

## Screening

### SCREENING

A screening study is implemented on one or a couple of occasions in order to determine, for example, whether a particular chemical substance or group of substances that can harm human beings and the environment are present in a specific location in one or more materials. However, screening can also have the aim of determining which chemical substances are present in a particular material (matrix).

Screening studies are carried out in order to rapidly analyse which chemical substances constitute health or environmental problems. This can be done through examining the presence and distribution of a particular chemical substance in one or a number of materials – matrices. Screening can also be undertaken in order to ascertain which different chemical substances occur in a particular matrix, for example air, water that drains off from landfills, sludge from sewage treatment plants, or a particular cloth. In distinction from continuous environmental monitoring, where the same substances are examined every year, screening studies are carried out on one or more occasions over a limited time.

Screening studies are a prerequisite in being able to monitor the development towards a non-toxic environment. They are also necessary to enable follow-up of various international requirements concerning emissions, occurrence and effects of metals and organic substances.

When environmental monitoring was introduced, it was considered best to study environmental toxins as far away as possible from the sources, in so-called background areas. This would provide an understanding of how widely environmental toxins were distributed, and was relevant as the majority of environmental



## ENVIRONMENTAL MONITORING

Continuous environmental monitoring entails systematically checking the content of a particular substance over a longer period. Environmental monitoring measures amounts of a substance in different materials such as air, water, biological material and soil. The substances that are to be monitored are determined by environmental legislation, as well as international directives and conventions. It is primarily the EU's environmental policy that places major requirements on environmental monitoring.

toxins derived from point sources – factories. The problems today are different. We have a much more diffuse distribution of environmental toxins in towns and cities that derive from traffic and building materials. We now also have environmental monitoring in urban environments and examine how environmental toxins from a number of different sources affect our health and environment.

Screening studies are designed in various ways, depending on the issue. If the aim is to get an idea of the overall pollution situation in a particular area, a wide-ranging examination of as many groups of substances as possible is carried out. The study is then able to provide a pointer as to which substances might need further study. If instead the intention is to study the distribution of a substance or groups of substances, measurements are taken in a number of different matrices and in several different locations throughout the country.

The results of a screening study can lead to a decision that a substance should be included in the continuous monitoring, but also that it is removed from it. It can also lead to a decision to limit the risks associated with a particular substance. Finally, the results can lead to a decision to ban a substance. Screening frequently leads to an increased realisation that there is a lack of knowledge about a particular substance and the results then become the basis for new research. The screening can also provide us with results indicating that a substance is neither detrimental to health nor the environment.

## SELECTION OF SUBSTANCES FOR SCREENING

Around 120,000 chemical substances are registered in Sweden. In addition there are thousands of substances that are produced unintentionally, decomposition products and metabolites. It would be impossible, or at least extremely costly, to regularly study all the substances that human beings discharge into the natural world. The screening programme provides a snapshot of whether a chemical substance might be detrimental to our health or the environment.

The substances to which screening pays particular attention have the following properties:

- Substances that break down slowly (persistents),
- have the capacity to spread over large distances (cross-border),
- affect biological systems,
- concentrate in humans and animals (bioaccumulate).

## UNINTENTIONALLY PRODUCED SUBSTANCES

Chemical substances can arise unintentionally as by-products and decomposition products in connection with various processes, for example, incomplete incineration, production or processing of metals and other chemical processes. Further reading is available, for example in the Swedish EPA's report 5736.



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## Long-range distribution

To assess the risk of a substance being dispersed over long distances (cross-border), samples are taken from a background area (a long way from the discharge location).

## THE PRODUCT REGISTER

The Product Register is a national register that is kept by the Swedish Chemicals Agency, containing information on more than 120,000 substances. The Register provides a picture of which chemical substances and products are used in Sweden. Every year some 2,500 companies submit details of new products and substances that are used or brought into Sweden.

Further reading at:  
[www.kemi.se](http://www.kemi.se)

## MATRIX

A matrix is a material that is used to study contents of various environmental toxins. Matrices can be sludge from sewage treatment plants, sediment from sea or lakes, bird's eggs, tissues from different animals, water (from sewage, landfills, lakes or sea). Samples from humans (breast milk, blood or urine) are also classified as matrices.

When a substance is selected for study there should also be an idea about what the results are going to be used for. Among other reasons, the Swedish Environmental Protection Agency conducts environmental monitoring in order to comply with reporting requirements in relation to contents of certain substances that are specified in various EU directives or international conventions. In some cases these substances are not particularly prevalent in Sweden. Screening can then demonstrate that the environmental risk is insignificant, thus enabling expensive, repeat measurements of these substances to be avoided.

