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NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME

FULL PUBLIC REPORT

Polymer in Coagulant 130A/139

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Director
Chemicals Notification and Assessment

FULL PUBLIC REPORT

Polymer in Coagulant 130A/139

1. APPLICANT

Betz Laboratories Pty Ltd of 69-77 Williamson Road, Ingleburn NSW 2565 have submitted a limited notification in support of their application for an assessment certificate for the new synthetic polymer in Coagulant 130A/139.

2. IDENTITY OF THE CHEMICAL

The notified polymer is not considered to be hazardous based on the nature of the chemical and the data provided. Therefore the chemical name, CAS number, molecular formula, structural formula and monomer composition have been exempted from publication in the Full Public Report and the Summary Report.

Trade names:	Coagulant 130A (30% aqueous solution of polymer) Coagulant 139 (35% aqueous solution of polymer)
Number-average molecular weight:	> 1000
Maximum percentage of low molecular weight species (molecular weight < 1000):	Coagulant 139: <500 = <1% <1000 = <4% (polydispersity = ~ 12.7)

Method of detection and determination: The polymer can be analysed by Gel Permeation Chromatography, Fourier Transform Infrared Spectroscopy and ^{13}C NMR.

Spectral data: Infrared and ^{13}C NMR spectra were provided for the polymer.

3. PHYSICAL AND CHEMICAL PROPERTIES

The notified polymer will be imported as an aqueous solution. The following physico-chemical data were provided for Coagulant 130A (30% aqueous solution) unless otherwise stated.

Appearance at 20°C and 101.3 kPa:	Light yellow to amber aqueous liquid
pH:	~ 11.9
Boiling Point:	Not provided

Specific Gravity:	1081 $kg.m^{-3}$ @ 21°C
Vapour Pressure:	18 mm Hg (water)
Water Solubility:	100%
Partition Co-efficient (n-octanol/water) log P_{ow}:	Log P_{OW} < 0 (Coagulant 139, HPLC method, OECD guideline 117)
Hydrolysis as a function of pH:	Not determined
Adsorption/Desorption:	Not determined
Dissociation Constant:	Not determined
Flash Point:	> 93°C
Flammability Limits:	The polymer is not flammable
Explosive Properties:	The polymer is stable
Reactivity/Stability:	May react with oxidising agents

Comments on physico-chemical properties:

The boiling point was not determined. It is expected that it would approach that of water.

Hydrolysis was not determined. It is noted the polymer contains no functionalities likely to undergo hydrolysis in the environmental pH range expected.

The experimentally derived value for the octanol/partition co-efficient was obtained for two components of the Coagulant 139 sample (first and last eluting components). This derived value, obtained for each component, was outside the applicable range for the method (0-6), and the accuracy could not be stated.

No dissociation constant was derived for the polymer. The notifier states that the polymer contains sulphate functional groups which will dissociate completely in water. Further, Coagulant 139 (as a 35% aqueous solution of the notified substance) is expected to have a pH of 11.9. It is agreed that complete dissociation is likely within the expected environmental pH range, and hence its usefulness as an anti-foulant.

No adsorption/desorption constants were derived for the polymer. The notifier claims that because Coagulant 139 is a charged anionic polymer, it will not bind strongly to organic matter in soils. It is agreed that this is likely, although it is noted that Coagulant 139 is a relatively small and highly charged polymer which is able to coordinate to metal ions. Therefore, although the adsorption to organic matter in

soils is estimated to be low, it may interact with suspended clays by coordinating to metal ions.

4. PURITY OF THE CHEMICAL

The notified chemical contains no hazardous impurities at levels necessary to classify it as a hazardous substance (1). Therefore, information on the purity of the chemical has been exempted from publication in the Full Public Report and the Summary Report.

Maximum content of residual monomers: 0.2%

5. INDUSTRIAL USE

The notified polymer will be the main ingredient in a Betz water treatment product, Coagulant 139. The product will be imported into Australia as a 35%, pale yellow, aqueous solution. Coagulant 139 will be used to prevent calcium or magnesium carbonate deposition (scaling) and fouling due to iron and silica, in industrial boiler water systems using softened water, demineralised water or condensate as feedwater. The expected volume of Coagulant 139 to be imported is > 1 tonne per annum for the first 5 years, used at about 10-15 sites.

