necessary to provide information on chemicals which are used in research and product development. Neither is information necessary if a hazard-causing chemical is placed on the market in so small amounts per year that the chemical cannot be considered to cause risk. It is up to the operator to determine the limit.

The following information must be submitted to the register:
- trade name
- contact information
- information on ingredients
- first-aid measures
- fire-fighting measures
- accidental release measures
- instructions on storage and handling
- instructions for preventing exposure
- national occupational exposure limits (HTP values)
- personal protective equipment as well as physical and chemical properties of the product

- toxicological information
- ecological information
- disposal considerations
- transport information
- regulatory information
- use category of the product

The product register can be used by the chemicals authorities, the Poison Information Centre and research institutes. The data is used as a tool of chemicals control, market surveillance and supervision of the use of chemicals. KETU contains data on about 28 500 products containing about 5500 substances available on the market (information received from STTV 10.11.2000). About 8000 new chemical products are registered yearly and about 2000 products are removed from the market. There are 4231 substances in common in NSDB and KETU, which means that there are 1243 substances in KETU for which there is no data in the NSDB.

4.2.2 Nordic substance database

The Nordic Council of Ministers initiated a joint Nordic project “Criteria for selecting OSPAR substances” and within this project a Nordic Substance Database, NSDB, was developed. NSDB is based on the Swedish Sunset database, which has been complemented with several other data sources. The version of NSDB (1.7.3) used in this work contains data from several different sources, including EU List of hazardous substances (Annex 1 to Directive 67/548/EEC), IUCLID, AQUIRE, ENVICHEM, NORDBAS, BUA, GESAMP, IARC and the Nordic product Registers (Avenir 2000).

NSDB contains 31 parameters divided into 7 categories (Table 2). The seven categories are aquatic toxicity, bioaccumulation, biodegradation, calculated aquatic toxicity, calculated biodegradation, exposure, and secondary poisoning. However, the categories calculated aquatic toxicology, calculated biodegradation and exposure contain no information in the NSDB version 1.7.3. Each parameter value is scaled from 1 to 10 according to the scaling rules defined in the system (Avenir 2000). Original parameter values and corresponding scaled values are presented in Annex 3. A denominator value is calculated for each category and for each substance by taking the highest scaling values of all the parameters in that category and for that particular substance. NSDB contains 18180 substances. However, there is not data on all properties for all these substances (Table 2). Furthermore, it is important to note that evaluation of data quality has not been performed before importing data into the database, this has to be performed after selection of substances during the expert judgement phase.

***Table 2**. Number of substances with data in NSDB and KETU. Total number of substances in NSDB and KETU are 18180 and 5474, respectively.*

Category	Parameter	Number of substances with data in NSDB	% of substances with data in NSDB	Number of substances with data in KETU	% of substances with data in KETU
Aq tox	Acute algae	1767	10	826	15
Aq tox	Acute Daphnia	2261	12	997	18
Aq tox	Acute fish	4575	25	1411	26
Aq tox	Chronic Daphnia	754	4.1	407	7.4
Aq tox	Chronic fish	731	4.0	388	7.1
Bioacc	BCF	8012	44	2546	46
Bioacc	Log K_{ow}	8469	46	2652	48
Biodeg	BOD/COD	153	0.8	116	2.1
Biodeg	Half-time	331	1.8	165	3.0
Biodeg	Inherent	1116	6.1	548	10
Biodeg	Ready	1928	11	775	14
Sec pois	Human acute tox	3871	21	1022	19
Sec pois	Human carcinogenicity	1637	9.0	416	7.6
Sec pois	Humuan chronic tox	898	4.9	169	3.1
Sec pois	Human mutagenicity	46	0.2	22	0.4
Sec pois	Human repro tox	196	1.1	77	1.4

4.3 Proposal for criteria and cut-off values to be used in the selection of Finnish priority chemicals

The use of combination of criteria biodegradation, toxicity and bioaccumulation is proposed in this report. According to this proposal the substance must be persistent **and** toxic **and** have potential to bioaccumulate to be selected on the Finnish priority list. The reason for the use of combination of criteria is to select the most hazardous substances, i.e. PBT substances. Inclusive cut-off values are suggested because all PBT properties are simultaneously used in the selection. The use of inclusive criteria is supported by the precautionary principle. The use volumes cannot be used as selection criteria due to the lack of data. The selection criteria and cut-off values are given in Table 3. The list of the selected substances is given in Annexes 1-2.

***Table 3**. The proposal for the cut-off values to be used in selection of Finnish priority substances*.

Category	Criteria	Cut-off values
Biodegradation	Substances that are not readily biodegradable	Degradation $\leq$ 70% in the ready test DT50 $\geq$ 5 days, BOD/COD $\leq$ 1
Bioaccumulation	Substances having liability to bioaccumulate	BCF $\geq$ 500, Log $K_{ow} \geq 4$
Toxicity	Acute or chronic aquatic toxicity	LC/EC50 $\leq$ 10 mg/l, NOEC $\leq$ 1 mg/l , R50

Not readily biodegradable substances may be persistent in the Finnish conditions and should be selected as priority chemicals. Hence, also chemicals that pass the criteria for inherent biodegradation are selected. The inclusive criteria on biodegradation is based on the assumption that biodegradation is retarded in most part of the year in the Finnish environmental conditions. Substances that are easily hydrolysed, but not readily biodegradable, are considered as persistent because hydrolysis does not necessarily lead to complete degradation. Hydrolysis, however, contributes to degradation in the biodegradation experiments of organic compounds and is, thus, taken into account to some degree. Photolytical degradation is ignored in the selection of Finnish priority chemicals due to the negligible phototransformation during the winter, which is the longest season in Finland.

According to Swedish view all persistent chemicals should be regarded hazardous. The criteria for persistency in Swedish OBS-list, however, are much more exclusive than in the this proposal. The Swedish criteria for persistency is less than 20% degradation in ready or inherent tests, which means that inherently biodegradable substances are not regarded persistent.

In contrast to degradation, there is no evidence that bioaccumulation and toxicity of chemicals would generally be worse in the Finnish environment compared to other regions in Europe. Hence, the cut-off values for bioaccumulation and toxicity could be similar to values used recently in other prioritisation processes. Inclusive criteria on bioaccumulation and toxicity are set, because selected substances are simultaneously persistent, toxic and bioaccumulating. In addition to aquatic toxicity, also information on mammalian toxicity (secondary poisoning) has been utilised in the selection. (The selection criteria for secondary poisoning are equal to or higher than 7 in NSDB. The correspondence of scaling value 7 with original data is given in Annex 3.)

Simultaneous use of all three PBT property as well as exclusive cut-off values reduces the amount of priority substances. The number of substances obtained in NSDB and KETU with different combinations of criteria and cut-off values are given in Tables 4-6.

***Table 4**. Number of substances obtained in NSDB and KETU by using simultaneous combination of persistency, toxicity and bioaccumulation and different cut-off values. The combination of cut-off values used in this proposal for selection of priority substances is given in bold. Total number of substances in NSDB and KETU are 18180 and 5474, respectively.*

Selection profile	No of substances in NSDB	% of substances in NSDB	No of substances in KETU	% of substances in KETU
< 20% degradation in ready or inherent test, half life > 30 d BCF $\geq$ 5000, log $K_{ow} \geq$ 5 LC50 < 0.1 mg/l, NOEC < 0.01 mg/l	94	0.5	40	0.7
< 70% degradation in ready or inherent test, half life > 5 d BCF $\geq$ 500, log $K_{ow} \geq$ 4 LC50 < 1 mg/l, NOEC < 0.1 mg/l	254	1.4	103	1.9
< 70% degradation in ready or inherent test, half life > 5 d BCF $\geq$ 100, log $K_{ow} \geq$ 3 LC50 < 10 mg/l, NOEC < 1 mg/l	524	2.9	209	3.8
< 70% degradation in ready or inherent test, half life > 5 d **BCF $\geq$ 500, log $K_{ow} \geq$ 4** **LC50 < 10 mg/l, NOEC < 1 mg/l**	**307**	**1.7**	**119**	**2.2**

***Table 5**. Number of substances obtained in NSDB and KETU by using simultaneous combination of two criteria, i.e. bioaccumulation and toxicity or bioaccumulation and persistency, and different cut-off values. Total number of substances in NSDB and KETU are 18180 and 5474, respectively.*

Selection criteria	No of substances in NSDB	% of sub-stances in NSDB	No of sub-stances in KETU	% of sub-stances in KETU
BCF $\geq$ 1000, log $K_{ow} \geq$ 5 LC50 < 0.1 mg/l, NOEC < 0.01 mg/l	282	1.6	83	1.5
BCF $\geq$ 1000, log $K_{ow} \geq$ 5 LC50 < 1 mg/l, NOEC < 0.1 mg/l	437	2.4	118	2.2
BCF $\geq$ 1000, log $K_{ow} \geq$ 5 LC50 < 0.1 mg/l, NOEC < 0.01 mg/l	564	3.1	157	2.9
BCF $\geq$ 1000, log $K_{ow} \geq$ 5 LC50 < 0.1 mg/l, NOEC < 0.01 mg/l	657	3.6	181	3.3
BCF $\geq$ 500, log $K_{ow} \geq$ 4 LC50 < 1 mg/l, NOEC < 0.1 mg/l	564	3.1	157	2.9
< 70% degradation in ready or inherent test, half life > 5 d BCF $\geq$ 500, log $K_{ow} \geq$ 4	376	2.0	188	3.4
< 70% degradation in ready or inherent test, half life > 5 d LC50 < 1 mg/l, NOEC < 0.1 mg/l	1198	6.6	523	9.6
< 70% degradation in ready or inherent test, half life > 5 d LC50 < 10 mg/l, NOEC < 1 mg/l	1488	8.2	635	12

***Table 6**. The number of substances obtained in NSDB and KETU by using different cut-off values of individual selection criteria, i.e. persistency, toxicity and bioaccumulation. The cut-off values used in the this proposal for selection of priority substances are given in bold. Total number of substances in NSDB and KETU are 18180 and 5474, respectively.*

Criteria	No of substances in NSDB	% of substances in NSDB	No of substances in KETU	% of substances in KETU
< 20% degradation in ready or inherent tests, half life > 30 d	1132	6.2	436	8
20-50% degradation in ready test, 20-70% degradation in inherent test, half life $\geq$ 10 days	2083	11	842	15
< 70% degradation, half life > 5 days	**2195**	**12**	**897**	**16**
BCF $\geq$ 5000, log K_{ow} $\geq$ 5	490	2.7	131	2.4
BCF $\geq$ 1000, log K_{ow} $\geq$ 4	973	5.4	247	4.5
BCF $\geq$ 500, log K_{ow} $\geq$ 4	**1323**	**7.3**	**349**	**6.4**
BCF $\geq$ 100, log K_{ow} $\geq$ 3	2447	13	642	12
LC50 < 0.1 mg/l, NOEC < 0.01 mg/l	2356	13	539	9.8
LC50 < 1 mg/l, NOEC < 0.1 mg/l	3960	22	945	17
LC50 < 10 mg/l, NOEC < 1 mg/l	**4914**	**27**	**1191**	**22**

4.4 Lack of data

Due to the lack of data a great majority of chemicals remain outside the selection procedure. Only 897 of chemicals in the KETU have information on all three PTP properties, i.e. biodegradation and bioaccumulation and toxicity, used in the selection profile (Table 7). Hence, more than 4500 chemicals that are in use in Finland remain outside the potential selection. Of 5500 substances in KETU, 1243 substances are not found in NSDB. In addition, not all chemicals that are in use in Finland are registered in the KETU.

Most information is available on bioaccumulation, mainly based on log K_{ow}, which is easier to determine empirically compared to biodegradation, toxicity or BCF. About half of the chemicals in KETU have some kind of estimate on bioaccumulation potential. The next best situation is for toxicity, almost 30% have information about aquatic toxicity. Only 20% of chemicals have information about biodegradation, which is regarded as a key parameter in the selection of Finnish priority chemicals.

Furthermore, the test results in the NSDB are somewhat contradictory, and this applies in particular for biodegradation. The same substance may be assigned as readily biodegradable and persistent. The selection is based on the worst criteria, and therefore it is possible that substances that in reality are readily biodegradable are selected as persistent substances. In order to get reliable information on the biodegradation of substances, the original test reports should be reviewed or only data which quality has been assured should be used.

Table 7*. Number of substances in NSDB and KETU with information on biodegradation, bioaccumulation or toxicity and different combinations of these properties. Total number of substances in NSDB and KETU are 18180 and 5474, respectively.*

Category	Number of substances with data in NSDB	% of substances with data in NSDB	Number of substances with data in KETU	% of substances with data in KETU
Biodegradation	2640	15	1078	20
Bioaccumulation	8600	47	2694	49
Aquatic tox. or sec. poisoning	7459	41	1776	32
Biodegradation and bioaccumulation	2279	12	957	17
Biodegradation and aquatic toxicity or secondary poisoning	2344	13	1000	18
Bioaccumulation and aquatic toxicity or secondary poisoning	4929	27	1447	26
Biodegradation and bioaccumulation and aquatic toxicity or secondary poisoning	2049	11	893	16

5 Analysis of the selected priority chemicals

The selection profile *< 70% degradation in ready or inherent test or half-life > 5 days and BCF* $\geq$ *500 or log* K_{ow} $\geq$ *4 and LC50 < 10 mg/l or NOEC < 1 mg/l* yielded 119 substances among 5474 substances obtained from KETU in July 2000. After subsequent expert judgement of the list some substances were excluded, and the final list contained 77 substances. Thirteen metal compounds except organotin compounds, were excluded, and they are treated separately. A more detailed examination of KETU register showed that eight substances occurred in products that were removed from the Finnish market. Fourteen substances were removed from the list, because the closer examination showed that they did not fulfil all the selection criteria. Finally, alpha-pinene fraction of turpentine oil (CAS 65996965) and alpha-pinene (Bicyclo[3.1.1]hept-2-ene, 2,6,6-trimethyl-, CAS 80568) were considered to be one substance and six PAH compounds were combined to one substance, PAH in creosote oil (CAS 61789248). The remaining 77 substances can be classified as industrial chemicals (54 substances), biocides (17 substances), and plant protection products or agricultural pesticides (13 substances) (Fig. 1). The sum of substances is higher than 77 because a few substances are included in two groups.

