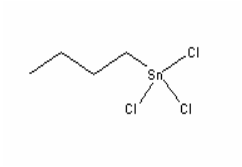
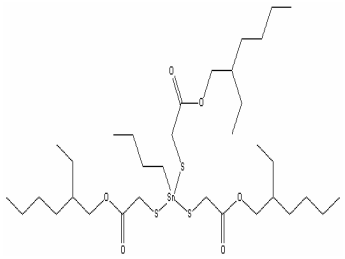
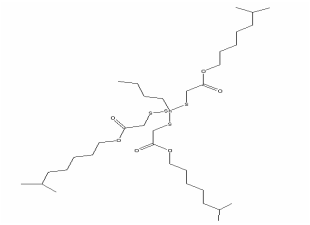
SIDS INITIAL ASSESSMENT PROFILE

Chemical Category	Monobutyltin trichloride and selected thioglycolate esters	
Structural Formula		Monobutyltin trichloride (MBTC, CASRN 1118-46-3)
		Monobutyltin tris(2-ethylhexyl thioglycolate), [MBT(EHTG), CASRN 26864-37-9]
		Monobutyltin tris(isooctyl thioglycolate), [MBT(IOTG), CASRN 25852-70-4]

SUMMARY CONCLUSIONS OF THE SIAR

Category Rationale

MBTC, MBTC(EHTG), and MBT(IOTG) are considered one category of compounds for mammalian toxicology studies via the oral route. The justification for this category is based on structural similarities and the demonstrated rapid conversion of the thioesters to MBTC when placed in simulated mammalian gastric contents [0.07 M HCl] under physiological conditions. For MBT(EHTG), 98% conversion to MBTC occurred within 0.5 hours. Thus, MBTC is the appropriate surrogate for mammalian toxicology studies via the oral route.

Sensitization, irritation and *in vitro* genotoxicity are not covered under the category approach and the results of the mammalian *in vivo* tests via the oral route with the representative chloride cannot be extrapolated to the dermal or inhalation routes. However, the esters have much higher molecular weight and lower volatility than the chlorides, reducing the possibility of toxicity via inhalation and dermal routes.

The category approach was not used for the ecotoxicity and environmental fate endpoints. The considerable difference in the structures of the labile ligands causes differences in water solubility between the alkyltin chloride and thioesters affecting their respective bioavailabilities and distribution in the environment. Furthermore, MBT(EHTG) and MBT(IOTG) will degrade in aqueous solution such that organisms will be exposed to the parent material and their different degradation products. MBTC is not an appropriate surrogate for the thioesters.

Analogue Rationale

Data for MBT(EHTG) and MBT(IOTG) are used interchangeably because they are isomers, differing only slightly in the structure of the C-8 alcohol of the mercaptoester ligand. In addition, the breakdown products of MBT(EHTG) and MBT(IOTG) are the thioglycolate esters (EHTG and IOTG), which have the common degradates, thioglycolic acid and C-8 alcohols (either 2-ethylhexanol or isooctanol). EHTG and IOTG also have similar physicochemical and toxicological properties.

EHTG (CAS No. 7659-86-1) and IOTG (CAS No. 25103-09-7) form the Thioglycolic Acid Esters B Category, assessed within the OECD HPV Chemicals Program.

Human Health

The majority of toxicology studies were conducted with commercial mixtures having high monoalkyltin to dialkyltin ratios. There are no available data on absorption, distribution, metabolism, or excretion; however, simulated gastric hydrolysis studies were conducted, as described above. For MBTC and MBT(EHTG)/(IOTG), acute oral LD_{50}s are > 1000 mg/kg bw in mice and > 2000 mg/kg bw in rats. Acute dermal and inhalation data are not available. MBTC is corrosive and MBT(EHTG)/(IOTG) is irritating to the skin and eyes of rabbits. No data on sensitization are available, but the hydrolysis products EHTG or IOTG are sensitizers.

