Maleated, fumarated rosins and salts: Human health tier II assessment

04 July 2014

Chemicals in this assessment

Chemical Name in the Inventory	CAS Number
Rosin, maleated	8050-28-0
Rosin, polymer with acrylic acid and pentaerythritol	68425-05-8
Resin acids and rosin acids, maleated, ammonium salts	68911-89-7
Rosin, fumarated	65997-04-8
Rosin, fumarated, polymer with pentaerythritol	65997-11-7
Tall oil rosin, maleated, polymer with pentaerythritol	68188-28-3
Resin acids and rosin acids, fumarated, sodium salt	68201-59-2
Resin acids and rosin acids, maleated, sodium salts	68201-60-5
Rosin, maleated, polymer with pentaerythritol	68333-69-7
Resin acids and rosin acids, fumarated, potassium salt	68649-83-2
Resin acids and rosin acids, maleated, potassium salts	85409-27-4

Preface

This assessment was carried out by staff of the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) using the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework.

The IMAP framework addresses the human health and environmental impacts of previously unassessed industrial chemicals listed on the Australian Inventory of Chemical Substances (the Inventory).

The framework was developed with significant input from stakeholders and provides a more rapid, flexible and transparent approach for the assessment of chemicals listed on the Inventory.

Stage One of the implementation of this framework, which lasted four years from 1 July 2012, examined 3000 chemicals meeting characteristics identified by stakeholders as needing priority assessment. This included chemicals for which NICNAS already held exposure information, chemicals identified as a concern or for which regulatory action had been taken overseas, and chemicals detected in international studies analysing chemicals present in babies' umbilical cord blood.

Stage Two of IMAP began in July 2016. We are continuing to assess chemicals on the Inventory, including chemicals identified as a concern for which action has been taken overseas and chemicals that can be rapidly identified and assessed by using Stage One information. We are also continuing to publish information for chemicals on the Inventory that pose a low risk to human health or the environment or both. This work provides efficiencies and enables us to identify higher risk chemicals requiring assessment.

The IMAP framework is a science and risk-based model designed to align the assessment effort with the human health and environmental impacts of chemicals. It has three tiers of assessment, with the assessment effort increasing with each tier. The Tier I assessment is a high throughput approach using tabulated electronic data. The Tier II assessment is an evaluation of risk on a substance-by-substance or chemical category-by-category basis. Tier III assessments are conducted to address specific concerns that could not be resolved during the Tier II assessment.

These assessments are carried out by staff employed by the Australian Government Department of Health and the Australian Government Department of the Environment and Energy. The human health and environment risk assessments are conducted and published separately, using information available at the time, and may be undertaken at different tiers.

This chemical or group of chemicals are being assessed at Tier II because the Tier I assessment indicated that it needed further investigation.

For more detail on this program please visit:**www.nicnas.gov.au**

Disclaimer

ACRONYMS & ABBREVIATIONS

Grouping Rationale

The chemicals in this group are UVCBs (unknown or variable composition, complex reaction products or biological materials) derived from rosin. Rosins are a complex combination of chemicals derived from wood, especially pine wood. They are composed primarily of resin acids and modified resin acids such as dimers and decarboxylated resin acids. Abietic acid (CAS No. 514-10-3), typically 25–45 %, is the major resin acid component of rosin (NICNAS).

The chemicals in this group are formed through rosin reacting with fumaric, maleic (in the form of maleic anhydride) or acrylic acid. A Diels-Alder reaction between the unsaturated olefinic bond in the rosin and olefinic bond in the acid occurs (US EPA, 2008; Illing HP et al., 2009). There are likely to be some reaction products in common (10–20 %) in the maleated and fumarated derivatives, due to the temperature at which the reaction occurs (US EPA, 2008). In addition, the maleic anhydride adduct will be readily hydrolysed to the fumaric acid adduct in an aqueous medium (US EPA, 2008). Whilst anhydride reaction products are not expected for a rosin polymer with acrylic acid and pentaerythritol (CAS No. 68425-05-8), the reaction products will be structurally similar to the non-anhydride fumaric acid derivatives.

These chemically modified compounds have been reported to be strong sensitisers that are immunologically distinct from that of oxidised rosin (refer to **Sensitisation** section). Although esterification with pentaerythritol appears to reduce the potency of the sensitisation reaction, the potential for skin sensitisation is still present.

The following structurally related rosins on the Australian Inventory of Chemical Substances (AICS) have been included due to their related end-uses and their close chemical relationship:

- resin acids and rosin acids, fumarated, sodium salt (CAS No. 68201-59-2)
- resin acids and rosin acids, fumarated, potassium salt (CAS No. 68649-83-2)
- resin acids and rosin acids, maleated, sodium salts (CAS No. 68201-60-5)
- resin acids and rosin acids, maleated, potassium salts (CAS No. 85409-27-4)
- resin acids and rosin acids, maleated, ammonium salts (CAS No. 68911-89-7)

Import, Manufacture and Use

Australian

The majority of this group's chemicals have the following Australian industrial uses reported under previous mandatory and/or voluntary calls for information.

Reported potential commercial and/or domestic use including in adhesives and binding agents.

