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December 2001

NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME

FULL PUBLIC REPORT

Polymer in Superfloc AF 124 and Superfloc 1264 Flocculants

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, Plaza level, Alan Woods Building, 25 Constitution Avenue, Canberra ACT 2600 between 9 AM and 5 PM Monday to Friday.

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 Section at:

Street Address: 334-336 Illawara Road MARRICKVILLE NSW 2204, AUSTRALIA
Postal Address: GPO Box 58, SYDNEY NSW 2001, AUSTRALIA
Telephone: (61) (02) 8577 8800 FAX (61) (02) 8577 8888

Director
Chemicals Notification and Assessment

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1. APPLICANT

Cytec Australia Holdings Pty Ltd of Suite 1, 7-11 Railway Street, Baulkham Hills, NSW 2153 (ABN 45 081 148 629) has submitted a limited notification statement in support of their application for an assessment certificate for Polymer in Superfloc AF 124 and Superfloc 1264 Flocculants.

2. IDENTITY OF THE CHEMICAL

The chemical name, CAS number, molecular and structural formulae, molecular weight, spectral data, details of the polymer composition and details of customers have been exempted from publication in the Full Public Report and the Summary Report.

Marketing Name: Superfloc AF 124 (24-27% polymer)
Superfloc 1264 (22-23% polymer)

3. PHYSICAL AND CHEMICAL PROPERTIES

Unless otherwise stated, the following data refer to the aqueous product containing the notified polymer.

Appearance at 20°C & 101.3 kPa: Opaque white liquid with petroleum distillate or ammonia odour.

Boiling Point: 101°C (water).

Specific Gravity: 1.03-1.06 kg/m^3.

Vapour Pressure: 2.4 kPa at 20°C (approximately) (water).

Water Solubility: Soluble. See comments below.

Partition Co-efficient (n-octanol/water): Not determined. See comments below.

Hydrolysis as a Function of pH: Not determined. See comments below.

Adsorption/Desorption: Not determined. See comments below.

Dissociation Constant:	Not determined.
Particle Size:	Not applicable. Polymer exists in aqueous solution.
Flash Point:	No flash point up to the boiling point of 101°C (closed cup)
Flammability Limits:	Not flammable.
Autoignition Temperature:	Not determined. The polymer is not expected to auto-ignite.
Explosive Properties:	Not explosive.
Reactivity/Stability:	Stable.

3.1 Comments on Physico-Chemical Properties

The notifier indicates that the notified polymer has a relatively high solubility in water but is limited by viscosity (5 g/L). It is expected that the notified polymer will be highly soluble due to the proportion of carboxylate units present. Polyacrylamides are also known to be water soluble (Smith 1997). We note, however, solubility problems were encountered at 10 mg/L and above in the fish test.

The notified polymer is not expected to hydrolyse under normal environmental conditions (pH 4-9).

The notifier expects that the notified polymer will have a low partition coefficient due to its high solubility in water and hydrophilic nature.

The notifier claims that the notified polymer is not expected to adsorb to organic matter in soils, but may adsorb to clays and silicates. The notifier also indicates that the notified polymer is expected to complex with metals (especially iron) in clays and silicates. Smith (1997) indicates the polyacrylamides are capable of moving through various soil types but quotes literature information noting that under certain conditions they can bind to particulate matter such as clay particles.

The notified polymer is expected to remain fully dissociated above pH 4.5 but some carboxylic acid will form below this.

4. PURITY OF THE CHEMICAL

Degree of Purity: ≥ 96%

Hazardous Impurities:

Chemical name: Acrylamide

CAS No.:	79-6-1
Weight percentage:	0.01%
Toxic properties:	R45, R46
Chemical name:	Ammonia
CAS No.:	7664-41-7
Weight percentage:	0.5-1.9%
Toxic properties:	R20, R36/37/38
Chemical name:	Sodium hydroxide
CAS No.:	1310-73-2
Weight percentage:	0.5%
Toxic properties:	R36/38

Non-hazardous Impurities (> 1% by weight): None

Maximum Content of Residual Monomers: As above

Additives/Adjuvants:	Petroleum distillates
Chemical name:	Petroleum distillates
CAS No.:	64742-47-8
Weight percentage:	22-28%
Toxic properties:	R65

5. USE, VOLUME AND FORMULATION

The notified polymer is an anionic flocculant to be used for secondary clarification of industrial wastewater. It will be imported in two finished products - Superfloc AF 124 and Superfloc 1264 (24-27% and 22-23% notified polymer respectively).