6. OCCUPATIONAL EXPOSURE

The notified polymer will be imported by ship in either 205L drums or 1500L intermediate bulk containers (IBC-also known as Betz Semi-Bulk Containers, SBC's). It will be imported as Coagulant 139 (35% solution of polymer) and loaded onto trucks for road transport. The containers will be taken to a warehouse facility in Sydney where they will be stored in a purpose built containment area. The transport and handling of the notified chemical will be performed by between 10 to 20 people. Exposure is only likely in the event of a spill.

The imported product will be reformulated into specialty blended products at the factory facility. It will be pumped from the drums or containers into mixing tanks. There is potential here for exposure to the notified polymer from removing bungs and connecting pumping equipment. Local exhaust ventilation will be used to capture any vapours during pumping. All employees will be required to wear impermeable gloves, chemical goggles and protective overalls. The formulated product (containing 10-20% Coagulant 139) will be pumped into 25 L drums, 205 L drums or 1500 L SBC's for customer distribution. The potential exposure of the 6-10 warehouse workers during the storage and reformulation and the 2-5 transport workers during customer delivery is 10 times/year for 2-3 hours per day.

At each customer site (wastewater treatment facility) 1- 2 plant operators will be exposed to a maximum of 35% notified polymer, once per day for 0.5-1 hour/day. This will occur from potential exposure while handling the product containers, removing bungs and connecting pumping equipment to the storage containers. Coagulant 139 will be automatically pumped to a holding tank from which the

solution will be injected (either diluted or neat) into feedwater. Local exhaust ventilation will be employed during decanting to capture any mist or vapour, while all personnel will be required to wear impermeable gloves, chemical goggles and protective overalls.

7. PUBLIC EXPOSURE

The notified polymer will not be sold to the public and will be used only for industrial applications. Imported product will be distributed to industrial customers in sealed 205 L drums or 1500 L intermediate bulk containers. Reformulation will be conducted in mixing tanks using appropriate engineering controls.

During reformulation, release to the environment of the notified polymer is expected to be minimal. Dilution tank concentrations of the notified polymer are expected to contain < 10 g/L. Release to the environment may potentially occur from leaking storage containers, accidental spills, and discharged cleaning water. Discharge water containing the notified polymer from the Betz site will be disposed of at Lidcombe Aqueous Waste Treatment Plant, as will residual product or empty containers which have been returned to Betz for disposal.

Under normal use situations public exposure to the notified polymer is expected to be minimal.

8. ENVIRONMENTAL EXPOSURE

Release

Coagulant 139 will be reformulated into specialty products, typically containing 10% Coagulant 139, but may contain up to 60%. Any reformulation is performed at Betz, Sydney, in mixing tanks with appropriate engineering controls. Any residue from cleaning of equipment etc, will be disposed of through the Lidcombe Aqueous Waste Treatment Plant Operated by Waste Recycling and Processing Service of NSW. Any residual product or empty containers returned to Betz will also be disposed of to that facility.

At customer sites, Coagulant 139 will be automatically pumped from the transport containers into a holding tank (and diluted if necessary), and then injected into feedwater. The notifier claims that appropriate engineering controls will be used, and will decrease the chance of spillage and wastage. The concentration of the polymer in boiler water is expected to be up to 100 ppm, depending on quality of feedwater. Release of the polymer to the environment might occur from leaking storage containers, accidental spills, discharged cleaning water, short-term manual blowdown, or operational blowdown (ie release of excess water, either continuously or periodically). The majority of the polymer is expected to be released via the latter two mechanisms.

Disposal of release water will be according to the relevant government regulations. Such disposal would include release to sewer, together with other process streams, and might involve secondary treatment. Any containers (eg small 25 L pails) not

returned to Betz, will be washed thoroughly and disposed of according to the relevant government regulations.

Fate

The application of Coagulant 139 will involve its use as an anti-foulant in industrial boilers. Any significant residues from this application are likely to be associated with the waste water stream. It is not expected to form a sludge in use, as phosphates (in which situation a sludge could occur) will not be added.

Using OECD test guideline 301D (closed bottle test), Coagulant 139 can not be classified as ready biodegradable, with 23% dissolved oxygen loss after 28 day (cf with lower limit of 60% needed for ready biodegradation). Also, Coagulant 139 was further tested for biodegradation in a 28 day using OECD test guideline 302B (Zahn-Wellens test). This indicated that Coagulant 139 was also not inherently biodegradable, with a minimum calculated TOC loss of 14% (a loss of 20-70% would indicate that the test substance was inherently biodegradable).

