File No: SN/6

October 1999

NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME

FULL PUBLIC REPORT

Component of AERO® 6697 Promoter

This Assessment has been compiled in accordance with the provisions of the *Industrial Chemicals (Notification and Assessment) Act* 1989 (the Act) and Regulations. This legislation is an Act of the Commonwealth of Australia. The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) is administered by the National Occupational Health and Safety Commission which also conducts the occupational health & safety assessment. The assessment of environmental hazard is conducted by the Department of the Environment and the assessment of public health is conducted by the Department of Health and Aged Care.

For the purposes of subsection 78(1) of the Act, copies of this full public report may be inspected by the public at the Library, National Occupational Health and Safety Commission, 92-94 Parramatta Road, Camperdown NSW 2050, between the following hours:

Monday - Wednesday	8.30 am - 5.00 pm
Thursday	8.30 am - 8.00 pm
Friday	8.30 am - 5.00 pm

Copies of this full public report may also be requested, free of charge, by contacting the Administration Coordinator on the fax number below.

For enquiries please contact the Administration Coordinator at:

Street Address: 92 Parramatta Rd Camperdown, NSW 2050, AUSTRALIA
Postal Address: GPO Box 58, Sydney 2001, AUSTRALIA
Telephone: (61) (02) 9577-9514 FAX (61) (02) 9577-9465

Director
Chemicals Notification and Assessment

FULL PUBLIC REPORT

Component of AERO® 6697 Promoter

1. APPLICANT

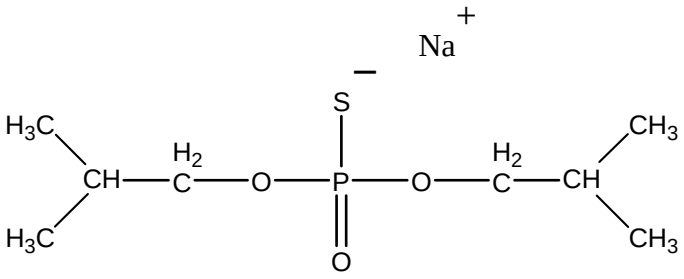
Cytec Australia Holdings Pty Ltd of Suite 1 First Floor 7 – 11 Railway St BAULKHAM HILLS 2153 has not applied for any information relating to Component of AERO 6697 Promoter to be exempt from publication in the Full Public and Summary Reports.

In the original notification (NA/221), the imported chemical was for export only. Therefore, the notifier was granted a variation for the following information: hydrolysis as a function of pH; adsorption/desorption; dissociation constant; skin sensitisation; repeated dose toxicity and chromosome damage. As the chemical is now to be used in Australia, the notifier has provided this additional information and it is included in this report together with the information previously assessed.

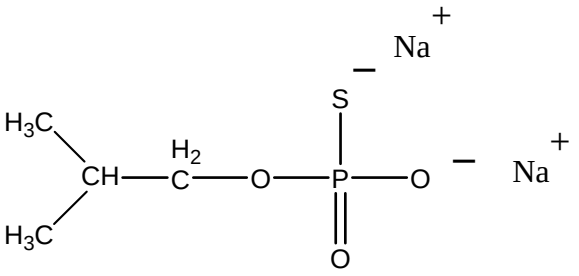
2. IDENTITY OF THE CHEMICAL

Chemical Name:	Phosphorothioic acid, O,O-bis(2-methylpropyl) ester, sodium salt
Chemical Abstracts Service (CAS) Registry No.:	53378-52-2
Other Names:	sodium diisobutyl monothiophosphate isobutyl sodium phosphorothioate S-6697 (42% aqueous solution)
Marketing Name:	AERO® 6697 PROMOTER (42% aqueous solution)
Molecular Formula:	$C_8H_{19}O_3PS.Na$

Structural Formula:



Di-ester



Mono- ester

Molecular Weight: 249

Method of Detection and Determination: infrared (IR) spectroscopy

Spectral Data: major IR peaks were as follows: 600, 800, 830, 900, 950, 1 000, 1 100, 1 350, 1 375, 1 500, 2 850, 2 950 cm^{-1}

Comments on Chemical Identity

The notifier indicates the new chemical is the diisobutyl ester of mono thiophosphoric acid. As depicted in the notification dossier, the two isobutyl moieties are esterified through the oxygen atoms as in a conventional phosphate ester and the sulphydryl group of the thiophosphoric acid is apparently not esterified. In the commercial product, the sulphydryl group is neutralised with sodium hydroxide, and the resultant salt is extremely water soluble. The new chemical is supplied and used as a 50% solution of this salt in water.

While the purity is stated as > 92%, the titration curve supplied with the dossier indicates two end points when the material is titrated with hydrochloric acid, indicating the presence of some monoisobutyl ester in the commercial product. This is addressed further in section 3.

