

Toxicology Topics in Brief

Phthalates

Introduction

Phthalates (pronounced ‘tha-lates’) are man-made chemicals. They are common components of everyday items, for example, cosmetics, toys, curtains, food packaging, detergents, medical devices, and many other products. Occurrence of phthalates around us is therefore extensive.

There have been some reports of concerns about effects to health of the public exposed to phthalates. But the studies used extremely high doses of phthalates, very much higher than levels in our homes and the environment. However, to be on the safe side, the EU and UK have taken a precautionary approach and introduced measures to reduce our exposure to phthalates.

Should we worry about contact with phthalates?

There have been some reports of concern over the effects to health of the public exposed to phthalates.

How do phthalates get into our bodies?

Inhalation and ingestion are the main routes of internal exposure of phthalates. Very small amounts of phthalates can leach out of plastics and building materials to accumulate in dust. As we breathe in dust, we can inhale small amounts of phthalates. Ingestion of phthalates, most particularly of DEHP and DINP, occurs via food and drinks, and from trace amounts leaching out of food packaging. Infants and children have greater likelihood of phthalate ingestion than adults, due to hand-to-mouth behaviour. Exposure by skin contact is also a means of absorption into the body.

Phthalates and cancer

Although reports have linked phthalates with cancer, in fact no phthalates have been classified as ‘carcinogenic to humans’ by the International Agency for Research on Cancer (IARC). Based upon animal studies, one phthalate (di-2- ethylhexyl phthalate (DEHP)), has been classified as ‘possibly carcinogenic to humans’ but there is no conclusive evidence that any phthalates cause cancer in humans. (IARC Monograph 101, 2013)

Are phthalates endocrine disruptors ?

Endocrine disruptors are chemicals that interfere with the body’s hormone system. Phthalates are often quoted as being endocrine disruptors and occasionally sensationally referred to as ‘gender-bending’ chemicals. This is due to some scientific studies suggesting that certain phthalates mimic the

Did you know?

EU Regulations restrict the use of phthalates based upon their concentration and their individual characteristics, such as ability to migrate (for example from packaging material into food). Post-Brexit, the UK Regulations continue to be updated in line with EU amendments.



female sex hormone oestrogen. There is some evidence that some phthalates may be endocrine disruptors in rodents. However, there is not enough scientific evidence to conclude that any phthalates are endocrine disruptors in humans. However as a precautionary measure the phthalates that are considered to be potential endocrine disruptors are already being phased out across Europe.

Do phthalates cause obesity ?

There have been several reports in the media warning that there is a link between phthalates and obesity. A study has shown that mice exposed to high doses of certain phthalates became obese. Another study found higher levels of phthalates in the urine of obese children than in children of a healthy weight. However, the current evidence for a link between phthalates and obesity is very weak. Phthalates have not been shown to be a cause of obesity in humans.

Reproductive toxicity

At high doses, some phthalates, including dibutyl phthalate (DBP), benzylbutyl phthalate (BBP) and DEHP, have been found to be harmful to the reproductive systems of rodents. However, the doses used during these tests were many times higher than the level of exposure experienced by humans in everyday life. Although phthalates are widely used, humans are only exposed to relatively low levels. There is currently not enough evidence to show similar harmful effects in humans.

Persistence

Phthalates do not build up (i.e. bio-accumulate) in the bodies of humans or animals, but are metabolised and then excreted. Similarly, they do not remain in the environment for long periods of time as they are readily biodegradable.

What is being done about phthalates?

Most phthalates, in the majority of applications, do not pose a significant risk to human health or the environment. We are exposed to phthalates in our homes, offices and environment. However, the level of exposure that we experience is significantly lower than levels that have been shown to cause harm in rodents.

Nevertheless, the EU has taken some precautionary action to deal with phthalates. The phthalates which have been identified as posing potentially higher risks to human health have been addressed by legislation and their use is being phased out in Europe.

Did you know?

