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NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME

FULL PUBLIC REPORT

M 389, Unsaturated Polyester

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Director
Chemicals Notification and Assessment

FULL PUBLIC REPORT

M 389, Unsaturated Polyester

1. APPLICANT

Paint Industries (Australia) Pty Ltd of 1-19 Bennet Street, Mortlake NSW 2137 has submitted a limited notification statement with their application for an assessment certificate for M 389, Unsaturated Polyester.

2. IDENTITY OF THE CHEMICAL

M 389, Unsaturated Polyester is not considered to be hazardous based on the nature of the chemical and the data provided. Therefore the chemical name, CAS number, molecular and structural formulae have been exempted from publication in the Full Public Report and the Summary Report.

Trade name: M 389, Unsaturated Polyester

3. PHYSICAL AND CHEMICAL PROPERTIES

All physico-chemical properties relate to the notified polymer unless indicated otherwise.

Appearance at 20°C and 101.3 kPa:	clear, light brown viscous liquid
Odour:	similar to styrene (based on polymer in styrene solution)
Boiling Point:	145°C (based on styrene)
Specific Gravity/Density:	base polymer 1242kg/m^3 styrene solvent 903 kg/m^3 polymer solution 1100 kg/m^3
Vapour Pressure:	4.5 mm Hg 20°C
Water Extractivity:	estimated to be within 0.004-0.008% of the polymer
Partition Co-efficient (n-octanol/water) log P_{ow}:	product is estimated to be insoluble and therefore partition coefficient cannot be determined

Hydrolysis as a function of pH:	product is estimated to be insoluble and therefore hydrolysis cannot be determined
Adsorption/Desorption:	product is estimated to be insoluble and therefore adsorption/desorption cannot be determined
Dissociation Constant pK_a**:**	product is estimated to be insoluble and therefore dissociation constant cannot be determined
Flash Point:	31°C
Flammability Limits:	based on styrene LEL 1.1% UEL 6.1% (formulation)
Combustion Products:	water vapour and oxides of carbon
Autoignition Temperature:	490°C (based on styrene)
Explosive Properties:	vapours of styrene solution may be explosive
Reactivity/Stability:	stable under normal conditions
Particle size distribution:	product is an homogenous liquid

Comments on physico-chemical properties

The water extractable portion of the polymer has been estimated by shaking the polymer with water at room temperature for 48 h, filtering and quantifying (a) the total residue recovered (b) amount dissolved in the filtrate by evaporating it to dryness.

The ester linkages in polyester resins are generally stable under a wide range of pH values and do not undergo hydrolysis.

On the basis of the polymer's low solubility and high molecular weight it is likely to adsorb to or be associated with soil/sediment and be immobile in soil. The polymer is expected to show typical acidity due to the presence of about 0.5% free Benzenedicarboxylic acid.

4. PURITY OF THE CHEMICAL

Degree of purity: > 80%

Additives/Adjuvants:

Chemical name:	zinc acetate
Synonyms:	acetic acid, zinc salt, dicarbomethoxyzinc, zinc diacetate
CAS No.:	557-34-6
Weight percentage:	<0.1

Chemical name:	hydroquinone
Synonyms:	arcutivin; benzene, p-dihydroxy-; p-benzenediol; 1,4 benzenediol; benzohydroquinone; benzoquinol.
CAS No.:	123-31-9
Weight percentage:	<0.1

5. INDUSTRIAL USE

M 389 Unsaturated Polyester will be manufactured as a clear brown viscous liquid. This is added to styrene at approximately 58% and used in the formulation of laminating compounds. The M 389 Unsaturated Polyester resin in styrene will be manufactured at a level of approximately 100 tonnes per year over the next five years, approximately 58 tonnes of this being the notified polymer.

6. OCCUPATIONAL EXPOSURE

The manufacturing process will start with the batch weighing, handling and dispensing solid raw material into 1200 kg capacity bulker bags for loading into the manufacturing reactor. This will be performed by up to four personnel. While there is no exposure to the notified chemical, there is a potential for exposure to the monomer constituents which may pose a major occupational health risk. All personnel at this stage will be wearing mandatory safety goggles, PVC gloves and long sleeved and long legged overalls.

The movement of bulk solid raw materials from store to plant and loading onto the reactor platforms will be performed by up to four store persons/forklift drivers. There is potential for exposure to the raw materials through spillage of the ingredients but no risk of exposure to the notified chemical. All forklift operators will be wearing protective overalls, safety glasses and chrome leather gloves. Exhaust ventilation will be employed at the store and during loading to reduce atmospheric concentrations of potentially harmful monomer species.

