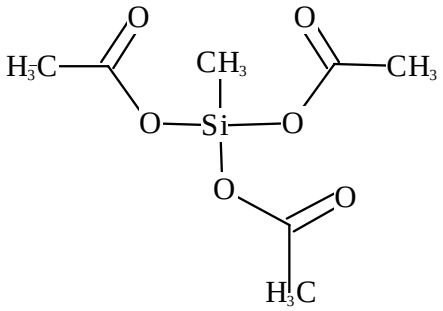
SIDS INITIAL ASSESSMENT PROFILE

CAS No.	4253-34-3
Chemical Name	Methyltriacetoxysilane
Structural Formula	

SUMMARY CONCLUSIONS OF THE SIAR

Analogue Justification

Methyltriacetoxysilane undergoes rapid hydrolysis in moist/aqueous environments (t1/2 is less than 12 seconds) to acetic acid and the corresponding trisilanols, thus observed toxicity is likely due primarily to acetic acid. Abiotic hydrolysis products of the test substance undergo continuous, condensation reactions to produce higher molecular weight cyclic and linear siloxanes (the number-average and weight-average molecular weights (MW) were determined to be 1247 and 6208, respectively, with 69% of the chromatogram represented by a MW range higher than 1000 at the 1-hr reaction time; at the 4-hr reaction time, the number-average and weight-average molecular weights increased to 1629 and 152600 with 77% of the chromatogram higher than 1000 molecular weight, respectively). The polymerization products are not volatile and are in a molecular weight range large enough to be considered biologically unavailable. The structural analogue, ethyltriacetoxysilane (CAS number 17689-77-9) and hydrolysis product, acetic acid (CAS number 64-19-7) [and its salts: calcium acetate (CAS number 62-54-4), potassium acetate (CAS number 127-08-2) and sodium acetate (CAS number 127-09-3)] have been used for assessing the biodegradation, acute aquatic toxicity (fish, aquatic invertebrate, and algae) and repeat dose toxicity endpoints. Acetic acid and its salts are grouped together because of their close structural relationships and the salts are the neutralized form of the acid that can be more easily administered, their natural occurrence in plants and animals, and their fundamental role in cell metabolism, particularly in the tricarboxylic acid cycle (also known as the citric acid or Kreb's cycle), which is where humans get their energy. Acetic acid and its salts have also been used to address the reproductive and developmental toxicity endpoints. In addition the structural analogue, vinyltriacetoxysilane (CAS number 4130-08-9) has been used for the acute aquatic toxicity endpoints. Data from both ethyltriacetoxysilane and vinyltriacetoxysilane are representative of acetic acid, based on the rapid hydrolysis of these materials

Human Health

The acute toxicity of methyltriacetoxysilane is described by LD50s in the rat (oral) of 1602 (neat) and 2850 (in corn oil vehicle) mg/kg bw. The clinical signs included decreased body weight and food consumption, labored breathing,

rales, red stains around the snout and extremities, salivation, lacrimation, lethargy, irregular gait, hunched posture, red urination, black/brown anogenital staining, paleness, chromodacryorrhea and hypothermia. Necropsy findings, mainly involving the stomach were stomach adhesions, thickened walls and abnormal stomach contents. Although acute toxicity data for the inhalation or dermal routes of exposure are not available for methyltriacetoxysilane, these exposures will likely result in local site of contact effects from acetic acid. Methyltriacetoxysilane is severely irritating and corrosive to the skin, and corrosive to the eyes of animals and is likely to be a respiratory irritant based on production of acetic acid following hydrolysis.

In a 7-day oral range-finding study (gavage) rats were treated with undiluted ethyltriacetoxysilane (dose levels of 0, 17 (males), 23 (females), 100, 500 and 1000 mg/kg/d). Ethyltriacetoxysilane rapidly hydrolyzes (in seconds) to acetic acid and a trisilanol (3:1). The silanol generated is insignificant in both quantity and toxicity relative to the production of acetic acid and its associated toxicity. Animals from the 17 (males), 23 (females) and 100 mg/kg/day dose groups survived to day 7. Animals from the 500 and 1000 mg/kg/day dose groups were sacrificed after the third dose as a consequence of two deaths (one from each group), marked body weight loss, and severity of lesions (ulceration and erosion of stomach and esophagus) observed in necropsied animals. The stomach lesions observed resembled irritation from acetic acid production. This 7-day range-finder study indicated that a maximum dose level of less than 17 (males) and 23 (females) mg/kg/day would be required for a longer duration repeated dose study in order to avoid death or obvious suffering due to the corrosivity of the hydrolysis product, acetic acid. NOAELs following repeated exposure to acetic acid and its salts range from 210 mg/kg bw/day (2-4 month acetic acid drinking water study; systemic toxicity) to 3600 mg/kg bw/day (acetic acid, sodium salt, 4 week dietary study; no effects reported). Signs of irritation/corrosion at the site of contact as well as systemic toxicity have been reported. Prolonged inhalation exposure to acetic acid results in muscle imbalance, increase in blood cholinesterase activity, decreases in albumins and decreased growth at concentrations greater than 0.01 mg/m^3/day.