There are many different phthalates and their long chemical names, are usually abbreviated to shorter acronyms. For example, di-2-ethylhexyl phthalate is shortened to DEHP, and diisononyl phthalate to DINP

Did you know?



This is the recycling symbol for PVC. So any plastic with this symbol on it may well contain some phthalates.

Phthalate	Uncertainties or concerns	What is being done?
DEHP (di-2-ethylhexyl phthalate)	Possibly carcinogenic to humans At high doses has been shown to harm the reproductive system of rodents	Not permitted for use in cosmetics or toys. Restrictions for use in food packaging. The majority of uses of these phthalates will be phased out over the next few years.
DBP (dibutyl phthalate)	At high doses has been shown to harm the reproductive system of rodents	
BBP (benzylbutyl phthalate)		
DINP (diisononyl phthalate)	No definite risks have been identified for the applications of these phthalates but there are some uncertainties	Restrictions for use in food packaging and toys.
DIDP (diisodecyl phthalate)		
DNOP (di(n-octyl) phthalate)		Restriction for use in toys.
DIBP (diisobutyl phthalate)	Suspected of causing harm to the reproductive system and/or the unborn child at high doses.	The use of DIBP in the majority of applications will be phased out over the next few years.
DMEP (di(methoxyethyl) phthalate or bis(methylglycol) phthalate)	Suspected of causing harm to the reproductive system and/or the unborn child at high doses.	These phthalates are likely to be phased out over the next few years.
DIHP (diisooheptyl phthalate)		
DHNUP (1,2-benzenedicarboxylic acid, di-C7-11 – branched and linear alkyl esters)		

Food

The EU established that the exposure of humans to some phthalates was close to the calculated tolerable daily intake (TDI). The TDI is the amount of a substance that is safe to consume every day over a lifetime. For this reason, the EU introduced restrictions on the use of phthalates in food contact applications. The extent of the restriction depends on the phthalate in question and the type of food involved. The length of time the food is intended to come into contact with the plastic is also a factor. Phthalates migrate (leach out) more easily into fatty foods than into non-fatty foods. In addition, specific limits must be met for the migration of phthalates into various food types. This means that the manufacturers of plastic must carry out safety tests to show that the phthalates do not get into the food at levels considered to be too high.

Toys

Since the EU considers young children (due to their small size, and to partial development status of their metabolic systems) to be particularly vulnerable to potential reproductive toxicity of phthalates, they decreed exposure of young children to all avoidable sources of phthalates should be reduced. The use of DBP, BBP and DEHP has been banned in toys and childcare articles. DINP, DIDP and DNOP can only be used in toys that cannot be placed in the mouth.

Cosmetics

The phthalates DBP, BBP and DEHP are not permitted to be used in cosmetics in the EU and UK.

Blood bags

Although most uses of DEHP are currently being phased out, there is one important application that has been exempted from this ban. In Europe, DEHP is the only plasticiser permitted for use in blood bags. This may seem surprising but there are so many benefits in using DEHP for this application that regulators consider the benefits to outweigh the risks.

PVC that is treated with DEHP is strong, light, and tear and heat resistant. The DEHP also helps to soften the plastic, which is important because it allows the blood bags to be easily squeezed by hand.

Someone who receives blood from one of these blood bags would only be exposed to an extremely low level of DEHP. This level is much lower than the amount that has been shown to cause harm. At the moment there are no suitable alternatives to DEHP, so it will continue to be used for this purpose.

Further Reading

Benjamin, S. et al. Review. Phthalates impact human health: Epidemiological evidences and plausible mechanism of action. *Journal of Hazardous Materials* 340: 360-83 (2017)

International Agency for Research on Cancer (IARC). Some chemicals present in industrial and consumer products, food and drinking-water Monograph 101 (2013)

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Did you know?

Phthalates cannot leach out of bottles containing water or fizzy drinks. These bottles are made of a different type of plastic, polyethylene terephthalate (PET), which does not usually contain plasticisers. Despite its similarity in name, it is chemically very different, from plasticiser phthalates.