The solid raw materials will be loaded via a chute to the manufacturing reactor where dust and vapour emissions are collected by a vacuum pump to an incinerator. Raw liquid material will be automatically pumped from storage tanks to the reactor and batch tanks. The manufacturing process will be initiated which will involve the heating of the reactor to melt the solids. Just prior to this up to two quality control personnel will sample the reactor to monitor the progress of the reaction. They will be wearing dust masks, an air supplied hood, chrome leather gloves, safety glasses and a face shield as well as protective overalls. The reaction will then proceed by sealing the reactor to form a closed system into which an inert nitrogen blanket and heat will be applied. On completion of the reaction the batch is cooled and dropped into a thinning tank (mixer), containing the styrene reducer. The final concentration of the polymer in styrene will be between 30-60%.

This entire process will be operated by reactor operating personnel (up to four) as well as up to two supervising personnel. All will be wearing the same personal protective equipment as the quality control personnel. The operating personnel will also be in charge of maintenance which will involve the changing of filter bags/cartridges in the filtering vessels of the reactor system. This represents potential exposure to the notified chemical.

The notified chemical in styrene solution will then be automatically pumped into 200 litre steel metal drums for use in the production of the laminating compound at the same site. This will involve the transport by forklift to the mixing room where it will be incorporated into a mixer to fabricate the laminate. This will involve the release of styrene vapours which will be captured by ventilators. The final laminating product will be dispensed to customers in 200 litre steel drums or 20 litre steel pails.

All vapour produced during production and mixing will be exhausted to an incinerator where it will be burned to oxides of carbon and water vapour, keeping the concentration in the workplace below the occupational exposure standard for styrene of 50 ppm TWA. Atmospheric monitoring for styrene will also be part of standard procedures. Biological monitoring will also be performed on staff for exposure to specific substances involved in the manufacturing process.

7. PUBLIC EXPOSURE

M 389 Unsaturated Polyester will be produced on-site in a closed reactor system as a 58% solution in styrene, and used on site. The level of production will be approximately 100 tonnes per year over the next five years. The notified polymer will be combined with other chemicals to form a resin solution from which laminates are prepared.

The potential for public exposure to M 389, Polyunsaturated Polyester is anticipated to be very low, since this compound will be produced and used at an industrial site and will not be sold in any uncompounded form or formulated for any domestic use.

Although members of the public may come into contact with laminates produced from M 389 Unsaturated Polyester, the resin will be in a cured form, formulated to be resistant to hydrolysis. Exposure can thus be expected to be very low.

8. ENVIRONMENTAL EXPOSURE

. Release

Manufacture and Volume

Approximately 100 tonnes of M 389 Unsaturated Polyester in styrene (containing about 58 tonnes of the polymer) will be manufactured annually starting initially at a plant in Glendenning, NSW. Manufacture may also start at the plant of Anzol Victoria Pty Ltd, Dandenong, Victoria within the next 5 years.

On completion of the polymerisation in a reaction vessel the product is dissolved in styrene in a thinning and mixing tank to form M 389 Unsaturated Polyester in styrene. About 3700 L/year of distillate (95% water) generated from the reaction vessel is neutralised, sedimented and digested in an aerobic digester. The purified water phase (about 3515 kg/year) is discharged to the sewer system. The sludge (about 185 kg/year), is disposed to farmland as nitrogenous fertiliser. The company states that there are no toxic chemicals in this material as small amounts organic compounds in the distillate are broken down by the bacteria. The organic vapours and dust from all components of the plant are drawn into an on line incinerator where they are converted to oxides of carbon and water. The company has provided the details of the manufacturing process in a diagram.

M389 Unsaturated Polyester produced will be stored on site, either in holding tanks (up to 10000 L) or in 200 L metal drums. The transport of drums is only within the site as M389 Unsaturated Polyester is reprocessed to formulate laminating compounds at the same site. The above arrangements indicate that the release of the polymer to the environment during manufacture, storage and transport of M389 Unsaturated Polyester would be negligible.

Formulation, handling and disposal

To formulate the laminating solution, M 389 Unsaturated Polyester in styrene is pumped from storage tanks or drums into a closed dispersion tank fitted with a stirrer. A small quantity of styrene is pumped through closed lines and inert solid (silica) added through the manhole on the top of the dispersion tank. The concentration of the notified polymer in the laminating solution remains around 57-59%.

Laminating solution so prepared is filtered and packed in 200 L non-returnable steel drums and 20 L steel pails and transported by road to customers across Australia. The company estimates the loss of the polymer through spent filter cartridges to be 0.2%. About 1% of the polymer is lost as solid waste associated with rags used to clean equipment and spills during mixing and packing. This waste will be disposed to landfill.