3. PHYSICAL AND CHEMICAL PROPERTIES

Unless otherwise stated, the physicochemical properties listed are those of Aero 6697 Promoter, the 42% aqueous solution of the notified chemical.

Appearance at 20°C and 101.3 kPa:	clear yellow liquid with strong sulphurous odour
Boiling Point:	100 °C (for aqueous solution).
Specific Gravity:	1 120 – 1 160 kg/m^3
Vapour Pressure:	see notes below
Water Solubility:	600 g/L at 25°C - see notes below
Partition Co-efficient (n-octanol/water):	not determined (see comments below)
Hydrolysis as a Function of pH:	slowly hydrolyses under acidic (low pH) conditions (see comments below)
Adsorption/Desorption:	not determined (see comments below)
Dissociation Constant:	pK_a is low (see comments below)
Flash Point:	> 93.3°C
Flammability Limits:	not flammable
Autoignition Temperature:	not self-igniting
Explosive Properties:	not explosive
Reactivity/Stability:	the product will react with strong oxidising agents and acids

Comments on Physico-Chemical Properties

The melting point, boiling point and specific gravity data supplied are for the 50% aqueous solution of the sodium salt, which is the form in which the chemical will be imported and used.

The chemical is supplied and used as an aqueous solution of the sodium salt, and as such is expected to have negligible vapour pressure.

Although no report was submitted, the indicated high water solubility is consistent with the ionic nature of the notified chemical.

A report on hydrolytic degradation as a function of pH was submitted. In this study the degradation at 50°C of a 0.1 M solution (25 g/L) in buffered solutions of pH 4.6, 6.9 and 9.0

was studied using ^{31}P NMR. After one week under these conditions no discernible degradation had occurred for the pH 9 and pH 6.9 solutions, but around 15% degradation had occurred in the pH 4.6 solution. These results indicate stability under neutral and alkaline conditions, but some susceptibility to hydrolysis in acidic conditions. Hydrolytic degradation is expected to produce 2-methyl propanol and thiophosphate ions. The product Aero 6697 Promoter as produced has a pH ≥ 13.0.

The notifier indicated that the new chemical is expected to be surface active, as the compound contains non polar hydrocarbon groups bonded to the highly polar (ionic) head group. Consequently determination of n-octanol/water partition coefficient and adsorption/desorption data would be difficult. In any case, the very high water solubility indicates the chemical would have very little affinity for organic matter, and may also be expected to be very mobile in soils.

As the new chemical is the salt of a strong acid, the pKa is low. Titration data submitted with the application indicates two end points, one corresponding to an apparent pKa of approximately 3 and the other to a pKa of around 8. These appear to correspond to the first and second dissociations of the mono- and di- substituted phosphate esters whose anions are depicted in the structural formula above.

On the basis of the pH (≥ 13), Aero 6697 Promoter is a Class 8 (Corrosive) dangerous good.

4. PURITY OF THE CHEMICAL

Degree of Purity: ≥ 92%

Hazardous Impurities:

Chemical name:	sodium hydroxide
CAS No.:	1310-73-2
Weight percentage:	0.5%

Non-hazardous Impurities (> 1% by weight):

Chemical name:	sodium diisobutyl dithiophosphate
CAS No.:	53378-51-1
Weight percentage:	3%

Additives/Adjuvants: none

5. USE, VOLUME AND FORMULATION

The notified chemical is used as a gold or copper collector for the froth flotation of sulphide minerals. It is to be imported as a 50% aqueous solution at 20 tonnes/year for the first 2 years and 50 tonnes/year in the following 3 years.

The notified chemical will be imported in 200 L drums or 1 000 L intermediate bulk containers (IBC).

6. OCCUPATIONAL EXPOSURE

Imported notified chemical will be unloaded and transported to the notifier's chemical warehouse by 3 – 6 workers and handled by 2 – 3 workers at the warehouse. Transport and storage workers may handle containers for 2 – 3 hours/day, 10 – 15 days/year. They may be exposed to the notified chemical in the event of accidental spillage.

Ore treatment by plant operators (6 – 12 workers, 1 – 8 hours/day, 300 days/year) involves transfer of the notified chemical from 200 L drums or IBC by pumping or gravity feed to a flotation cell where it mixes and chelates the ore. Therefore, there is potential for dermal and possibly ocular exposure during connecting and disconnecting lines and cleaning pumping and ancillary apparatus. The concentration of the chemical in the slurry is approximately 2.5 – 25 ppm (0.0025%). The chelated metal, including the notified chemical is successively concentrated. The transfer, mixing and flotation process are automated, continuous and recycling, with little need for worker intervention. The reagent storage and flotation areas are open and well ventilated. The notifier states that plant operators in the reagent storage area are required to wear respirators, impervious gloves, coveralls and eye protection due to the presence of other hazardous chemicals. The notifier states that personnel in other areas will be required to wear impervious gloves, coveralls and chemical splash goggles. The metal concentrate is stockpiled before removal from the mine to the smelter.