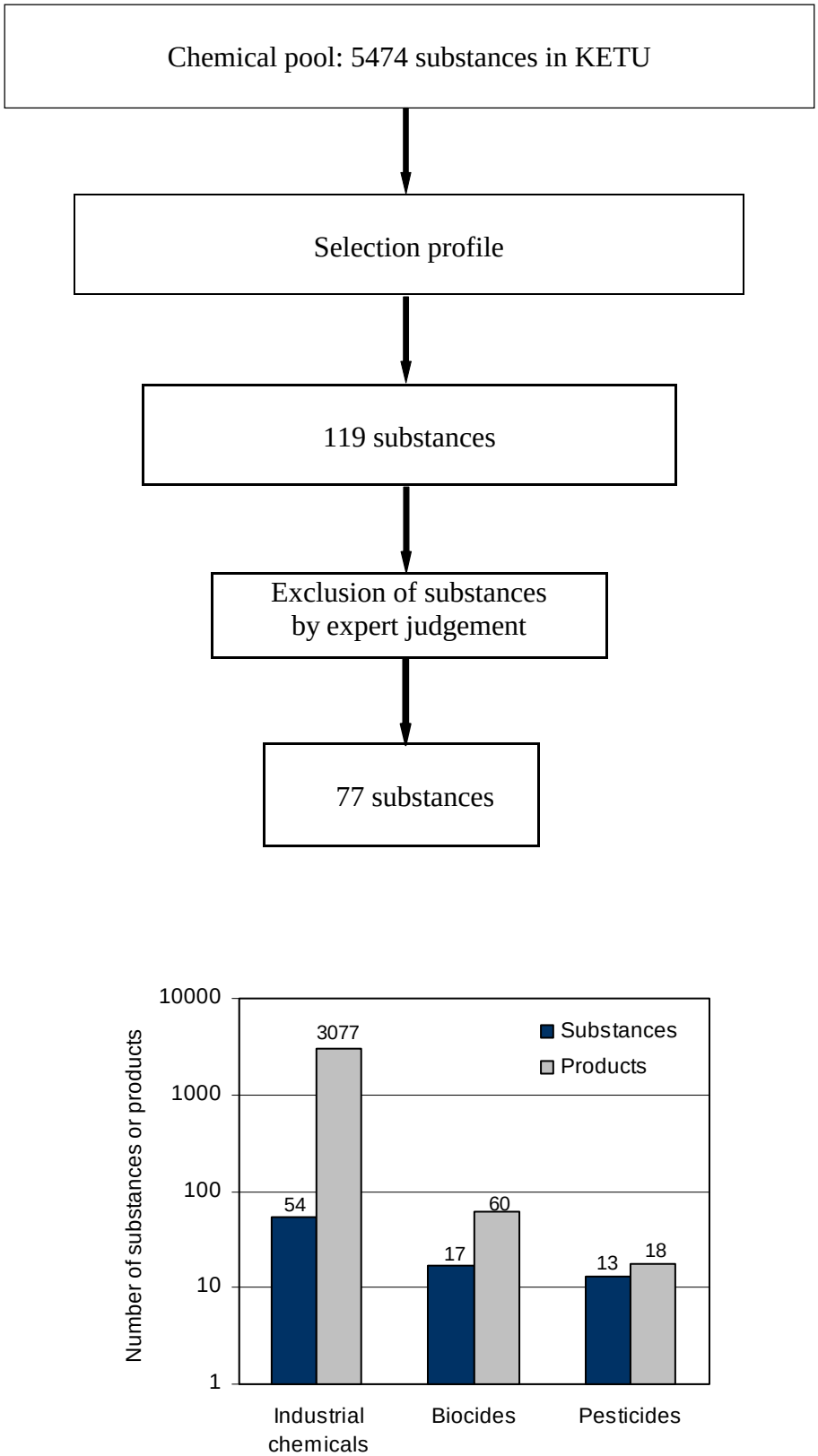

***Fig. 1**. Distribution of priority chemicals in major chemical groups.*

Its effects and exposure in the environment determine the risk of a chemical to the environment. Information about use volume or monitoring data from the environment is needed for the evaluation of the exposure of chemicals. It has not been possible to take into account the exposure in selecting the priority chemicals because use volumes are not yet available in Finland for other chemicals than pesticides. There is monitoring data available only for very few substances (mainly historical substances like DDT, PCB). In other Nordic countries, only chemicals exceeding a certain use volume have been included in the priority lists.

In order to evaluate the potential exposure of the priority chemicals, they have been assigned emission factors determined according to the use pattern of chemicals (EC 1996). The purpose of the emission factor is to tell approximately what proportion of the chemical will be released to the environment. The emission factors ranges from 0.001 to 1. The emission factor 0.001 indicates a very low emission to the Finnish environment whereas the factor 1 means that the whole use volume finally ends up in the environment. For example, pesticides are assigned the emission factor 1.

For 65 priority chemicals one or two use patterns are given in KETU (Fig. 2). The use pattern refers to the way chemical is used, e.g. paint, resin, solvent, washing agent or biocide. Twelve chemicals have three or more use patterns. There is a great variation in the number of products per individual priority substance. 46 priority chemicals occur in less than five products (Fig. 3). Two substances occur in more than 100 products; xylene in 2501 products and heptane in106 products.

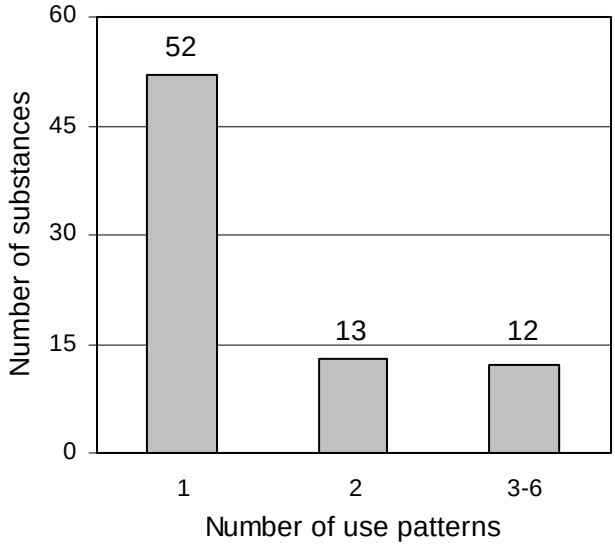

Fig. 2*. Numbers of use patterns per single priority chemical.*

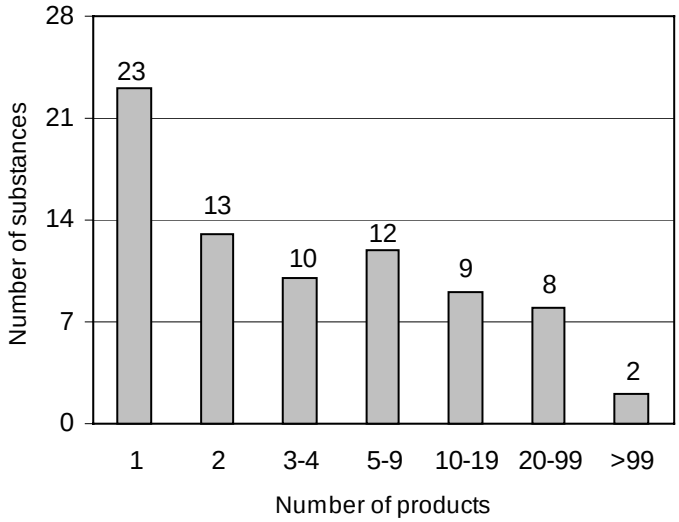

Fig. 3*. Number of products per single priority chemical.*

5.1 Industrial chemicals

Most of the priority chemicals (54) are industrial chemicals. Five industrial chemicals are also used as biocides and three industrial chemicals are used as additives or solvents in pesticides. The industrial chemicals are divided into sub-groups according to their use pattern and emission factor. 31 chemicals have one industrial use pattern, 13 have two industrial uses and 10 chemicals have three or more industrial use patterns.

The emission factors are determined on the basis of the main use categories adopted from the TGD (EC 1996). The main use categories are “use in closed systems”, “use resulting in inclusion into or onto a matrix”, “non dispersive” and “wide dispersive use. The emission factors for these categories are 0.01, 0.1, 0.2 and 1, respectively.

The biggest category is “wide dispersive use” having the emission factor 1 (Fig. 4). 27 substances occurring in 2779 products belong to this category. Solvents, washing agents and lubricants typically represent product types having “wide dispersive use”. The great number of products is due to xylene, occurring as solvent in more than 2400 products, but even without this particular substance this category would have the highest number of products.

The next most common use category is “non dispersive use” with emission factor of 0.2. 27 substances and 142 products are put into this category. Resins in filling materials, glues, paints, lacquers and varnishes are considered to have “non dispersive use”. Other use patterns in this category are some additives, softeners, flame retardants and laboratory chemicals. It is assumed that most part of “non dispersive” substances has been degraded before it enters into the environment.

Substances belonging to the category “use resulting in inclusion into or onto a matrix”, reacts or are bound so tightly to a matrix, that only a small proportion will end up in the environment. Resins and industrial additives belong to this category. Seven substances are classified in this group. Even smaller exposure is expected from raw materials which have been assigned to the

category “closed use” with emission factor 0.01. Five substances are used as raw materials, but most of them are assigned to some other category, too. Also fuels have the emission factor of 0.01, although their use is considered to be “wide dispersive”. Five substances are used as fuels. Finally, emission factor 0.001 is assigned for six trading chemicals which are not intended to be used in Finland.

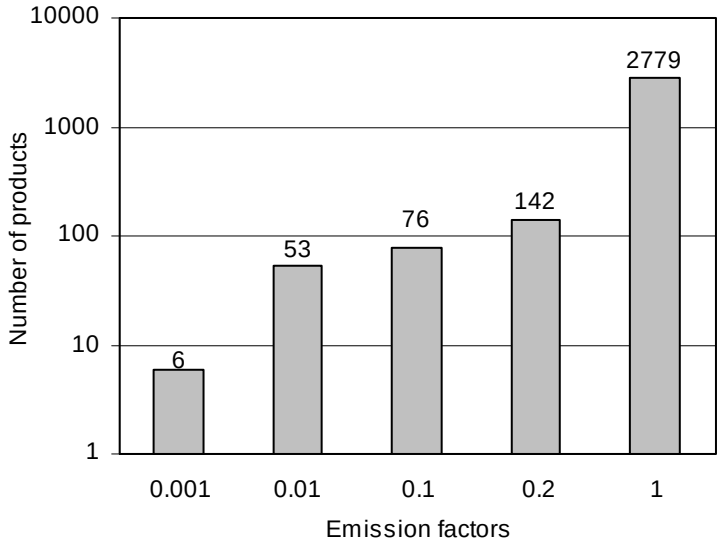

Fig. 4*. Emission factors assigned to the products containing industrial priority chemicals.*

Solvent use is the absolutely most common use pattern of industrial priority chemicals. 21 substances are assigned the use pattern solvent, solvent in paints, varnishes and solvent in resins, glues (Fig. 5). Other common groups are additives, laboratory chemicals, lubricants and washing agents. Only few priority chemicals are used as flame retardants and softeners which is partially due to the fact that they are imported to Finland in articles and therefore they might not be registered in the KETU. Several substances have been assigned into the use pattern “other use”. This is a highly diverse group containing dentist products, fragrances, heat transferring oils and various industrial additives such as anti-corrosive media, accelerators and inhibitors. The common use fields of industrial priority chemicals are chemical, metal, plastic and rubber industry. Several priority chemicals are also used in building and car service.