Other authorities, such as the Medical Products Agency, GSS, the Swedish Chemicals Agency, the National Food Administration and the county administrative boards, may perceive a need to follow-up a substance or a group of substances. They can then submit a proposal to the Swedish EPA to measure the content of this substance in our environment.

Coordinating the screening programme requires knowledge and expertise from a number of different authorities, organisations and companies. The reference groups include representatives from other authorities and from companies and county administrative boards.

## SCREENING STUDIES

The screening programme increases our understanding of how different chemical substances are dispersed in the environment, and the quantities in which they are to be found. We also want to understand how human beings are affected. If the substance is harmful, this should lead to its use being restricted or in some cases even prohibited. Different measures might be required to reduce the distribution of substances that are already stocked in society and that constitute a risk.

Different substances require different approaches in screening. If data is available suggesting that a substance is bioaccumulative (concentrates in the food chain), the occurrence is screened in, for example, birds of prey or humans (breast milk, urine and blood). For a group of substances with unknown toxicity, it can be best to start by looking at how much is found in the environment and then at the extent to which humans are exposed.

A screening study has the aim of providing answers to one or more questions about a substance:

- Can the substance be dispersed over long distances?



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### Diffuse distribution

Environmental toxins from a large range of sources give rise to diffuse distribution. Ordinary emissions from road traffic, household- or building materials. The environmental impact from diffuse emissions is more distinct in densely built-up areas than in background areas (far away from the source). Occurrences of a particular substance in waste water or sewage sludge can also be a sign of diffuse emissions.



#### Point source

Emissions from point sources can cause local environmental damage. With large emissions they can also be dispersed over long distances (cross-border). The screening programme collects environmental samples close to potential point sources, and their environmental impact is assessed by comparing them with levels in the background areas.

#### BIO-ACCUMULATION

Bioaccumulation means that environmental toxins are concentrated and transported onward in the biological food chain. Predatory animals are the most vulnerable as they can consume large quantities of toxins through their prey. Toxins that are not broken down biologically are concentrated in organisms and found in higher quantities in organisms further up the food chain. DDT is perhaps the most well-known example of a substance that is bioaccumulated.

- Is the substance released from point sources or diffusely from a very large number of sources in society?
- Can the substance be bioaccumulated?
- Is the substance present in human beings?
- For how long does the substance remain in the environment?

Thereafter the screening study systematically runs through the following points:

- Describes where a particular substance or group of substances derives from, in other words, products of which it is a part.
- Gives an account of where in nature the substances or groups of substances that are being screened are to be found.
- Provides a scientific review (study of the literature) of the research available on the substance/group of substances.
- Takes samples in a selection of matrices (fish, sludge, air, waste water, breast milk, blood or urine in humans).
- Analyses the matrices to answer the questions set in the study.
- Compiles a report that is published on a data host.

The reports include an overall assessment of any environmental risks associated with the substance. It summarises the likelihood of a substance being dispersed over long distances (cross-border), whether the substance reaches the environment via point or non-point sources, how toxic the substance is and whether it is concentrated in the food chain.

#### RESULTS OF THE SCREENING PROGRAMME

The screening programme has been underway since 1996/97 and has gathered a considerable amount of information about a number of different environmental toxins. Since the outset some sixty screening studies have been carried out, and about 600 substances have been screened between 2000 and 2010. During the initial years screening had well-defined questions to answer. For example, where (in which matrix) pesticides should be measured in the agricultural sector. Or, for example, ascertaining which other metals it was relevant to study in relation to their distribution. Future screening studies will hopefully provide us with increased knowledge about more hard to define environmental toxins that derive from lots of different sources.

Knowledge is currently lacking about how to measure the occurrence of many of the substances that are released into the environment, in order to subsequently be able to analyse the effects they have. It is therefore important to constantly



**Bioaccumulation**

If a substance is bioaccumulated in, for example, shellfish or fish it is significant for how harmful a substance can be in the longer term. It can also mean that a substance is concentrated higher up in the food chain and is a risk to human health.

improve the measurement methods and to look for better methods to analyse the effects of potential environmental toxins.

For certain substances, for example those that are (or were) included in paints used on boat keels, screening has contributed to the substances no longer being used. In some cases, they have even been banned. Some substances that have been screened are now included in the regular environmental monitoring and are followed-up at regular intervals. Other substances are in the process of being included in the continuous monitoring. For a third group of substances screening has led to decisions to repeat screening studies after a lengthy period. Finally, screening has led to decisions that a large number of substances do not require regular monitoring.

**DATA HOST FOR SCREENING STUDIES**

The results from the screening studies are stored on data hosts, from where both reports and raw data can be downloaded. Links to the data hosts are to be found on the Swedish EPA’s website under ”the environmental situation/environmental monitoring”.