7. PUBLIC EXPOSURE

As the notified chemical will only be used for the process of flotation extraction of gold and copper, public exposure is unlikely.

The notified chemical may be dispersed following a transport accident. As the notified chemical is an aqueous solution and the compound is neither volatile nor flammable, in solution, the primary potential route of exposure is via contamination of waterways. The emergency procedures provided by the applicant specify that any spilt material must be contained within dykes to prevent entry to waterways, adsorbed onto sand or similar material and disposed of in accordance with local regulations.

8. ENVIRONMENTAL EXPOSURE

Release

The chemical functions as a flotation reagent, and most (the notifier indicates around 70%) remains bound to the mineral surfaces, and consequently becomes incorporated in the copper sulphide concentrates.

The ore is firstly crushed to the size of pebbles (around 5 mm mean diameter), and then mixed with water and finely ground in a ball mill circuit to produce a slurry of fine mineral and waste rock particles. In a typical benefaction mill, the slurry (usually termed pulp) issuing from the ball milling process is 55-60% solids, and at this point the minerals and rock have been reduced to a mean diameter of 40-50 micron. After having been reduced in this fashion, the mineral particles are small enough to be separated from the unwanted waste material (termed gangue) in the flotation circuit.

The gangue material usually comprises clay minerals, and in sulphide ore deposits invariably contains a high percentage of iron pyrite.

The pulp is pumped to a "conditioning" tank where the flotation reagent is added from the 200 L drums through a metered dosing pump, and thoroughly mixed with the slurry. The residence time in this tank is sufficient to allow the reagent(s) to react with (adsorb to) the surface of the desirable sulphide minerals. After conditioning, the slurry is usually diluted to around 30% solids with more water, and pumped to the flotation machines where the sulphide minerals attach themselves to air bubbles (generated by a turbine at the bottom of the flotation chamber), and float to the surface of the pulp. Here they are skimmed off, collected and filtered. The solids are then further dried to produce the final mineral concentrate which is then either exported, or transported to a copper smelter to be refined into copper metal.

The gangue material (which has not been made sufficiently hydrophobic to attach to the bubbles) remains in the slurry, and is pumped out of the flotation cells to the tailings thickener. Here this waste is allowed to settle (usually with the aid of flocculants) into a high solids pulp, and then pumped to the tailings storage dam for final disposal. The excess water overflows from the thickener, and is returned to the flotation process. The tailings slurry is then pumped to tailings storage dams where the solids settle to the bottom and the excess water forms a shallow layer overlying these solids. This water usually becomes highly polluted with acid and dissolved heavy metals (see further below), and is allowed to evaporate in shallow, large surface area ponds called evaporation dams.

These are eventually smelted for recovery of copper metal and the high temperature of the furnaces would destroy the compound (see further below). Some of the remaining reagent becomes attached to the surface of the gangue (waste) minerals which are deposited into the tailings dams. However, the compound has a low affinity for the surface of these particles, and only a fraction of the reagent is released in this manner. The notifier indicates that typically 10% of the reagent would be disposed of with the tailings, while the remaining 20% stays dissolved in the water and is reused in the flotation process.

The reagent disposed of with the tailings, either attached to gangue particles or dissolved in

the water, is not likely to be released to the wider environment. The tailings dams are sealed with special geo-textile lining fabric designed to prevent influx or efflux of water. In any case, the compound is expected to have a short residence time in these dams and decompose under the low pH conditions expected to prevail in tailings dams (see further below).

Fate

The use pattern of the compound is such that most (more than 70%) is expected to be exported with the metal concentrates, and the remainder will be associated with the tailings solids and waters, and confined to the tailings dams.

The material exported with the concentrates will be destroyed in the smelters, with production of water vapour and oxides of carbon and sulphur. During the smelting of sulphide ores, most of the contained sulphur (including the sulphur content of the attached promoter reagent) is oxidised to sulphur dioxide, then used in the production of sulphuric acid. The phosphorus content of the reagent would be converted to phosphate and form metal salts. These would become associated with the solids in the smelter slag, and deposited into landfill or where appropriate, used for backfill or other construction.

The notifier indicated that around 10% of the reagent will become attached to solid particles of gangue (waste) and sent to the tailings dams, and some would remain in the tailings dam water. It is a characteristic of most sulphide metal mines that pyrite and other gangue metal sulphides slowly oxidise when exposed to air with production of sulphuric acid and solutions of iron, copper and zinc metal sulphates. Consequently the water in the tailings dams becomes very acidic (pH 1-2 is common) and highly polluted with heavy metal sulphates. The new compound is susceptible to hydrolysis at low pH and is expected to quickly decompose to 2-methyl propanol and thiophosphate ions. These two products would be slowly degraded through chemical and physical processes (eg ultraviolet light, and photolysis) to simpler compounds.