The notified polymer will be imported in 1000 L Intermediate Bulk Containers at a rate of 20-30 tonnes per year for the first 5 years.

6. OCCUPATIONAL EXPOSURE

Import and Transport

The notified polymer will be imported in 1000L Intermediate Bulk Containers and transported by road to a warehouse and then to customer sites. Up to a total of 15 transport

workers and 10 storage personnel working 2-3 hours/day for 10-20 days/year will handle the notified chemical during these activities. No reformulation will occur and import containers will not be opened prior to end-use and so exposure of these workers to the notified polymer would be envisaged only as a result of accidental puncture of import containers.

End-use: Wastewater Treatment

At wastewater treatment sites, the notified polymer will be pumped from import containers to a holding tank where the polymer is diluted with water to 0.5% solution (0.14% notified polymer). It is likely this decanting will be conducted indoors under local exhaust ventilation.

Up to a total of 20 wastewater treatment operators working an average of 4 hours/day for one day/month will be exposed potentially to the notified polymer during these decanting procedures and during addition of the polymer to wastewater streams. During decanting, workers may experience dermal exposure to the notified polymer from spills and residue while connecting and disconnecting pump lines to and removing and replacing bungs on import containers. Ocular exposure is also possible. The high molecular weight and expected low volatility of the notified polymer in addition to exhaust ventilation fitted at points of transfer makes inhalation exposure unlikely.

Exposure of workers during end-use addition to wastewater streams is not expected as the polymer is metered through an automatic mechanical dosing system.

It is intended that dermal and ocular exposure to the notified polymer will be controlled via personal protective equipment consisting of protective clothing, impervious gloves and eye protection such as goggles or face shield.

7. PUBLIC EXPOSURE

The potential for public exposure to the notified polymer is negligible. Superfloc products will be transported to industrial sites by the importer and dosed directly into the customers wastewater system using automated dosing equipment.

The MSDS for the imported product containing the notified polymer indicates that the product presents a significant slip hazard. Consequently, considerable care will need to be taken to remove any residual material following a spill onto a road or pedestrian area.

8. ENVIRONMENTAL EXPOSURE

8.1 Release

The notified polymer will be used for the treatment of wastewater streams generated from industrial processes. During the water treatment, the efficacy of treatment chemical diminishes and new water treatment solution is added to the system. A continual bleeding and discharge of the treated water compensates replenishment of the chemical in the system.

The notified polymer will be prepared at a concentration of less than 1% either by an automatic make down unit or on a batch basis. The typical polymer dosage rate is 1 mg/L and that the flow rate at a large industrial plant could be as much as 2 ML per day. This equates to a release of approximately 2 kg per day (730 kg per annum) of the notified polymer prior to on-site treatment. It is estimated that more than 80% of the notified polymer (1.6 kg per day/584 kg per annum) will be removed from the aquatic compartment and remain in the resulting sludge or flocculant, which will be disposed of either in landfill or a liquid waste treatment facility. The remaining 20% (0.4 kg per day/146 kg per annum) of the notified polymer will remain in the effluent stream and released into the sewer at an estimated concentration of 0.2 mg per L.

The empty import containers will be washed and the rinsate added to the wastewater system. The cleaned containers will be either reused or sold to recyclers.

8.2 Fate

In an industrial wastewater treatment plant such as a paper mill, the flocculated material would either settle to the bottom of the retention ponds and become assimilated with the waste sludge or collected from the surface of the wasterwater stream. These solid wastes would be periodically removed from the plant, and either incinerated or placed into landfill. Incineration of sludge would produce oxides of carbon and nitrogen. Under normal operating conditions approximately 20% of the added polymer is expected to be released with effluent water. However, as referred to above, control equipment malfunction or accidents could lead to overdosing in the treatment circuit. In such situations, unless there is sufficient oily or solid material present in the waste with which the polymer can interact (and then become assimilated in the waste sludge), the excess would remain in the water and be released to receiving waters with plant effluent. If the receiving waters contain high concentrations of particulate or colloidal organic matter (eg sewage), then the excess polymer would be expected to interact with this material and again become associated with sludge or flocculant.

At a mine site, the notified polymer will become attached to the surface of gangue (waste) minerals, and these will be deposited into the tailings dams. The reagent disposed of with the tailings is not expected to be released to the wider environment as tailings dams are designed to reduce the potential for seepage.