The Swedish EPA also regularly issues compilations of the screening studies that have been conducted during a certain period.

**Examples of results from screening:**

Groups of substances incorporated into the monitoring programme, examples	Groups of substances where more information is needed, examples	Examples of groups of substances that do not require further monitoring
HBCDD (flame retardant)	Adipates (solvents, softeners, oils)	Limonene (aromatic substance in make-up, detergents etc.)
Antibiotics	Softeners	LAS (detergent)
Triclosan (antibacterial agent in toothpaste)	UV-filters (sunscreen)	Antimony (mascara, batteries etc.)
Organic tin compounds (boat keel paints)	Product additives, e.g. additives in concrete	Butylphenol (surface coatings, engine oil, rubber, soap)
Perfluorinated substances (impregnates clothes, shoes and furniture)	Phenolic substances (plastics)	Isocyanates (production of plastics and bonding agent in e.g. adhesive)
Siloxanes (cosmetics, car windows and biogas)	New brominated flame retardants	Mirex (insecticide)
Endosulfan (insecticide)		

## Examples of screening

### SUN CREAMS SPREAD ENVIRONMENTAL TOXINS

Every year we use hundreds of tonnes of sun screen products to protect our skin against sunburn and to reduce the risk of skin cancer caused by the sun's ultraviolet radiation. The active substances in the sun creams that protect the skin from UV radiation are called UV filters. Washing or swimming in lakes and the sea disperses them out into nature. Several of the UV filters that are used to protect the skin from sunburn constitute a grave environmental risk.

The screening study that was commissioned by the Swedish EPA in 2011 looked into the occurrence of 13 UV filters in 52 different environmental samples. Samples, matrices, were taken from surface water at bathing places, outgoing water from sewage treatment plants, sludge in sewage treatment plants and sediment, and in fish. Analysis revealed that UV filters were present in all tests. All the substances that were screened were found in wastewater and sludge from sewage treatment works. Samples of surface water that were taken at bathing places contained 12 of 13 UV filters. Five substances were also found in fish.

Swedish researchers have previously demonstrated that two different EU-approved UV filters can disturb reproduction in birds. Other studies have revealed that algae are sensitive to UV filters and that they bleach coral.



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### Human exposure

Describes how human beings are exposed to environmental toxins and analyses the levels of environmental toxins that are present in breast milk, urine and/or blood.

## **SWEETENERS ARE BEING DISPERSED INTO THE ENVIRONMENT**

Sucralose is a synthetic sweetener that is used as an additive in foodstuffs. It is 600 times sweeter than sugar and passes through the stomach/intestinal canal without being absorbed into the body. The actual sucralose molecule is not toxic in the quantities used in food. However, the compound decomposes extremely slowly out in the environment.

In principle all the sucralose that human beings consume passes directly out into the environment. The Swedish EPA commissioned samples to be taken of outgoing water from 25 different sewage treatment plants throughout the country. All tests turned out to contain the sweetener sucralose.

Approximately six to seven tonnes of sucralose are released every year. The quantities measured were a long way below the limit for what is counted as acute toxicity for aquatic organisms. However, as sucralose decomposes slowly, the fear is that it will bioaccumulate. Further research is required to ascertain how sucralose affects the ecosystem.

## **MEDICINES IN WASTEWATER**

There are more than 1,200 active substances in the different medicines that are sold in Sweden and consumption is increasing. Medicines are secreted from the body via urine and faeces, either in their original form or as decomposition products, and then end up in sewers. Some substances are not broken down, but rather are transported further up the food chain and are accumulated in ever greater concentrations. Ultimately this can seriously affect our health and the environment.

Active substances from medicines have been measured in aquatic environments within the framework of the Swedish EPA's screening studies. Pharmaceutical residues in lakes and watercourses are undesirable per se, however, perhaps the most important question is whether the concentrations are hazardous for animals and plants.

Screening studies of pharmaceuticals have led to research projects that study the effects of medicines in the environment. Research projects such as MistraPharma (I and II) have identified pharmaceutical substances that represent a risk for aquatic organisms. In MistraPharma Phase II, which has a grant of SEK 52 million, researchers will review all pharmaceutical substances that are available on the Swedish market. The researchers will also look at how we can reduce damage caused by pharmaceutical discharges.



### **Toxicity**

The symbol shows that a substance is toxic for human beings or other organisms. Toxicity studies are not usually included in screening studies, rather the assessment is based on the information that is summarised in the literature studies.

## EVALUATION OF RESULTS FROM SCREENING STUDIES

The following factors are considered when evaluation the results from the different screening studies.



Long-range distribution



Diffuse distribution



Point source



Bioaccumulation



Human exposure



Toxicity

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