No biodegradation data was supplied with the notification, and a variation to the Schedule was sought by the notifier. The use pattern of the chemical is such that very little will be released to natural waterways containing the usual bacteria and other biota capable of degrading organic matter, and non provision of this data is acceptable. Almost all the compound not incorporated into metal concentrates will be disposed of into the mine tailings dams, where the low pH and high levels of toxic metals preclude the growth of all but the most specialised bacteria.

Similarly, bioaccumulation data was not submitted, but the high water solubility indicates little potential for bioaccumulation. In addition, as none of the chemical is likely to be released to natural waters containing fish, crustaceans or algae, the issue of bioaccumulation is largely irrelevant for this assessed use of the chemical.

9. EVALUATION OF TOXICOLOGICAL DATA

Additional studies provided under secondary notification were:

- skin sensitisation;
- two week repeated dose toxicity;
- mouse micronucleus test

Unless otherwise stated, the studied were conducted on AERO® 6697 Promoter, the 42% aqueous solution of the notified chemical.

9.1 Acute Toxicity

Summary of the acute toxicity of Component of AERO® 6697 Promoter

Test	*Species*	*Outcome*	*Reference*
acute oral toxicity	rat	LD_{50} > 5 000 mg/kg	(Moreno, 1991a)
acute dermal toxicity	rabbit	LD_{50} > 2 000 mg/kg	(Moreno, 1991b)
skin irritation	rabbit	slight irritant	(Moreno, 1991c)
eye irritation	rabbit	severe irritant	(Moreno, 1991c)
skin sensitisation	guinea pig	non-sensitiser	(Coleman, 1998)

9.1.1 Oral Toxicity (Moreno, 1991a)

This study was carried out according to OECD Guidelines for Testing of Chemicals No: 401.

A single dose of 5000 mg/kg of the notified chemical was administered by gavage to Sprague-Dawley rats (5 males). The animals were observed at 1, 4 and 24 hours after dosing and subsequently once daily for 7 days. No deaths were noted during the study. All animals showed the expected gain in body weight and signs of lethargy, ataxia, chromodacryorrhea, dyspnea and wetness of the anogenital area over the study period. Necropsy findings were not recorded in the study.

The results of this study indicate an oral LD_{50} of > 5 000 mg/kg for the notified chemical in male rats.

9.1.2 Dermal Toxicity (Moreno, 1991b)

This study was carried out in accordance with OECD Guidelines for Testing of Chemicals No: 402.

A single dose of 2 000 mg/kg of the notified chemical was administered by semi-occlusive application to the shaved skin of New Zealand Albino rabbits (5 males) for 24 hours. The animals were observed at 1, 4 and 24 hours after dosing and subsequently once daily for 7 days after removal of the bandage. No deaths were noted during the study. All animals showed expected gain in body weight during the study. One animal exhibited yellow nasal discharge up to day one. All animals showed slight to moderate erythema and oedema. Necropsy findings were not recorded in the study.

The results of this study indicate a dermal LD_{50} of > 2 000 mg/kg for the notified chemical in male rabbits.

9.1.3 Inhalation Toxicity

Data not provided.

9.1.4 Skin Irritation (Moreno, 1991c)

This study was carried out in accordance with OECD Guidelines for Testing of Chemicals No: 404.

A single dose of 0.5 mL of the notified chemical moistened with water was administered by occlusive application to one intact and one abraded site on the clipped flank of three male New Zealand White rabbits for four hours. The site of application was examined approximately 1 hour and 24, 48 and 72 hours after removal of the dressing. Very slight erythema was observed in all animals at 1 hour and in one animal at 24 hours post-treatment. No other erythema or oedema was observed.

The results of this study indicate that the notified chemical is a slight irritant to the skin of rabbits.

9.1.5 Eye Irritation (Moreno, 1991c)

This study was carried out in accordance with OECD Guidelines for Testing of Chemicals No: 405.

Three New Zealand White rabbits (3 males) were used in the study. Initially, a single dose of 0.1 mL of the notified chemical was instilled into the conjunctival sac of both eyes of each rabbit. The left eye of each animal was washed with water soon after exposure. Ocular reactions were assessed after 1 hour and 24, 48 and 72 hours post-exposure.

Slight to moderate corneal opacity observed in all animals after 1 hour post-exposure, persisted up to day seven in two animals. Moderate iritis was observed in two animals at 24 hours post-exposure, and this appeared normal on day seven in all animals. Moderate to

severe conjunctival redness and chemosis were observed in all animals after 1 hour post-exposure, and persisted up to day 7 in two animals. Moderate conjunctival discharge was observed in all animals after 1 hour post-exposure, which persisted up to day 7 in one animal.

The results of this study indicate that the notified chemical is a severe eye irritant in rabbits.

