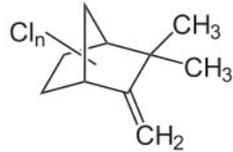


## Toxaphene – a pesticide with long-term consequences

**Toxaphene is a mixture of more than 1000 halogenated compounds. The pesticide has been banned in Western countries since the early 1970s, while the Eastern Bloc continued to use it up until the 1990s. Huge amounts of toxaphene that have been used as insecticide or simply deposited at dilapidated storage sites continue to pollute the environment. Researchers from the University of Hohenheim are analysing the complex substance and looking for economical microbiological and abiotic solutions to degrade it.**



Toxaphene is a pesticide consisting of a complex mixture of polychlorinated bornanes, polychlorinated bornenes, dihydrocamphenes and camphenes

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East German manufacturers named their toxaphene product "Melipax", an acronym of "pax" (Latin for peace) and *Apis mellifera* (zoological name of the honey bee) because it was supposed to have a deadly effect on pests whilst sparing bees. The compound was heavily promoted and sold in Eastern Bloc countries before it was finally banned in the 1990s.

However, toxaphene did not always leave the bees in peace as the name suggested. "Toxaphene is mutagenic and also toxic to bees, although to a lesser degree than other pesticides," explained Prof. Dr. Walter Vetter from the Institute of Food Chemistry at the University of Hohenheim. Toxaphene had been sold under different brand names in Western countries since the 1940s and was frequently combined with polychlorinated compounds such as DDT because, as Vetter explains, "toxaphene dissolved more easily in water than the other substances".

Both toxaphene and DDT belong to the so-called "dirty dozen", a list of highly toxic substances whose production, sale and application was banned by the 2001 Stockholm Convention on Persistent Organic Pollutants. The use of DDT in disease vector control continues, especially in the control of insects that are of particular danger to human health such as the malaria-transmitting *Anopheles* mosquitoes. Like DDT, toxaphene accumulates in the fatty tissue of humans and animals, is mutagenic and is believed to cause cancer. "However, while it can be excluded with high certainty that adults can take up high enough amounts of the compound with toxaphene-contaminated food such as fish to lead to acute intoxication, direct toxaphene intake is deadly in children. This danger still exists, in particular in the Eastern Bloc where storage sheds with old and rotten bags of toxaphene are frequently discovered.

“Hundreds of thousands of tons of toxaphene might still be found in the East”

"People who come across such finds often contact us and ask us for advice on what to do with the pesticide," said Vetter who has been working with toxaphene for many years. His research group is one of only a handful of groups around the world with a great deal of experience in the analysis of toxaphene. "There are not many laboratories that deal with the analysis of toxaphene because it contains over 1000 different compounds. In addition, some of the components decompose during analysis, which leads to erroneous results," said Vetter. Descriptions and chemical structures are only known for around 10 per cent of these compounds. The team from Hohenheim University has made a considerable contribution to clarifying the compounds. They have also developed new methods for separating and analysing the toxic compound mixture. For example, they have established a special type of counter-current distribution chromatography to separate the compounds from one another.

In addition to measuring and analysing toxaphene, the Hohenheim researchers are also seeking to remove it from the environment. They are looking for efficient methods to decompose this highly toxic mixture. Some initial ideas have come from nature, in particular sewage sludge. Vetter was at the University of Jena until 2003, where together with the microbiologist Prof. Dr. Gabriele Diekert, he worked with an anaerobic bacterium that is able to dechlorinate toxaphene. "In laboratory experiments, we succeeded in partially degrading toxaphene with *Sulfurospirillum multivorans* bacteria," said Vetter explaining why it is not very practical to use the bacteria for specific degradation in toxaphene-contaminated soil: "It is always very difficult to introduce bacteria into ecosystems other than their natural ones. This can provoke a real time bomb that might potentially lead to the permanent alteration of the entire ecosystem."

Promising degradation possibilities under investigation





Toxaphene researchers are also closely monitoring seals.  
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Vetter has therefore been looking for alternatives in cooperation with Dr. Anke Neumann amongst others, one of Diekert's former doctoral students who is now working in Karlsruhe. "We are using a bacterial co-factor (corrinoïd), which is important for the anoxic degradation of toxaphene. We are now focusing on using commercial corrinoïds such as vitamin B12 for abiotic degradation and for dechlorination under controlled conditions," said Vetter who is also investigating the possibility of dechlorinating toxaphene in the presence of oxygen. "Numerous studies have shown that toxaphene can be degraded oxidatively."

In addition to investigating toxaphene in the laboratory, Vetter goes on frequent field trips to collect sediment samples in contaminated areas in order to find out exactly when most of the toxaphene accumulated in the soil and how it has degraded over time. Vetter also looks for contaminated animals in order to find out how toxaphene is metabolised in the body. "We assume that toxaphene is converted in the liver into water-soluble metabolites which are then cleared from the body by way of the kidneys. In order to analyse the metabolites in greater detail, a specialist in the USA who collects seal and other cadavers provides us with animal liver samples," said Vetter.

### Was the death of a large number of seals a few years ago associated with toxaphene pollution?

It is believed that the death of a large number of seals a few years ago had something to do with toxaphene toxication. "Although the animals died as a result of a viral infection, it is generally agreed that the viruses would not have caused such devastating damage if the animals had been in good health and had had an effective immune system," said Vetter. Antarctic seals were found to contain high quantities of toxaphene, which is why it was seen as necessary to further pursue toxaphene research. At present, Vetter is financing the investigations with institute funds. However, as soon as the preliminary work is completed and initial results are available, he hopes to submit applications for funding that will enable him to carry out broad-based investigations.

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