Why BFRs and PVC should be phased out of electronic devices

Background - February 26, 2010

Here is an in-depth explanation of two problems caused by BFR's, PVC and phthalates in electronics. This page also tackles some of the common misconceptions, assumptions or myths regarding these hazardous substances. See also Toxic Transformers Briefing: The hazards of brominated and chlorinated substances in electrical and electronic equipment (Feb 2010)

On this page

Brominated Flame Retardants (BFRs)

What are they?

The term brominated flame retardants (BFRs) refers a wide range of brominated chemicals added to materials to both inhibit their ignition and slow their rate of combustion. Commonly used examples include polybrominated diphenyl ethers (PBDEs), hexabromocyclododecane (HBCD) and tetrabromobisphenol A (TBBPA), as well as brominated polymeric and oligomeric materials.

What's the problem?

Several BFRs, including certain PBDEs and HBCD, have known toxic properties, are highly resistant to degradation in the environment and are able to bioaccumulate (build up in animals and humans). Some are now widespread environmental pollutants, with higher levels generally being found in the atmosphere and rivers close to urban and industrialised areas. As well as being released from facilities producing goods such as electronics, these compounds can be released from such products during use, leading to their presence in household dust and resulting in increased human exposure. And when these products reach the end of their useful lives, some disposal or recycling operations (e.g incineration, smelting and open burning) can release the bromine in other hazardous forms, including as hydrogen bromide and brominated dioxins.

BFRs - Questions, myths, misunderstandings

There are several misconceptions surrounding BFR's often quoted in relation to our work. Here's the answer to two common ones:

BFRs are vital for fire safety. There are no alternatives.

Alternatives which provide the degree of fire safety required under law without using organic compounds of bromine of chlorine do already exist, including some direct chemical substitutes, as well as use of alternative materials and even product redesign in order to reduce or eliminate the need for flame-retardant additives. Indeed, a number of electronics companies have already phased out brominated flame retardants in a range of key applications.

Several major companies are already using alternatives or alternative designs. Different casing materials used in the Sony Vaio and Apple Macbook Air have reduced the need for BFR's.

Greenpeace is against bromine - but that's part of seawater!

Greenpeace does not campaign against bromine (or any other element that is part of the natural make-up of our planet), but against the unsustainable ways in which bromine has been used to manufacture organobromine compounds which, in turn, have caused such widespread environmental pollution. Many of the man-made chemicals recognised around the globe as being the most polluting are compounds of the so-called 'halogens', including bromine, chlorine and fluorine.

It is, however, a common mistake to confuse the chemical elements (e.g. bromine) that make up a chemical compound with the compound itself. The presence of a particular element in a compound (e.g. lead, mercury, chlorine, bromine) can confer particular toxic properties to that compound, but this is far from the whole story. The environmental and toxicological properties of

a compound are governed not only by the elements it contains, but also by their arrangement, and both factors are important in determining the ways in which the compound may react in the environment, including in animals and plants. This is equally true for brominated flame retardants.

During high temperature processes used in some recycling or disposal operations, however, the chemical structures of BFRs can be partially or completely destroyed, creating free reactive forms of bromine which can recombine with other elements in the waste gases to form other highly toxic, persistent and bioaccumulative by-products, including brominated dioxins.

Polyvinyl chloride (PVC)

What is it?

Polyvinyl chloride (PVC) is a relatively cheap and widely used chlorinated plastic. It is naturally rigid and in this form is used in many ways, including by the building industry. Through the addition of various chemical additives, including plasticisers to make it flexible and soft, PVC can be used in a diversity of applications. It is in flexible (plasticised) form that it is most often used by the electronics industry, mainly as an insulator and coating for electrical cables.

What's the problem?

PVC presents environmental problems and human health concerns throughout its lifecycle.

Its manufacture involves the use of hazardous raw materials, including the basic building block of the plastic, vinyl chloride monomer (VCM) which is explosive, highly toxic and carcinogenic. PVC production facilities have a long history of generating complex and hazardous chlorinated wastes, some of which are inevitably released into the surrounding environment.