In vitro, methyltriacetoxysilane was negative in bacterial gene mutations assay and did not induce structural and numerical chromosome aberrations in CHO cells.

Groups of 20 mice/sex were given 0.025% sodium acetate in drinking water (about 60 mg/kg bw/day) for 1 week before breeding, during a 9-day breeding period and (females only) throughout pregnancy, lactation and until the offspring were weaned at 3 weeks of age. No effects on fertility were observed. The male offspring were given the same solution until they were 5-7 weeks old and were then examined in a 24-hour activity test. Examination of the litters revealed no overt deformities and normal pup weights at day 1 and day 21. The activity of offspring of the treated group was lower than that of controls during the first 12 hours but was similar during the second 12 hours. It is unknown if the decreased activity observed in the sodium acetate treated group to was a result of exposure in utero and/or post-weaning, since the pups were exposed during both time periods.). Acetic acid had no effects on implantation or on maternal or fetal survival in rats, mice or rabbits dosed via gavage during gestation days 6-19 at doses up to 1600 mg/kg/day. The number of abnormalities seen in either soft or skeletal tissues of the test groups did not differ from the number occurring in the controls. Sodium acetate had no effect on pregnant mice or offspring when mice were administered 1000 mg/kg bw, by gavage on days 8-12 of gestation.

Environment

The melting point of methyltriacetoxysilane is 41°C and the boiling point is 220°C at 1013 hPa. The vapor pressure is 0.26 hPa at 20 deg C. The estimated water solubility of methyltriacetoxysilane is 91 g/L; the estimated log Kow is 0.25. The water solubility and log Kow values may not be reliable because the chemical is hydrolytically unstable. The atmospheric half-life based only on photodegradation (i.e., reaction with hydroxyl radical) is 58 days. The atmospheric half-life based on photodegradation and hydrolysis is <2 min. However, photodegradation as a mode of removal is unlikely because methyltriacetoxysilane is highly reactive and hydrolytically unstable, such that acetic acid and methylsilanetriol are rapidly generated upon contact with water or water vapor. Consequently, reaction with water vapor is likely the predominant degradation process for methyltriacetoxysilane in air. The vapor pressure indicates that methyltriacetoxysilane resides in the atmosphere and may undergo photodegradation due to ozone and/or hydroxyl radicals. Due to the very fast hydrolysis, the substance is not expected to reside in air and vapor pressure of the substance may not be relevant.

Methyltriacetoxysilane is hydrolytically unstable over a range of environmentally relevant pH and temperature conditions. At pH 7, the half-life is = <12 seconds. Rapid hydrolysis of this material produces acetic acid and trisilanols.

Level III Fugacity modeling, using loading rates for Air, Soil, and Water of 1000 kg/h for each media, shows the following percent distribution: Air = 47.8%; Soil = 47.8%; Water = 4.3%; Sediment = 0.00%. However, methyltriacetoxysilane is unlikely to be found in the environment, as this material is hydrolytically unstable. Methyltriacetoxysilane is likely to be readily biodegradable based on results with a close structural analog, ethyltriacetoxysilane; however these materials rapidly hydrolyze and generate 3 moles of acetic acid for every mole of parent material. Thus, the biodegradation observed is likely reflective of the hydrolysis product, acetic acid. The biodegradation rate for acetic acid after 14 days under aerobic conditions is 74%. Bioaccumulation is not anticipated since this material is hydrolytically unstable.