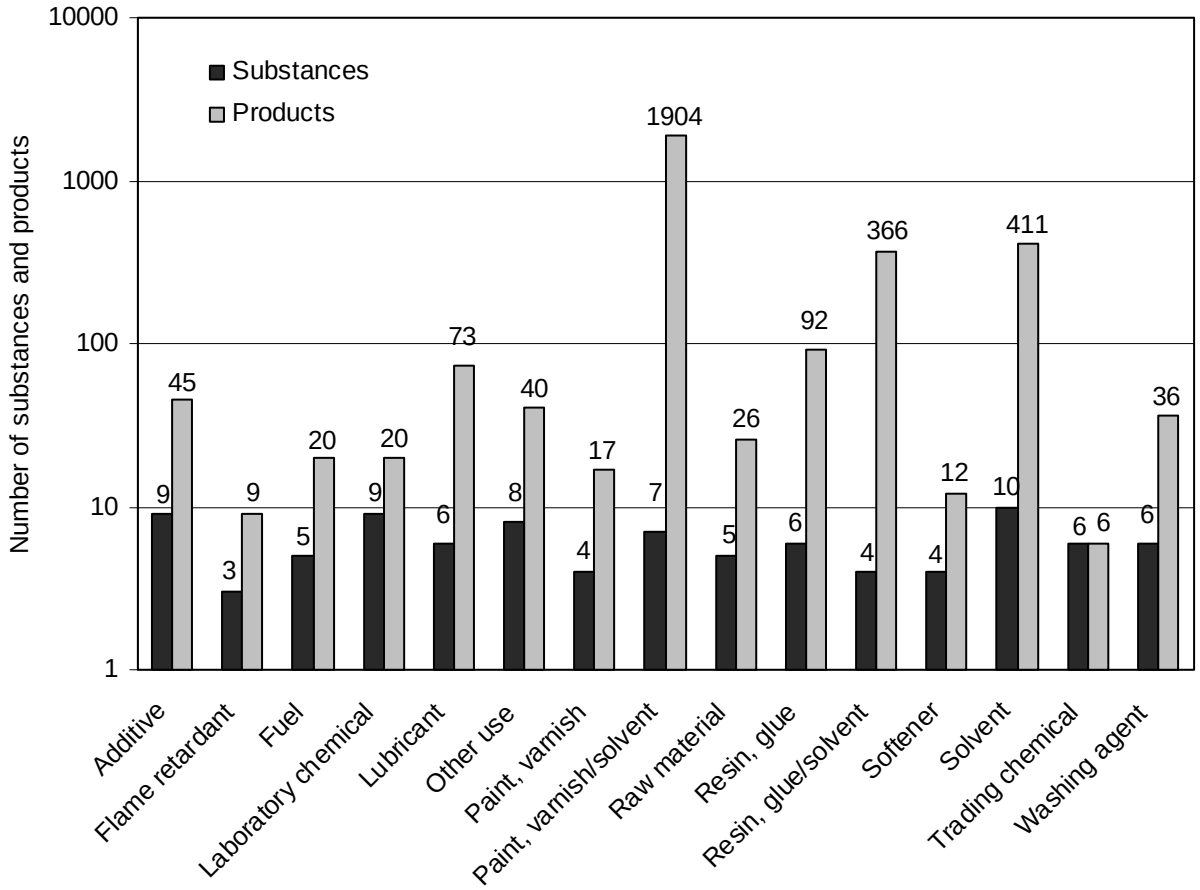

Fig. 5. *Number of industrial priority chemicals and products per use pattern*.

Table 8. *Industrial priority chemicals, their use patterns and number of products. The chemicals given in bold are included in the EU list of endocrine disrupters (see Table 12).*

No	CAS	Name	Synonyme	Use pattern	No of products
1	106990436	1,3,5-Triazine-2,4,6-triamine, N,N'''-[1,2-ethanediylis[[[4,6-bis[butyl(1,2,2,6,6-pentamethyl-4		Additive	2
2	85449	1,3-Isobenzofurandione		Resin, glue	4
				Trading chemical	1
3	92842	10H-Phenothiazine		Lubricant	7
4	90302	1-naphthalenamine, N-phenyl	1-Anilinonaphthalene	Lubricant	15
5	67762258	Alcohols, C12-18		Washing agent	1
6	71432	Benzene		Raw material	16
				Fuel	8
				Trading chemical	1
				Solvent	8
				Solvent in paints and varnishes	9
7	101815	Benzene, 1,1'-methylenebis-	Benzylbenzene	Other use	1
8	101848	Benzene, 1,1'-oxybis-	Phenyl ether	Solvent	1
9	120821	Benzene, 1,2,4-trichloro-	1,2,4-trichlorobenzene	Solvent in paints and varnishes	1

No	CAS	Name	Synonyme	Use pattern	No of products
				Laboratory chemical	1
10	106467	Benzene, 1,4-dichloro-	1,4-Dichlorobenzene	Solvent	2
11	108907	Benzene, chloro-	Chlorobenzene	Solvent	8
				Trading chemical	1
				Solvent in resins and glues	3
12	1330207	Benzene, dimethyl-	Xylene	Solvent in resins and glues	328
				Trading chemical	1
				Solvent	260
				Solvent in paints and varnishes	1848
				Fuel	6
				Raw material	7
13	100663	Benzene, methoxy-	Anisole	Solvent	1
14	42615292	Benzenesulfonic acid, alkyl derivs.	LAS	Washing agent	1
15	120785	Benzothiazole, 2,2'-dithiobis-	Benzothiazyl disulfide (MBTS)	Additive	15
16	538750	Cyclohexanamine, N,N'-methanetetraylbis-	Dicyclohexyl carbodiimide	Laboratory chemical	2
17	5124301	Cyclohexane, 1,1'-methylenebis[4-isocyanato-	Methylene-bis(4-cyclohexyl)icocyanate	Resin, glue	16
18	4098719	Cyclohexane, 5-isocyanato-1-(isocyanatomethyl)-1,3,3-trimethyl-	Isophorone diisocyanate	Resin, glue	38
19	138863	Cyclohexene, 1-methyl-4-(1-methylethenyl)-	Limone	Solvent in paints and varnishes	35
				Solvent	17
				Raw material	1
20	5989275	Cyclohexene, 1-methyl-4-(1-methylethenyl)-, (R)-	D-limone	Washing agent	29
				Lubricant	8
21	41556267	Decanedioic acid, bis(1,2,2,6,6-pentamethyl-4-piperidinyl) ester		Paint, varnish	5
22	67721	Ethane, hexachloro-	Hexachloroethane	Other use	3
23	79016	Ethene, trichloro-	Trichloroethylen	Solvent	45
24	67663	Methane, trichloro-	Chloroform	Laboratory chemical	3
				Solvent	2
				Trading chemical	1
25	91203	Naphthalene		Other use	7
				Fuel	1
26	119642	Naphthalene, 1,2,3,4-tetrahydro-	1,2,3,4-Tetrahydronaphthalene	Paint, varnish	3
27	38640629	Naphthalene, bis(1-methylethyl)-		Laboratory chemical	8
				Additive	1
28	91178	Naphthalene, decahydro-	Decahydronaphthalene	Washing agent	1
				Laboratory chemical	1
29	51000523	Neodecanoic acid, ethenyl ester	Vinyl neodecanoate	Additive	1

No	CAS	Name	Synonyme	Use pattern	No of products
30	61789284 (creosote oil) 130498292 (PAH)	PAHs in creosote oil 50328 Benzo(a)pyrene 53703 Dibenz(a,h)anthracene 56553 Benz(a)anthracene 85018 Phenanthrene 205823 Benzo(j)fluoranthene 207089 Benzo(k) fluoranthene	Creosote oil	Raw material	1
				Fuel	1
				Other use	1
31	80433	Peroxide, bis(1-methyl-1-phenylethyl)	Dicyumyl peroxide	Additive	9
32	70304	Phenol, 2,2'-methylenebis[3,4,6-trichloro-	Hexachlorophene	Laboratory chemical	1
33	88062	Phenol, 2,4,6-trichloro-	2,4,6-T	Laboratory chemical	1
34	96764	Phenol, 2,4-bis(1,1-dimethylethyl)-	2,4-Di-tert-butyl phenol (2,4 DTBP)	Fuel	4
35	128370	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	Butylhydroxytoluene	Lubricant	13
				Other use	21
				Washing agent	3
36	84852153	4-nonylphenol, branched		Additive	3
37	**25154523**	**Phenol, nonyl-**	**Nonyylifenoli**	**Additive**	**8**
				Resin, glue	24
				Paint, varnish	8
38	1241947	Phosphoric acid, 2-ethylhexyl diphenyl ester	Ethylhexyl diphenyl phosphate	Flame retardant	1
39	115866	Phosphoric acid, triphenyl ester	Triphenyl phosphate	Softener	3
				Flame retardant	1
40	1330785	Phosphoric acid, tris(methylphenyl) ester	Tricresyl phosphate	Flame retardant	7
				Softener	6
41	6846500	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(1-methylethyl)-1,3-propanediyl ester	2,2,4-Trimethyl-1,3-pentanediel diisobutyrate	Other use	5
42	1338438	Sorbitan, mono-9-octadecenoate, (Z)-	Sorbitane oleate	Washing agent	1
43	26140603	Terphenyl		Other use	1
44	63449398	Paraffin waxes and Hydrocarbon waxes, chlorinated		Resin, glue	2
Alcanes C20-50					
45	64742058	Extracts (petroleum), light paraffinic distillate solvent		Lubricant	16
Alcanes C15-30					
46	64742047	Extracts (petroleum), heavy paraffinic distillate solvent		Additive	3
				Lubricant	14
Alcanes C6-15					
47	85535848	Alkanes, C10-13, chloro	SCCP	Paint, varnish	1
				Additive	3
48	142825	Heptane		Solvent	60
				Solvent in resins and glues	34
				Raw material	1

No	CAS	Name	Synonyme	Use pattern	No of products
				Trading chemical	1
				Solvent in paints and varnishes	4
				Solvent	6
49	111659	Octane		Solvent in paints and varnishes	2
				Solvent in resins and glues	1
				Laboratory chemical	1
Phthalates					
50	**85687**	**1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester**	**Butyl benzyl phthalate (BBP)**	**Resin, glue**	8
				Laboratory chemical	2
51	117840	1,2-Benzenedicarboxylic acid, dioctyl ester	Bis(n-octyl)phthalate (DNOP)	Softener	2
52	3648202	1,2-Benzenedicarboxylic acid, diundecyl ester	Diundecyl phthalate	Softener	1
Tall oils					
53	80568	Bicyclo[3.1.1]hept-2-ene, 2,6,6-trimethyl-	alpha-Pinene	Solvent in paints and varnishes	6
	65996965	Turpentine, oil, .alpha.pinene fraction			
54	127913	Bicyclo[3.1.1]heptane, 6,6-dimethyl-2-methylene-	beta-Pinene	Other use	1

5.2 Biocides

Seventeen priority chemicals are classified as biocides, and five of these (creosote oil, D-limone, hexachloroethane, naphthalene, and 1,4-dichlorobenzene) are used as industrial chemicals, too. Three industrial chemicals, xylene, turpentine oil and nonylphenol are used as solvents or additives in biocidal products. Two biocidal active substances, permethrin and deltamethrin, are used as agricultural pesticides. One metal, copper, is used as biocide in disinfectants and wood preservatives. Tributyltin compounds that are used in antifouling paints, have endocrine disrupting effects. The priority biocides, their use pattern, number of products and sales if available are listed in Table 9. Biocides, which are used as preservatives in plastic or rubber industry, have the emission factor 0.1, because only a small proportion of these biocides is believed to enter in the environment. All other biocides have the emission factor 1 due to the more or less direct release to the environment. Priority biocides are used as antifouling paints, disinfectants, insecticides, rodenticides and wood preservatives (Fig. 6).

Table 9*. Selected priority biocides in Finland, and their use pattern, number of products and sales in 1999 if available. The endocrine disrupters are given in bold (see Table 12).*

No	CAS	Name	Use pattern	No of products	Sales 99 kg
1	**56359**	**Tributyltin oxide (TBTO)**	**Antifouling**	**14**	**-**
2	**85409172**	**Tributyltin naphthenate**	**Antifouling**	**1**	**-**
3	61789284 (creosote oil) 130498292 (PAH)	PAHs in creosote oil 50328 Benzo(a)pyrene 53703 Dibenz(a,h)anthracene 56553 Benz(a)anthracene 85018 Phenanthrene 205823 Benzo(j)fluoranthene 207089 Benzo(k) fluoranthene	Antifouling, wood preservative	19	5438610
4	5989275	D-limonene	Disinfection	2	-
5	67721	Hexachloroethane	Insecticide	2	162
6	91203	Naphthalene	Insecticide	1	162
7	106467	1,4-Dichlorobenzene	Insecticide	1	-
8	333415	Diazinon	Insecticide	1	87
9	2921882	Chlorpyriphos	Insecticide	1	27
10	52645531	Permethrin	Insecticide	4	4,2
11	52918635	Deltamethrin	Insecticide	1	301
12	68359375	Cyfluthrin	Insecticide	2	44
13	14816183	Phoxim	Insecticide, wood preservative	4	479
14	793248	1,4-Benzenediamine, N-(1,3-dimethylbutyl)-N'-phenyl-	Preservative	2	-
15	28772567	Bromadiolone	Rodenticide	2	4,3
16	56073075	Difenacoum	Rodenticide	2	2,4
17	56073100	Brodifacoum	Rodenticide	1	0.05

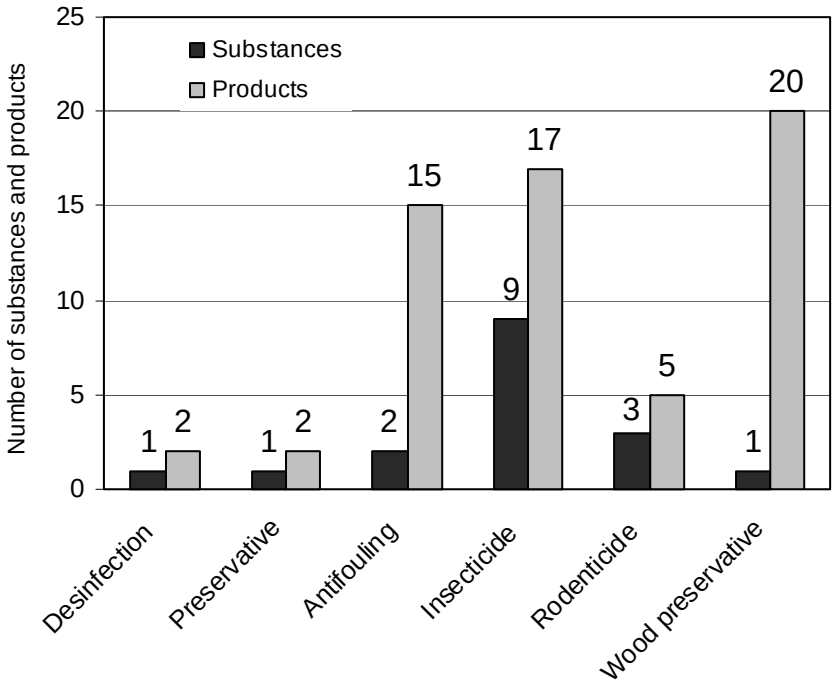

Fig. 6*. Number of substances and products of different type of proposed priority biocides.*

5.3 Pesticides

Thirteen active substances of pesticides or plant protection products are included in the priority list (Table 10). Three industrial chemicals, chlorbenzene, sorbitan and xylene, are used as additive or solvent in the pesticides. Two pesticides, endosulfan and simazin are potential endocrine disrupters. The largest group is insecticides, but also two fungicides and four herbicides have been qualified as priority chemicals (Fig. 7). All pesticides are directly distributed to the environment, and hence they are assigned the emission factor 1. In contrast to other chemical groups, the sales of pesticides are published yearly. Herbicides are sold most, although they compose minority of priority pesticides (Table 10).