Rats exposed to an aerosol of MBTC (1, 10, or 30 mg/m^3, 6h/day, 5 days/week) for up to 28 days exhibited clinical signs and histopathologic changes consistent with exposure to corrosive substance. In the 90-day rat dietary study of MBTC (purity = 99.7%, the concentrations were 300, 1500, and 7500 ppm diet (equivalent to 19-25, 96-101, and 521-553 mg/kg bw/day, respectively). Treatment-related effects were limited to the high dose (7500 ppm) group. The NOAEL was 96-101 mg/kg bw/day. Hematological changes included increased reticulocytes in males, decreased mean corpuscular hemoglobin in females, decreased prothrombin time in both sexes, and increased WBC and lymphocytes in males; clinical chemistry changes included increased ALP, GGT, A/G ratio, bile acids, phospholipids and potassium in males; increased ASAT and triglycerides in both sexes; decreased sodium in males.

MBTC and MBT(EHTG) were negative in standard Ames assays (*S. typhimurium* strains) conducted with and without metabolic activation. MBTC was negative in two in vitro assays for chromosomal aberrations conducted with and without metabolic activation, and a Rec-assay conducted without metabolic activation. MBTC was positive as an SOS inducer and MBTC induced gene mutations in *Salmonella typhimurium* strain TA100, when tested in the absence of metabolic activation. MBTC was negative in an *in vivo* mouse micronucleus assay. The thioester ligands showed no evidence of genotoxicity in *in vitro* or *in vivo* studies. Overall, this category is considered not to be genotoxic.

No treatment-related effects were observed in a reproduction/developmental screening study (OECD TG 421), and the NOAEL for maternal toxicity and reproductive effects was the high dose of 7500 ppm diet (433-685 mg/kg bw/day).

Other studies confirmed that MBTC was not a developmental toxicant to pregnant rats exposed during the entire or selected segments of the period of organogenesis. MBT(EHTG) and MBT(IOTG) may have potential to cause adverse reproductive/developmental effects, based on the screening data for the hydrolysis product, 2-ethylhexl thioglycolate (EHTG).

There is no available information on carcinogenicity of the monobutyltin compounds.

Environment

The EPIWIN suite developed by Syracuse Research Corporation has not been validated for chemicals that contain metals in their molecular structure; therefore, there is uncertainty associated with the calculated values and they should be used with caution whenever they are reported below.

All of the monobutyltin category members are liquids at room temperature. MBTC has a freezing point of -63°C, a boiling point of 98ºC at 13 hPa, the specific gravity is 1.71, and the measured vapor pressure is 0.06 hPa at 25°C. MBTC is completely soluble in water (1000 to 10,000 mg/L). Log BCF of 0.5 (calculated) and 1.7 and 2.1 (measured) for MBTC indicate a low to moderate potential to bioaccumulate in the tissues of aquatic organisms. Calculated log Kow value for MBTC is 0.18.

In water, MBTC undergoes rapid degradation by hydrolysis and is expected to hydrolyze within minutes. It is expected that the chlorines in MBTC will be displaced to form mono-butyltin hydroxide which eventually precipitates as the oxide. (The alkyltin moiety (MBT) was hydrolytically stable at pH 4, 7, and 9 (t½ > 1year at 25°C)).

Monobutyltin chloride has sufficient water solubility that it can be studied in water using analytical methods that involve derivitization. This analysis method only measures the amount of the alkytin moiety, and can determine if the alkyltin itself is degrading. This method does not identify the other ligands attached to the tin, and thus hydrolysis of the chloride on tin to the hydroxide is not detected using this method.

MBTC is not readily biodegradable. MBTC is atmospherically degraded by photochemically induced hydroxyl radicals and UV radiation half-life =18 hours. Based on Henry's Law constants, volatilization of the monobutyltin compounds from surface water is predicted to occur; half-lives from a model river and lake are 31 and 340 days, respectively. Level III distribution modeling predicts that MBTC will partition primarily to water (54%) and soils (44%).

