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## Action plan for the reduction of emissions of brominated flame retardants

Updated in 2005 [\[In Norwegian\]](#)

**Brominated flame retardants are used in a large number of product types to make them less flammable. Many brominated flame retardants are known to have very harmful properties. Norway's target is to reduce emissions of these substances substantially by 2010. The environmental authorities drew up an action plan in 2002 to achieve this goal. The plan includes risk reduction measures such as a prohibition against the use of specific substances, information activities, the collection of data and stricter control of waste collection and treatment. The action plan has now been updated so as to take new knowledge and measures into account.**

The work with the measures in the different areas is well underway, yet it takes time to disseminate knowledge as well as to increase the level of competence in working with the problems involving brominated flame retardants. This is a large group of substances, with various undesirable health and environmental characteristics. They are important in relation to the fire safety of different types of products and for some types of products it is difficult to find an alternative. The analysis methods that are required in order to gain increased knowledge about their content and emission from products and waste processing plants, as well as their levels in the environment, are at present complicated and expensive. The ban against 2 substances has probably led to a minor reduction in consumption, but also to a transition over to still other brominated flame retardants. An earlier target of 80 per cent recovery of EEE waste (WEEE) has been achieved and the most important brominated flame retardants must now be treated as hazardous waste. It will take time before reductions in the use and emissions of these substances will be able to be measured.

### Problems associated with brominated flame retardants

Brominated flame retardants are a group of brominated organic substances that inhibit or suppress combustion in organic material. They are used in electrical and electronic equipment (EEE), textiles and plastics in vehicles, building materials, paints and insulation foam. An estimated 60 tonnes per year is used in Norwegian production of various goods. The total quantity of brominated flame retardants put on the market in products in Norway is estimated to be approx. 300 tonnes per year.

Many brominated flame retardants have undesirable health and environmental effects. Because they are extremely stable, they can spread through the environment and accumulate in food chains and in sediments, where they are only slowly degraded. They are therefore often compared to persistent organic pollutants (POPs) such as PCBs. Various studies have shown that concentrations of brominated flame retardants in the environment and in human tissue are rising. These substances have been found in sediments from many European rivers, in fish from the Baltic Sea, in Norway (Lake Mjøsa and lakes in Hordaland county), in the Arctic (Bear Island) and in fish caught off Iceland and the Åland Islands. More recent data shows that they are leaking from landfills. New data is showing continual increases in the Arctic areas. Some of them have also been detected in human breast milk and blood. When waste containing brominated flame retardants is incinerated, brominated dioxins may be formed.

Brominated flame retardants are released into environment during the manufacture of products, during their use and after they have been discarded as waste. A manufacturing process that does not cause emissions is not sufficient. It is also necessary to avoid emissions from products during use as well as after they have been discarded. Long-range transport in the atmosphere is another source of inputs of brominated flame retardants to the environment in Norway. Inputs from this source can only be reduced with binding international agreements that limit their use globally.

There are about 70 different brominated flame retardants on the market. Previously, they were often divided into two main types, additive and reactive. Additive substances were generally considered to pose the greatest risk because they are most easily released from products. This is no longer considered to be a correct hypothesis. The health and environmental effects vary from one substance to another, and the need to reduce their use will depend on the properties of individual substances. However, on the basis of the precautionary principle, it may be necessary to limit the use of brominated flame retardants even without full knowledge of the properties of every substance.

Penta-, octa- and decabromodiphenyl Ether (BDE), TetraBromoBisPhenol-A (TBBPA) and HexabromoCycloDodecane (HBCDD) account for the largest volumes of brominated flame retardants in use around the world today. It has been documented that penta-, octa- and decabromodiphenyl Ether (BDE) have properties that could make them quite hazardous to health and the environment. TBBPA and HBCD are the brominated flame retardants that are most widely used currently in Norway. HBCD is additive, whereas TBBPA is mostly used reactively, but it is also additive to a certain extent. Despite the largest use being reactively, TBBPA has also been detected in recent years in human blood, plus the substance has been found leaking from landfills. A recent study shows a significant leakage potential for TBBPA from the plastic in discarded EEE products. The undesirable properties of TBBPA and HBCD relating to the environment and/or health are now becoming increasingly better documented. However, the need for more information on the effects of TBBPA and HBCD and their fate in the environment persist, and their use should be closely monitored. The Norwegian Pollution Control Authority considers that because these substances are so widely used and disperse so widely in the environment, there is reason to regulate their use even though no final conclusions are as yet available from risk assessments.