Acute aquatic toxicity studies are available from two structural analogs, ethyltriacetoxysilane, and vinyltriacetoxysilane, as well as the primary hydrolysis product, acetic acid. The 96-hour LC50 of ethyltriacetoxysilane for *Brachydanio rerio* is 251 mg/L (the test media was not neutralized). The 96-hour LC50 of vinyltriacetoxysilane for *Oncorhyncus mykiss* is 51 mg/L and for *Lepomis macrochirus* is 68 mg/L (in both cases the test media was not neutralized). The 72 hour LC50s for acetic acid are 75, 79-88 (pH $\leq$5.9) and 251 mg/L (several species of fish). The 48 hour EC50 of ethyltriacetoxysilane is 62 mg/L for *Daphnia magna*. The 48 hour EC50 of vinyltriacetoxysilane is 100 mg/L for *Daphnia magna* (the test media was not neutralized). Under static conditions, the 48 hour EC50 value for acetic acid is 65 mg/L for aquatic invertebrates (the test media was not neutralized). When the test solutions are neutralized, the static 48 hour EC50 for acetic acid is 6000 mg/L. In renewal systems with aquatic invertebrates, 48 hour EC50s for acetic acid are 100 mg/L and 180 mg/L. Ethyltriacetoxysilane toxicity to *Scenedesmus subspicatus* provided a 72 hour EC50 of 73 and 76 mg/L for biomass and growth rate, respectively (the test media was not neutralized). When results are expressed on the basis of the amount of acetic acid generated from the hydrolysis reaction, the toxicity of the parent material is comparable to the reported toxicity of acetic acid (EC_{50} = 50-450 mg/L, depending on test species). Studies have been performed with a silanol monomer, trimethylsilanol (CAS No. 1066-40-6). Although this silanol is not expected to be produced following hydrolysis of methyltriacetoxysilane. A semistatic 96h study with trimethylsilanol and rainbow trout (*Oncorhynchus mykiss*) resulted in a No Observed Effect Concentration (NOEC) of 128 mg/L and an LC_{50} of 271 mg/L.

Exposure

The commercial use of this material is almost exclusively as a cross linker for silicone sealants and adhesives. The final formulated sealant and adhesive is sold in consumer markets. In production, this material is mostly handled in closed systems. Necessary engineering controls during production include proper ventilation, containment, safety equipment and actual hardware designed to minimize exposure, through splashing, or exposure to the air. Transfer of this material is in closed pipe, drums, or tanks rather than in open systems to minimize loss of this material (through hydrolysis). Methyltriacetoxysilane is transported from the production site as the parent silane to sealant formulators. The parent silane partially reacts during sealant formulation and then completely reacts during curing of the sealant into the polymer matrix and is no longer available for consumer or worker exposure. Methyltriacetoxysilane does not volatilize during cure of sealants. Instead this material hydrolyzes and condenses, releasing acetic acid. Therefore, there is no human exposure to methyltriacetoxysilane from use in silicones sealants. Generally, methyltriacetoxysilane is used as a cross linker at 3% to 5%. As methyltriacetoxysilane is compounded into a consumer or industrial sealant or adhesive, it reacts with the silicone. After curing the parent silane becomes cross linked into the silicone rubber matrix and no longer exists, this greatly reduces the potential for consumer or worker exposure. Any toxicological effects of the silane are greatly reduced as a result of this coupling process. The production volume of methyltriacetoxysilane in the sponsor country was 1389 tonnes in 2001.

The reactive nature of this material destroys the parent material in any moisture-containing environment, thus limiting environmental exposure to the parent silane. In a spill situation, the parent material is hydrolyzed; the rapid hydrolysis means that the parent silane is unlikely to be found in the environment. If methyltriacetoxysilane monomer is slowly released into the environment such that resulting concentrations of the parent compound are low, it is less likely that polymerization will occur and more likely that free triol or short-chain oligomers will result. The

spectrum of by-products will depend upon the initial concentration of the parent compound.

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

Human Health: The chemical possesses properties indicating a hazard for human health (severe irritation and corrosivity caused by acetic acid). Due to the extremely rapid hydrolysis to acetic acid and the corresponding trisilanol and based on exposure data presented by the Sponsor country, the parent material will not be available for exposure, and therefore this chemical is currently of low priority for further work. The identified hazards should nevertheless be noted by chemical safety professionals and users

Environment: The chemical has properties indicating a hazard for the environment (acute aquatic EC/LC50 values between 1 and 100 mg/l). However the chemical is currently of low priority for further work for the environment because of its rapid hydrolysis and its limited potential for bioaccumulation.