The total volume introduced into Australia, reported under previous mandatory and/or voluntary calls for information, was <1000 tonnes.

Of the chemicals in this group, no specific Australian use, import, or manufacturing information has been identified for:

- rosin, maleated (CAS No. 8050-28-0); or

- rosin, maleated, polymer with pentaerythritol (CAS No. 68333-69-7).

International

Of the chemicals in this group, no specific international use, import, or manufacture information has been reported for a rosin polymer with acrylic acid and pentaerythritol (CAS No. 68425-05-8).

The remaining chemicals in the group have one or more of the following reported uses, which have been identified through European Union Registration, Evaluation and Authorisation of Chemicals (EU REACH) dossiers; Substances and Preparations in the Nordic countries (SPIN) database, Galleria Chemica, US Department of Health and Human Services, Household Products Database and several material safety data sheets (MSDSs):

The chemicals have reported domestic use including:

- as adhesives and binding agents;
- in inks; and
- in surface treatments

Overall, the chemicals do not appear to be widely available for domestic use with the exception of maleated rosin (CAS No. 8050-28-0), which was identified in one cement adhesive (<30 % concentration). Available North American databases do not give evidence for the other chemicals being used in consumer products. In publically available MSDSs, rosin, maleated, polymer with pentaerythritol (CAS No. 68333-69-7) was identified as an ingredient of an ink for copy markers (<12 % concentration) and maleated rosin was identified in a floor coating (<5 % concentration).

Reported commercial use including:

- as sizing agents in papermaking:
- as reprographic agents;
- in tipping paper and ink for cigarette manufacture (known as fumaric colophony resin); and
- as synthetic polymers used as binders in electrostatic photocopier papers.

There is reported site-limited use as chemical intermediates.

Restrictions

Australian

No known restrictions have been identified.

International

No known restrictions have been identified.

Existing Worker Health and Safety Controls

Hazard Classification

The chemicals are not listed on the Hazardous Substances Information System (HSIS) (Safe Work Australia).

Exposure Standards

Australian

No specific exposure standards are available.

International

No specific exposure standards are available.

Health Hazard Information

With the exception of sensitisation reactions, rosin is considered to be of low toxicity (NICNAS). Therefore, the toxicity of the chemicals in this group is expected to be driven by the Diels-Alder reaction products. Although polymerisation with pentaerythritol should decrease bioavailability, in the absence of chemical-specific data, data for maleated rosin (CAS No. 8050-28-0) and fumarated rosin (CAS No. 65977-04-8) are considered representative for all the chemicals in the group.

Acute Toxicity

Oral

Based on the available animal test data for maleated rosin (CAS No. 8050-28-0) and fumarated rosin (CAS No. 65997-04-8), the chemicals in this group are considered to have low acute toxicity following oral exposure.

In three acute studies, rosin, maleated (CAS No. 8050-28-0) and rosin, fumarated (CAS No. 65997-04-8) are reported to have low acute oral toxicity in Sprague Dawley (SD) rats, with an oral median lethal dose (LD50) value >2000 mg/kg. No treatment-related adverse effects were reported, although clinical signs of oral toxicity including staggered movement, piloerection (erection of the hair of the skin), ungroomed appearance, hunched posture, and diarrhoea were reported, but were reversible within the 14-day observation period (IUCLID, 2000; US EPA, 2008; REACHa; REACHb).

Dermal

Based on the available animal test data for fumarated rosin (CAS No. 65997-04-8), the chemicals in this group are considered to have low acute toxicity following dermal exposure.

Rosin, fumarated (CAS No. 65997-04-8) is reported to have low acute dermal toxicity in SD rats with a dermal median lethal dose (LD50) value of >2000 mg/kg bw. No treatment-related adverse effects were reported. Erythema (redness of skin) and yellow colouration of the treated area 24 hours post-dose in all animals were reported, but were reversible within the observation period (IUCLID, 2000; REACHb).

Inhalation

No data are available.

Observation in humans

Exposure to vapours of rosin-based chemicals has been reported, typically in solder fluxes. Although respiratory sensitisation has been reported (refer to **Sensitisation**), there have been no reports to support acute toxicity by inhalation.

Corrosion / Irritation

Skin Irritation

Based on the available animal test data for maleated rosin (CAS No. 8050-28-0) and fumarated rosin (CAS No. 65997-04-8), the chemicals in this group are not considered to be skin irritants.

Rosin, maleated (CAS No. 8050-28-0) was reported to not be irritating to the clipped skin of New Zealand White rabbits, following application of 0.5 g to three animals for four hours, using a semi-occlusive patch. Animals were observed at 1, 24, 48 and 72 hours after the patch was removed. The mean erythema and oedema scores (for the 24–72 hour observation period) were reported to be 0.1 and 0, respectively (IUCLID, 2000; REACHa).

In another skin irritation study, three New Zealand White rabbits were exposed to 0.5 g of rosin, fumarated (CAS No. 65997-04-8), under semi-occlusive conditions on clipped skin for four hours, and observed over 72 hours (at 24, 48 and 72 hour intervals) after the patch was removed. No dermal irritation was reported and the mean erythema and oedema scores (for the 24–72 hour observation period) were 0 (IUCLID, 2000; REACHb).