9.1.6 Skin Sensitisation (Coleman, 1998)

Test substance:	Aero® 6697 Promoter, containing 42% notified chemical in water
Species/strain:	guinea pig/Dunkin-Hartley
Number of animals:	20 test, 10 control
Induction procedure:	three pairs of injections of 0.1 mL in the dorsal scapular region followed by topical application under occlusive dressing for 48 hours
test group: day 1	injections: 1. Freund's Complete Adjuvant (FCA) (1:1 in water; 2. 7.5% (v/v) AERO® 6697 Promoter in water; 3. 7.5% (v/v) AERO® 6697 Promoter in FCA diluted 1:1 in water
day 8	topical induction with 50% (v/v) AERO 6697 Promoter in distilled water
control group:	the control group was treated in exactly the same fashion as the test group except that the notified chemical was omitted from the intradermal injections and the topical application
Challenge procedure:	
day 22	AERO® 6697 Promoter at 5% or 10% (v/v) in distilled water under occlusive dressing for 24 hours
Test method:	OECD TG 406

Challenge outcome:

	Test animals		*Control animals*	
Challenge concentration	***24 hours****	***48 hours****	***24 hours***	***48 hours***
5%	0/20**	0/20	0/10	0/10
10%	0/20	0/20	0/10	0/10

* time after patch removal
** number of animals exhibiting positive response

Result: the notified chemical was not sensitising to the skin of guinea pigs

9.2 Repeated Dose Toxicity (Blaszcak, 1998)

Test substance: Aero® 6697 Promoter (solution)

Species/strain: rat/Sprague-Dawley

Number/sex of animals: 5/sex/dose group

Method of administration: orally by gavage

Dose/Study duration:: 0, 100, 500 or 1 000 mg/kg/day for 14 days

Test method: OECD TG 407

Clinical observations:

In mid and high dose animals, there was laboured breathing, moist or dry rales, red stains on the snout, distended abdomen, ano-genital staining, yellow/brown stains on the ventral surface and decreased food consumption and faecal volume. In control and low dose animals, there were no treatment-related clinical signs.

One of the high dose males was euthanised as moribund on day 12; two of the high dose females were found dead on days 13 and 14.

Decreased body weight gain was observed in males and females at 500 and 1 000 mg/kg/day. At study termination the mean body weights of the mid dose males and females were 11% and 9%, respectively lower than controls, the corresponding figures for the high dose males and females were 17% and 4%.

Clinical chemistry/Haematology

There were no treatment-related effects for haematology parameters. The only statistically significant change in clinical chemistry parameters was an increase in aspartate aminotransferase (AST) levels of 23% and 15% in mid and high dose females, respectively.

Organ weights/Macroscopic findings/Histopathology

Testes/body weight ratios were increased in the mid and high dose males but this was ascribed to the decreases in body weight; minor stomach lesions were seen in the male high dose animal euthanised and in one of the females found dead.

Comment

The increased AST in mid and high dose females was not correlated with histopathological changes; the stomach lesions were judged not to be treatment-related by the study authors as they have been seen in other studies conducted in the laboratory.

Result

The notified chemical reduced body weight gain at doses of 500 or 1 000 mg/kg/day for 14 days; the NOEL was 100 mg/kg/day.

9.3 Genotoxicity

9.3.1 *Salmonella typhimurium* Reverse Mutation Assay (San, 1991)

This study was carried out according to OECD Guidelines for Testing of Chemicals No: 471.

The notified chemical at dose levels of 10 000, 6 667, 3 333, 1 000, or 667 µg/plate was tested for mutagenicity using *Salmonella typhimurium* strains TA 98, TA 100, TA 1535, TA 1537 and TA 1538 in either the presence or absence of metabolic activation provided by rat liver S9 fraction. Positive controls used were 2-nitrofluorene, sodium azide, ICR-191 (without S9) and 2-aminoanthracene (with S9). Distilled water was used as the diluent for the test substance and as the negative control.

The test substance did not induce increases in the number of revertant colonies of *Salmonella typhimurium* strains either in the absence or presence of S9. The positive controls induced the expected increases in all strains tested.

The results of this study indicate that the notified chemical is not mutagenic in bacteria.

9.3.2 Micronucleus Assay in the Bone Marrow Cells of the Mouse (Proudlock, 1991)

Species/strain:	mouse/CD-1
Number and sex of animals:	5/sex/dose group
Doses:	0, 500, 1 000 or 2 000 mg/kg with 24 and 48 hour sampling times
Method of administration:	i.p. injection
Test method:	OECD TG 474

Comment:	there was no treatment-related decrease in the proportion of polychromatic to normochromatic erythrocytes and no treatment-related increase in the frequency of micronucleated polychromatic erythrocytes; the positive control substance demonstrated the sensitivity of the test
Result:	the notified chemical was not clastogenic in mouse bone marrow cells *in vivo*

9.4 Overall Assessment of Toxicological Data

The notified chemical was of very low acute oral toxicity in rats (LD_{50} > 5 000 mg/kg) and low acute dermal toxicity in rabbits. It was a slight skin irritant in rabbits and a severe eye irritant in rabbits. It was not a skin sensitiser in guinea pigs. In a subacute14-day repeated dose toxicity study in Sprague-Dawley rats, reduced body weight gain was observed in males and females at 500 mg/kg/day and above and the NOEL was 100 mg/kg/day. The notified chemical was not mutagenic in bacteria or clastogenic in mouse bone marrow cells.