The notification included no information on biodegradation, but ready biodegradation of the notified polymer is unlikely. However, once the polymer has become associated with soils or sediments, it is expected to biodegrade slowly through biological and abiotic processes, with ultimate formation of oxides of carbon and ammonia (Smith 1997).

The notified polymer is not expected to cross biological membranes due to its high molecular weight and is therefore not expected to bioaccumulate (Connell 1990).

9. EVALUATION OF TOXICOLOGICAL DATA

Limited toxicological data were provided for the product containing the notified polymer. Skin and eye irritation studies were conducted concurrently in the same set of animals.

9.1 Acute Toxicity

Summary of the acute toxicity of Superfloc AF 124 (24-27% notified polymer).

Test	*Species*	*Outcome*	*Reference*
skin irritation	rabbit	irritating	Cerven (1997)
eye irritation	rabbit	irritating	Cerven (1997)

9.1.1 Skin Irritation (Cerven, 1997)

Species/strain: Rabbit, New Zealand White

Number/sex of animals: 3 males

Observation period: 7 days

Method of administration: 0.5 mL of test substance applied via a 2.5 x 2.5 cm gauge pad secured by adhesive tape to shaved, intact and abraded skin for 4 hours.

Test method: OECD TG 404

Draize scores:

	Time after treatment						
Animal #	***3 min***	***1 hour***	***4 hours***	***1 day***	***2 days***	***3 days***	***7 days***
Erythema							
1 (intact)	0[a]	0	1	2[b]	2[b]	2[b]	0[b,f]
1 (abraded)	0	0	1	2[b]	2[b]	2[b]	0[b,f]
2 (intact)	0	1	2	2[b]	2[b]	2[b]	1[b,f]
2 (abraded)	0	1	2	2[b]	2[b]	2[b]	2[b,f]
3 (intact)	0	0	1	2[b]	2[b]	2[b]	>4[b]
3 (abraded)	0	0	1	2[b]	2[b]	2[b]	0[b,f]
Oedema							
1 (intact)	0	0	0	2	1	1	0
1 (abraded)	0	0	0	2	2	2	0
2 (intact)	0	0	1	2	2	2	1
2 (abraded)	0	0	1	2	2	2	1
3 (intact)	0	0	0	2	2	2	1
3 (abraded)	0	0	0	2	2	2	1

[a] see Attachment 1 for Draize scales

[b] residual test substance remaining on skin
[f] flaking skin

Comment: No abnormal systemic signs were noted during the observation period. Skin irritant effects persisted to the end of the observation period.

Result: The product containing the notified polymer was irritating to the skin of rabbits.

9.1.2 Eye Irritation (Cerven, 1997)

Eye irritation was studied in the same animals

Species/strain: Rabbit, New Zealand White

Number/sex of animals: 3 males

Observation period: 7 days

Method of administration: After initial reaction testing in the left eye of one animal, 0.1 mL of test substance was instilled into the conjunctival sac of both eyes in all animals. After 30 seconds, left eyes were washed. Right eyes remained unwashed.

Test method: OECD TG 405

Draize scores of unwashed and washed eyes:

	Time after instillation									
Animal	***1 hour***		***1 day***		***2 days***		***3 days***		***7 days***	
Cornea	***o***	***a***	***o***	***a***	***o***	***a***	***o***	***a***	***o***	***a***
1 (unwashed)	0[1]	0	0	0	0	0	0	0	0	0
1 (washed)	0	0	0	0	0	0	0	0	0	0
2 (unwashed)	0	0	0	0	0	0	0	0	0	0
2 (washed)	0	0	0	0	0	0	0	0	0	0
3 (unwashed)	0	0	0	0	0	0	0	0	0	0
3 (washed)	0	0	0	0	0	0	0	0	0	0
Iris										
1 (unwashed)	1		0		0		0		0	
1 (washed)	1		0		0		0		0	
2 (unwashed)	0		0		0		0		0	
2 (washed)	0		0		0		0		0	
3 (unwashed)	0		0		0		0		0	

3 (washed)		0			0			0			0			0	
Conjunctiva	***r***	***c***	***d***	***r***	***c***	***d***	***r***	***c***	***d***	***r***	***c***	***d***	***r***	***c***	***d***
1 (unwashed)	2	2	2	1	2	2	1	2	2	1	0	0	0	0	0
1 (washed)	2	2	2	1	2	2	1	2	2	1	0	0	0	0	0
2 (unwashed)	2	2	2	2	2	2	2	2	2	1	2	2	0	0	0
2 (washed)	1	2	2	2	2	2	2	2	2	1	2	2	0	0	0
3 (unwashed)	2	2	2	2	2	2	1	2	2	0	0	0	0	0	0
3 (washed)	1	2	2	1	2	2	0	0	0	0	0	0	0	0	0

[1] see Attachment 1 for Draize scales
o = opacity a = area r = redness c = chemosis d = discharge

Comment: No abnormal systemic signs were noted during the observation period.