***Table 10**. Selected pesticides and their sales (kg) in 1999. The endocrine disrupters are given in bold (see Table 12).*

No	CAS	Name	Use	Sales kg
1	66332965	Flutolanil	Fungicide	626
2	67564914	Fenpropimorph	Fungicide	2.5*
3	**122349**	**Simazin**	**Herbicide**	**4299**
4	1582098	Trifluralin	Herbicide	16404
5	3861470	Ioxynil	Herbicide	61
6	111479051	Propaquizafop	Herbicide	1886
7	**115297**	**Endosulfan**	**Insecticide**	**0**
8	52645531	Permethrin	Insecticide	25
9	52918635	Deltamethrin	Insecticide	301
10	65907304	Furathiocarb	Insecticide	3600
11	67375308	Alpha-cypermethrin	Insecticide	559
12	91465086	Lambda-cyhalothrin	Insecticide	477
13	66230044	Esfenvalerate	Insecticide	0

* propicanozale and fenpropimorph

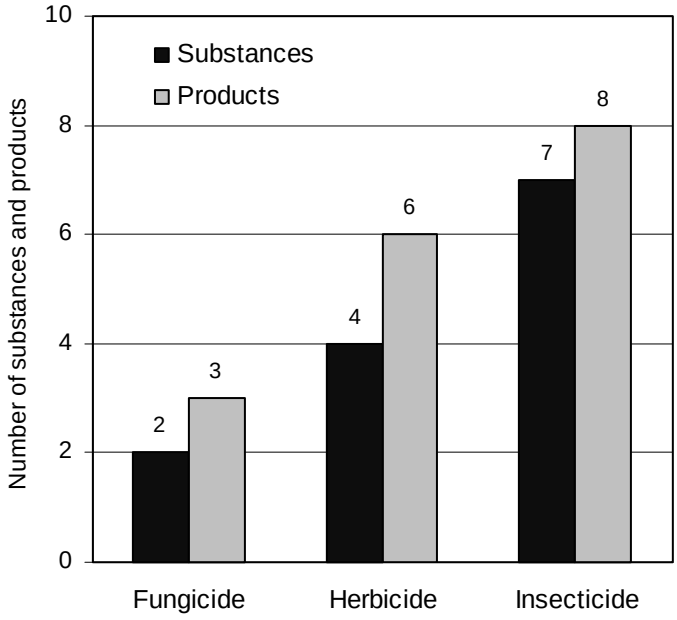

***Fig.7**. Number of substances and products of proposed priority pesticides.*

5.4 Metals

Eight metals have been selected as priority substances (Table 11). The selection of metals is based on the COMMPS procedure and national expert judgement (EC 1999). Metals have been selected outside the selection procedure, because persistency and bioaccumulation cannot be automatically applied for metals. Metals are elements, and they do not degrade. The bioaccumulation of metals must be confirmed experimentally, it is not possible to predict it by modelled log K_{ow} or BCF. Selected metals are recognised as highly toxic and they can also accumulate in the organisms. Except mercury, the selected metals are in wide use in industrialised countries.

Anthropogenic sources of lead include mining and metallurgic industries, ammunition and in some places incineration (NIVA 1999). The regulation or banning of lead containing gasoline additives and paints has reduced emissions to the environment considerably in the last decade. Cadmium is the by-product in the production of zinc and lead which results is the most important anthropogenic source of cadmium to the environment. Other major sources are iron and steel industry, fossil fuel combustion and waste incineration. The main use of cadmium is in nickel and cadmium batteries. Cadmium is also a contaminant in chemical fertilisers, manure and sewage sludge. The main atmospheric sources of arsenic are combustion processes of coal and fuel oils as well as copper, steel and glass industry.

Most zinc emissions to the atmosphere come from the non-ferrous metal industry, iron and steel production and coal combustion. Besides atmospheric deposition, catchments with arable land receive zinc load from fertilisers (NIVA 1999). Important sources for copper emissions are copper industry, industrial combustion processes and road transport. Major atmospheric sources of nickel are thermal power plants, especially oil burning, and more locally steel industry and smelters. The anthropogenic emission sources of chromium include combustion of coal and fuel oils and the production of iron and steel.

The statistical survey of Finnish lakes showed that very few lakes have concentrations of heavy metals that exceed the critical limits determined in Sweden (NIVA 1999). Most lakes are classified to have very low or low heavy metal contamination. 2.1% of Finnish lakes are classified as medium contaminated by lead, for other metals the proportions of medium contaminated lakes is less than 1%. Practically no lakes are considered to be highly or very highly contaminated by heavy metals. The median and maximum concentrations of priority metals except mercury in Finnish lakes are given in Table 11.

***Table 11**. Finnish priority metals and their median and maximum concentrations µg/l) in Finnish lakes (NIVA 1999). The median cadmium concentration is under detection limit.*

CAS	Name	Median	Maximum
7440382	Arsenic	0.29	4.06
7440439	Cadmium	0.011	0.23
7440473	Chromium	0.29	2.83
7440508	Copper	0.42	13
7439921	Lead	0.17	2.78
7440020	Nickel	0.37	47.6
7439976	Mercury	-	-
7440666	Zinc	2.2	55

5.5 Endocrine disrupters

Seven Finnish priority substances belong to group I or II on the EU candidate list of endocrine disrupters (BKH Consulting Engineers 2000). (The explanation for group I and II are given in the next paragraph.) In addition, 37 substances or groups of substances belonging to group I or II on the EU candidate list of endocrine disrupters are on the Finnish market according to KETU (Table 12). The original list contains 553 substances, which have been divided into three groups according to available information on production volume, persistency, and evidence of endocrine disruption from scientific literature and exposure considerations.

Group I contains 60 substances which are produced in high volumes or are highly persistent in the environment, for which there is evidence of endocrine disruption in an intact organism and which are deemed to be of high concern in terms of exposure to humans/wildlife. Group II contains 56 substances the majority of which are produced in high volumes or are highly persistent in the environment, for which there is scientific evidence indicating potential for endocrine disruption and which are deemed to be of medium concern in terms of human/wildlife exposure. Finally, group III contains 437 substances for which some data exists but which was deemed insufficient to make expert judgements.

***Table 12**. Endocrine disrupters (I) and potential endocrine disrupters (II) identified in EU that are in use in Finland. The endocrine disrupters selected as Finnish priority substances on the basis of PBT properties are given in bold. Number of products are not given for pesticides.*

No	CAS	Name	Chem type	Group	No of products
1	330552	Linuron (Lorox)	Pesticide	I	
2	12427382	Maneb	Pesticide	I	
3	137268	Thiram	Pesticide	I	
4	108463	Resorcinol	Other substance	I	40
5	*No CAS 100*	*Methoxyetylacrylate tinbutyltin, copolymer*	*Metal*	*I*	*Unknown*
6	**56359**	**Tributyltin oxide (bis(tributyltin) oxide**	**Metal**	**I**	**14**
7	**85409172**	**Stannane, tributyl (mono(naphtenoyloxy)**	**Metal**	**I**	**1**
8	1983104	Stannane, tributylfluoro	Metal	I	1
9	26354187	2-propenoic acid, 2-methyl-, methyl ester Stannane, tributylmeacrylate	Metal	I	6
10	*No CAS 050*	*Tributyltin compounds*	*Metal*	*I*	*Unknown*
11	*No CAS 051*	*Triphenyltin*	*Metal*	*I*	*2*
12	80057	Bisphenol A	Industrial	I	68
13	**85687**	**Butylbenzylphthalate (BBP)**	**Industrial**	**I**	**10**
14	117817	Di-(2-ethylhexyl)phthalate (DEHP)	Industrial	I	*Unknown*
15	84742	Di-n-butylphthalate (DBP)	Industrial	I	*Unknown*
16	*No CAS 004*	*PBBs (Brominated flame retardants*	*Industrial*	*I*	*Unknown*
17	**25154523**	**Phenol, nonyl**	**Industrial**	**I**	**42**
18	100425	Styrene	Industrial	I	214
19	94757	2,4-Dichlorophenoxy acetic acid (2,4-D)	Pesticide	II	
20	10605217	Carbendazim	Pesticide	II	
21	**333415**	**Diazinon**	**Pesticide**	**II**	
22	60515	Dimethoate	Pesticide	II	
23	**115297**	**Endosulfan**	**Pesticide**	**II**	
24	36734197	Iprodiane	Pesticide	II	
25	121755	Malathion	Pesticide	II	
26	67747095	Prochloraz	Pesticide	II	
27	**122349**	**Simazine**	**Pesticide**	**II**	
28	43121433	Triadimefon	Pesticide	II	
29	75150	Carbon disulphide	Other substance	II	3
30	127184	Perchloroethylene	Other substance	II	31
31	1675543	2,2'-bis(4-(2,3-epoxypropexy)phenyl)propane (2,2'-[(1-methylethylidene)bis(4,1-phenyleneoxymethylene)]bisoxirane	Industrial	II	11
32	1570645	4-Chloro-2-methylphenol	Industrial	II	3
33	59507	4-chloro-3-methylphenol	Industrial	II	12
34	98544	4-tert-butylphenol	Industrial	II	20
35	*No CAS 044*	*Decabrominated diphenyl ether (decaBDE)*	*Industrial*	*II*	*Unknown*
36	26761400	Diisodecyl phthalate	Industrial	II	5
37	90437	o-phenylphenol	Industrial	II	7

6 Utilisation of the priority list

In the past risk reduction measures have often been taken only after severe adverse effects had already occurred. During the last years precaution and the need to take action before widespread damage arise have been stressed. A systematic selection and prioritisation of substances for further action is one part of precautionary action. In addition to international priority substance lists national selection and priority setting is needed as the chemicals used, use patterns and the environmental conditions vary from country to country. Furthermore, the EU water legislation requires selection of national priority substances already currently.

The Finnish Government Programme (April 15, 1999) includes the preparation of a targeted programme with the aim of restoring the ecological balance of the Baltic Sea by reducing releases of fertilising nutrients as well as hazardous substances. The proposed priority substance list can be used in the implementation of the programme.

According to the Chemicals Act (744/1989, amendment 1198/1999, art 16 a) users of chemicals have a duty to select, when feasible, from the existing alternatives a chemical or method, that causes least hazard (the substitution principle). The national priority substances list can be used to support the users to fulfil their obligation to follow the substitution principle.

The Dangerous Substances Directive (76/464/EEC, article 7) requires preparation of pollution reduction programmes for the substances within list II. List II identifies directly some substances but it also contains large groups of substances and an identification of those individual substances, which are liable to cause pollution of waters, is needed. The Water Framework Directive (WFD, 2000/60/EC) includes the same basic obligation to identify pollution sources of substances listed in Annex VIII (e.g., persistent and bioaccumulative organic toxic substances) and to identify methods to progressively reduce pollution. This national priority substances list serves as a basis for identification of relevant substances for the purposes of Directive 76/464/EEC and the WFD.

The Environmental Protection Act and Degree i.a., implementing the IPPC Directive (96/61/EC), require that the environmental permits include emission limit values for substances listed in Annex III. As for the WFD and the Dangerous Substances Directive, the Annex III contains large groups of substances. The national priority substances list facilitates the operators to identify which chemicals have to be included in the application and the permitting authorities to determine for which chemicals there has to be limit values.

There is a growing interest to develop and use fairly simple indicators to follow up the progress in different environmental issues. Chemical indicators used so far nationally or in the EU have been based either on total production volumes of certain chemicals or on the environmental concentrations of few chemicals (heavy metals or “historical pollutants” like PCB, DDT). Number of chemicals in use fulfilling selection criteria could be used as an indicator. Chemicals selected to the national priority substances list can also be utilized in the development of a risk-based indicator (Seppälä 2001).

7 Conclusions

The proposal for the first Finnish priority list of hazardous substances contains 80 chemicals of which 57 are industrial chemicals, 17 and 13 are biocidal and pesticidal active substances, respectively. The selection was based on the PBT properties of substances. In addition to PBT properties, seven priority chemicals have in addition an endocrine disrupting function. A separate list of endocrine disrupters or potential endocrine disrupters identified in EU is attached. Furthermore, eight metals have been selected as priority substances.