The notified chemical is determined to be a hazardous substance according to NOHSC *Approved Criteria for Classifying Hazardous Substances* (National Occupational Health and Safety Commission, 1999) in terms of eye irritancy. The risk phrase R34: Causes burns, is warranted on the basis of the pH (>13) of the aqueous solution of the notified chemical. The risk phrase R41: Risk of serious damage to eyes is warranted on the basis of corneal effects and is implicit as a result of R34.

10. ASSESSMENT OF ENVIRONMENTAL EFFECTS

The following ecotoxicity studies have been supplied by the notifier. The tests were carried out to OECD Test Methods.

Test	***Species***	***Results (Nominal)***
Acute Toxicity to fish [OECD 203]	Oncorhynchus mykiss (Rainbow trout)	LC_{50}(96 h) = 30 mg/L NOEC = 18 mg/L
Acute Toxicity to fish [OECD 203]	Lepomi macrochirus (Bluegill sunfish)	LC_{50}(96 h) = 42 mg/L NOEC = 18 mg/L
Acute Toxicity [OECD 202 – Part 1]	Daphnia magna	LC_{50}(48 h) = 47 mg/L NOEC (48h)=32 mg/L

The tests on Rainbow trout were performed in a static system over a 96 hour period at 12 ± 1°C. Five solutions containing nominal concentrations of the test compound with 5.6, 10, 18, 32 and 56 mg/L, together with one control (no test substance) were made up in a blended water, and ten fish were tested at each nominal concentration. No fish mortality occurred over the 96 hour period for the solutions containing 18 mg/L or less of the compound, but 2 fish died after 48 hours exposure to the solution containing a nominal 32 mg/L of compound. All 10 fish died after 48 hour exposure to the highest test concentration. No sublethal effects were observed at test concentrations below 32 mg/L, but at this concentration after 24 hours

exposure, and at higher exposure levels, erratic swimming, laboured respiration and surfacing were observed. The water hardness for all tests was between 160 and 190 mg/L as $CaCO_3$, while pH was always between 7.9 and 8.3 and dissolved oxygen levels between 7.6 and 9.2 mg/L (corresponding to 75 and 91 % saturation at 13°C respectively). The data was analysed using an analysis program developed by Stephan et al (1978), and this furnished the nominal 96 hour LC_{50} of 30 mg/L (95% confidence interval 18-56 mg/L). The 96-hour NOEC was estimated as 18 mg/L.

The tests on Bluegill sunfish were conducted using the same methodology as for the Rainbow trout. The same range of (nominal) test concentrations were used, but the temperature was 22 ± 1°C, with water hardness between 160 and 190 mg/L as $CaCO_3$, pH between 8.2 and 8.4 and dissolved oxygen between 5.3 and 8.3 mg/L. No fish mortality occurred over the 96-hour period for the solutions containing 32 mg/L or less of the compound, but 2 fish had died after 24 hours exposure to the solution containing a nominal 56 mg/L of compound. All 10 fish died after 96-hour exposure to the highest test concentration. No sublethal effects were observed at test concentrations below 32 mg/L, but at this concentration after 72 hours exposure, and at higher exposure levels erratic swimming, laboured respiration and surfacing were observed. The data was analysed using an analysis program (Stephan et al, 1978), and this furnished the nominal 96-hour LC_{50} of 42 mg/L (95% confidence interval 32-56 mg/L). The 96-hour NOEC was estimated as 18 mg/L.

The conclusion from these tests is that the new compound is slightly toxic to both fish species, with the Rainbow trout being slightly more sensitive.

The acute immobilisation tests on *Daphnia magna* were also performed in a static test over a 48-hour period using one control (no test compound) and six test solutions made up at nominal concentrations of 18, 32, 56, 100, 180 and 320 mg/L and 20 ± 2°C. The test was conducted in duplicate using 10 daphnia in each test vessel. No mortality or sublethal effects were observed over the 48 hour test period at $\leq$ 32 mg/L but after 24 hours exposure at 56 mg/L, quiescent behaviour and animals immobile on the bottom of the test vessels were observed. After 48 hours exposure at 56 mg/L, 16 (of a total of 20) animals were dead, complete (100%) mortality was observed after 24 hours at the two highest concentrations. The data was analysed using an analysis program (Stephan et al, 1978) and this furnished the nominal 48-hour LC_{50} of 47 mg/L (95% confidence interval 32-56 mg/L). The 48-hour NOEC was estimated as 32 mg/L. The test indicates that the new chemical is slightly toxic to this species.