MBT(EHTG) has a melting point range of -85 to -65°C, decomposes at ≥ 260°C, has a relative density is 1.14 g/cm3, and an estimated vapor pressure of 0.02 hPa at 25°C. Measured vapor pressure values for the organotins are difficult to obtain, and similar problems exist for measuring water solubility and partition coefficient. The low molecular weight impurities in the named substance (MBT(EHTG)) will volatilize (or solubilize) more readily and, therefore, influence the reported values. MBT(EHTG) is only slightly soluble in water (0.06–4.4 mg/L). Calculated log Kow values for MBT(EHTG)/(IOTG) are 12.45. Log BCFs of 2.0 (calculated) for MBT(EHTG) indicate a low to moderate potential to bioaccumulate in the tissues of aquatic organisms.

In water, MBT(EHTG)/(IOTG) undergo rapid degradation by hydrolysis. Although there is no stability data for MBT(EHTG)/(IOTG), data for other organotins (DOTC, DBTL, DBT(EHTG)), indicate that the monobutyltin compounds are expected to hydrolyze within minutes to hours. The thioester ligands on MBT(EHTG)/(IOTG) will be similarly rapidly displaced to form mono-butyltin hydroxide which eventually precipitates as the oxide. It is also possible that the labile ligands can be displaced by other anions in the medium. The displaced thioester ligands, EHTG/IOTG, can also undergo further hydrolysis of the ester linkage to form thioglycolic acid and either ethylhexanol or isooctanol, respectively.

MBT(EHTG) is readily biodegradable and MBT(IOTG) is expected to be biodegradable based on the data for IOTG and analogy to MBT(EHTG). Most of the degradation of MBT(EHTG)/(IOTG), as measured by CO_2 release, is from the breakdown of the thioester (EHTG/IOTG) ligands on the monobutyltin.

MBT(EHTG)/(IOTG) is atmospherically degraded by photochemically induced hydroxyl radicals and UV radiation half-life =4.8 hours. Based on Henry's Law constants, volatilization of the monobutyltin compounds from surface water is predicted to occur; half-lives from a model river and lake are 340 days and 11 days, respectively. Level III distribution modeling predicts that MBT(EHTG)/(IOTG) will partition primarily to sediment (71-78%) and soil (20-25%).

MBTC contains technical impurities, including tributyltin chloride (TBTC). Because of its high toxicity, the level of this impurity should be taken into account when assessing the ecotoxicological profile of commercial products. Typically the MBTC commercially produced contains less than 1% TBTC by weight. Also, in the ecotoxicity tests the organisms were most likely exposed to parent substance as well as hydrolysis/degradation products.

MBTC was not acutely toxic to zebra fish (*Brachydanio rerio*) (96-h LC_{50} > 100 mg/L), affected *Daphnia magna* condition (48-h EC_{50} = 85 mg/L) and inhibited the growth (72-h EC_{50} = 0.31 mg/L) and biomass (72-h EC_{50} = 0.11 mg/L) in the green alga *Scenedesmus subspicatus* (NOEC = 0.12 mg/L). A 100% WAF (water accommodated fraction) of MBT(EHTG) was not acutely toxic to zebra fish (*B. rerio*) (96-h LC_{50} > 2.3 mg/L), and the 99% WSF (water soluble fraction) produced inhibition to growth (72-h EC_{50} > 0.36 mg/L) and biomass (72-h EC_{50} = 0.20 mg/L) of the green alga *S. subspicatus* (NOEC = 0.025 mg/l). The concentrations in the WSF were based on measurement of total tin. The concentration of dissolved tin in the algae study was not stable over the duration of the test. It is known that dissolved MBT compounds hydrolyze rapidly to MBT hydroxide, and the hydroxide remains in solution for a short period, depending on pH, but does eventually precipitate as a solid oxide.

The 21-d EC_{50} of MBT(EHTG) for *D. magna* reproduction was 0.103 mg/L, and the NOEC and LOEC were 0.049 and 0.117 mg/L, respectively. The data for MBT(EHTG) are considered applicable to MBT(IOTG).