Several groups of substances were intentionally excluded from the selection. Radioactive substances, cosmetics, human and veterinary medicines as well as food and feed additives were excluded from the selection due to the administrative reasons. Further, the adverse effects in the atmosphere such as global warming, ozone depletion in stratosphere or ozone formation in troposphere were not considered in the selection of hazardous substances.

The proposed priority chemicals have been selected among substances listed in the Finnish register of chemical products (KETU) by using a combination of criteria persistency, toxicity and bioaccumulation. The selection criteria was *< 70% degradation in ready or inherent test or half-life > 5 days and BCF $\geq$ 500 or log Kow $\geq$ 4 and LC50 < 10 mg/l or NOEC < 1 mg/l*. Unfortunately, majority of chemicals in KETU remained outside the potential selection due to lack of information on one or more criteria. Furthermore, the inconsistency of available test results, in particular regarding biodegradation, in NSDB has complicated the selection procedure. It should also be noted that all hazardous substances are not necessarily included in the KETU.

Due to the lack of data the priority list cannot be complete. Therefore, this kind of lists should always be considered as an example list of particularly hazardous chemicals. As the amount of data on chemical properties is continuously increasing, the prioritisation should be repeated regularly.

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Annex 1 Proposed priority chemicals in the alphabetic order

The endocrine disrupters occurring in the EU candidate list are given in bold.

No	CAS	Name	Synonyme	Category
1	**85687**	**1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester**	**Butyl benzyl phthalate (BBP)**	Industrial
2	117840	1,2-Benzenedicarboxylic acid, dioctyl ester	Bis(n-octyl)phthalate (DNOP)	Industrial
3	3648202	1,2-Benzenedicarboxylic acid, diundecyl ester	Diundecyl phthalate	Industrial
4	106990436	1,3,5-Triazine-2,4,6-triamine, N,N'"-[1,2-ethane-diylis[[[4,6-bis[butyl(1,2,2,6,6-pentamethyl-4		Industrial
5	**122349**	**1,3,5-Triazine-2,4-diamine, 6-chloro-N,N'-diethyl-**	**Simazin**	**Pesticide**
6	85449	1,3-Isobenzofurandione		Industrial
7	793248	1,4-Benzenediamine, N-(1,3-dimethylbutyl)-N'-phenyl-		Biocide
8	92842	10H-Phenothiazine		Industrial
9	90302	1-naphthalenamine, N-phenyl	1-Anilinonaphthalene	Industrial
10	56073075	2H-1-Benzopyran-2-one, 3-(3-[1,1'-biphenyl]-4-yl-1,2,3,4-tetrahydro-1-naphthalenyl)-4-hydroxy-	Difenacoum	Biocide
11	56073100	2H-1-Benzopyran-2-one, 3-[3-(4'-bromo[1,1'-biphenyl]-4-yl)-1,2,3,4-tetrahydro-1-naphthalenyl]-4-hydroxy-	Brodifacoum	Biocide
12	28772567	2H-1-Benzopyran-2-one, 3-[3-(4'-bromo[1,1'-biphenyl]-4-yl)-3-hydroxy-1-phenylpropyl]-4-hydroxy-	Bromadiolone	Biocide
13	14816183	3,5-Dioxa-6-aza-4-phosphaoct-6-ene-8-nitrile, 4-ethoxy-7-phenyl-, 4-sulfide	Phoxim	Biocide
14	84852153	4-Nonylphenol, branched		Industrial
15	**115297**	**6,9-Methano-2,4,3-benzodioxa-thiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide**	**Endosulfan**	**Pesticide**
16	65907304	6-Oxa-3-thia-2,4-diazadecanoic acid, 2,4-dimethyl-5-oxo-, 2,3-dihydro-2,2-dimethyl-7-benzofuranyl ester	Furathiocarb	Pesticide
17	67762258	Alcohols, C12-18		Industrial
18	85535848	Alkanes, C10-13, chloro	SCCP	Industrial
19	66332965	Benzamide, N-[3-(1-methylethoxy)phenyl]-2-(trifluoromethyl)-	Flutolanil	Pesticide
20	1582098	Benzenamine, 2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)-	Trifluralin	Pesticide
21	71432	Benzene		Industrial
22	101815	Benzene, 1,1'-methylenebis-	Benzylbenzene	Industrial
23	101848	Benzene, 1,1'-oxybis-	Phenyl ether	Industrial
24	120821	Benzene, 1,2,4-trichloro-	1,2,4-Trichlorobenzene	Industrial
25	106467	Benzene, 1,4-dichloro-	1,4-Dichlorobenzene	Industrial, biocide
26	108907	Benzene, chloro-	Chlorobenzene	Industrial
27	1330207	Benzene, dimethyl-	Xylene	Industrial
28	100663	Benzene, methoxy-	Anisole	Industrial
29	66230044	Benzeneacetic acid, 4-chloro-.alpha.-(1-methylethyl)-, cyano(3-phenoxyphenyl)methyl ester, [S-(R*,R*)]-	Esfenvalerate	Pesticide
30	42615292	Benzenesulfonic acid, alkyl derivs.	LAS	Industrial

No	CAS	Name	Synonyme	Category
31	120785	Benzothiazole, 2,2'-dithiobis-	Benzothiazyl disulfide (MBTS)	Industrial
32	80568 65996965	Bicyclo[3.1.1]hept-2-ene, 2,6,6-trimethyl- Turpentine oil, alpha-pinene fraction	alpha-Pinene	Industrial
33	127913	Bicyclo[3.1.1]heptane, 6,6-dimethyl-2-methylene-	beta-Pinene	Industrial
34	538750	Cyclohexanamine, N,N'-methanetetraylbis-	Dicyclohexyl carbodiimide	Industrial
35	5124301	Cyclohexane, 1,1'-methylenebis[4-isocyanato-	Methylene-bis(4-cyclohexyl icocyanate)	Industrial
36	4098719	Cyclohexane, 5-isocyanato-1-(isocyanatomethyl)-1,3,3-trimethyl-	Isophorone diisocyanate	Industrial
37	138863	Cyclohexene, 1-methyl-4-(1-methylethenyl)-	Limone	Industrial
38	5989275	Cyclohexene, 1-methyl-4-(1-methylethenyl)-, (R)-	D-limone	Industrial, biocide
39	52918635	Cyclopropanecarboxylic acid, 3-(2,2-dibromoethenyl)-2,2-dimethyl-, cyano(3-phenoxyphenyl)methyl ester, [1R-[1.alpha.(S*),3.alpha.]]-	Deltamethrin	Biocide, pesticide
40	52645531	Cyclopropanecarboxylic acid, 3-(2,2-dichloro-ethenyl)-2,2-dimethyl-, (3-phenoxyphenyl)methyl ester	Permethrin	Biocide, pesticide
41	67375308	Cyclopropanecarboxylic acid, 3-(2,2-dichloroethenyl)-2,2-dimethyl-, cyano(3-phenoxyphenyl)methyl ester, [1-alpha.(S*),3.alpha.]-(.+-.)-	Alpha-cypermethrin	Pesticide
42	68359375	Cyclopropanecarboxylic acid, 3-(2,2-dichloroethenyl)-2,2-dimethyl-, cyano(4-fluoro-3-phenoxyphenyl)methyl ester	Cyfluthrin	Biocide
43	91465086	Cyclopropanecarboxylic acid, 3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethyl-, cyano(3-phenoxyphenyl)methyl ester, [1.alpha.(S*),3.alpha.(Z)]-(.+-.)-	Lambda-cyhalotrin	Pesticide
44	41556267	Decanedioic acid, bis(1,2,2,6,6-pentamethyl-4-piperidinyl) ester		Industrial
45	**56359**	**Distannoxane, hexabutyl-**	**Tributyltin oxide (TBTO)**	**Biocide**
46	67721	Ethane, hexachloro-	Hexachloroethane	Industrial, biocide
47	79016	Ethene, trichloro-	Trichloroethylen	Industrial
48	64742047	Extracts (petroleum), heavy paraffinic distillate solvent		Industrial
49	64742058	Extracts (petroleum), light paraffinic distillate solvent		Industrial
50	142825	Heptane		Industrial
51	67663	Methane, trichloro-	Chloroform	Industrial
52	67564914	Morpholine, 4-[3-[4-(1,1-dimethylethyl)phenyl]-2-methylpropyl]-2,6-dimethyl-, cis-	Fenpropimorph	Pesticide
53	91203	Naphthalene		Industrial, biocide
54	119642	Naphthalene, 1,2,3,4-tetrahydro-	1,2,3,4-Tetrahydronaphthalene	Industrial
55	38640629	Naphthalene, bis(1-methylethyl)-		Industrial
56	91178	Naphthalene, decahydro-	Decahydronaphthalene	Industrial
57	51000523	Neodecanoic acid, ethenyl ester	Vinyl neodecanoate	Industrial
58	**25154523**	**Nonylphenol**		**Industrial**
59	111659	Octane		Industrial
60	3861470	Octanoic acid, 4-cyano-2,6-diiodophenyl ester	Ioxynil	Pesticide

No	CAS	Name	Synonyme	Category
61	61789284 creosote oil 130498292 PAH	PAHs in creosote oil 50328 Benzo(a)pyrene 53703 Dibenz(a,h)anthracene 56553 Benz(a)anthracene 85018 Phenanthrene 205823 Benzo(j)fluoranthene 207089 Benzo(k) fluoranthene	Creosote oil	Industrial, biocide
62	63449398	Paraffin waxes and Hydrocarbon waxes, chlorinated		Industrial
63	80433	Peroxide, bis(1-methyl-1-phenylethyl)	Dicumyl peroxide	Industrial
64	70304	Phenol, 2,2'-methylenebis[3,4,6-trichloro-	Hexachlorophene	Industrial
65	88062	Phenol, 2,4,6-trichloro-	2,4,6-T	Industrial
66	96764	Phenol, 2,4-bis(1,1-dimethylethyl)-	2,4-Di-tert-butyl phenol (2,4 DTBP)	Industrial
67	128370	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	Butylhydroxytoluene	Industrial
68	1241947	Phosphoric acid, 2-ethylhexyl diphenyl ester	Ethylhexyl diphenylphosphate	Industrial
69	115866	Phosphoric acid, triphenyl ester	Triphenyl phosphate	Industrial
70	1330785	Phosphoric acid, tris(methylphenyl) ester	Tricresyl phosphate	Industrial
71	2921882	Phosphorothioic acid, O,O-diethyl O-(3,5,6-trichloro-2-pyridyl) ester; chlorpyriphos	Chlorpyrifos	Biocide
72	**333415**	**Phosphorothioic acid, O,O-diethyl O-[6-methyl-2-(1-methylethyl)-4-pyrimidinyl] ester**	**Diazinon**	**Biocide**
73	6846500	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(1-methylethyl)-1,3-propanediyl ester	2,2,4-Trimethyl-1,3-pentanediel diisobutyrate	Industrial
74	111479051	Propaquizafop	Propaquizafop	Pesticide
75	1338438	Sorbitan, mono-9-octadecenoate, (Z)-	Sorbitane oleate	Industrial
76	**85409172**	**Stannane, tributyl-, mono(naphthenoyloxy) derivs.**	**Tributyltin naphthenate**	**Biocide**
77	26140603	Terphenyl		Industrial

Annex 2 Proposed priority chemicals sorted according to the CAS number

The endocrine disrupters occurring in the EU candidate list are given in bold.