No test for inhibition of algal growth was submitted. The notifier sought an exemption on the grounds that the compound is unlikely to be released to natural waterways. Algae are unlikely to live under the harsh conditions prevailing in tailings dams, particularly where there may be high ambient concentrations of dissolved copper. It is not unusual for copper levels in tailings dams at base metal mines to exceed 200 mg/L resulting from oxidation of tailings and waste rock.

11. ASSESSMENT OF ENVIRONMENTAL HAZARD

The environmental hazard from the notified chemical is considered low provided the material is used as a mineral flotation reagent as described in the notification. The new chemical will

be used at a limited number of mine sites within Australia, and there is no anticipated release to the general aquatic compartment.

Most of the compound will become associated with the surface of mineral particles in metal concentrates (specifically copper concentrates), and will be destroyed during smelting. The compound would decompose to water vapour and oxides of carbon and sulphur, while the phosphorus content would become assimilated into the furnace slag as metal phosphate.

The remainder of the reagent is expected to be released with the mine tailings, and confined within specialised tailings dams. Here the ambient pH is expected to be low, and will promote hydrolytic degradation of the compound.

The new compound is slightly toxic to the aquatic test species. However, release to natural waters is unlikely except in the case of a transport accident. Should the chemical be accidentally released to the general water compartment, bioaccumulation is unlikely considered low because of the high chemical water solubility.

Given that the notified chemical will be used at a small number of mine sites, and that these are essentially closed systems the environmental hazard from use of the new chemical is assessed to be low.

12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS

The notified chemical exhibited low acute and subacute toxicity in rats, was a slight skin irritant in rabbits and was not a skin sensitiser in guinea pigs. It was not genotoxic. However, the notified chemical is a severe eye irritant in rabbits.

The notified chemical is determined to be a hazardous substance according to NOHSC *Approved Criteria for Classifying Hazardous Substances* (National Occupational Health and Safety Commission, 1999) in terms of eye irritancy. The risk phrase R34: Causes burns, is warranted on the basis of the pH (>13) of the aqueous solution of the notified chemical and the risk phrase R41: Risk of serious damage to eyes is warranted on the basis of corneal effects and is implicit as a result of R34.

Occupational Health and Safety

The notified chemical is used as a flotation agent in mining. Transport and storage of the 200 or 1 000 L containers in which the notified chemical is to be imported should not result in worker exposure except in the event of accidental spillage.

Worker exposure during normal use of the notified chemical is most likely to occur when connecting or disconnecting lines or cleaning pumps and ancillary equipment. The notifier states that plant operators involved in transferring the notified chemical to the flotation cell and overseeing the flotation process are required to wear impervious gloves, chemical splash goggles and coveralls thus minimising the potential for exposure. Once mixed in with the ore slurry, the notified chemical is contained within an automated process requiring little worker intervention. The maximum concentration of reagent is 0.005% in the slurry. The notified chemical will be transported to the smelter with the ore particles.

The chemical is a severe eye irritant. Therefore plant operators will need to wear eye protection during connection and disconnection of transfer lines. The reagent is at 0.005% in the slurry and concentrated onto metal particles thereafter. Consequently workers should wear the above personal protective equipment at all times.

Public Health
The primary hazard presented by the notified chemical is severe eye irritation. The public is unlikely to be exposed to the chemical, which will be used solely for the extraction of minerals from ore at mining sites.

13. RECOMMENDATIONS

To minimise occupational exposure to the notified chemical during its addition to the mineral flotation process the following guidelines and precautions should be observed:

- Goggles, gloves and overalls conforming to Australian or Australian/New Zealand Standards should be worn during transfer of the notified chemical. Goggles should conform to AS 1336 and AS/NZS 1337, gloves to AS 2161.2 and overalls to AS 2919. If a respirator or mask is required, it should conform to AS/NZS 1715 and 1716;

- Spillage of the notified chemical should be avoided. Spillages should be cleaned up promptly with absorbents which should be put into containers for disposal;

- Good personal hygiene should be practised to minimise the potential for ingestion;

- A copy of the MSDS should be easily accessible to employees.

14. MATERIAL SAFETY DATA SHEET

The MSDS for Aero 6697 Promoter was provided in a format consistent with the *National Code of Practice for the Preparation of Material Safety Data Sheets* (National Occupational Health and Safety Commission, 1994).

This MSDS was provided by the applicant as part of the notification statement. It is reproduced here as a matter of public record. The accuracy of this information remains the responsibility of the applicant.

15. REQUIREMENTS FOR SECONDARY NOTIFICATION

Under the Act, secondary notification of the notified chemical shall be required if any of the circumstances stipulated under subsection 64(2) of the Act arise. No other specific conditions are prescribed.

16. REFERENCES

Blaszcak BS (1998) A 2 Week Oral Toxicity Study in the Rat, Study No. 98-2585, Huntingdon Life Sciences Ltd, England.

