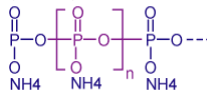


SIDS INITIAL ASSESSMENT PROFILE

CAS Nos.	7722-76-1, 7783-28-0, 68333-79-9, 8011-76-5, 65996-95-4
Chemical Names	<u>Phosphate category</u> : Monoammonium phosphate (MAP), Diammonium phosphate (DAP), Ammonium polyphosphate (APP), Single superphosphate (SSP), Triple superphosphate (TSP)
Structural Formula	<p>MAP: $\text{NH}_4\text{H}_2\text{PO}_4$ DAP: $(\text{NH}_4)_2\text{HPO}_4$</p>  <p>APP: $\text{[O=P(O)(OH)-O-P(O)(OH)-O]}_n\text{NH}_4$ SSP: main components: $\text{Ca}(\text{H}_2\text{PO}_4)_2 \cdot \text{H}_2\text{O} / \text{CaSO}_4 \cdot \text{H}_2\text{O}$ TSP: $\text{CaHPO}_4 \cdot 2\text{H}_2\text{O}$</p>

SUMMARY CONCLUSIONS OF THE SIAR

Category/Analogue Rationale

The category consists of monoammonium phosphate (MAP; CAS No. 7722-76-1), diammonium phosphate (DAP; CAS No. 7783-28-0), ammonium polyphosphate (APP; CAS No. 68333-79-9), single superphosphate (SSP; CAS No. 8011-76-5), and triple superphosphate (TSP; CAS No. 65996-95-4). All members of the category are mainly or exclusively used as fertilizer and have one common functional group (phosphate) that equilibrates between several different ionic species [H_3PO_4 , H_2PO_4^- , HPO_4^{2-} , HPO_4^- , or PO_4^{-3}] depending on the pH of the environment. Thus, chemical reactions for all compounds in this category are similar with the exception of the actual dissociation product, which forms calcium or ammonia along with common phosphate moieties. However, the presence of the ammonium ion will influence the observed toxicity and its data are used to conservatively represent the toxicity of the category members.

Under typical environmental conditions, the phosphate would be present as monohydrogen phosphate (HPO_4^-) or dihydrogen phosphate (H_2PO_4^-) with the equilibrium favoring H_2PO_4^- as the acidity of the environment increases. Under these conditions, the proportions of phosphoric acid (H_3PO_4) and the phosphate anion (PO_4^{-3}) would be extremely low.

For the three ammonium phosphates, with increasing pH, a greater portion of the ionized ammonium will be converted to nonionized ammonia. However, an increase of pH may be limited due to the buffering capacity of hydrogenphosphate and dihydrogenphosphate.

In the case of SSP and TSP data from the major compounds calcium superphosphate (CAS No. 7758-23-8) and calcium sulphate have been presented to assist with addressing the physical chemical properties.

Human Health

Phosphates are absorbed from the gastrointestinal tract as orthophosphate. In adults about two thirds of ingested phosphate is absorbed from the gastrointestinal tract and almost entirely excreted into the urine.

The acute oral LD_{50} in rats was >2000 mg/kg bw for MAP, DAP, and APP. No signs of toxicity were observed. Clinical signs in an additional oral study with MAP ($\text{LD}_{50} = 3,250$ mg/kg bw)

included sedation, convulsions, tremors, ataxia, prostration. The acute dermal LD₅₀ in rats was >5000 mg/kg bw (for MAP, DAP, and APP). These dermal studies also showed no clinical signs of toxicity.

The phosphates are slightly irritating to skin and slightly to moderately irritating to eyes in animal studies and a respiratory tract irritant in humans. No animal data are available on skin sensitization.

In a gavage study performed according to OECD TG 422, male and female rats were administered 0, 250, 750 and 1,500 mg/kg bw of DAP for 35 days (7 days/week). In males activated partial thromboplastin time was reduced at 750 and 1,500 mg/kg bw/day. Blood chemistry deviations found in males included alkaline phosphatase levels (increased at 750 and 1,500 mg/kg bw/day), glucose and phosphorous levels (reduced at 1,500 mg/kg bw/day) and total protein (reduced at 750 and 1,500 mg/kg bw/day with a slightly increased albumin/globulin ratio at the high dose). Changes in females were limited to decreased phosphorous levels and non-significantly increased alkaline phosphatase levels at 1,500 mg/kg bw/day. Histological examination of the stomach revealed some submucosal inflammation at all doses, but was not dose-dependent. The NOAEL was set at 250 mg/kg bw/day.