Some product groups are regulated by international standards for fire safety. This applies for example to some building materials, materials used in road and railway embankments to prevent frost heave, electrical material, industrial packaging, insulation for tunnels, upholstered furniture, curtains, electronic household appliances and electrical cables. These standards specify the flame-retarding properties that are required but not which flame retardants are to be used. Until now, brominated flame retardants have been considered to be cheapest and most efficient. Today, it has become increasingly more common to replace these substances either with flame retardants without bromine or by changing the design of the product such that there is no need for the continued use of flame retardants. It has also become important to avoid the use of products containing flame retardants if such is not absolutely necessary on the basis of fire safety.

It is difficult to predict precisely which alternatives will be used as replacement substances now that the use of the most commonly used brominated flame retardants is being restricted. Increasing the information on possible substitutes in the future is a substantial challenge, because it is important that health and environmental impacts are clarified before any changeover to new, alternative flame retardants occurs.

## Regulation of brominated flame retardants today

According to Norwegian legislation, chemicals containing brominated flame retardants that are hazardous to health or the environment must be classified and labelled before they are placed on the market. Classification in one of the categories of dangerous chemicals means that labelling is required, but also has other consequences. These may include restrictions on sales, regulations relating to the working environment and requirements for waste to be treated as hazardous waste. Experience has shown that industries try to replace substances for which labelling is mandatory with less hazardous substances in order to avoid these consequences. This means that the quantities of brominated flame retardants in products will be reduced as their harmful properties are documented. Penta- and octa-BDE are already classified, while proposals are put forward for HBCDD and TBBPA.

The use of two types of brominated flame retardants, tris (2,3 dibromopropyl) phosphate and polybrominated biphenyls (PBB), in textiles that are intended to come into contact with skin is prohibited both in Norway and in the EU through Council Directive 76/769/EEC on restrictions on the marketing and use of certain dangerous substances and preparations. Controls in recent years have not revealed any use of these substances in Norway.

From 1 January 2004, products containing more than 0.25 % of either HBCDD, TBBPA, penta-, octa- or deca-BDE will be classified as hazardous waste when they are discarded. This has led to an increased focus on substitutes for these substances. Industrial enterprises generally wish to reduce their use of products that are classified as hazardous waste when they are discarded, because it involves incurring increased expenses.

The EU and Norway have banned the use of penta- and octa-BDE with effect on 15 August 2004 and 1 July 2004 respectively. The EU has also included poly-BDE in the list of substances for which the IPPC Directive requires an exchange of information to be organized, and penta-BDE is on the list of priority hazardous substances under the Water Policy Directive. Penta-, octa- and deca-BDE, TBBPA and HBCDD are all on the list of substances for which risk assessments are to be carried out within the EU. Processing of the risk assessments for penta- and octa-BDE has been completed.

According to the RoHS (Reduction of Hazardous Substances in EEE) Directive, no new electrical and electronic products may contain PBB or poly-BDE after 1 July 2006. The continued discussion within the EU/EEA will show whether an exception will be made for deca-BDE based upon the preliminary results from the EU's risk assessment. The RoHS Directive will be implemented in the Regulations relating to restrictions the use of chemicals dangerous to health and environment and other products within a short period of time.

During the summer of 2004, the target of collecting 80 % of discarded electrical and electronic equipment was reached; cf. the provisions concerning EEE waste in the Norwegian Hazardous Waste Regulations. This involves the majority of the flame retardant products now being collected for controlled processing. Additional work to further increase the degree of collection will primarily be directed towards the most hazardous of the products.

## Other work in Norway as well as internationally

Brominated flame retardants are included on the observation list drawn up by the Norwegian environmental authorities. Substances are included on this list if they are hazardous to health or the environment and current information indicates that they represent special problems at national level. All five types of brominated flame retardants discussed in this document are on the list. As a result, the Norwegian Pollution Control Authority expects that manufacturers and importers will treat these substances with greater caution, and that the statutory requirement to apply the substitution principle will result in a reduction in their registered use. The inclusion of these substances on the observation list will also make it possible for the Authority to follow the situation more closely.