Result: The product containing the notified polymer was irritating to the eyes of rabbits.

9.4 Overall Assessment of Toxicological Data

Both skin and eye irritation were observed when the product containing the notified polymer was tested in a combined acute skin and eye irritation study in rabbits. According to the NOHSC *Approved Criteria for Classifying Hazardous Substances* (National Occupational Health and Safety Commission, 1999) the product should therefore be classified Irritant (Xi) with the risk phrase R36/38 – Irritating to Eyes and Skin. In the absence of toxicological data for the notified polymer itself, the notified polymer should be classified similarly.

10. ASSESSMENT OF ENVIRONMENTAL EFFECTS

Full test reports on the ecotoxicity studies were submitted by the notifier. The fish and daphnia tests were conducted on SF-1266 (30% acrylic acid and 70% acrylamide) and the algal test was conducted on a polyacrylamide polymer consisting of 10% acrylic acid and 90% acrylamide. The ratios for the notified polymer lie within this range.

Test	***Species***	***Results***
96 h Acute Toxicity OECD TG 203	Fathead minnow *Pimephales promelas*	LC_{50} = 32 mg/L NOEC = 18 mg/L
48 h Acute Toxicity *OECD TG 202*	*Daphnia magna*	EC_{50} = 0.15 mg/L NOEC = 0.1 mg/L
72 h Algal Growth Inhibition ISO/PARCOM 1990	*Skeletonema costatum*	72 h E_bC_{50} = 1.49 mg/L WAF

* NOEC - no observable effect concentration

The tests on fish (ABC Laboratories Inc 1994a) were performed using a static methodology. Observations were performed at 24, 48, 72 and 96 hours. The test was performed using ten specimen fish per test concentration at a temperature of 23°C. The tests were conducted using nominal concentrations of 10, 18, 32, 56 and 100 mg/L. The results of the definitive study showed that no mortalities or sublethal effects were observed in the test vessels containing less than 18 mg/L of the notified polymer while at a concentration of 32 mg/L, 50% mortality was observed. After 96 h, 100% mortality was observed at test concentrations above 56 mg/L.

The 96-hour LC50 for the notified polymer to *Pimephales promelas* is therefore 32 mg/L as calculated by least squares regression analysis. It should be noted that all of the test solutions were opaque and that at the nominal concentrations of 56 and 100 mg/L the solutions were also slightly viscous. Furthermore, TOC analyses at 0 and 96 h returned values of approximately 10% of the expected values suggesting the results should be viewed with considerable caution and that actual toxicity is probably greater.

The immobilisation tests with Daphnia (ABC Laboratories Inc 1994b) were also performed under static conditions with observations performed at 24 and 48 hours. The test was performed using 10 daphnids per flask at a temperature of 20°C. The tests were conducted using nominal concentrations of 0.1, 0.18, 0.32, 0.56 and 1.0 mg/L. All test solutions were clear but no analysis was conducted. After 48 h, no immobilised daphnids were observed in the test vessels with less than 0.1 mg/L of the notified polymer and 60-100 % mortality was observed after 48 h in all the remaining test vessels. The 48-hour EC50 for the notified chemical to Daphnia magna is 0.15 mg/L of the notified polymer.

The marine algal ecotoxicity test was performed on the Water Accommodated Fraction (WAF) of the notified polymer. The WAF was prepared by adding the nominal amount of the notified polymer to treated seawater to give the required loading rate and the resulting solution was then stirred at 20˚C for 20 hours. The mixture was then allowed to stand for approximately 1 hour prior to the removal of supernatant by siphoning. No analysis of these solutions was performed. Algae were exposed to the test substance at concentrations of 1.0, 3.2, 5.6, 10 and 32 mg/L WAF for 72 h at 20˚C under constant illumination and shaking (Orkney Water Technology Centre 1996). After 72 h, there was significant inhibition of algal growth at concentrations above 3.2 mg/L WAF. The 72 h EbC50 for the notified polymer to the marine unicellular algae *Skeletonema costatum* is 1.49 mg/L WAF.