In a similar gavage study (according to OECD TG 422), granular TSP was administered at 0, 250, 750 and 1,500 mg/kg bw for 35 days (7 days/week) to male and female rats. Platelet counts were increased and activated partial thromboplastin time was decreased at 1,500 mg/kg bw in both sexes. White blood cells were increased in females at 750 and 1,500 mg/kg bw. Neutrophil and basophil counts were increased at 1,500 mg/kg bw in females. Total plasma protein level was reduced at 750 and 1,500 mg/kg bw in both sexes. Phosphorus levels were decreased at 750 and 1,500 mg/kg bw in both sexes. Calcium levels were decreased at 750 and 1,500 mg/kg bw in males, and bilirubin levels were decreased at 1,500 mg/kg bw in females. Males at 1,500 mg/kg bw displayed decreased motor activity. Histopathological examination of the stomach revealed degenerative/inflammatory changes at all dose levels in both sexes, probably due to irritant effects of the administered test substance formulation; a dose-response wasn't seen. Minimal cortical tubular basophilia were observed in the kidney among most males in all dose groups and one female per dose group. Horizontal banding of the enamel of the incisors was observed at 750 and 1,500 mg/kg bw in both sexes and one male at 250 mg/kg bw, which may be related to phosphorus or calcium ion imbalances. The NOAEL is considered to be <250 mg/kg bw, because of degenerative changes in the stomach and kidney at all dose levels.

From a spirometer test performed with DAP plant workers, it was concluded that the pulmonary alveoli can be affected after longer exposure resulting in restrictive types of lung disorders.

DAP and TSP were negative in the Ames test with and without metabolic activation and chromosomal aberration test.

In the combined general toxicity and developmental/reproduction studies with DAP and TSP in rats described above, no effects on reproduction were reported up to 1,500 mg/kg bw/d. No developmental effects were observed for DAP up to 1,500 mg/kg bw/d although TSP showed a decrease in body weight of female offspring at 1,500 mg/kg bw/d. The NOAEL for reproductive toxicity was 1500 mg/kg bw/d for DAP and TSP. The NOAEL for developmental toxicity is 750 mg/kg bw/d based TSP.

Environment

The phosphates in this category are soluble in water (18g/L to completely miscible) and their vapour pressures are minimal (although ammonium phosphates may release some ammonia gas). These phosphates decompose at ≥ 150 °C, and their physical state is solid, except APP, which is liquid (at 20°C and 1.013hPa). Any phosphate salt released into the environment will be distributed between water and soil. Land-applied phosphate and ammonium are adsorbed to soil particles. Ammonia may be released from the soil more easily than phosphate by cation exchange. In natural waters with high pH, ammonia containing category members may elicit ammonia toxicity. Soil bacteria may convert ammonium to nitrate, which can be taken up by plants or

denitrified by micro-organisms to nitrogen and nitrous oxide gas.

In water the phosphate salts may result in eutrophication (caused by ammonium and phosphate ions), which may lead to increased algal growth. Decomposition of the algae may in turn result in lower dissolved oxygen concentrations. If dissolved oxygen concentrations are lowered significantly, suffocation of other aquatic organisms may occur.

In acute fish studies, 96-hr LC₅₀ values were >85.9 and >101 mg/L for MAP and APP, respectively in *Oncorhynchus mykiss*. Exposure to DAP of *Cirrhinus mrigala* juveniles resulted in 96-hr LC₅₀ values of 1,700 mg/L for fry and 1,875 mg/L for fingerlings at 21°C.

In an acute study with *Daphnia carinata* using commercial grade superphosphate the 72-hr EC₅₀ value was 1,790 mg/L.

Acute algal tests with *Pseudokirchneriella subcapitata* resulted in NOEC values of 97.1 mg/L for DAP and 87.6 mg/L for TSP.

Exposure

The global market for phosphates is estimated to be ca. 50 million metric tonnes annually. The substances are mainly used as fertilizer and APP is exclusively used as a fertilizer.

Occupational exposure occurs during manufacturing and during use as fertilizer. The dermal and inhalation routes will be the most important routes of exposure.

Environmental exposure is mainly dependent on the amount of fertilizer used on fields, the climatic conditions, and the hydrological conditions of the area of application.

Consumer exposure may occur from food additives (MAP and DAP are generally recognised as safe; 21 CFR 582.1141), fertiliser use, drinking water and use in dental cements and flame retardants.

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

Human Health: The chemicals are of low priority for further work. The chemicals possess properties indicating a hazard for human health (slight skin and eye irritation, and respiratory tract irritation, repeated-dose toxicity, and body weight changes in offspring). These hazards do not warrant further work as they only become evident at extreme exposure levels. They should nevertheless be noted by chemical safety professionals and users. Countries may desire to investigate any exposure scenarios that were not presented by the Sponsor country.

It is recommended that the use of the chemicals as fertilizers be taken into account when assessing the exposure of nitrite and nitrate to humans through drinking water.

Environment: The chemicals in this category are currently a low priority for further work based on their low hazard profiles. However, the possibility of eutrophication should be considered as well as the potential toxicity of ammonium/un-ionized ammonia at higher pH for the ammonium phosphate compounds.

Note: Additional ammonium salts are being considered at SIAM 24 in the ammonia compounds category.