About 1% of the styrene in M389 Unsaturated Polyester is also lost, by vapourisation, to the aerial environment during the formulation of the laminating solution. This equates to about 420 kg of styrene for a 100 tonne annual production of M 389 Unsaturated Polyester in styrene.

Use

The laminating solution containing the notified polymer will be used in the manufacture of fibre-reinforced plastics at various customer sites across Australia. The laminate solution and fibre glass is sprayed through a spray gun on to fibre glass moulds where it cures and forms a hard composite material. The company estimates that about 1% of the polymer will be lost to land fill through wastes during the fabrication of such plastic products. The high efficiency is achieved by spraying inside the mould.

About 3% of the styrene is expected to be lost to the aerial environment during laminate fabrication. The rest of the styrene forms crosslinks to become an integral part of the solid composite laminate.

The total amount of styrene lost to the atmosphere from exhausts at all work places and through volatilisation from waste resin is estimated to be about 1800-3000 kg/year or 5-8 kg/day.

. Fate

The polymer will be released to the environment in two main ways; (a) as a component of the finished fibre-reinforced plastic product and (b) in the form of waste from manufacture, formulating and packing of the laminating solution and fabrication of the plastic. The polymer will not be released from the finished plastic product as it is highly crosslinked and held into a solid matrix. Photo and/or thermal degradation of the plastic over long periods may release some polymer breakdown products but this would be extremely slow. Up to 2-3% of the total annual production of the polymer can be lost to the environment as waste from sources mentioned under (b) above. This will be either landfilled or incinerated.

The polymer is expected to have minimum mobility in the soil environment because of its high molecular weight and low water solubility. Residues consigned to landfill will therefore remain immobile. Incineration of residues or degraded plastic will result in the destruction of the polymer as oxides of carbon and water.

9. EVALUATION OF TOXICOLOGICAL DATA

Toxicological information is not required for a limited notification. It should however be noted that the Material Safety Data Sheet (MSDS) for the notified chemical states that there may be adverse health effects from oral administration, inhalation and that it may cause dermal irritation or sensitisation. These effects are typical of the common toxicological reactions seen with styrene (1), and are therefore unlikely to be due to the notified polymer.

The polymer is a polyester with low solubility and a high molecular weight (NAMW > 1400-1500) and as such is unlikely to be absorbed through the skin. The residual monomers used in the manufacture of the polymer are present at less than 0.5%, a level not expected to result in exposure related health effects.

The notifier states that there is no record of occurrence of work related health effects attributable to the manufacture of similar polymers and raw materials among the personnel employed in the Australian operations.

As no toxicological information was required or submitted for this notification, the notified chemical cannot be classified according to Worksafe *Australia's Approved Criteria for Classifying Hazardous Substances* (2).

10. ASSESSMENT OF ENVIRONMENTAL EFFECTS

According to the *Industrial Chemicals (Notification and Assessment) Act 1989*, environmental effects testing is not required for polymers with NAMW>1000.

The notified polymer is not likely to exhibit toxic characteristics in the environment because it is too large to cross biological membranes.

11. ASSESSMENT OF ENVIRONMENTAL HAZARD

The polymer is expected to present a negligible hazard to the environment because of its lack of mobility and inability to cross biological membranes. The Australian EPA considers polynonionic polymers with molecular weights above 1000 to be of low concern based on US EPA findings (3). When used in the composite industry, the polymer will be held in a highly cross-linked manner inside a durable, fibre-reinforced plastic with negligible environmental hazard.

12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS

There is no risk of exposure to the notified chemical during the weighing and transporting of the component monomers for the manufacturing process. However as the constituent monomers can pose an occupational health risk the appropriate protective clothing, impermeable gloves and eye protection are employed. This will be supplemented by exhaust ventilation to reduce possible exposure.

The manufacture of the notified chemical will take place within a closed reactor system thereby reducing any direct exposure to the notified chemical. However there is potential for some exposure to prepolymer mixtures during quality control sampling and changing the filters, as well as vapour and dust emissions during the loading of the raw constituent monomers. Because of the often hazardous nature of the constituent monomers, all personnel working at the reactor site will be required to wear dust masks, air supplied hoods, chrome leather gloves, safety glasses or face shield as well as protective overalls. Vacuum pumps from the reactor will capture most of the vapour and dust emissions during manufacture and mixing and be incinerated thereby reducing the potential for occupational exposure.