No bioaccumulation of the chemical is expected because its very high water solubility and low (measured) octanol/water partition coefficient.

9. EVALUATION OF TOXICOLOGICAL DATA

Toxicological data were provided for Coagulant 139 (35% aqueous solution), although not required by the *Industrial Chemicals (Notification and Assessment) Act 1989* (*the Act*) for a polymer with number-average molecular weight > 1000.

9.1 Acute Toxicity

Table 1 Summary of the acute toxicity of Coagulant 139

Test	Species	Outcome	Reference
Acute oral toxicity	Rat	LD_{50} > 5800 mg/kg	(2)
Acute dermal toxicity	Rat	LD_{50} > 5800 mg/kg	(3)
Skin Irritation	Rabbit	non-irritant	(4)
Eye irritation	Rabbit	non-irritant	(5)

9.1.1 Oral Toxicity (2)

Result: LD_{50} > 5.8 g/kg

Species/strain: Sprague-Dawley rats *Dose:* 5.8 g/kg

Number/sex of animals: 5/sex *Observation period:* 14 days

Method of administration (vehicle): gavage (administered as supplied)

Clinical observations: all animals appeared normal throughout the study

Mortality: nil *Morphological findings:* no abnormalities

Test Method: in accordance with USEPA Health Effects Testing Guidelines (6)

9.1.2 Dermal Toxicity (3)

Result: LD_{50} > 5.8 g/kg *Dose:* 5.8 g/kg

Species/strain: New Zealand White rabbits

Number/sex of animals: 5/sex *Observation period:* 14 days

Method of administration (vehicle): 24 hour patch (test substance administered as supplied)

Clinical observations: all animals appeared normal throughout the study

Mortality: nil *Morphological findings:* no abnormalities

Skin effects: no erythema and no oedema was observed throughout the study

Test Method: in accordance with USEPA Health Effects Testing Guidelines (6)

9.1.4 Skin Irritation (4)

Result: non-irritant

Species/strain: New Zealand White rabbits

Number/sex of animals: 4 males, 2 females

Method of administration: 0.5 ml of undiluted test substance applied to approximately 6 cm^2 of clipped skin; 4 hour patch

Test Method: in accordance with USEPA Health Effects Testing Guidelines (6)

Draize (7) Scores[i]:

Animal	Time after decontamination			
	30-60 min	1 day	2 days	3 days
ERYTHEMA				
1	0	0	0	0
2	1	1	0	0
3	1	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
OEDEMA				
1	0	0	0	0
2	1	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0

[i] See Attachment 1 for Draize Scales

9.1.5 Eye Irritation (5)

Result: non-irritant

Species/strain: New Zealand White rabbits

Number of animals: 6 females

Method of administration: 0.1 mL of undiluted test substance into conjunctival sac of one eye of each animal (eyes remained unwashed)

Test Method: in accordance with USEPA Health Effects Testing Guidelines (6)

Draize (7) Scores[i]

Animal	Time after instillation									
	1 day		2 days		3 days		4 days		7 days	
CORNEA:	opacity	area	opacity	area	opacity	area	opacity	area	opacity	area
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
IRIS										
1	0		0		0		0		0	
2	0		0		0		0		0	
3	0		0		0		0		0	
4	0		0		0		0		0	
5	0		0		0		0		0	
6	0		0		0		0		0	
CONJUNCTIVA	r[a]	c[b]	d[c]	r[a]	c[b]	d[c]	r[a]	c[b]	d[c]	r[a]	c[b]	d[c]	r[a]	c[b]	d[c]
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] redness [b] chemosis [c] discharge
[i] See Attachment 1 for Draize Scales

9.3 Genotoxicity

9.3.1 Salmonella typhimurium Reverse Mutation Assay (8)

Result: non-mutagenic

Strains: Salmonella typhimurium TA 98, TA 100, TA 1535, TA 1537, TA 1538

Concentrations: 0, 100, 333, 1000, 3333 or 5000 μg/plate

Test Method: in accordance with Maron and Ames, 1983 (9)

9.4 Overall Assessment of Toxicological Data

Coagulant 139 (containing 35% notified polymer in aqueous solution) exhibited low acute oral and dermal toxicity in rats and was found to be non-irritating to the skin and eyes of rabbits. The product was found to be non-mutagenic when tested in *Salmonella typhimurium*.

