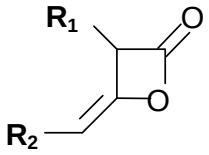
SIDS INITIAL ASSESSMENT PROFILE

CAS No.	84989-41-3* *CAS No 68390-56-7 is used in the USA
Chemical Name	2-Oxetanone, 3-C_{12-16}-alkyl-4-C_{13-17}-alkylidene (Alkyl Ketene Dimer, AKD)
Structural Formula	 $R_1 = C_{12-16}$, $R_2 = C_{12-16}$

SUMMARY CONCLUSIONS OF THE SIAR

Human Health

There are no specific toxicokinetic data for alkyl ketene dimer (AKD). Due to the high lipophilicity and the effects in rat feeding studies, intestinal absorption and distribution in the body is anticipated. Cross reading from a newly developed alkyl ketene dimer demonstrated that dermal absorption is very low. AKD is of low toxicity after a single exposure (LD_{50} oral, rat >40 000 mg/kg bw). It is neither irritating to skin and eyes nor a skin sensitiser, as concluded from experimental animal and human studies. AKD was not genotoxic *in vitro* (three Ames tests and a mammalian cell chromosomal aberration test). There are no other data regarding the carcinogenic potential of AKD. In an OECD TG 422 screening test, repeated oral gavage of 100, 350 and 1000 mg/kg bw/day to rats resulted in inflammation of several organs, including female reproductive organs. As a result of ovary inflammations, an increase in pre-implantation losses (the number of implantation sites compared to corpora lutea was reduced) was observed at all doses; this effect is secondary to the general organ inflammation and therefore not a specific reproductive effect. No effects on male reproductive organs and pup development were observed. In a 90-day feeding study in rats inflammation of several organs (typically lymph nodes, liver, heart, kidney, pancreas and lung) were observed at concentrations of 650 ppm and 6500 ppm (which was the highest dose tested) in the feed; at a concentration of 65 ppm in the feed no adverse effects were observed. The LOAEL was 63.4 and 69.6 mg/kg bw/day and the NOAEL was 6.3 and 6.8 mg/kg bw/day for males and females, respectively (estimated from dietary concentrations of 650 and 65 ppm, respectively). The observed inflammation is considered a generic response in the rats to higher molecular weight hydrocarbons, and is not considered to be a response specific to AKD.

Environment

Alkyl ketene dimer (AKD) is a waxy solid material with a low melting point. i.e., between 43.6 °C and 56.4 °C, and decomposes above 200° Celsius without boiling. It has a very low solubility in water, predicted to be 5.6×10^{-7} to 4.8×10^{-11} mg/l. Its predicted Log Kow of 11 – 15 suggests a high bioaccumulation potential. Its vapour pressure is predicted to be very low, 5.85×10^{-13} – 6.12×10^{-10} hPa. Distribution modelling using Mackay Level I indicates that AKD will partition to sediment and soil (49.54% to soil and 50.10% to sediment) and the estimated Koc of 1.51×10^{7} - 2×10^{9} indicates that AKD will adsorb strongly to soil and sediments. Its Henry's law constant is predicted to be 46 – 648 indicating that AKD could partition from water into the atmosphere but in practice this is unlikely to be

an important route of transport in the environment due to its low water solubility.

AKD is predicted to photodegrade rapidly in air with a half life for indirect photolysis of 3.7 hours. Studies on the hydrolysis of commercial AKD preparations show that AKD hydrolyses readily under neutral and alkaline conditions but only slowly under acid conditions. Half lives of between 23 – 140 hours have been calculated for AKD emulsion at 30˚C, pH 8, under the conditions of a paper mill. There is no information available on the hydrolysis half lives in the aquatic environment. Based on the available data, AKD is expected to hydrolyse readily under neutral and alkaline conditions in the environment and is assumed to be stable to hydrolysis at acidic pHs in the environment, pH 5-7. AKD has been shown to be readily biodegradable when tested in the presence of small amounts of emulsifier, used to increase bioavailability of the substance to micro-organisms, with >94% biodegradation in 28 days.