Experiments at two Norwegian waste incineration plants have shown that the controlled mixing of flame retardant plastic into waste being incinerated did not lead to increased emissions of brominated and/or chlorinated dioxins, nor were there any noticeable emissions of unincinerated flame retardants. Studies of runoff water from landfills and areas that are affected by runoff water have shown that brominated flame retardants can leak from landfills, however the concentrations demonstrated in runoff water are generally low but varying. They do not give any unambiguous picture of the situation. The Norwegian Pollution Control Authority thus continues to work with incorporating brominated flame retardants into measurement programmes that are being carried out at landfills. The measures that must be taken at the landfills up through 2009 will, regardless, contribute to limiting the danger of any emissions of brominated flame retardants from these.

Studies of the light waste fraction after scrap metal shredding (fluff) show that it contains less flame retardants than the allowed limit for hazardous waste, and that such fluff can hence be treated as ordinary waste. The shredding facilities are in the process of investigating whether the immediate environment is contaminated by the activity. The interim results available indicate that there could be somewhat elevated values of flame retardants around such facilities. We do not have sufficient information to determine whether the facilities are the source of this or whether the values are so high that there is a need for measures to be taken. These conditions will be followed up on by SFT and the county governors as a part of the on-going monitoring of the industry.

In addition to the EU, international efforts are also under way to limit the use of brominated flame retardants. For example, they are included on OSPAR's (The Oslo and Paris Convention for the Protection of the Marine Environment of the North-East Atlantic) list of chemicals for priority action to protect the marine environment. At the 4th North Sea Conference, it was decided to phase out the use of brominated flame retardants by 2020. The Nordic countries are seeking to have penta-BDE included in the global Convention on Persistent Organic Pollutants (POPs). In the autumn of 2004, the Arctic Council adopted a new arctic project concerning the reduction of brominated flame retardants. The project will be managed by Norway.

## Proposals for action to achieve national targets

Brominated flame retardants are encompassed in the Norwegian national goal of substantially reducing emissions before 2010 (Report No. 25 (2002-2003) to the Storting). The main challenge is to affect a decrease in the use of the brominated flame retardants posing the largest hazards to health and the environment. For brominated flame retardants, the main tasks will be to reduce the use of those substances that pose the greatest risks to health and the environment, and to manage waste from products containing these substances so that no further emissions to the environment are generated.

To achieve this, the Norwegian Pollution Control Authority will carry out the specific measures, as described below.

#### **Restrictions on use**

1. The Pollution Control Authority has considered the consequences of a ban against the use of deca-BDE and will prepare a proposal for banning deca-BDE with effect on 1 July 2006.

The work within the EU with risk assessments has shown that deca-BDE is extremely low degradability and has been demonstrated to be present high up in the food chain. The substance has now also been found in birds and animals in the Arctic areas. There are suspicions that the substance can harm the central nervous system during the development of organisms, and comprehensive studies are now being commenced to clarify this. It is highly probably that deca-BDE also can be converted into penta-BDE (and other homologues with similar properties).

2. Risk assessments and further testing of HBCDD and TBBPA are being carried out as part of the EU risk assessment programme. The Pollution Control Authority is playing its part in risk assessment and the classification process so that they will be completed as soon as possible, with results that are satisfactory for the Norwegian authorities. During the course of 2005, the Pollution Control Authority will review possible national regulations.

The preliminary results of the risk assessments show that HBCDD and TBBPA also have undesirable health and environmental effects, and they are widely used. TBBPA is the most commonly used brominated flame retardant on a global basis. Both TBBPA and HBCDD are very toxic to aquatic organisms, they are not readily biodegradable, and they can have long-term effects in the aquatic environment. Both substances are considered to warrant classification as environmentally hazardous. TBBPA has been detected in the blood in the general population of Norway and leakage from EEE waste and landfills. HBCDD has a high potential for bioaccumulation and hence can accumulate in the environment and in organisms at different levels in food chains. Comprehensive studies have now been commenced of the degradability of HBCDD in the environment. Risk assessments are time-consuming and costly, and it is important that all EEA states, including Norway, play an active part in completing the assessments and classifying the substances so that the need for risk reduction measures can be identified as quickly as possible.

3. The Pollution Control Authority will follow up on the ban against penta- and octa-BDE in imported products in relevant branches. We will also take steps to obtain information, if necessary by issuing orders, on what types of brominated flame retardants other than the banned ones are also contained in the electrical and electronic equipment (EEE) they import. The Norwegian importers will also be required to present plans for reducing or phasing out the use of brominated flame retardants.