Although the test results show no irritancy in animal skin and eyes, it is possible that some irritation may result due to the high pH of the solution (pH ~ 11.9).

The notified chemical is not classed as hazardous according to Worksafe Australia's Approved Criteria for the Classifying of Hazardous Substances (1) in relation to the toxicity data provided.

10. ASSESSMENT OF ENVIRONMENTAL EFFECTS

Although no ecotoxicological data has to be provided for polymers of NAMW > 1000 according to the *Act*, the company did provide data for fish and water flea (Table 2). These studies were conducted using Coagulant 139 dissolved in water, and reported as a nominal concentration of Coagulant 139.

The test reports indicate that Coagulant 139 is practically non-toxic to fish and water fleas. Literature suggests that anionic polymers polymers could chelate metal ion nutrients, and therefore affect algae (10). This effect however, is expected to be dramatically reduced when Ca or Mg ions are present. The notifier therefore expects the polymer to have little effect on algae because it will be released to the environment already chelated with Ca or Mg ions when used as an anti-foulant.

Due to its high NAMW the polymer is not expected to cross biological membranes.

Table 2 Summary of the Ecotoxicity of Coagulant 139

Species	**Test**	**Result**[a] (mg.L^{-1})
Fathead minnow (*Pimephales promelas*)	96 h acute	LC_{50} > 5000 *(>1750)*
Water Flea (*Daphnia magna*)	48 h acute	EC_{50} > 5000 *(>1750)*

[a] Actual concentration of polymer given in brackets

11. ASSESSMENT OF ENVIRONMENTAL HAZARD

Coagulant 139 is to be used as an anti-foulant in industrial boiler water treatments, and where there is potential for its release to the environment in effluent which could lead to wide-spread environmental exposure.

The notifier estimates that on release of boiler water, the maximum concentration of polymer would be 100 ppm. The notifier gives no indication of expected dilution, but EPA expects that at least a 50% dilution would be achieved when discharged from the facility; the remaining water would come from cooling and process water. The maximum polymer concentration would therefore be 50 ppm. If the combined facility waste water was released to sewer, and involved some form of secondary treatment plant, a further order of magnitude dilution could be expected, which would reduce the typical discharge concentration to around 5 ppm.

The above would indicate that the worst case environmental concentration (ie in receiving waters with no dilution after release from treatment plant) would be 5 ppm of the polymer. This is at least three orders of magnitude below the lowest effect concentration (fish and water flea, LC_{50} or EC_{50} > 1750 $mg.L^{-1}$). The actual concentration in receiving waters is likely to be much less, when given further dilution of the treatment plant discharged to receiving waters. Therefore, the use of Coagulant 139 is not likely to cause any significant environmental impact when used as an anti-foulant in industrial boiler water treatments.

12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS

The notified polymer has NAMW > 1000 and is therefore not expected to cross biological membranes and cause systemic effects. It contains low levels of low molecular weight species (<4% < 1000) and a number of hazardous residual monomers/impurities. The hazardous residual monomers/impurities are not present at levels great enough to classify the polymer as hazardous (1).

The product, Coagulant 139 (containing 35% of the notified polymer), did not display any significant acute oral or dermal toxicity. It is not a skin or eye irritant, although the product has high pH (pH 11.9) and is expected to have some irritancy potential. The product is not mutagenic. Based on the toxicological data submitted for the product, the polymer alone is not expected to present a significant toxicological hazard to workers.

The polymer is not volatile, is stable and is not flammable. Hazards associated with the polymer's physical properties therefore also do not pose a significant concern to workers.

There is little potential for exposure to Coagulant 139 during importation due to the nature of the containers used for importation and transport. It is only envisaged that exposure would occur in the case of a spill, in which case the measures outlined in the MSDS involving containment of the spill with an inert absorbent material for disposal will be implemented.

During reformulation there is potential for occupational exposure during the connection of pumping equipment. Any potential exposure should be reduced by the employees' usage of impermeable gloves, chemical goggles and protective overalls. The risk of exposure will be further reduced by the implementation of local exhaust ventilation to capture any fumes that may be released during pumping.