No	CAS	Name	Synonyme	Category
1	**56359**	**Distannoxane, hexabutyl-**	**Tributyltin oxide (TBTO)**	**Biocide**
2	67663	Methane, trichloro-	Chloroform	Industrial
3	67721	Ethane, hexachloro-	Hexachloroethane	Industrial, biocide
4	70304	Phenol, 2,2'-methylenebis[3,4,6-trichloro-	Hexachlorophene	Industrial
5	71432	Benzene		Industrial
6	79016	Ethene, trichloro-	Trichloroethylen	Industrial
7	80433	Peroxide, bis(1-methyl-1-phenylethyl)	Dicumyl peroxide	Industrial
8	80568 65996965	Bicyclo[3.1.1]hept-2-ene, 2,6,6-trimethyl- Turpentine oil, alpha-pinene fraction	alpha-Pinene	Industrial
9	85449	1,3-Isobenzofurandione		Industrial
10	**85687**	**1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester**	**Butyl benzyl phthalate (BBP)**	Industrial
11	88062	Phenol, 2,4,6-trichloro-	2,4,6-T	Industrial
12	90302	1-naphthalenamine, N-phenyl	1-Anilinonaphthalene	Industrial
13	91178	Naphthalene, decahydro-	Decahydronaphthalene	Industrial
14	91203	Naphthalene		Industrial, biocide
15	92842	10H-Phenothiazine		Industrial
16	96764	Phenol, 2,4-bis(1,1-dimethylethyl)-	2,4-Di-tert-butyl phenol (2,4 DTBP)	Industrial
17	100663	Benzene, methoxy-	Anisole	Industrial
18	101815	Benzene, 1,1'-methylenebis-	Benzylbenzene	Industrial
19	101848	Benzene, 1,1'-oxybis-	Phenyl ether	Industrial
20	106467	Benzene, 1,4-dichloro-	1,4-Dichlorobenzene	Industrial, biocide
21	108907	Benzene, chloro-	Chlorobenzene	Industrial
22	111659	Octane		Industrial
23	**115297**	**6,9-Methano-2,4,3-benzodioxa-thiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide**	**Endosulfan**	**Pesticide**
24	115866	Phosphoric acid, triphenyl ester	Triphenyl phosphate	Industrial
25	117840	1,2-Benzenedicarboxylic acid, dioctyl ester	Bis(n-octyl)phthalate (DNOP)	Industrial
26	119642	Naphthalene, 1,2,3,4-tetrahydro-	1,2,3,4-Tetrahydronaphthalene	Industrial
27	120785	Benzothiazole, 2,2'-dithiobis-	Benzothiazyl disulfide (MBTS)	Industrial
28	120821	Benzene, 1,2,4-trichloro-	1,2,4-Trichlorobenzene	Industrial
29	**122349**	**1,3,5-Triazine-2,4-diamine, 6-chloro-N,N'-diethyl-**	**Simazin**	**Pesticide**
30	127913	Bicyclo[3.1.1]heptane, 6,6-dimethyl-2-methylene-	beta-Pinene	Industrial
31	128370	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	Butylhydroxytoluene	Industrial
32	138863	Cyclohexene, 1-methyl-4-(1-methylethenyl)-	Limone	Industrial
33	142825	Heptane		Industrial
34	**333415**	**Phosphorothioic acid, O,O-diethyl O-[6-methyl-2-(1-methylethyl)-4-pyrimidinyl] ester**	**Diazinon**	**Biocide**
35	538750	Cyclohexanamine, N,N'-methanetetraylbis-	Dicyclohexyl carbodiimide	Industrial
36	793248	1,4-Benzenediamine, N-(1,3-dimethylbutyl)-N'-phenyl-		Biocide
37	1241947	Phosphoric acid, 2-ethylhexyl diphenyl ester	Ethylhexyl diphenylphosphate	Industrial

No	CAS	Name	Synonyme	Category
38	1330207	Benzene, dimethyl-	Xylene	Industrial
39	1330785	Phosphoric acid, tris(methylphenyl) ester	Tricresyl phosphate	Industrial
40	1338438	Sorbitan, mono-9-octadecenoate, (Z)-	Sorbitane oleate	Industrial
41	1582098	Benzenamine, 2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)-	Trifluralin	Pesticide
42	2921882	Phosphorothioic acid, O,O-diethyl O-(3,5,6-trichloro-2-pyridyl) ester; chlorpyriphos	Chlorpyrifos	Biocide
43	3648202	1,2-Benzenedicarboxylic acid, diundecyl ester	Diundecyl phthalate	Industrial
44	3861470	Octanoic acid, 4-cyano-2,6-diiodophenyl ester	Ioxynil	Pesticide
45	4098719	Cyclohexane, 5-isocyanato-1-(isocyanatomethyl)-1,3,3-trimethyl-	Isophorone diisocyanate	Industrial
46	5124301	Cyclohexane, 1,1'-methylenebis[4-isocyanato-	Methylene-bis(4-cyclohexyl icocyanate)	Industrial
47	5989275	Cyclohexene, 1-methyl-4-(1-methylethenyl)-, (R)-	D-limone	Industrial, biocide
48	6846500	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(1-methylethyl)-1,3-propanediyl ester	2,2,4-Trimethyl-1,3-pentanediel diisobutyrate	Industrial
49	14816183	3,5-Dioxa-6-aza-4-phosphaoct-6-ene-8-nitrile, 4-ethoxy-7-phenyl-, 4-sulfide	Phoxim	Biocide
50	**25154523**	**Nonylphenol**		**Industrial**
51	26140603	Terphenyl		Industrial
52	28772567	2H-1-Benzopyran-2-one, 3-[3-(4'-bromo[1,1'-biphenyl]-4-yl)-3-hydroxy-1-phenylpropyl]-4-hydroxy-	Bromadiolone	Biocide
53	38640629	Naphthalene, bis(1-methylethyl)-		Industrial
54	41556267	Decanedioic acid, bis(1,2,2,6,6-pentamethyl-4-piperidinyl) ester		Industrial
55	42615292	Benzenesulfonic acid, alkyl derivs.	LAS	Industrial
56	51000523	Neodecanoic acid, ethenyl ester	Vinyl neodecanoate	Industrial
57	52645531	Cyclopropanecarboxylic acid, 3-(2,2-dichloro-ethenyl)-2,2-dimethyl-, (3-phenoxyphenyl)methyl ester	Permethrin	Biocide, pesticide
58	52918635	Cyclopropanecarboxylic acid, 3-(2,2-dibromoethenyl)-2,2-dimethyl-, cyano(3-phenoxyphenyl)methyl ester, [1R-[1.alpha.(S*),3.alpha.]]-	Deltamethrin	Biocide, pesticide
59	56073075	2H-1-Benzopyran-2-one, 3-(3-[1,1'-biphenyl]-4-yl-1,2,3,4-tetrahydro-1-naphthalenyl)-4-hydroxy-	Difenacoum	Biocide
60	56073100	2H-1-Benzopyran-2-one, 3-[3-(4'-bromo[1,1'-biphenyl]-4-yl)-1,2,3,4-tetrahydro-1-naphthalenyl]-4-hydroxy-	Brodifacoum	Biocide
61	63449398	Paraffin waxes and Hydrocarbon waxes, chlorinated		Industrial
62	64742047	Extracts (petroleum), heavy paraffinic distillate solvent		Industrial
63	64742058	Extracts (petroleum), light paraffinic distillate solvent		Industrial
64	65907304	6-Oxa-3-thia-2,4-diazadecanoic acid, 2,4-dimethyl-5-oxo-, 2,3-dihydro-2,2-dimethyl-7-benzofuranyl ester	Furathiocarb	Pesticide
65	66230044	Benzeneacetic acid, 4-chloro-.alpha.-(1-methylethyl)-, cyano(3-phenoxyphenyl)methyl ester, [S-(R*,R*)]-	Esfenvalerate	Pesticide
66	66332965	Benzamide, N-[3-(1-methylethoxy)phenyl]-2-(trifluoromethyl)-	Flutolanil	Pesticide

No	CAS	Name	Synonyme	Category
67	67375308	Cyclopropanecarboxylic acid, 3-(2,2-dichloroethenyl)-2,2-dimethyl-, cyano(3-phenoxyphenyl)methyl ester, [1-alpha.(S*),3.alpha.]-(.+-.)-	Alpha-cypermethrin	Pesticide
68	67564914	Morpholine, 4-[3-[4-(1,1-dimethylethyl)phenyl]-2-methylpropyl]-2,6-dimethyl-, cis-	Fenpropimorph	Pesticide
69	67762258	Alcohols, C12-18		Industrial
70	68359375	Cyclopropanecarboxylic acid, 3-(2,2-dichloroethenyl)-2,2-dimethyl-, cyano(4-fluoro-3-phenoxyphenyl)methyl ester	Cyfluthrin	Biocide
71	84852153	4-Nonylphenol, branched		Industrial
72	**85409172**	**Stannane, tributyl-, mono(naphthenoyloxy) derivs.**	**Tributyltin naphthenate**	**Biocide**
73	85535848	Alkanes, C10-13, chloro	SCCP	Industrial
74	91465086	Cyclopropanecarboxylic acid, 3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethyl-, cyano(3-phenoxyphenyl)methyl ester, [1.alpha.(S*),3.alpha.(Z)]-(.+-.)-	Lambda-cyhalotrin	Pesticide
75	106990436	1,3,5-Triazine-2,4,6-triamine, N,N‴-[1,2-ethane-diylis[[[4,6-bis[butyl(1,2,2,6,6-pentamethyl-4		Industrial
76	111479051	Propaquizafop	Propaquizafop	Pesticide
77	61789284 creosote oil 130498292 PAH	PAHs in creosote oil 50328 Benzo(a)pyrene 53703 Dibenz(a,h)anthracene 56553 Benz(a)anthracene 85018 Phenanthrene 205823 Benzo(j)fluoranthene 207089 Benzo(k) fluoranthene	Creosote oil	Industrialbiocide

Annex 3 Original parameter values and corresponding scaled values in NSDB

Biodegradation

0 1 2 3	4 5 6	7 8 9 10	
>70% 2	70-50% 5	50-20% 7	<20% 9	Ready test
	>70% 5	70-20% 7	<20% 9	Inherent test
<5 d 2	5-10 d 5	10-30 d 7	30-60/>60 d 9	Half-life
>1 2	1-0.2 7		<0.2 9	BOD/COD
>70% 2	<70% 5			BOD5

Bioaccumulation

0 1 2	3 4	5 6	7 8	9 10	
<100 1.25	100-500 3.125	500-1000 4.375	1000-5000 5.625	5000-10 000 6.875	≥10 000 8.75	BCF

<3 1	3-4 3	4-5 5	5-6 7	≥6 9	Log K_{ow}

Aquatic toxicity

0 1 2	3 4	5 6	7 8	9 10		
>1000 0.83	1000-100 2.5	100-10 4.17	10-1 5.83	1-0.1 7.5	<0.1 9.17	Acute tests
>100 0.83	100-10 2.5	10-1 4.17	1-0.1 5.83	0.1-0.01 7.5	<0.01 9.17	Chronic tests
		R52 4.17	R51 5.83	R50 7.5		Risk phrase

Secondary poisoning

0 1 2 3 4	5 6	7 8	9 10	
>2000 2	2000-200 5	200-25 7	<25 9	Acute oral LD50
>20	20-2 5	2-0.25 7	0.25 9	Chronic NOAEL
R322 3	R20-22,40 5	R23-25,39 7	R26-28,39 9	Acute tox Risk phrase
R33 4	R48(Xn) 5	R48(T) 7		Chronic tox Risk phrase
		Cat 3: R62,63 7	Cat 1-2: R60,61 9	Reprod tox Risk phrase
		B 8	A 9	Reprod GER MAK/BAK
		Cat 3: R40 7	Cat 1-2: R46 9	Mutagen tox Risk phrase
		CAT 3: R40 7	Cat 1-2: R45,49 9	Cancer tox Risk phrase
4 0 3 2		2B 7.5	2A, 1 9	Cancer IARC
		2 8	1 9	Cancer NTP
		B 7	A2, A1 9	Cancer GER MAK/BAK
		A,B,B1,B2 7		Cancer US EPA
		A2 7	A1 9	CANCER ACGIH

Annex 4 Prioritisation of the existing HPV chemicals in EU (EURAM)

Purpose

EURAM is an abbreviation from the EU Risk rAnking Method. EURAM is a tool for ranking and scoring high production volume chemicals (HPVCs) (http://ecb.ei.jrc.it/existing-chemicals/). HPVCs are existing substances that are produced in EU in volumes exceeding 1000 tonnes per year. The aim of the ranking is to select the HPVCs for the EU risk assessment. The order of risk assessment of HPVCs should be positively related to the risk that is believed to arise from the use of these substances. National priority substances are incorporated into the working list through the EURAM database or ranking commenting step.

Database and method

EURAM is applied on data of HPVCs stored in the IUCLID, International Uniform Chemical Information Database. There are about 2500 HPVCs listed on the EINECS list, European Inventory of Existing Commercial Substances (Hansen et al. 99). The EURAM ranks substances on the basis of their potential risks to humans and the environment using a simple exposure-effect model. The EURAM calculates scores, one for the environment and one for human health. For the calculation of the environmental score the PEC and PNEC are calculated using simple models, which are consistent with the methodology in Technical Guidance Document, TGD (EC1996).

The first EURAM ranking includes preparation of automated rankings based on the IUCLID data and generated automatically using the EURAM data selection routine and applying the EURAM method to the resulting database. In the second step, the Member States, Industry and other NGOs comment on the EURAM database and have possibility to add flags on the ranking on concerns not reflected in the ranking of substance. In the third step, experts select substances from the EURAM rankings to place them on the Working List. Working list of national priorities is developed. The final step is the preparation of the priority lists.

Result

So far four priority lists have been adopted under the regulation (EEC) 793/93. The first, second, third, and fourth list contain 42, 36, 31, and 30 substances, respectively. For each substance one (or two) Member State is nominated which is responsible to prepare a risk assessment for this substance. When risk is identified, the Member State will make a risk reduction plan.

Annex 5 Selection of WFD priority substances by COMMPS procedure

Purpose

The Water Framework Directive (WFD) requires the Commission to establish a priority list of substances based on their risk to the aquatic environment and to human health via the aquatic environment. For those priority substances the Commission has to propose community wide EQSs and measures to progressively reduce releases. In order to establish this priority list, a Combined Monitoring-based and Modelling-based Priority Setting scheme (COMMPS) has been elaborated (EC 1999).

Database and method

The COMMPS procedure is based on an approach to combine an automated relative risk-based ranking and subsequent expert judgement (simplified risk assessment). The COMMPS procedure comprises the five steps: 1. Selection of candidate substances subject to the ranking procedure, 2. Calculation of exposure scores, 3. Calculation of effects scores, 4. Computation of the risk-based score, 5. Recommendation of priority substances. The candidate substances are selected from various official lists and monitoring programmes and included 658 substances. The exposure score is based on monitoring or modelling data, while effects scores are derived from test data. Risk scores are calculated by multiplying the exposure and effect score for each substance. Different lists are established; monitoring-based list for the water phase, modelling based list, monitoring based list for sediment, several monitoring based lists for metals and metal compounds. 320 substances occurring on the different lists were accepted for the ranking. A final selection of priority substances are made from these lists by expert judgement.