The versatility of PVC relies on the use of numerous additives to transform the basic polymer into a range of functional materials. These additives often have a poor environmental and toxicological profile themselves. For example, the most commonly used plasticiser additives are the phthalates, a group of chemicals associated with a diversity of toxic properties (see below). Other chemicals may be added as stabilisers, colours, fillers, etc., including some compounds of lead designed to prevent PVC from degrading in sunlight. Some of these additives, especially the phthalate plasticisers, can leach from PVC during use.

When it enters the waste stream, PVC presents further problems as a result of both its chlorine content and its additives. For example, when PVC is burned for disposal (e.g. incineration, uncontrolled burning) or, in the case of electrical cables, to recover valuable copper wire, its high chlorine content can contribute to the formation of highly toxic and persistent chlorinated dioxins. In landfills, some of the chemical additives contained in PVC may leach out, adding to the overall contaminant burden of landfill leachate.

Is PVC necessary in electronics?

PVC is not necessary in electronics. Indeed, a number of companies have already phased it out of a wide range of their products and committed to a total phase-out.

PVC - Questions, assumptions and myths

The electronics industry is not the biggest user of PVC

True, PVC is commonly used for drain pipes and other building materials in relatively large quantities compared to use in electronics. And because of this, PVC presents substantial problems for recycling and disposal of construction wastes. Furthermore, just as is the case in electronics, there are many alternatives to PVC for use in building materials. Greenpeace is opposed to the use of PVC in all applications, not just electronics.

The use of flexible PVC in electrical and electronic goods presents some particular problems. Firstly, the hazardous phthalate plasticizers most commonly used can leach out during the lifetime of a product, adding to overall contaminant levels in the indoor environment. When they enter the waste stream, electronics have all too often ended up being sent to countries such as China for crude recycling. Here the plastic is often simply burnt in a way that exposes people directly to toxic chemicals including chlorinated dioxins.

While the amount of PVC used in individual electronics might be small the huge quantities produced each year and massive amounts dumped and often crudely recycled by burning greatly increased the environmental impact of PVC in electronics.

Phthalates

Phthalates are a group of chemicals possessing similar structures, many of which are widely used as plasticisers (softeners) in plastics, especially PVC. These chemicals are not chemically bound to

the plastic, and so are able to migrate out of the material over time into the surrounding environment. Many phthalates are toxic to wildlife and humans, often through their metabolites (chemicals to which they breakdown in the body). Some widely used phthalates are known to be toxic to reproduction, capable of causing changes to both male and female reproductive systems in mammals.

Are Phthalates necessary in electronics?

Phthalates are not necessary in electronics. Their major use is in PVC plastic. So by switching from PVC to other materials, manufacturers should also be able to eliminate the use of phthalates.

Phthalates - Questions, assumptions and myths

Surely phthalates are only dangerous to me if I eat my gadget?

Even if not placed in the mouth, soft PVC products add to the complex background of chemical contamination to which we are all now exposed, especially in the enclosed environments of our homes, workplaces and vehicles. In order to tackle the wider problems of hazardous chemical exposure, it is therefore essential to reduce and, as far as possible, eliminate all sources. Stopping the use of PVC in electronics and other consumer goods is one simple step that all manufacturers can take immediately to reduce pollution.

Individual electronic items only contain small amounts of phthalates

There are, without doubt, items in most houses and other indoor environments that contain larger quantities of these chemicals than electronics alone. Nonetheless, as explained above, all sources need to be tackled in order to address the problems of complex chemical exposures. Phthalates, like many other pollutants, are capable of causing adverse effects through long-term (chronic) exposure to relatively low doses, such that constant exposure to even relatively small levels of the chemicals from numerous different sources nevertheless presents significant concerns. All sources of exposure, no matter how seemingly insignificant, contribute to the overall burden of contamination and should be avoided.

In depth reports on hazardous chemicals in electronics

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- Cutting Edge Contamination - A Study of... Publication
- Cleaning up our Chemical Homes - Changing the... Publication
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