Exposure

In 2000, global production was estimated at 10,000-15,000 tonnes of MBTC, and 2500-7500 tonnes of MBT(EHTG). MBTC is used as an industrial intermediate in the production of organotin compounds by the manufacturer, or is sold to other chemical companies for conversion to other products. MBTC also is marketed for use in glass coatings applications. The MBT(EHTG) stabilizer is added to polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) to preserve the polymeric structure and properties of the resins during the final stages of fabrication into finished articles. After being blended into the PVC and CPVC resin, the stabilizer remains there throughout the subsequent processing steps. All systems are designed and maintained to ensure that moisture is kept away from the resin compound, because the presence of water creates significant problems during

processing. Therefore, losses to water during blending and melt processing are low, as these are designed to be "dry" processes.

Over a period of approximately ten years, use of MBT(IOTG) has gradually decreased, and MBT(EHTG) is being used instead.

Monobutyltin chemicals either leach out of PVC and CPVC articles or are released into the atmosphere during processing. The monobutyltin compounds that leach out of PVC/CPVC articles into the environment will be hydrolyzed to the monobutyltin cation and associated anions. When tested, PVC/CPVC water pipes showed an initial release of monobutyltins, which is followed by decreased releases until lower levels of release are reached. Other articles that have monobutyltin stabilizers, such as window profiles and building siding, will show the same type of leaching behavior, i.e., initial level falling to lower levels.

MBT concentrations in drinking water passed through new CPVC pipe at two temperatures initially ranged from 1.2-2.7 ng Sn/g and 5.5-13.4 ng Sn/g at 24 and 65°C, respectively, and declined to 0.2-0.4 8 ng Sn/g and 0.3-0.6 ng Sn/g, respectively, over a period of 28 days. MBT concentrations measured in potable water in Canada range from non-detected (< 0.5 ng Sn/L) to 52 ng Sn/L. In the U.S., organotins are on the contaminant candidate list (published in February 2005) because they are known or anticipated to occur in public drinking water systems and are of sufficient concern to warrant further investigation. BT was detected at a frequency of 16% (4/25) in a winter-spring survey and 7% (2/28) in an autumn survey of Canadian drinking water samples. MBT concentrations ranged from not detected (< 0.5 ng Sn/L) to 28.5 ng Sn/L. MBT concentrations in distributed water samples from 5 municipalities in Canada ranged from not detected (< 0.5 ng Sn/L) to 3.1 ng Sn/L.

Consumers may be exposed to butyltins in food products. MBT was found in 15.6% of 90 blended wine samples at concentrations ranging from not detected (< 0.05 ng Sn/ml) to 0.50 ng/ml. The source of the butyltins was believed to be from the PVC transportation tanks used import wines for blending. MBT was only detected in 4 of 42 fruit juices at levels of 0.1-0.2 ng/cm^3, and no MBT was found in edible oils sold in PVC containers.

MBT has been found in fish and various seafood products. In Europe, MBT concentrations in fish from 6 European countries ranged from 0.1 to 1920 µg/kg whole weight, with a mean of 10.1 and a median of 2.4 µg/kg. Eleven samples of fish products collected in 1996 (representative of the Japanese fish market) had MBT concentrations from not detected (~ <1.0 ng/g) to 31.8 ng/g (cultured oysters). MBT levels in seafood collected from several locations throughout Asia-Pacific ranged from <5.6 µg /kg (several species of fish and invertebrates) to up to 42 µg/kg (blue groper). MBT concentrations found in mussels, oysters, clams, Dungeness crab range from not detected to 2.6 µg/kg (tissue wet weight).

Exposure in the workplace is controlled through equipment design and administrative controls such as the use of personal protective equipment. Based on an air monitoring survey in 2003, workers in PVC processing facilities that manually handled the stabilizer had exposures ranging from 50 percent of the threshold limit value (TLV) to just at the TLV.

