

DETOX Program
Hazardous Substances Fact Sheet

Organotin Compounds

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1 Background

In the textile industry organotins are used as biocides to prevent microbiological activities in wet processes, water based chemical preparations but also for the anti-odor treatment of final products. They are also commonly applied as stabilizers in polymers or in plastisol prints (and in sanitary silicones). The most important exposure pathways for consumers are food, indoor air, household dust and dermal contact with products containing these substances. Organotin compounds can have serious effects on the immune, nervous, reproductive and endocrine system, and they may cause sensitization. They persist in the environment and can cause serious changes of whole ecosystems.

Organotin compounds are widely used as additives in plastic material and as biocides in wood preservatives, marine biocides, agricultural pesticides and in industrial wet processes. In textile and shoe industry, organotin compounds are used as biocides for the treatment of final products to prevent unpleasant odor (shoes and sportswear) or damages of the product during storage and transport.¹ They may be present in plastics, rubber, inks, paints, metallic glitter, and heat transfer material where they are used as catalysts and stabilizers². PVC plastisol prints³ and silicone-based finishes (e.g. for elastomeric properties and water repellency) may also contain organotins⁴.

2 Definition

Organotin compounds (organotins) are substances composed of tin directly bound to different organic groups. Some relevant organotins that are also subject to restriction are⁴:

- Tributyltin (TBT) Compounds
- Trimethyltin (TMT) Compounds
- Triphenyltin (TPhT) Compounds
- Tetrabutyltin (TeBT) Compounds
- Tricyclohexyltin (TCyHT) Compounds
- Trioctyltin (TOT) Compounds
- Tripropyltin (TPT) Compounds
- Dibutyltin (DBT) Compounds
- Dioctyltin (DOT) Compounds
- Dimethyltin (DMT) Compounds
- Monobutyltin (MBT) Compounds
- Monoctyltin (MOT) Compounds

¹ CIRS, undated. Textile and Leather Testing. Online available: <http://www.cirs-reach.com/Textile>

² AFIRM Supplier RSL Toolkit • 2011

³ German Institute for Risk Assessment (Bundesinstitut für Risikobewertung, BfR) 2012. Introduction to the problems surrounding garment textiles. Online available: <http://www.bfr.bund.de/cm/349/introduction-to-the-problems-surrounding-garment-textiles.pdf>

⁴ ZDHC undated. Organotin Compounds. Online available: <http://www.roadmaptozero.com/df.php?file=pdf/Organotins.pdf>

3 Legal Aspects

In the EU there are already restrictions for the use and marketing of several organotin-compounds⁵:

- Triorganotin compounds particularly TBT must not be used in products, if the concentration of tin in the product or in parts thereof exceeds 0.1 % by weight. The use of TBT in the EU is banned in anti-fouling paints for ships as well as in agricultural applications. However, it is still used as disinfectant, for material-protection as well as in sanitation silicones. Further restrictions can be expected due to the development of further legislation regarding endocrine disrupting substances.
- Similar bans have been in place for dibutyltin compounds in products which are intended for supply to, or use by, the general public.
- Similar bans have been in place for dioctyltin compounds in explicitly mentioned products intended for supply to the general public. This includes textile articles intended to come into contact with the skin.

Suppliers of the REWE Group must assure that they produce in full accordance with the legal requirements of the country where the production takes place, and the legal provisions of the European Union regarding final products. A comprehensive list with international regulation for individual hazardous substances can be found on the website of the American Apparel & Footwear Association's (AAFA).⁶

4 Hazardous Properties and Exposure

4.1 Hazardous Properties

Organotin compounds are known for their endocrine disrupting properties and are therefore classified as being toxic to aquatic organisms as well as to mammals⁷. They show a broad range of toxic, bioaccumulative and persistent properties. Their use in consumer products is classified as a "hazard to human health"⁸. They are partly prohibited in many countries. Known health hazards include⁹:

- immunotoxicity (especially di- and trialkyl and triphenyl tin compounds),
- sensitization,
- skin and eye-irritating properties (especially mixtures of mono- and dimethyl as well as mono- and dioctyl tin compounds),
- reproductive toxicity (especially di- [DBT] and tributyl tin [TBT]),
- neurotoxicity (methyl and ethyl tin compounds), and
- effects on the endocrine system of humans (DBT, TBT, and triphenyl tin).

⁵ German Institute for Risk Assessment (Bundesinstitut für Risikobewertung, BfR) 2012. Introduction to the problems surrounding garment textiles. Online available: <http://www.bfr.bund.de/cm/349/introduction-to-the-problems-surrounding-garment-textiles.pdf>

⁶ <https://www.wewear.org/rs/> https://www.wewear.org/assets/1/7/RSL_v16_final_UPLOAD.pdf

⁷ Greenpeace 2013. Hazardous chemicals in branded luxury textile products on sale during 2013. Online available: <http://www.greenpeace.org/international/Global/international/publications/toxics/2014/Technical-Report-01-2014.pdf>

⁸ German Institute for Risk Assessment (Bundesinstitut für Risikobewertung, BfR) 2012. Introduction to the problems surrounding garment textiles. Online available: <http://www.bfr.bund.de/cm/349/introduction-to-the-problems-surrounding-garment-textiles.pdf>

⁹ German Institute for Risk Assessment (Bundesinstitut für Risikobewertung, BfR) 2012. Introduction to the problems surrounding garment textiles. Online available: <http://www.bfr.bund.de/cm/349/introduction-to-the-problems-surrounding-garment-textiles.pdf>

In relation to the marine environment, TBT and TPT are persistent, bioaccumulative and toxic (PBT-substances)^{10, 11}:

No.	Name	Associated health hazard
	H301	Toxic if swallowed.
	H312	Harmful in contact with skin.
	H315	Causes skin irritation.
	H317	May cause an allergic skin reaction.
	H319	Causes serious eye irritation.
	H372	Causes damage to organs through prolonged or repeated exposure.
	H410	Very toxic to aquatic life with long lasting effects

4.2 Exposure

The risk of a chemical for human health and the environment is not only determined by its toxicity but by the degree of exposure, too.

a) Workers

Main routes for worker exposure are manufacturing factories for organotin compounds and facilities where they are used directly (e.g. as biocides) or if there is contact with materials that were treated with organotin compounds.

b) Environment

Potential sources for environmental contamination with organotin compounds are:

- Industrial effluents or air emissions
- Spraying in agricultural applications
- The use of organotin in products
- Antifouling paints for ships².
- Diffuse emissions from consumer products

Organotin compounds can be transported in water over long distances and tend to cause severe detrimental effects in the marine environment¹².

c) Consumers

The most important exposure pathways are food (e.g. contaminated fish), indoor air, household dust and dermal contact with treated textiles, shoes or polymer materials. Independent tests showed that organotins are present in a wide range of textile articles,

¹⁰ REACH Definition: *Persistent, Bio-accumulative and Toxic (PBT)*: Annex XIII defines criteria for the identification of substances that are Persistent, Bio-accumulative and Toxic (PBTs) and Annex I lays down general provisions for PBT assessment. PBTs are substances of very high concern (SVHC) and may be included in Annex XIV and by that be made subject to authorization.

very Persistent and very Bioaccumulative (vPvB): Substances of very high concern, which are very persistent (very difficult to break down) and very bio-accumulative in living organisms. Annex XIII defines criteria for the identification of vPvBs and Annex I lays down general provisions for their assessment. vPvBs may be included in Annex XIV and by that be made subject to authorisation. (<http://www.reach-compliance.eu/english/REACH-ME/engine/sources/definitions.html>)

¹¹ European Commission 2007. Impact Assessment of Potential Restrictions on the Marketing and Use of Certain Organotin Compounds. Online available: http://ec.europa.eu/enterprise/sectors/chemicals/files/studies/organotins_en.pdf

¹² Australian National Pollutant Inventory. Organotin. Online available: <http://www.npi.gov.au/resource/organo-tin-compounds>

predominantly MBT/DBT and MOT/DOT.¹³ There is a significant risk for children exposed to organotins from consumer articles.¹⁴ The German Federal Institute for Risk Assessment (BfR) found that 5 % of TBT added to textiles could migrate out of the product¹⁵.

5 Sources for Organotin Compounds in production of textiles

a) Processing chemicals used in the factory

E.g. biocides for the antimicrobial treatment of processing water or final products.

b) Raw materials used in the factory

Materials and pre-products that are bought by a factory and used in production may contain organotin compounds and should be controlled. Some risk materials are PVC materials such as synthetic leather, plastisol prints, synthetic shoe insoles, PU coatings, antimicrobial finishing (biocides), PU binders, glues and adhesives.¹⁶

c) Contamination

E.g. chemical impurities or unknown additives in processing chemicals, incoming water

6 Alternative and Substitute Substances

All alternatives used as substitutes for hazardous substances must be free of hazardous properties. Some tools to identify hazardous properties of chemicals and to find safer alternatives are listed in the factsheet about hazardous substances.

Potential alternatives listed by ZDHC¹⁷ and the European Commission¹⁸ are:

- Calcium-zinc stabilisers may be used in the form of metal carboxylates.
- Organic-based stabilisers are calcium-zinc stabilisers with zinc replaced by organic costabilisers. Calcium-organic is mentioned by the European Commission as “key alternative” to organotin stabilisers”, too.
- Bismuth, titanate, titanium and zirconium catalysts can be used for PU production.
- Titanate catalysts can be used for polyester production.

In order to minimize environmental and health effects and to use resources efficiently the use of best available technology (BAT¹⁹) in textiles industry is a standard requirement.

¹³ Greenpeace 2013. Hazardous chemicals in branded luxury textile products on sale during 2013. Online available: <http://www.greenpeace.org/international/Global/international/publications/toxics/2014/Technical-Report-01-2014.pdf>

¹⁴ European Commission 2007. Impact Assessment of Potential Restrictions on the Marketing and Use of Certain Organotin Compounds. Online available: http://ec.europa.eu/enterprise/sectors/chemicals/files/studies/organotins_en.pdf

¹⁵ German Institute for Risk Assessment (Bundesinstitut für Risikobewertung, BfR) 2012. Introduction to the problems surrounding garment textiles. Online available: <http://www.bfr.bund.de/cm/349/introduction-to-the-problems-surrounding-garment-textiles.pdf>

¹⁶ ZDHC: <http://roadmaptozero.com/df.php?file=pdf/Organotins.pdf>

¹⁷ ZDHC undated. Organotin Compounds. Online available: <http://www.roadmaptozero.com/df.php?file=pdf/Organotins.pdf>

¹⁸ European Commission 2007. Impact Assessment of Potential Restrictions on the Marketing and Use of Certain Organotin Compounds. Online available: http://ec.europa.eu/enterprise/sectors/chemicals/files/studies/organotins_en.pdf

¹⁹ European Commission: Integrated Pollution Prevention and Control (IPPC) Reference Document on Best Available Techniques for the Textiles Industry July 2003

Please refer to the factsheet about hazardous chemicals for further information on alternatives. In addition the Chemsec Textile Guide offers access to a list of hazardous and safer surfactants and should be taken into account when a chemical inventory is prepared²⁰.

²⁰ <http://textileguide.chemsec.org/find/textiles-come-with-a-toxic-footprint/>