SIDS INITIAL ASSESSMENT PROFILE

CAS No.	1313-13-9
Chemical Name	Manganese dioxide
Structural Formula	O=Mn=O

SUMMARY CONCLUSIONS OF THE SIAR

Human Health

A diet containing manganese dioxide (MnO_2) induced significant differences in manganese (Mn) levels in the liver, lung and kidney in mice. Histological examinations revealed some scattered inflammatory foci (macrophages and mononucleated cells) in the lung of rats dosed with MnO_2. The exposure to manganese (as MnO_2) is more readily accumulated in the blood and brain sub-regions via intraperitoneal injection > intratracheal instillation > oral gavage. Following the administration of manganese to rats, some manganese crosses directly from the blood to the bile, but most of the manganese is excreted into the bile. The elimination of manganese from the brain, and in particular, from the cerebrum, is much slower compared to the whole body.

Manganese dioxide is of low acute toxicity. The inhalation LC_{50} is > 1500 mg/m^3 for 4-hr exposure in rats [OECD TG 423]. The dermal LD_{50} is 2000 mg/kg bw in rats [OECD TG 402]. The oral LD_{50} is > 2197 mg/kg bw in male rats.

No reliable animal and human data are available for skin/eye irritation and sensitisation.

In humans, high occupational exposure to manganese is known to result in neurotoxicity. In addition, chronic inhalation of manganese dioxide particulates have been reported to lead to lung damage such as cough, bronchitis, pneumonitis, pneumonia, and minor reductions in lung function, and impaired visual reaction time, hand-eye coordination, and hand steadiness at the concentrations of total dust ranging from 0.073 to 17.158 mg/m^3 (0.046 - 10.840 mg Mn/m^3) and in respirable dust from 0.033 to 2.09 mg/m^3 (0.021 - 1.32 mg Mn/m^3).

Rhesus monkeys were exposed in a repeated inhalation toxicity study to manganese dioxide dust at the concentrations of 0, 0.7 and 3 mg Mn/m^3 for 22 hours daily for a duration of 10 months. The LOAEL was 1.1 mg/m^3 MnO_2, based on inflammation in the lung. In dietary studies, the short-term or long-term effects of manganese dioxide were investigated with male ddy mice. The LOAELs in male mice were 275 and 276 mg Mn/kg/day based on decreases in the white blood cell count (100-day study), body weight gain and locomotor activity (12-month study). These animal studies had limitations, in particular in relation to the neurotoxicity endpoint and no reliable NOAEL could be derived.

A bacterial reverse mutation assay [OECD TG 471] on manganese dioxide with and without metabolic activation suggested that this chemical was not mutagenic in *Salmonella typhymurium* TA1535, TA100, TA98, TA 1537 and *Escherichia coli* WP2 *uvrA*. However, manganese dioxide elicited positive results in *in vitro* chromosomal aberration test [OECD TG 473] for CHL/IU cell and in *in vivo* mammalian erythrocyte micronucleus assay [OECD TG 474]. The available information suggests that manganese dioxide is genotoxic.

No reliable standard study is available for carcinogenicity.

A single dose of manganese dioxide (250 mg/kg) in rabbits caused severe degenerative changes in the seminiferous tubules and these effects led to sterility. In an inhalation study in mice, effects on pup body weight and locomotor activity were observed at the dose of 61mg/m^3/day, the only dose used. A NOAEL for developmental toxicity could therefore not be derived. In humans, firm conclusions on the reproductive toxicity of manganese dioxide cannot be determined from the equivocal fertility data reported for male workers and the lack of data for females.

Environment

Manganese dioxide is a brownish-black powder with a density of 5.08g/cm^3 It occurs in nature as the mineral pyrolusite. No reliable measured data are available for water solubility, however based on thermodynamic considerations, manganese dioxide is considered to be almost insoluble in surface water.

Due to its inorganic properties, no applicable data are available for vapour pressure, partition coefficient in n-octanol/water, photodegradation and biodegradation. Regarding hydrolysis, this chemical is stable in water and soil. The oxidation state of manganese of MnO_2 is +4 which exists mostly as a precipitated form.

Manganese dioxide is of low toxicity to aquatic organisms (fish, aquatic invertebrate and algae) and earthworm (*Eisenia foetidas*). The following toxicity tests for manganese dioxide with aquatic organisms are available:

Acute toxicity:

Oryzias latipes: 96-hour LC_{50} : no effects at saturation, (100 mg/L, nominal concentration)

Daphnia magna: 48-hour EC_{50} : no effects at saturation , (100 mg/L, nominal concentration)

Pseudokirchneriella subcapitata : 72-h ErC_{50} , 72-h EbC_{50}: no effects at saturation (100 mg/L, nominal concentration)

Eisenia foetida: LC_{50} >1000mg/kg

Exposure

Manganese dioxide is used in the manufacturing of dry cell batteries and in the chemical industry as an oxidizing agent for the production of potassium permanganates and other manganese chemicals. In addition, it is commonly used in the production of matches, fireworks, porcelain and glass-bonding materials, and amethyst glass. In the Republic of Korea, releases into the environment are controlled during production and processing by employing bag filters, scrubbers, waste treatment plants, etc.

In the Republic of Korea, estimated usage volume of manganese dioxide was 2914 tonnes in 2002. In addition, the import volumes of manganese dioxide were decreased by 1.7%, 4591 tonnes in 2001 to 4515 tonnes, in 2002. However, in 2003, importing rates of manganese dioxide were increased by 7.4% (4819 tonnes) and 19.2% (5782 tonnes) in 2004.

In the user facilities of the Republic of Korea, filtered air is emitted and dust collected in the filter is deposited in the landfills. Wastewater is treated in the facilities and transported via the sewage system to wastewater treatment plants, and then the sludge is deposited in landfills. Waste and defective batteries are also disposed to landfill sites. The monitoring data showed that ranges of manganese concentrations in ambient air and in sewages are of 7.87~27.6 mg/m^3 and of 0.150~0.699 mg/L, respectively. The Mn concentrations are below the emission limit values of 100 mg/m^3 and 10 mg/L, respectively. Therefore, the exposure to the environment is expected to be low.

In the Republic of Korea, the occupational exposures are controlled during processing by wearing personal protective equipment (PPE) such as dust masks, goggle, and protective clothing. The material including MnO_2 is transferred into closed pipes or containers automatically excluding loading and packaging process and therefore occupational exposure would be considered low. According to the monitoring data, the 8hr-TWA (Time Weighted Average) concentrations of manganese were 0.0177 - 0.0631 mg/m^3 in the workplaces, which are below the occupational exposure limit of 5 mg/m^3. Although there is some potential for consumer exposure to MnO_2 via batteries, this is considered to be unlikely under normal handling conditions and therefore consumer exposure is considered to be very low.

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

Human Health: Manganese dioxide is of low priority for further work. This chemical possesses properties indicating a hazard for human health such as repeated dose toxicity, genetic toxicity, and reproductive toxicity including developmental toxicity. Based on data presented by the Sponsor country related to an unknown fraction of global production and relating to the use pattern in one country, exposure to humans is anticipated to be low. Countries may desire to investigate any exposure scenarios that were not presented by the Sponsor country.

Environment: This chemical is of low priority for further work because of its low hazard profile.