

1. Sources

Organotins are organic compounds that contain at least one tin-carbon bond. There are four main groups of organotin compounds, which are used in various applications.

Mono- and di-organotins are mainly used as heat stabilisers in polyvinyl chloride (PVC) in a wide range of applications, including window frames and house siding, PVC pipes, food contact blister packs and water bottles. Tri-organotins are mainly used as biocides (e.g. in wood preservatives, in anti-fouling paints for boats and in textiles) and as pesticides. Tetra-organotins have been used as intermediates in the preparation of other organotins and as oil stabilisers.



2. Why is it relevant?

Depending on the organotin compound, studies have also shown that toxicity of organotins may increase with the number of organic functional groups (mono- < di- < tri-organotins). Tributyltin is considered among the most hazardous substances released into the marine environment.



Organotins as biocides were identified by the Global Chemicals Outlook II as an issue with emerging evidence of risks to human health and the environment.



Exposure has been reported to cause skin, eye and respiratory irritation, neurological problems, and effects on the immune system. Some organotins are highly neurotoxic, and others are immunotoxic.



Hematological and hepatic effects and reproductive and developmental effects have been reported in animals treated with some organotins.



Endocrine disrupting potential has been observed for many organotins.

In aquatic environments, tributyltin compounds have been reported to lead to male sexual characteristics in female marine snails and have the potential to induce sex reversal in marine fish.

Organotins have solely anthropogenic origins, with the exception of some methylated compounds made by bacteria.

Organotins may be released to the environment at any point throughout their life cycles, e.g. direct releases from pesticidal uses, leaching from ship hulls and leaching from PVC microplastics.

As a result of their widespread use, releases and exposure to organotins are likely ubiquitous. Their degradation half-lives are on the order of months to years, and even decades, in soil and sediment.



Wildlife and humans are exposed to organotins through contaminated environmental media and foodstuffs. Accumulation in biota may occur for some organotins resulting in high levels in tissues.



Humans may be further exposed to organotins through the use of organotin-containing products (e.g. via leaching from silicone baking containers). Organotins may also enter the foetus via the placenta.



Occupational exposure may occur during the production and processing of organotins and associated products.



3. Existing instruments and actions

At the national and regional levels, many countries have taken action to address tributyltin in anti-fouling paints on ships before or in response to the International Convention on the Control of Harmful Anti-fouling Systems on Ships.

Some countries and regions have gone further and set legal restrictions on more organotins in a wider range of uses e.g., use of dibutyltins, dioctyltins and tri-organotins) as anti-fouling as biocidal agents, in the treatment of industrial waters, and in different consumer products.

Some governments have used soft-law instruments by setting norms such as guideline values in different exposure media including air, soil and groundwater and during occupational exposures.

These actions have been complemented by voluntary industry phase-out through tools such as restricted substances lists, and third-party standards and certification schemes.



4. Challenges and opportunities



Efforts have been made to address environmental and human exposure to organotins, particularly with regard to their use in anti-fouling paints on ships. However, current efforts are rather fragmented and likely not enough, as shown by continued contamination and exposure.

Ongoing uses of many organotins, including as biocides and pesticides, in many parts of the world remain significant and are of concern.

While further investigation may be needed to understand the magnitude of current exposure from these ongoing uses (including from PVC recycling), immediate actions can be taken by more governments and stakeholders to minimise environmental and human exposure to the large family of organotins.

Given the widespread use and contamination of organotins (and long-range transport potential of some organotins), international concerted action may be warranted.