There is a pressing need for exact information on the possible content of brominated flame retardants that imported EEE items contain. Experience has shown that many importers lack knowledge of the chemical content of their products. Up to now, their interest and possibility to acquire such knowledge has been limited. The Product Control Act requires Norwegian importers to exercise due care and to have adequate knowledge of the substances and products they place on the Norwegian market. The Pollution Control Authority now has the possibility of measuring whether products contain different elements. This check gives a quick indication of a product's bromine content. If products contain brominated flame retardants, the importers will have to draw up plans for reducing the content of such substances or for phasing out their use. The aim will be to eliminate the need for flame retardants wherever possible, or to replace them with flame retardants that are less hazardous to health and the environment.

4. The Pollution Control Authority will follow up on the ban on penta- and octa-BDE for Norwegian manufacturers. We will also follow up on the use of brominated flame retardants other than those that have been banned. The producers must be able to document that they are complying with the statutory requirement to apply the substitution principle pursuant to the Product Control Act, and/or that they are implementing measures to reduce emissions.

The Product Control Act requires Norwegian manufacturers to exercise due care and to have adequate knowledge of the substances and products they use in manufacturing processes. This also includes manufacturers of products such as textiles and fittings for vehicles and boats, where there may be special rules relating to fire safety. The requirement means that if substances and products that are hazardous to health or the environment are used, risk assessments shall be carried out and steps taken to reduce the risk. Because the Pollution Control Authority has already included brominated flame retardants on the observation list, we expect active steps to be taken to replace these substances.

5. The Pollution Control Authority is following up on the use of brominated flame retardants as well as precisely which substances are being used as substitutes in consequence of the bans against penta- and octa-BDE. We wish to obtain information on the quantities used and the health and environmental effects of these substances.

The ban against penta- and octa-BDE makes it necessary either to alter the design of the product so that the need for flame-retarding properties is reduced/eliminated or to replace the substance with a different one. There is a need to monitor precisely which substances are used as substitutes and to ensure that they represent the smallest possible risk to health and the environment.

#### **International efforts**

6. The Pollution Control Authority is working actively via participation within the EU system and the work of various international fora such as the Arctic Council, LRTAP (Convention on Long-Range Transboundary Air Pollution), OSPAR, the North Sea cooperation and the POPs Convention, to reduce the use of brominated flame retardants.

These are substances that are also transported extremely long distances. Hence global reductions in their use and emission are important. We are thus actively following up on the initiatives of other countries and possible proposals for national bans. Norway is managing the new Arctic Council action plan (ACAP) entitled "Reduction or Elimination of Sources and Releases of Brominated Flame Retardants". We have also presented a proposal to include penta- BDE in the LRTAP Convention and are planning the equivalent for the POP (Persistent Organic Pollutants) Convention.

#### **Green state and governmental acquisitions**

7. The Pollution Control Authority regards the implementation of the initiatives through the Green State procurement scheme as being important for increasing the state's purchases of products that contain as few brominated flame retardants as possible.

The public sector is a large customer, and it can use its influence to raise awareness of this important problem and create a demand for

products that are less hazardous to health and the environment. The Pollution Control Authority wishes to contribute to both the network guide and other informational material being easily accessible to public sector buyers in order to bring about green purchasing.

#### **Waste treatment**

8. The Pollution Control Authority will follow up at the industry level such that the agreed-upon target of 80 per cent *recovery of EEE waste* (WEEE) is maintained. For the types of EEE products that contain a lot of brominated flame retardants, SFT is attempting to further increase the degree of recovery via its strategy for increased collection of hazardous waste.

WEEE makes up a substantial proportion of the waste containing brominated flame retardants, and it is important to achieve good control of the way this waste is managed. The Ministry of the Environment has an agreement with the relevant branches of industry in which they take responsibility for the reduction, collection and treatment of EEE waste (the WEEE agreement). The target is to reach a waste recovery level of 80 per cent.

9. The Pollution Control Authority is implementing a strategy for the *increased recovery of hazardous waste*. One of the results of this will be that the degree of collection for the 3 prioritised types of hazardous waste that contain a lot of brominated flame retardants will increase significantly before 2006.

Regulations concerning hazardous waste are causing discarded products containing penta-, octa-, deca-BDE, HBCDD or TBBPA to be considered as hazardous waste. Through its strategy for the increased collection of hazardous waste, the Pollution Control Authority is prioritising 12 types of hazardous waste for measures during the period spanning 2004-2006. In this regard 3 of the types of waste: EEE plastic, expanded and extruded plastic and cellular rubber is being prioritised because they contain brominated flame retardants.