Coleman DG (1998) Skin Sensitisation in the Guinea-Pig, Project No. CTI 101/984275/SS, Huntingdon Life Sciences Ltd, England.

Draize JH (1959) Appraisal of the Safety of Chemicals in Foods, Drugs and Cosmetics. Association of Food and Drug Officials of the US, **49**: 2-56.

Moreno OM (1991c) Primary Dermal/Ocular Irritation in Albino Rabbits, Project No. MB 91-488 D, MB Research Laboratories Inc, USA.

Moreno OM (1991b) Acute Dermal Toxicity to the Rabbit, Project No. MB 91/488 B, MB Research Laboratories Inc, USA.

Moreno OM (1991a) Acute Oral Toxicity to the Rat, Project No. MB 91/488 A, MB Research Laboratories Inc, USA.

National Occupational Health and Safety Commission (1999) Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(1999)]. Canberra, Australian Government Publishing Service.

National Occupational Health and Safety Commission (1994) National Code of Practice for the Preparation of Material Safety Data Sheets [NOHSC:2011(1994)]. Canberra, Australian Government Publishing Service.

Organisation for Economic Co-operation and Development (1992) OECD Guidelines for the Testing of Chemicals. Paris, OECD.

Proudlock RJ (1997) *In Vivo* Mouse Bone Marrow Micronucleus Test, Project No. CTI 100/984367, Huntingdon Life Sciences Ltd, England

San RHC (1991) Bacterial Mutation Assay, Laboratory Study No. T9870.501015, Microbiological Associates Inc., USA.

Standards Australia (1987) Australian Standard 2919-1987, Industrial Clothing. Sydney, Standards Association of Australia.

Standards Australia (1990) Australian Standard 3765.1-1990, Clothing for Protection against Hazardous Chemicals Part 1 Protection against General or Specific Chemicals. Sydney, Standards Association of Australia.

Standards Australia (1994) Australian Standard 1336-1994, Eye protection in the Industrial Environment. Sydney, Standards Association of Australia.

Standards Australia (1998) Australian Standard 2161.2:1998, Occupational Protective Gloves, Part 2: General Requirements. Sydney, Standards Association of Australia.

Standards Australia/Standards New Zealand (1992) Australian/New Zealand Standard 1337-1992, Eye Protectors for Industrial Applications. Sydney/Wellington, Standards Association of Australia/Standards Association of New Zealand.

Standards Australia/Standards New Zealand (1994), Australian/New Zealand Standard 1715-1994, Selection, Use and Maintenance of Respiratory Protective Devices, Standards Association of Australia/Standards Association of New Zealand.

Standards Australia/Standards New Zealand (1994), Australian/New Zealand Standard 1716-1994, Respiratory Protective Devices, Standards Association of Australia/Standards Association of New Zealand.

Stephan CE et al (1978); A Computer Program for Calculating an LC_{50}, USEPA pre-publication manuscript.

Attachment 1

The Draize Scale for evaluation of skin reactions is as follows:

Erythema Formation	*Rating*	*Oedema Formation*	*Rating*
No erythema	0	No oedema	0
Very slight erythema (barely perceptible)	1	Very slight oedema (barely perceptible)	1
Well-defined erythema	2	Slight oedema (edges of area well-defined by definite raising	2
Moderate to severe erythema	3	Moderate oedema (raised approx. 1 mm)	3
Severe erythema (beet redness)	4	Severe oedema (raised more than 1 mm and extending beyond area of exposure)	4

The Draize scale for evaluation of eye reactions is as follows:

CORNEA

Opacity	*Rating*	*Area of Cornea involved*	*Rating*
No opacity	0 none	25% or less (not zero)	1
Diffuse area, details of iris clearly visible	1 slight	25% to 50%	2
Easily visible translucent areas, details of iris slightly obscure	2 mild	50% to 75%	3
Opalescent areas, no details of iris visible, size of pupil barely discernible	3 moderate	Greater than 75%	4
Opaque, iris invisible	4 severe		

CONJUNCTIVAE

Redness	*Rating*	*Chemosis*	*Rating*	*Discharge*	*Rating*
Vessels normal	0 none	No swelling	0 none	No discharge	0 none
Vessels definitely injected above normal	1 slight	Any swelling above normal	1 slight	Any amount different from normal	1 slight
More diffuse, deeper crimson red with individual vessels not easily discernible	2 mod.	Obvious swelling with partial eversion of lids	2 mild	Discharge with moistening of lids and adjacent hairs	2 mod.
Diffuse beefy red	3 severe	Swelling with lids half-closed	3 mod.	Discharge with moistening of lids and hairs and considerable area around eye	3 severe
		Swelling with lids half-closed to completely closed	4 severe		

IRIS

Values	*Rating*
Normal	0 none
Folds above normal, congestion, swelling, circumcorneal injection, iris reacts to light	1 slight
No reaction to light, haemorrhage, gross destruction	2 severe