Brominated flame retardants

Brominated flame retardants (BFR) are a group of bromine-containing chemical flame retardants, which have been very effective in plastics and textile applications. BFR are widely used in consumer products including computers, electronics and electrical equipment, televisions, textiles, foam furniture, insulating foams, and other building materials. The five major BFR in use in Europe in 2001 were tetrabromobisphenol-A (TBBP-A), hexabromocyclododecane (HBCD), and the following poly-brominated diphenyl ethers (PBDEs): decaBDE, octaBDE and pentaBDE. OctaBDE and pentaBDE were used in much smaller quantities than decaBDE. Polybrominated biphenyls (PBB) have also been used, but production was stopped in September 2000.

What is the problem?

The different BFR pose a range of risks to both the marine environment and human consumption of fish and shellfish. TBBP-A is persistent and toxic and may degrade in sediments to the endocrine disrupting substance bisphenol-A. Those PBDEs with smaller molecules (*e.g.* pentaBDE) are more toxic and bioaccumulative. Environmental degradation of decaBDE to these forms has been considered as a possibility. PentaBDE may also disrupt the oestrogenic system. HBCD is toxic to aquatic organisms and degrades slowly. Some of these chemicals are liable to bioaccumulate. The main sources of BFR to the environment are products and associated waste streams and treatment (*e.g.* incineration, waste dumps, dismantling and recycling activities), but also production and manufacture processes. Since the products containing these chemicals are widely dispersed, their possible release from waste disposal routes is also of concern.

What has been done?

OSPAR has promoted actions in the EU on use restrictions for PBDEs, risk-reduction strategies for octaBDE, decaBDE and HBCD, and waste legislation. OctaBDE and pentaBDE were banned in the EU in 2004 and the use of PBB and polyBDEs in electrical and electronic appliances has been restricted since 2006. DecaBDE was exempted from this restriction until 2008 and is still widely used in Europe. DecaBDE will now go through the REACH registration. An EU risk reduction strategy for decaBDE encouraged product stewardships and voluntary emissions control by the BFR industry. Uses of HBCD are not yet sufficiently regulated, although voluntary action has significantly reduced emissions from point sources. Current measures on releases from products are not adequate. No specific OSPAR or EU measures have been agreed for TBBP-A, although the IPPC Directive has been considered as the most appropriate measure to manage this chemical. EU waste legislation on electrical and electronic equipment supports the reduction of emissions, discharges and losses from end-of-life waste containing BFR. PentaBDE has recently been included for elimination under the UNEP Stockholm POP Convention.

Did it work?

There are insufficient data to quantify trends of releases of brominated flame retardants in the OSPAR area. Environmental monitoring data indicate that discharges/releases of pentaBDE and octaBDE are decreasing. However, some diffuse releases may remain due to illegal occurrence in imported products (plastics *etc*.). Emissions of HBCD in Europe have been heavily dominated by one point source production site, which has now been closed down. Total emissions have therefore probably gone down but emissions from products and materials (*e.g.* polystyrene) still exist. There are no data available on loads of TBBP-A entering the OSPAR maritime area and on atmospheric inputs, although the atmospheric pathway is considered to be less significant for TBBP-A. Although some BFR production sites in Europe have recently closed, world consumption and production of BFR may have seen a steady annual increase since 1998 due to growing demands, especially in Asia.

How does this affect the quality status?

Data from the period 2000 – 2005 show widespread contamination of the marine environment with PBDEs and HBCD in all components of marine ecosystems. Regular monitoring of these substances in the marine environment, which commenced at an OSPAR scale in 2008, needs to be continued to evaluate whether any of the actions that have been taken so far are effective in terms of reducing this burden on the marine environment. For the purposes of OSPAR, the polybrominated diphenyl ethers to be monitored covers the congeners PBDEs 28, 47, 66, 85, 99, 100, 153, 154 and 183 for sediment and biota. BDE 209 is covered for sediment but should not be included in any totals but reported separately.

In the Arctic Region (Region I), PBDEs have been measured in fish, seabirds, predatory birds and polar bears indicating widespread contamination. In seabirds, PBDEs have been detected in such diverse locations in Region I as northern Norway, Svalbard and southern Greenland. An increasing trend of certain PDBEs in seabird eggs in Norway has been reported up to 2003. In the Greater North Sea area congeners found in the toxic lower brominated PBDEs can be detected in sediment, fish and mussels from the coastal zone and the open sea at reference locations distant from known sources and in apparently high concentrations in the blubber of harbour porpoise and the harbour seal (*e.g.* >1000 µg kg^{-1} l.w.). PBDEs have also been detected in stranded dolphins and whales in the Greater North Sea (Region II) and Celtic Seas (Region III) and in mussels in Bay of Biscay/Iberian Coast (Region IV). DecaBDE has also been measured in the coastal zone and open sea of the North Sea and also has been detected in birds eggs in Region I. Monitoring in northern France has indicated more recent downward trends in the occurrence of pentaBDE and octaBDE in mussels but a more broadscale picture needs to be established. HBCD has also been measured in shellfish, fish, seabirds and mammals at locations distant from major sources. When detected in the marine environment, TBBP-A has mainly been measured in the vicinity of polluted locations occurring in sediment, shellfish, fish, seabirds and mammals.

Electronic navigator to OSPAR publication sources (publication number):

- ➥Status and trend of marine chemical pollution (395/2009) – Annex 2 for monitoring data
- ➥ Towards the cessation target (354/2008)
- ➥ Background Document (as updated) for
  - certain brominated flame retardants (135/2001)
  - tetrabromobisphenol-A (202/2005)