10. The Pollution Control Authority is working with county governors and the *waste disposal industry* in order to ensure that emissions of brominated flame retardants become a part of the future environmental monitoring at landfills where relevant. An updated monitoring programme is expected to be able to be launched at all depots by 1 July 2007 at the latest.

Water that flows through a landfill will absorb pollutants from the deposited waste. The waste depositories are thus deemed to be a potential source for emissions of environmental toxins. By strengthening the monitoring, the pollution authority will receive better data on these emissions and the authority can then require that the requisite measures be undertaken.

11. The Pollution Control Authority is working with county governors on the on-going follow-ups on the *shredding systems* in order to ensure the responsible management of EEE waste containing brominated flame retardants. A particular emphasis will be placed upon the follow-ups on the shredding facilities concerning the conditions of the discharge permits and whether one in turn finds pollutants from the facilities in the surroundings.

A number of shredding facilities receive and process EEE waste. It is important that the waste be handled in an environmentally responsible manner that prevents emissions of brominated flame retardants into the environment.

#### **Information on the harmful properties of brominated flame retardants**

12. The Pollution Control Authority will ensure that information is easily available *to the public*. It will explain the serious problems involved, help the public to demand products that do not contain brominated flame retardants, and ensure that products that contain these chemicals are delivered to the recovery system for WEEE.

A good deal of informational material already exists concerning the content of brominated flame retardants in electrical and electronic equipment and the hazardous properties they have with respect to health and the environment. Attempts must be made to see to it that the normal consumer still remembers to not dispose of WEEE with their ordinary household waste. Providing information on the serious health and environmental effects of these chemicals is a key factor in maintaining alterations in people's behaviour with respect to waste disposal as well as their desires to purchase environmentally friendly products.

13. We will also ensure that information on the serious hazards to health and the environment posed by brominated flame retardants in various products is readily available to the *relevant industries*. This will be to give the industries and relevant purchasers of the products more information and make it possible for them to demand less hazardous products. SFT is in close touch with the relevant industries such as electrical and electronic equipment (EEE), automotive, paints, textiles, etc.

Nowadays, a green procurement policy is part of the overall strategy of many companies. But this is difficult to put into practice without adequate knowledge of the problems. Knowledge is also an important basis for bringing about changes in waste management. It thus is important for purchasers that relevant informational material is available concerning the brominated flame retardant content of EEE products and the hazardous properties of such with respect to their health and the environment. The WEEE agreement requires the EEE industry to carry out waste reduction measures, for example by reducing the use of substances that are hazardous to health and the environment in these products. SFT will continue the contacts with other authorities and agencies in order to ensure a continuation of the work on avoiding the use of brominated flame retardants.

#### **Environmental monitoring**

14. The Pollution Control Authority is continuing its environmental monitoring and is assessing on an on-going basis the need for monitoring projects for brominated flame retardants in Norway.

SFT has performed many monitoring studies in recent years, however it will continue to be important to follow environmental developments concerning brominated flame retardants. Penta-BDE is on the list of priority hazardous substances under the EU Water Framework Directive, and requirements will therefore be laid down for monitoring of the substance in various ecosystems.

#### **Follow-up on brominated flame retardants in Lake Mjøsa**

15. The Pollution Control Authority will continue the work with brominated flame retardants as a part of the action programme for checking discharges of environmental toxins in Lake Mjøsa in co-operation with other authorities.

An action programme was established in 2003 for checking the discharges of brominated flame retardants in Lake Mjøsa in co-operation

with the county governors of Hedmark and Oppland, the Norwegian Food Safety Authority, the Water Resources Federation, the Norwegian Institute of Public Health and the Association for Sustainable Water Management of Lake Mjøsa. In 2004 the programme was expanded to encompass all relevant environmental toxins in Lake Mjøsa. Measures that concern brominated flame retardants will be followed up on as a part of this action programme.

#### **Updating the action plan**

16. The Pollution Control Authority will update the action plan during the course of 2006.

We expect to gain more knowledge about the substances, the products and their areas of use, as well as to access measures and regulations in other European countries that we can make use of in our work. It will be necessary at some point to assess whether the measures that have been implemented have had the desired effect and whether they are sufficient to achieve our targets.

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