Most PVC and CPVC articles will either be recycled or landfilled at end of life. Landfill leachate may directly enter the environment. Concentrations of organotins in leachate samples from sanitary landfills were found to be in the low parts per billion range. Butyltins were not found in 5 Canadian landfill leachate samples. If landfill leachate should directly enter the environment, the leachate would likely be more dilute, resulting in lowered environmental concentrations.

Of organotins detected in untreated wastewater, 80% is associated with suspended solids and are removed from wastewater primarily by sedimentation and adsorption into sewage sludge. Sediments were found to have varying concentrations of butyltins.

Higher concentrations are typically found in and around harbors, marinas, dry docks, etc., where TBT was used as an antifouling paint. TBT degrades via debutylization to DBT and MBT. MBT concentrations in sediments are generally in the low mg/kg range; and MBT concentrations in fresh and marine waters are in the low µg Sn/L range.

A multi-year national U.S. monitoring program measured MBT in water, sediment, and bivalve tissue. In 1999, mean measured MBT concentrations ranged from ≤ 3.2–3.1 ng/L in surface waters regardless of depth, 2.5–5.9 ng/g in surface sediments, 2.7–6.5 ng/g in deep sediments, and 25–54 ng/g in bivalve tissue.

Other monitoring studies have also been conducted; several studies have been conducted in areas where antifouling paints have been used. In a review of several studies, maximum concentrations of monobutyltins reported in freshwater, coastal waters, and in sediments were 1.9 µg Sn/L, 2.8 µg Sn/L, and 6.8 mg/kg,

respectively. In another study, a maximum concentration of monobutyltins in water of 0.076 µg Sn/L and 3.36 µg Sn/kg dry weight in sediment were observed. In half of seawater samples collected near Japan, a maximum concentration of 5.9 ng/L was seen.

Several studies in sediments have been conducted within the last several years. MBT was detected in some sediment samples in rivers in southwest France that were sampled in 2001, ranging from 0.001 to 0.125 mg Sn/kg dry weight. Also, in Spain, MBT concentrations ranged from 0.86 to 2.9 mg Sn/kg dry weight in five river estuaries; MBT accounted for the largest percent (47 percent) of total butyltin at all but one sampling site.

In the U.S., MBT in surface sediments (0-5 cm) in six cities near the Tennessee River and Kentucky Lake ranged from < 0.003 to 0.320 mg/kg dry weight (expressed as the butyltin ion). In the St. Lawrence River in Canada, surface sediments ranged from 0.006 to 0.989 MBT, expressed as mg Sn/kg dry weight,

MBT has also been found in seabirds, targeted organs in sea otters and other mammals, and in precipitation. Although sewage treatment can remove MBT, sludge has been found to have measurable concentrations.

Tin is not listed as a hazardous waste constituent by the U.S. EPA; therefore, its disposal is not restricted by federal land disposal restrictions. The recommended method of disposal of organotins is incineration in an approved hazardous waste incinerator, which converts the organotin to inorganic tin. Most PVC and CPVC articles will either be recycled or landfilled at end of life.

Exposure and risk assessments specific to several countries are available. These assessments have been performed in countries that produce monobutyltins for use in PVC.

RECOMMENDATIONS AND RATIONALE FOR THE RECOMMENDATION AND NATURE OF FURTHER WORK RECOMMENDED

Human Health: MBTC is of low priority for further work. This chemical possesses properties indicating a hazard for human health (skin and eye irritation). These hazards do not warrant further work as they are related to reversible effects which may become evident only at high exposure levels. They should nevertheless be noted by chemical safety professionals and users.

MBT(EHTG) and MBT(IOTG) are candidates for further work. These chemicals possess properties indicating a hazard for human health (skin and eye irritation; skin sensitization and reprotoxicity of the EHTG and IOTG ligands). Member countries are invited to perform an exposure assessment for consumers and workers, and if necessary a risk assessment.

Environment: The chemicals in this category are candidates for further work. The chemicals possess properties indicating a hazard for the environment (toxicity to fish, aquatic invertebrates and algae). Member countries are invited to perform an exposure assessment for the environment, and if necessary a risk assessment.