Result

The final selection resulted in four sub-lists. The monitoring-based list for the aquatic phase contained 20 organic substances or group of substances, the modelling-based list for the aquatic phase contained five substances or group of substances, monitoring-based list for sediment had pentachlorobenzene and brominated diphenylethers, and in the metal list nickel, lead, cadmium, copper and arsenic were included. The proposal for the priority substances of WFD included 32 substances selected from the four sub-lists.

Annex 6 Selection and prioritisation of hazardous substances in OSPAR and HELCOM

Purpose

The international agreements, OSPAR (the Convention for the protection of the Marine Environment of the Northeast Atlantic, http://www.ospar.org) and HELCOM (Convention on the Protection of the Marine Environment of the Baltic Sea Area (http://www.helcom.fi), obligate the member states including Finland to protect marine waters from pollution. The objective of both HELCOM and OSPAR strategies with regard to hazardous substances is to prevent pollution of maritime area by continuously reducing discharges, emissions and losses of hazardous substances, with the ultimate aim of achieving concentrations in the marine environment near background values for naturally occurring substances and close to zero for man-made synthetic substances. One part of the OSPAR strategy is the development of a dynamic selection and prioritisation mechanism to identify and select the hazardous substances to be given priority within the OSPAR programme. Substances selected as priority substances are added to Annex II of the strategy for subsequent identification of sources and pathways and identification of possible measures as foreseen in strategy.

Database and method

The Nordic Substance Database (18 000 substances), the Danish EPA QSAR database (166 000 substances) and the Dutch database (180 000 substances) served as the starting point for the initial selection (OSPAR 00/5/2-E). In the initial selection the substances of possible concern for the marine environment are identified. Persistent, toxic and substances that are liable to bioaccumulate are considered as threat to the marine environment. DYNAMEC has produced five combination of cut-off values on the PBT properties (Table 1). All selections use a combination of the properties, i.e. the selected substances are persistent, toxic and bioaccumulating. The initial selection with profile V produced 367 substances.

A safety-net was established in order to add substances to the preliminary list that fail to meet the PBT cut-off values, but are otherwise considered hazardous, e.g. metals and other inorganic compounds. Besides the intrinsic properties, the actual concern is also depending on whether the substances reach, or likely to reach, the marine environment. After additions and refinement of the initially selected substances the preliminary list contained 402 substances (PRAM 00/3/Info.1-E). In order to rank the initially selected substances they were characterised with respect to their production volumes, use patterns and/or measured occurrence in the environment (OSPAR 00/5/2-E). Each substance was assigned an effect score and an exposure score. The ranking algorithms were based on those used in the COMMPS procedure. The exposure score was derived with a modified EURAM algorithm. Toxicity and bioaccumulation as well as indirect effects on humans via food were included in the effect score. A priority index was calculated by multiplying the exposure score with effect score. One problem in the ranking was the confidentiality of production and use volumes of some substances. The ranking procedure was applied on those substances for which information on production and use and/or monitoring data were available, i.e. 241 substances out of 367. Finally, 80 most highly ranked substances (selection box) were divided to seven different groups by the expert judgement (Table 2).

***Table 1**. Cut-off values used in the initial selection of DYNAMEC process (DYNAMEC 00/3/1-E).*

Scenario	Cut-off values
I	P: Not inherently biodegradable and B: log K_{ow} >= 5 or BCF >= 5000 and T_{aq}: LC50 or EC50 =< 0.1 mg/l, NOEC =< 0.01 mg/l or $T_{mammalian}$ CMR or chronic toxicity
II	P: Not inherently biodegradable and B: log K_{ow} >= 5 or BCF >= 5000 and T_{aq}: LC50 or EC50 =< 1 mg/l, NOEC =< 0.1 mg/l or $T_{mammalian}$ CMR or chronic toxicity
III	P: Not inherently biodegradable and B: log K_{ow} >= 4 or BCF >= 500 and T_{aq}: LC50 or EC50 =< 1 mg/l, NOEC =< 0.1 mg/l or $T_{mammalian}$ CMR or chronic toxicity
IV	P: Not readily biodegradable and B: log K_{ow} >= 5 or BCF >= 5000 and T_{aq}: LC50 or EC50 =< 1 mg/l, NOEC =< 0.1 mg/l or $T_{mammalian}$ CMR or chronic toxicity
V	P: Not readily biodegradable and B: log K_{ow} >= 4 or BCF >= 500 and T_{aq}: LC50 or EC50 =< 1 mg/l, NOEC =< 0.1 mg/l or $T_{mammalian}$ CMR or chronic toxicity

***Table 2**. Breakdown of the 80 substances of the "selection box" drawn from the ranked lists of initially selected substances.*

Group	Description	Number of substances
I	Substances of very high concern (i.e. POP like substances or substances with PBT profile, selection I) and indication of production, use or occurrence in the environment	5
I*	Substances of very high concern (Group I) and indication of production, use or occurrence in the environment, but which have been initially selected as a result of reliance on QSAR data and/or experimental data about which confidence might be doubted	13
II	Other initially selected substances (with less severe PBT profile) and indication of use or exposure	7
II*	Other initially selected substances (with less severe PBT profile) and indication of use or exposure, but which have been initially selected as a result of reliance on QSAR data and/or experimental data about which confidence might be doubted	7
III	Substances of very high concern (Group I) with NO indication of use or exposure	8
IV	Other initially selected substances with NO indication of use or exposure	7
V	Substances with PBT properties but which are heavily regulated or withdrawn from the market	20
VI	Endocrine disruptors or natural hormones	6
	Substances which do not meet the initial selection criteria (and which should be deleted from the draft preliminary list) or substances already on Annex 2 of the strategy	7
		In total 80

Result

HELCOM has a list of 44 substances or groups of substances that are selected for immediate priority action. The current OSPAR list of chemicals for priority action contains 27 substances or groups of substances. Twelve new substances from Groups I and II were added to Annex II at the meeting of OSPAR Commission in 2000. Both HELCOM and OSPAR lists include e.g. polycyclic halogenated aromatic compounds, polycyclic aromatic hydrocarbons, phenols, musk xylene, heavy metals and most persistent pesticides.

Annex 7 Prioritisation of hazardous substances in the Netherlands

Purpose

The policy of the Dutch Government is aimed to replace the persistent, toxic and bioaccumulative substances for less harmful substances (Third National Environmental Policy Plan, BKH 1998). To promote this aim the prioritisation of hazardous substances is needed because the risk assessment procedure is too slow. Combination of inherent properties, persistence, toxicity and potential to bio-accumulate, give good reason for prioritisation of risk assessment or if relative exclusive criteria are applied for initiating restrictive measures without risk assessment. On the basis of the precautionary principle the substances may be restricted on the basis of their inherently hazardous properties.

Database and method

As a database the ISIS/Riskline (International Substances Information System) was used. The database contains almost 180 000 entries for substances. Two percent out of 180 000 substances have aquatic toxicity data. The potential for bioaccumulation and persistency were estimated by the help of SMILES notation and Syracuse KOWWIN and BIODEG programs, respectively. The use of computer programs ensured an identical treatment of all substances. The following criteria for toxicity, bioaccumulation and persistency were used (Table 1). Three levels for toxicity an bioaccumulation and two levels for persistence were applied leading in total of 18 selection categories.

Table 1. *Number of substances selected by different criteria in the Dutch priority process*.

Group	Toxicity (mg/l)	n	Bioaccumulation	n	Persistency	n
C	LC50 < 1 NOEC < 0.1	634	log $K_{ow} \geq 4$ BCF ≥ 1000	282	months	80
B	LC50 < 0.1 NOEC < 0.01	349	log $K_{ow} \geq 4.5$ BCF ≥ 3000	132	months	54
A	LC50 < 0.01 NOEC < 0.001	176	log $K_{ow} \geq 5$ BCF ≥ 5000	73	> months	19

Result

The number of substances scoring LC50 < 1 mg/l or NOEC < 0.1 mg/l were 877. The further selection steps finally resulted in a list with 634 substances which is split in 18 sub-lists on the basis of different values for the three selection criteria for ecotoxicity, bioaccumulation and persistence. The second criterion, bioaccumulation potential, reduced the number of substances, the more exclusive criteria resulted in a stronger reduction. The third criterion, persistence, was additionally selective. About 2/3 of the toxic and bioaccumulative substances were to be biodegradable, whereas only 10-20% of the substances seemed to persist longer than months. In general, lipophilicity was not correlated with persistence. Finally, 80 of 3598 or 1.8% of the

substances with toxicity data could be classified as PBT substances. In the first evaluation some substances were lumped. After lumping of substances 61 substances remained, of which 36 were pesticides, 6 PAH, 1 chlorodibenzofuran and 18 industrial chemicals. The selected chemicals were mostly highly halogenated chemicals. Additionally four substances were excluded by the expert judgement. The final list included 57 substances of which 16 did not occur on any other list. The conclusion was to recommend the use of mammalian toxicity in addition to ecotoxicity data.

Annex 8 Prioritisation of hazardous substances in Denmark

Purpose

The Danish Environment Protection Agency has published the first official list of undesirable substances in 1998 (Miljøstyrelsen 1998). An updated version of this list appeared in 2000 (Miljøstyrelsen 2000). The list should be considered as a signal and a guideline for the manufacturers, product developers, purchasers and other players concerned with chemicals. The long-term purpose of the list is to reduce the use of these substances. Various measures can be used to reduce the listed chemicals, such as regulations, classification and labelling, taxes on problematical chemicals, voluntary agreements on phase-out initiatives and information campaigns. The list is not exhaustive as new knowledge, changed patterns of consumption and new international initiatives are constantly emerging. This means that the list must be periodically updated.

Database and method

The initial selection of chemicals have been done among chemicals in the Danish product register which contained 7890 substances and among the 2700 HPV chemicals in EU (chemicals being more than 1000 ton in the EU market) (Miljøstyrelsen 1996). It should be noted that all chemicals that are in use in Denmark are not included in the Danish product register. Only substances which are used more than 100 tonnes in Denmark can potentially be selected on the List of Undesirable Substances. Substances are selected on the list on the basis of their effects and quantities in which they are marketed. The criteria that have been used in the selection of chemicals on the list are health effects such as high acute or chronic toxicity, carcinogenicity, toxicity to reproduction and cumulative effect, allergenic effect on skin and respiratory system, as well as its hazardous effects in the environment. The EU classification criteria have been used as selection criteria. The ecotoxicological information is based on QSAR computations. Some substances have been selected because they are considered to contribute strongly to the greenhouse effect. Th bioaccumulation potential were determined by LOGKOW program and cut-off values for log K_{ow} $\geq$ 3 and $\geq$ 4 were used for halogenated and non halogenated compounds, respectively (Miljøstyrelsen 1996). The biodegradability was determined by BPP1 program which determined whether the substance will be fast or slowly biodegradable. About 20% of halogenated substances having log K_{ow} $\geq$ 3 were determined to be fast biodegradable. The respective value for non-halogenated substances was 73%. In 1998 list 706 chemicals were hazardous to the human health or the environment according to the classification (Miljøstyrelsen 1996). Majority of chemicals (586) was selected on the basis of the health criteria.

Result

The 1998 list contained 56 substances or group of substances. The updated list contains 66 substances or group of substances (at least 148 substances). Of 66 substances 32 are selected on the basis of health effects, 12 on the basis of environmental effects, and 24 have both health and environmental effects. Substances only used as active ingredients in pesticides are not included in the list due to approval system used for pesticides in Denmark.

Annex 9 Prioritisation of hazardous substances in Norway

Purpose

Statens forureningstilsyn (Sft) has published an OBS-list of hazardous substances which are considered to cause risk for health or environment in Norway (Sft 2000). The risk can arise in use, manufacture, storage or waste management in Norway. The purpose of the list is to reduce the amount of these substances in the environment. The target group of the Obs-list are producers, importers, sellers and consumers of the chemicals or chemical products. The list can also be used when the substitution principle is applied.

Database and method

The chemicals on the Obs-list have been selected among the chemicals that are included in the Norwegian register of hazardous substances (Stofflisten) and the Nordic Substance Database. The initial selection of substances was done among about 12 000 substances which have at least some information about health or environment. In the selection of chemicals on the Obs-list the slow degradation rate and high potential for bioaccumulation were considered particularly important. Other properties that were taken into account were reproduction toxicity, genotoxicity, chronic toxicity, carcinogenicity, allergenicity, acute toxicity, or ozone depletion potential. Also chemicals that contribute to greenhouse effect were considered. All substances produced or imported more than 10 tonnes are selected. For substances with less production or import volume a more exclusive criteria are applied (Table 1). The environmental selection criteria are more distinctly defined in the Table 2.

Table 1. *Criteria for the selection on the Norwegian Obs-list*.