In view of the problems with the fish test, it is noted that ecotoxicity tests conducted on Rainbow fish using two anionic polyacrylamides, Y5 and Z1, similar to the notified polymer (Lamberton 1995), gave 96 h NOECs of 111 and 125 mg/L, respectively.

Ecotoxicity tests on daphnia (Lamberton 1995) using the same two anionic polyacrylamides gave NOECs of 0.084 and 0.05 mg/L, respectively and EC50 values of 0.19 and 0.09 mg/L, respectively, supporting that daphnia are likely to be the most sensitive species.

The ecotoxicity data indicate the notified polymer is slightly toxic to fish, highly toxic to daphnia and moderately to highly toxic to marine algae.

11. ASSESSMENT OF ENVIRONMENTAL HAZARD

The intended use pattern of the notified polymer is expected to result in the majority of the polymer being eventually released to the environment. The ecotoxicity data provided indicate the notified polymer is slightly toxic to fish, highly toxic to daphnia and moderately to highly toxic to marine algae.

Assuming a large urban paper mill or industrial effluent plant treats 5 ML of wastewater each day and flows into a sewerage treatment system with a capacity of 250 ML, then the concentration of the notified polymer would be diluted by a factor of 50. Assuming an industrial effluent plant located in a rural area treats 2 ML of waste each day and flows into a sewerage treatment system with a capacity of 5 ML, then the concentration of the notified polymer would be diluted by a factor of 2.5. Assuming these dilution factors, that 80% of the notified polymer is removed from the wastewater stream through association with effluent and a dosing rate of the notified polymer of 1 mg/L, then the metropolitan and rural PEC values are 0.004 and 0.08 mg/L, respectively. When released to receiving waters the concentration is generally understood to be reduced by a further factor of at least 10 (but not always the case in rural areas), and so the Predicted Environmental Concentration (PEC) for metropolitan and rural use are 0.0004 and 0.008 mg/L, respectively.

Applying an assessment factor of 100 (OECD 1997) to the EC50 for Daphnia (the most sensitive test species) suggests the recommended no effect concentration for the notified polymer would be 0.0015 mg/L. The PEC value for use in a metropolitan area is just below the recommended no effect concentration for the notified polymer (PEC/PNEC = 0.27) while the ratio for use in a rural area is 5.3. Given this latter ratio is greater than one, it suggests a potential hazard.

When used in a mining situation, the notified polymer is expected to be released to, and confined within, specialised tailings dams. Biodegradation of the notified polymer is considered unlikely. However, under the low pH conditions of the tailings dam, the notified chemical is expected to slowly degrade. When used in the treatment of wastewater from mine sites, the notified polymer is unlikely to pose a significant risk to the environment.

The notified polymer is not expected to cross biological membranes due to its high molecular weight and is therefore not expected to bioaccumulate (Connell 1990).

Wastes containing the notified polymer including residues from imported drums and sludge will be disposed of in landfill and are expected to be immobile. Even though the notified polymer is soluble in water, it is expected to adsorbed to soil and sediment due to its high molecular weight and polyanionic nature. However, some leaching of the notified polymer cannot be discounted.

In conclusion, the environmental exposure and overall environmental hazard from the use of the notified polymer in pulp and paper manufacture in metropolitan areas seems acceptable but in rural areas may be significant. We understand that only metropolitan use is expected at this time.

12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS

Hazard Assessment
A combined skin and eye acute irritation study in rabbits of Superfloc AF 124 containing 24-27% notified polymer resulted in both dermal and ocular irritation, with the product classified as hazardous with the risk phrases R36/38 – Irritating to Eyes and Skin according to the NOHSC *Approved Criteria for Classifying Hazardous Substances* (National Occupational Health and Safety Commission, 1999). The notified polymer is classified similarly.

The toxicological properties of the products containing notified polymer may be influenced by the presence of hazardous ingredients such as ammonia and petroleum distillate, which are inhalation hazards, with the former also a skin, eye and respiratory irritant. Given the high molecular weight of the notified polymer, absorption across biological membranes is highly unlikely and consequently, systemic toxicity is likely to be low.

The MSDS for the imported product containing the notified polymer indicates that the product presents a significant slip hazard.