There is further potential for exposure to the notified chemical during transport in 200 L drums to be incorporated into laminating products. In the case of spillage, any notified chemical will be dammed by sand which is employed during the fabrication of the final laminating product. The sand acts as a cross linking agent, solidifying any spills into an inert mass which can be disposed of.

The workplace atmosphere will be regularly monitored for styrene vapour emissions to maintain vapour levels to acceptable levels. Any vapour release will be captured by exhaust ventilation. This will be complemented with biological monitoring for all staff involved in the manufacturing process for exposure levels to the specific chemicals involved in the manufacturing process.

Given the site-limited nature of use for the notified polymer and its stability in a cured form in laminated products, public exposure to M 389 Unsaturated Polyester is expected to be very low.

13. RECOMMENDATIONS

To minimise occupational exposure to M 389, Unsaturated Polyester the following guidelines and precautions should be observed:

- local exhaust ventilation should be implemented where there is the likelihood of exposure to aerosols or vapour emissions.

- if engineering controls and work practices are insufficient to reduce exposure to M 389, Unsaturated Polyester 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:

- *Manufacturing and Use of M389-Polyester Resin Solution in Styrene*

  The notified chemical itself is not classified as hazardous, however, hazardous monomers are employed in its manufacture, and the resulting polymer is contained in styrene thereby requiring the use of the following:

  - appropriate fume extraction/ventilation should be employed during the manufacture and use of notified chemical.

  - a respirator with dust/mist cartridges should be selected and used in accordance to AS/NZS 1715 (4) and should comply to AS/NZS 1716 (5).

  - safety goggles should be selected and fitted in accordance to AS 1336 (6) to comply with AS/NZS 1337 (7).

  - industrial clothing must conform to the specifications detailed in AS 2919 (8) and AS 3765.1 (9).

  - impermeable gloves or mittens conforming to AS 2161 (10) and AS 3765.1 (9).

- *Spills*

  - a respirator with dust/mist cartridges should be selected and used in accordance to AS/NZS 1715 (4) and should comply to AS/NZS 1716 (5).

  - safety goggles should be selected and fitted in accordance to AS 1336 (6) to comply with AS/NZS 1337 (7).

  - industrial clothing must conform to the specifications detailed in AS 2919 (8).

  - PVC gloves or mittens conforming to AS 2161 (10) and AS 3765.1 (9).

  - should spillage occur, it should be contained by application of an inert absorbent material (ie sand) and scooped into containers suitable for disposal by landfill or incineration according to State Land Waste Management Authority. Prevent any release into waterways.

- M 389 Unsaturated Polyester solutions containing styrene may form an explosive air-vapour mixture. Keep away from heat, naked flames, sparks and oxidising agents.

- 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 M 389, Unsaturated Polyester was provided in an acceptable format according to Worksafe Australia's *National Code of Practice for the Preparation of Material Safety Data Sheets* (11).

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

15. REQUIREMENTS FOR SECONDARY NOTIFICATION

Under the *Industrial Chemicals (Notification and Assessment) Act 1989*, secondary notification of M389, Unsaturated Polymer 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

1. Sax, NI and Lewis, RJ (Eds), 1989, *Dangerous Properties of Industrial Materials*, 7th Ed., Van Nostrand Reinhold, New York.

2. National Occupational Health and Safety Commission, 1994, *Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(1994)],* AGPS, Canberra.

3. Nabholz, JV, Miller, P, and Zeeman, M (1993). Environmental Risk Assessment of New Substances under the Toxic Substances Control Act Section Five. In WG Landis, JS Hughes and MA Lewis (Eds), Environmental Toxicology and Risk Assessment, American Society for Testing and Materials, ASTM STP 1179, Philadelphia. pp 40-55.

4. Standards Australia, Standards New Zealand, 1994, *Australian/New Zealand Standard 1715 - 1994 Selection, Use and Maintenance of Respiratory Protective Devices*, Standards Association of Australia Publ., Sydney, Australia, Standards Association of New Zealand Publ., Wellington, New Zealand.

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

6. Standards Australia, 1994, *Australian Standard 1336-1994, Recommended Practices for Eye Protection in the Industrial Environment*, Standards Association of Australia Publ., Sydney, Australia.

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

8. Standards Australia, 1987, *Australian Standard 2919 - 1987 Industrial Clothing,* Standards Association of Australia Publ., Sydney, Australia.

9. Standards Australia, 1990, *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.

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

11. National Occupational Health and Safety Commission, 1994, *National Code of Practice for the Preparation of Material Safety Data Sheets [NOHSC:2011 (1994)],* AGPS, Canberra.