Production or import volume more than ten ton per year	Production or import volume between one and ten ton per year AND that have/are	Production or import volume less than one ton per year AND that have/are
	Chronic effects Strongly allergenic Not easily degradable Liability to bioaccumlate	High potential for distribution Consumer products Strongly allergenic Not easily degradable Liability to bioaccumulate

***Table 2**. Criteria for the environmental risk.*

Criteria No.	Properties	Criteria
1a	High potential for bioaccumulation combined with slow degradation rate	BCF > 1000 or log K_{ow} > 4 Slow degradation rate in biodegradation test, e.g. ≤ 20% degradation in ready biodegradability test
1b	High potential for bioaccumulation combined with high acute toxicity	BCF > 1000 or log K_{ow} > 4 Acute EC50 ≤ 1 mg/l for aquatic organisms (R50/53)
1c	Slow degradation rate combined with high acute toxicity	Low degradation (see 1a) Acute EC50 ≤ 1 mg/l for aquatic organisms (R50/53)
2	High acute toxicity for aquatic organisms	Acute EC50 ≤ 0.1 mg/l for aquatic organisms (R50)
3a	High potential for bioaccumulation combined with high chronic toxicity	BCF > 1000 or log K_{ow} > 4 Long-term NOEC ≤ 0.01 mg/l for aquatic organisms
3b	Slow degradation rate combined with high chronic toxicity	Slow degradation (see 1a) Long-term NOEC ≤ 0.01 mg/l for aquatic organisms
4	High chronic toxicity	Long-term NOEC ≤ 0.001 mg/l for aquatic organisms
5	Detrimental to ozone layer	Ozone Depletion Potential, ODP > 0 on the UNEP list or substances that have been classified as ozone depleting (R59)

Resultat

The Obs-list contains 219 substances or group of substances. The Obs-list includes also earlier prioritised environmentally hazardous substances on the List A and B (Stortingsmelding nr 58 1996-1997). The emissions or use of those substances are already reduced or are going to be reduced by the year 2010. In the list of substances the use category, product groups, criteria for selection, classification and special regulation or activities are given.

Annex 10 Prioritisation of hazardous substances in Sweden

Purpose

The purpose of the Swedish OBS-list is to inform about substances which are particularly hazardous to the human health or to the environment (KemI 2000). In order to help the manufacturers, importers and users to evaluate the hazardousness of their chemicals, KemI has prepared the list of chemicals which may potentially cause great risk to the human health or the environment. The OBS-list can be used for example in application of substitution principle. The OBS-list is by no means complete. It should be considered as an example of particularly hazardous chemicals. Substances not occurring on the list, but being equally hazardous, must be observed similarly than substances on the OBS-list. Pesticides are not included in the list due to the approval system for pesticides. To be on the list does not mean a ban or restriction of the chemical. In 90'ies a Sunset project was carried out in Sweden (KemI 2/95, KemI 12/95). In this project a number of the most hazardous multiproblem chemicals will be selected as candidates for risk reduction.

Database and method

In order to be selected on the OBS-list, more than one ton of the substance must occur on the Swedish market. The Swedish classification and labelling criteria (KIFS 1994:12) are used to select substances that are hazardous to the human health. Only substances with most environmentally hazardous properties are on the OBS-list. The environmentally hazardous substances have been collected from the IUCLID. The environmental selection criteria are in Table 1.

Table 1. *The environmental selection criteria*.

No.	Properties	Criteria
1	High potential for bioaccumulation combined with low degradability	BCF > 1000, low degradability in bio-degradation tests, e.g. < 20% degradation in ready or inherent biodegradability test
	High potential for bioaccumulation combined with very high toxicity	BCF > 1000, EC50 in short-term tests < 1 mg/l for aquatic organisms
	Low degradability combined with very high toxicity to aquatic organisms	Low degradability in biodegradation tests, EC50 in short-term tests < 1 mg/l for aquatic organisms
2	Very high toxicity to aquatic organisms	EC50 in short-term tests < 0.1 mg/l for aquatic organisms
3	Detrimental to ozone layer	Ozone depletion potential, ODP > 0 on UNEP List or ozone-depleting substances regulated within EU

Result

The OBS-list contains 13 groups of substances and 236 substances. The groups of substances are selected on the basis of environmental criteria. 152 substances are selected entirely on the basis of health criteria, whereas 57 substances are selected on the basis of environmental criteria. 27 substances are selected on the basis of both health and environmental criteria.

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Abstract
Currently ten thousands of chemicals are in industrial use. In order to reduce the risk of hazardous chemicals to the environment, selection and prioritisation of chemicals is needed. A proposal of selection and prioritisation method applicable to the Finnish conditions is presented in this report. The environmental conditions in Finland and the Baltic Sea have been taken into account in the selection of substances. Hazardous chemicals are defined as substances that are persistent, bioaccumulating and toxic (PBT). According to the proposal a substance must fulfil all three PBT criteria to be selected on the Finnish priority list. Persistency has been stressed in the selection profile, since degradation of chemicals is assumed to occur slower in the Nordic conditions in particular due to the low temperature. Also phototransformation is considered to be negligible during the winter.

The Finnish Register of Chemical Products (KETU) has been used as a pool of chemicals. The data on the hazardous properties has been obtained from the Nordic Substance Database. The lack of data hampers the selection of chemicals. Only about 900 chemicals registered in KETU have information on persistency, toxicity and bioaccumulation, and can potentially be selected as priority chemicals. More than 4500 chemicals remain outside the selection.

The proposal for priority list contains 77 chemicals including industrial chemicals, biocides and pesticides. Separate lists of 8 heavy metals and 37 endocrine disrupters are made. The listed endocrine disrupters have been found in KETU and are identified as endocrine disrupters on the basis of EU candidate list. Solvents are most common industrial priority substances, and other typical use patterns are glues, resins, paints, lacquers, varnishes, lubricants and washing agents. Industrial priority chemicals are commonly used in chemical, metal, rubber and plastic industry. Also construction and car service are the fields where several products containing priority chemicals are used. Of the biocidal and pesticidal active substances, the insecticides are the most common. Regarding the number of products, most typical biocidal uses are antifouling paints and wood preservatives.

The priority list is intended to be used by all actors involved with manufacture, import or use of chemicals or products containing these chemicals to indicate that special care should be taken to reduce potential risks. The list may help to evaluate the hazard potential of chemicals and also to support the substitution principle. To be on the list does not necessarily mean a ban or restriction of the chemical. The priority setting mechanism and the proposed list are developed for a tool to implement the requirements of EU water legislation regarding national identification of priority substances. The proposed priority list cannot be complete. This kind of lists should always be considered as an example of particularly hazardous chemicals. As the amount of data on chemical properties is continuously increasing, the prioritisation should be repeated regularly.

Keywords
Hazardous substances, persistence, bioaccumulation, toxicity, degradation, industrial chemicals, biocides, pesticides, heavy metals, endocrine disrupters, risk management, databases, Finnish Register of Chemical Products, Nordic Substance Database, environment, Finland, Baltic Sea

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Sanna Koivisto

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Julkaisun laji	*Toimeksiantaja*	*Toimielimen asettamispvm*

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Tiivistelmä

Teollisessa käytössä on nykyisin kymmeniä tuhansia kemiallisia aineita. Niiden ympäristölle aiheuttamien riskien systemaattinen vähentäminen edellyttää aineiden priorisointia. EY:ssä ja kansainvälisillä foorumeilla on kehitetty eri tarkoituksia varten vaarallisten aineiden valinta- ja priorisointimenetelmiä. Tässä työssä näiden menetelmien pohjalta on kehitetty Suomen oloihin soveltuva aineiden valintamenetelmä. Menetelmä ottaa huomioon aineiden pysyvyyden, kertyvyyden ja myrkyllisyyden ja sen perusteella valitut aineet esitetään tässä raportissa. Ehdotuksen mukaan aineella tulee olla kaikki haitalliset ominaisuudet eli sen tulee olla pysyvä, kertyvä ja myrkyllinen, jotta se valittaisiin Suomen prioriteettikemikaaliksi. Orgaanisten yhdisteiden hajoaminen on hidasta Suomen luonnossa ja Itämeressä alhaisen lämpötilan takia. Talvella myös kemikaalien muuntuminen valon vaikutuksesta vähenee vähäisen säteilyn ja lumi- ja jääpeitteen vuoksi. Suomen ympäristöolojen takia aineiden pysyvyyttä on erityisesti painotettu valintamenetelmässä.

Valinnan kohteena tulisi periaatteessa olla kaikki Suomessa käytössä olevat kemikaalit. Tässä työssä kemikaalien lähtöjoukkona on käytetty Tuoterekisteriä (KETU), joka sisältää pääosan Suomessa käytetyistä vaarallisista aineista. Aineiden ominaisuustiedot on haettu Pohjoismaisesta ainetietokannasta (NSDB). Monen kemikaalin ominaisuustietojen puutteellisuus hankaloittaa valintaa olennaisesti. Tuoterekisteristä löytyi 900 kemikaalia, joilla oli tiedot pysyvyydestä, kertyvyydestä ja myrkyllisyydestä. Yli 4500 kemikaalilta puuttui yksi tai useampi ominaisuustieto, minkä takia ne jäivät automaattisesti valinnan ulkopuolelle.

Prioriteettilistalle valittiin 77 kemikaalia, joista suurin osa on teollisuuskemikaaleja. Lisäksi listalla on myös biosidejä ja torjunta-aineita. Raskasmetalleille ja hormonitoimintaa häiritseville aineille laadittiin omat listat. Priorisoituja teollisuuskemikaaleja käytetään eniten kemian-, metalli-, kumi- ja muoviteollisuudessa. Haitallisia kemikaaleja käytetään paljon myös autokorjaamoissa ja rakentamisessa. Torjunta-aineista yleisimpiä olivat hyönteisten torjunta-aineet eli insektisidit ja biosideistä insektisidit, antifouling-maalit ja puunkyllästysaineet.

Prioriteettilista ei ole täydellinen, vaan pikemmin esimerkkilista aineista, jotka ovat erityisen haitallisia. Listaa tulisi päivittää usein, koska markkinoilla olevat aineet vaihtelevat ja myös ominaisuustietojen karttuminen voi lisätä tai poistaa aineita prioriteettilistalta. Prioriteettilista on tarkoitettu apuvälineeksi kemikaalien valmistajille, maahantuojille, käyttäjille ja viranomaisille. Listalla olevien kemikaalien korvaamista vähemmän haitallisilla aineilla tulisi harkita mm. kemikaalilain valintavelvollisuutta toteutettaessa.

Asiasanat (avainsanat)
Vaaralliset aineet, pysyvyys, kertyminen, hajoaminen, myrkyllisyys, teollisuuskemikaalit, torjunta-aineet, biosidit, raskasmetallit, hormonit, kemikaalit, biologiset vaikutukset, Tuoterekisteri, Pohjoismainen kemikaalitietokanta, ympäristö, Suomi, Itämeri

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Referat

Det finns tiotusentals kemikalier i industriellt bruk i dag. För att systematiskt kunna minska dessa kemikaliers miljörisker, måste man prioritera vilka kemikaliers risker man väljer att begränsa. Inom EG samt andra internationella fora har man utvecklat metoder för att välja och prioritera kemiska ämnen. Den här rapporten presenterar en urvals- och prioriteringsmetod för farliga ämnen som är anpassad till finländska miljöförhållanden. Enligt urvalsmetoden skall ett ämne samtidigt ha tre farliga egenskaper, nämligen låg nedbrytbarhet, bioackumulerbarhet och giftighet, för att det skall kunna inkluderas i prioriteringslistan. I urvalsmetoden har särkild vikt lagts på låg nedbrytbarhet eftersom nedbrytningen av organiska föreningar sker långsamt i Finland och Östersjön på grund av det kalla klimatet. Under vintern minskar även den nedbrytning som förorsakas av ljus på grund av snö- och istäcket samt den låga instrålningen.

I princip skall urvalet av kemikalierna göras bland alla kemikalierna som används i Finland. De flesta kemikalierna på den finska marknaden finns med i Produktregistret som har använts som en utgångspunkt för urvalet. Information om de farliga egenskaperna har hämtats från den Nordiska substansdatabasen (NSDB). Ofullständiga uppgifter om kemikaliernas farliga egenskaper försvårar urval av kemikalierna. Det fanns 900 kemikalier i Produktregistret som hade uppgifter om alla tre farlighetskriterier. Mer än 4500 kemikalier uteblev från urvalet på grund av brist på information om en eller flera farliga egenskaper.

77 kemikalierna valdes ut och togs med på prioriteringslistan och de flesta av dem används industriellt. På listan finns också biocider och bekämpningsmedel. Särskilda listor gjordes för tungmetaller och hormonstörande ämnen. Lösningsmedel var de mest typiska industriellt använda kemikalierna på listan, men prioriterade ämnen förekom även ofta i lim, harts, färg, lack, smörjmedel och tvättmedel. De prioriterade kemikalierna används mest i kemisk, metall-, gummi- och plastindustri. Även byggnadsverksamhet och bilreparering var brancher där farliga ämnen förekommer ofta. Insekticiderna var de vanligaste bland bekämpningsmedlen och biociderna. Det finns också många antifouling produkter och träskyddsmedel som innehåller prioriterade biocider.

Prioriteringslistan är inte fullständig utan snarast en exempellista över speciellt farliga ämnen. Listan skall uppdateras regelbundet eftersom sortimentet av kemikalier på marknaden varierar. Även ny information om kemikaliernas egenskaper kan påverka prioriteringslistans sammansättning. Prioriteringslistan är avsedd för alla som hanterar kemikalier. Enligt kemikalielagens §16 a är man skyldig att välja den kemikalie (eller metod) som orsakar minst skada, vilket kan innebära att kemikalieanvändare vanligen bör överväga att ersätta kemikalier på prioriteringslistan med mindre farliga ämnen.

Sakord (nyckelord)

Farliga ämnen, låg nedbrytbarhet, nedbrytning, bioackumulering, giftighet, industrikemikalier, bekämpningsmedel, biocider, tungmetaller, hormoner, kemikalier, biologiska effekter, Produktregister, Nordiska substansdatabasen, miljön, Finland, Östersjön

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