Occupational Health and Safety
During the dilution and subsequent addition of the imported flocculants containing the notified polymer to industrial wastewaters, skin contamination may occur, resulting in a risk of skin and eye irritation. The risk is low during addition of the diluted solution to the wastewater streams due to the use of metering equipment and the low concentration of Superfloc. There is also a risk of slipping during handling of the imported flocculants due to their physical nature.

Therefore, it is important that that the dilution procedure be automated as much as possible and that safe work practices be introduced to prevent spillage. To further reduce the risks, appropriate personal protective equipment such as impervious clothing and footwear, impervious gloves and safety goggles/face shield should be worn by workers when handling the flocculants containing the notified polymer.

Public Health
Exposure of the public as a result of the use, transport and disposal of products containing the notified polymer is likely to be negligible. Therefore, the notified polymer is unlikely to pose a significant risk to public health when used in the proposed manner.

13. RECOMMENDATIONS

Control Measures

Occupational Health and Safety

- Employers should ensure that transfer procedures are automated as much as possible. Spills should be avoided and cleaned up promptly.

- Employers should ensure that the following personal protective equipment is used by workers to minimise occupational exposure to the notified polymer as introduced in the products Superfloc AF 124 and Superfloc 1264:

– Impervious clothing and footwear
– Impervious gloves
– Safety goggles/face shield

Guidance in selection of personal protective equipment can be obtained from Australian, Australian/New Zealand or other approved standards.

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

If products and mixtures containing the notified polymer are classified as hazardous to health in accordance with the NOHSC *Approved Criteria for Classifying Hazardous Substances*, workplace practices and control procedures consistent with provisions of State and Territory hazardous substances legislation must be in operation.

Storage

- The following precautions should be taken regarding storage of the notified polymer:

– Avoid iron, copper or aluminium containers or equipment.
– Store at < 32°C.

Emergency procedures

– Precaution should be observed following spills/release as the product containing the notified polymer may cause a slip hazard. Dry-sweeping compound may be required if slipperiness remains following clean-up.

Secondary notification

The Director of Chemicals Notification and Assessment must be notified in writing within 28 days by the notifier, other importer or manufacturer:

(1) Under subsection 64(1) of the Act;

– If use in rural paper mills or industrial effluent plants is proposed, details of the plant effluent releases including sewerage capacity and flows should be provided to enable a more accurate assessment of hazard.

or

(2) Under subsection 64(2) of the Act:

- if any of the circumstances listed in the subsection arise.

The Director will then decide whether secondary notification is required.

14. MATERIAL SAFETY DATA SHEET

The MSDS for the notified polymer 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. REFERENCES

ABC Laboratories Inc (1994a) Report number 41493: Static Acute Fish Toxicity of CT-546-94 to Fathead minnow (Pimephales promelas), Columbia, Missouri, (unpublished report submitted by Cytec Industries).

ABC Laboratories Inc (1994b) Report number 441494: Static Acute Toxicity of CT-546-94 to Daphnia magna, Columbia, Missouri, (unpublished report submitted by Cytec Industries).

Cerven DR (1997) Primary dermal/ocular irritation in rabbits. Project MB 97-5931.34. MB Research Laboratories, Spinnerstown, PA, USA.

Connell D W (1990) General characteristics of organic compounds which exhibit bioaccumulation. In Connell D. W., (Ed) Bioaccumulation of Xenobiotic Compounds. CRC Press, Boca Raton, USA.

Lamberton C J (1995) MSc Thesis, University of Technology, Sydney.

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.

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

OECD Secretariat, (July 1997) Screening Information Data Set (SIDS) Manual, OECD Program on the Co-operative Investigation of High Volume Chemicals; http://www.oecd.org/ehs/sidsman.htm.

Orkney Water Technology Centre (1996) Study number 145-3-2: Assessment of the Toxicity of OFXC 1257 and OFXC 1260 to marine algae Skeletonema costatum, Orkney, UK, (unpublished report submitted by Cytec Industries).

Smith EA, Prues SL and Oehme FW (1997) Environmental Degradation of Polyacrylamides 1. Effects of Environmental (Outdoor) Exposure. Ecotoxicology and Environmental Safety 37: 76-91.

Attachment 1

The Draize Scale (Draize, 1959) 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 (Draize *et al*., 1944) 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

Draize, J. H., Woodward, G., Calvery, H. O. (1944) Methods for the Study of Irritation and Toxicity of Substances Applied Topically to the Skin and Mucous Membranes, J. Pharmacol. Exp. Ther. 82 : 377-390.

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