Alkyl ketene dimer showed no toxicity in acute toxicity tests on the fish *Danio rerio*, the aquatic invertebrate Daphnia magna and the algae *Selenastrum capricornutum*. The E/LC50s were all above the water solubility limit. In a 21 day reproduction test with *Daphnia magna*, conducted on a dispersion of AKD, no effects on either reproduction or growth were observed at the highest concentration tested (mean measured concentration of 0.8 mg/l). This indicates that the NOEC is greater than the water solubility limit. There is no data available on toxicity to sediment dwelling organisms. AKD is not inhibitory to activated sludge microorganisms, in an activated sludge respiration inhibition test the 30 minute EC20 was > 1000 mg/l.

AKD is of low acute toxicity to plants and earthworms. The 14d EC50 (emergence) and 28d EC50 (vegetative growth) for oat (*Avena sativa*), sunflower (*Helianthus annuus*) and mung bean (*Phaseolus aureus*) were all > 1000 mg/kg soil. The 14 day LC50 for the earthworm *Eisenia foetida* is >1000 mg/kg.

Exposure

Alkyl ketene dimers are produced in a Best Available Technology [BAT] closed process in Belgium, China, France, Finland, Germany, Italy, Japan, Sweden, United Kingdom and United States of America. The total production volume amount is between 10 000 and 50 000 tonnes per annum. AKD is normally transported and used as a dispersion containing between 5 and 25% AKD.

Alkyl Ketene Dimer [AKD] is used exclusively as a process chemical by the paper industry to add some hydrophobic character to the surface of the cellulose fibres. This is traditionally known within the industry as “sizing”. Typical examples of paper products manufactured with AKD are office paper, liquid packaging board and folding-box board. The amount used is between 0.05 and 0.3% by weight of the end product.

Releases into the environment may occur during the production and processing of AKD. AKD itself is unlikely to be detected in paper as it either reacts with the cellulose to form a covalent bond or with the water present in the paper making system to form the dialkyl ketone. Releases of AKD itself are therefore not anticipated from paper recycling. Release of AKD to wastewater treatment plants could potentially occur from production, formulation and paper making sites.

A survey completed by the GPA consortium demonstrated that, for the five production sites covered by the survey, 29 people (2 of whom were female) worked continuously with the product and another 20 people (no females) worked intermittently, i.e., up to 50% of their time. The recommended personal protection equipment [PPE] included gloves, goggles and overalls in the manufacturing, maintenance and disposal/waste management areas.

Consumer exposure to AKD is negligible because it is only used in the manufacture of paper and board. Paper made with AKD can be used in the manufacture of packaging materials intended to come into contact with food. However, the AKD itself will not be detected in the paper as it will have either reacted with the cellulose fibre to form a covalent bond or with the water present in the paper making system to form the dialkyl ketone. AKD has many national approvals for use in food contact packaging materials, e.g., in America, France, Germany, Italy and The Netherlands.

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

Human Health: The chemical possesses properties indicating a hazard for human health (inflammation of several organs following repeated oral exposure, and secondary to this, pre-implantation loss). Based on data presented by the Sponsor country, exposure to humans is anticipated to be low, and therefore this chemical is currently of low priority for further work. Countries may desire to investigate any exposure scenarios that were not presented by the Sponsor country.

Environment: The high Log Kow of AKD suggests it has a high bioaccumulation potential. However, the concern that AKD could cause long term effects in the environment is reduced by the data which indicate that AKD is readily biodegradable by micro-organisms when tested in the presence of a 1.5% concentration of emulsifier and hydrolyses under neutral and alkaline conditions. AKD shows low acute toxicity to aquatic organisms, plants and earthworm and low chronic toxicity to Daphnia and algae. It is therefore of low priority for further work due to its low hazard potential.