There will also be the same potential for exposure at the customer plant during the pumping of the notified chemical into holding tanks or directly into the water treatment systems. The risk of exposure will be reduced significantly by the use of if automatic pumping equipment. All employees will be wearing impermeable gloves, chemical goggles and protective overalls to reduce the risk of exposure. Any mist or vapour will be captured by local exhaust ventilation.

The overall risk to workers is expected to be negligible considering the level of personal protective equipment employed and engineering controls, as well as the low levels of toxicity indicated by the information presented.

Under normal use situations public exposure to the notified polymer will be low. Coupled with the low toxicity of the polymer, the risk to the public is expected to be low.

In the event of accidental spillage during transport, public exposure will be minimised by the practices for storage and transportation recommended by the notifier.

13. RECOMMENDATIONS

To minimise occupational exposure to the notified polymer the following guidelines and precautions should be observed:

- if engineering controls and work practices are insufficient to reduce exposure to the polymer in Coagulant 130A/139 to a safe level, then the following personal protective equipment which conforms to Australian Standard (AS) or Australian/New Zealand Standard (AS/NZS) should be worn:
  - a respirator with dust/mist cartridges should be selected and used in accordance to AS/NZS 1715 (11) and should comply to AS/NZS 1716 (12).
  - safety goggles should be selected and fitted in accordance to AS 1336 (13) to comply with AS/NZS 1337 (14).
  - industrial clothing must conform to the specifications detailed in AS 2919 (15) and AS 3765.1 (16).
  - impermeable gloves or mittens conforming to AS 2161 (17) and AS 3765.1 (16).
  - all occupational footwear should conform AS/NZS 2210 (18).
- spillage of the notified chemical should be avoided.
- good personal hygiene should be practised to minimise the potential for ingestion.
- a copy of the Material Safety Data Sheet should be easily accessible to employees.

14. MATERIAL SAFETY DATA SHEET

The Material Safety Data Sheet (MSDS) for Coagulant 139 was provided in an Worksafe Australia format (19).

This MSDS was provided by Betz Laboratories Pty Ltd as part of their notification statement. The accuracy of this information remains the responsibility of Betz Laboratories Pty Ltd.

15. REQUIREMENTS FOR SECONDARY NOTIFICATION

Under the *Industrial Chemicals (Notification and Assessment) Act 1989*, secondary notification of polymer in Coagulant 130A/139 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

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2. Bioresearch Project Number 93-7907A, *Acute Oral Toxicity, Single Level - Rats. Test article: Coagulant 139*, Biosearch Incorporated, Pennsylvania, 1993.

3. Bioresearch Project Number 93-7907A, *Acute Dermal Toxicity, Single Level - Rabbits. Test article: Coagulant 139*, Biosearch Incorporated, Pennsylvania, 1993.

4. Bioresearch Project Number 93-7907A, *Primary Skin Irritation - Rabbits. Test Article: Coagulant 139*, Biosearch Incorporated, Pennsylvania, 1993.

5. Bioresearch Project Number 93-7907A, *Primary Eye Irritation - Rabbits. Test article: Coagulant 139*, Biosearch Incorporated, Pennsylvania, 1993

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12. Standards Australia/ Standards New Zealand, *Australian/New Zealand Standard 1716 - 1991 Respiratory Protective Devices,* Standards Association of Australia Publ., Sydney, Australia, 1991.

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16. Standards Australia, *Australian Standard 3765-1990 Clothing for Protection Against Chemical Hazards, Part 1 Protection Against General or Specific Chemicals, Part 2 Limited Protection Against Specific Chemicals,* Standards Association of Australia Publ., Sydney, Australia, 1990.

17. Standards Australia, *Australian Standard 2161-1978, Industrial Safety Gloves and Mittens (excluding Electrical and Medical Gloves*), Standards Association of Australia Publ., Sydney, Australia, 1978.

18. Standards Australia, Standards New Zealand, *Australian/ New Zealand Standard 2210 - 1994 Occupational Protective Footwear, Part 1: Guide to Selection, Care and Use. Part 2: Specifications,* Standards Association of Australia Publ., Sydney, Australia, Standards Association of New Zealand Publ. Wellington, New Zealand, 1994.

19. National Occupational Health and Safety Commission, *Code of Practice for the Preparation of a Material Safety Data Sheets,* Australian Government Publishing Service, Canberra, 1994.

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