Eye Irritation

Based on the available animal test data for fumarated rosin (CAS No. 65997-04-8), the chemicals in this group are considered to be eye irritants. The chemicals are recommended for classification based on the severe effects observed (refer to **Recommendation** section).

In an equivalent OECD guideline study (test guideline (TG) 405), 0.1 g of rosin, fumarated (CAS No. 65997-04-8) was instilled into the eyes of one New Zealand White rabbit and observed over five hours (at one- and five-hour intervals). At five hours, severe eye irritation was reported with respective corneal, iris, conjunctival redness and chemosis (swelling of the conjunctivae), Draize scores of one (max score of four), one (max two), three (max three), and four (max four). It was reported that the animal was euthanised five hours after the application as further testing was not warranted given the severity of effects observed (IUCLID, 2000; REACHb).

Sensitisation

Respiratory Sensitisation

There are equivocal data to show that fumes from heated compounds containing rosin-based chemicals may cause occupational asthma (NICNAS, 2005). These compounds do not have uses that are likely to lead to fumes of this type being formed.

Skin Sensitisation

This group's chemicals are considered to be skin sensitisers. The chemicals are recommended for classification (refer to **Recommendation** section) based on the positive results seen in a single guinea pig maximisation test, a Buehler test and several local lymph node assays (LLNA). Although esterification with pentaerythritol appears to reduce the potency of the sensitisation reaction, the potential for skin sensitisation is still present.

Maleated rosin (CAS No. 8050-28-0) in a study equivalent to OECD TG 429 was reported to be positive for skin sensitisation in mouse local lymph node assays (LLNAs). Female mice (four/dose) were administered daily applications of 0 %, 0.5 %, 5 %, or 50 % (w/v) of the chemical in acetone/olive oil (ratio of 4:1). Stimulation indexes of 0, 1.91, 22.84 and 19.27 were reported, respectively. The effective concentration at which a three-fold increase in stimulation index is achieved (EC3) was reported to be 0.74 %. A similar study, using fumarated rosin (CAS No. 65997-04-8) at the same daily dose concentrations, reported positive for skin sensitisation with stimulation indexes of 0, 1.2, 7.0, and 12.8 respectively, and an EC3 of 1.9 % (IUCLID, 2000; Illing HP et al., 2009; REACHa; REACHb).

Two additional skin sensitisation studies on maleated rosin (CAS No. 8050-28-0) also reported positive results for skin sensitisation. In a guinea pig maximisation test (GPMT) in accordance with OECD TG 406, male guinea pigs (20/dose) were administered a 0.003 % (w/v) solution of the chemical (in olive oil) by an intradermal injection. The animals were topically induced with a 30 % (w/v) concentration of the chemical in olive oil. Skin sensitisation was reported in 15/19 animals challenged with 10 % of the chemical and in all animals challenged with 30 % of the chemical. Another study, using the Buehler method, reported that Hartley guinea pigs (20/dose; 10 controls/dose) were positive for skin sensitisation (16/20 animals), when observed 24 hours after the challenge exposure (IUCLID, 2000; REACHa).

Rosin esters with pentaerythritol

Several rosin esters with pentaerythritol tested positive for skin sensitisation (Illing HP et al., 2009) in the mouse LLNA at concentrations of 0.25 %, 2.5 %, 25%:

- reaction product of gum rosin with 8% maleic anhydride and esterified with pentaerythritol (acid value 35) caused stimulation indexes of 1.25, 1.36, 4.17 respectively and an EC3 of 16 %;
- reaction product of gum rosin with 8% maleic anhydride and esterified with pentaerythritol (acid value 13) caused stimulation indexes of 1.34, 1.41, 3.83, respectively and an EC3 of 17 %; and
- reaction product of gum rosin with 10% maleic anhydride and esterified with pentaerythritol caused stimulation indexes of 0.39, 1.34, 3.3, respectively and an EC3 of 22 %.

Observation in humans

Sensitisation to rosin chemicals has been reported following human exposure.

Human evidence was summarised for 10 studies showing that preparations of abietic acid or rosin (CAS No. 8050-09-7) could elicit a skin sensitisation response in humans, but that oxidised resin acids are stronger sensitisers than the resin acids themselves. In one study, no subjects were sensitised to abietic acid that was purified immediately before application. More recent publications also provide evidence that rosin is a contact allergen, with positive response rates up to 12 % reported in clinics. The prevalence of allergy to rosin in the general population has been reported as approximately 1 % (NICNAS).

Samples of rosin material used in human testing (including commercial preparations for patch testing) have been shown to contain oxidised rosin products that increase in concentration upon storage (NICNAS).

Repeated Dose Toxicity

Oral

Based on the limited information available for fumarated rosin (CAS No. 65997-04-8), the chemicals in this group are considered to have low toxicity following repeated oral exposure.

In a combined repeated dose/reproductive/developmental toxicity screening test with fumarated rosin (CAS No. 65997-04-8), male and female SD rats were administered dose concentrations of 0, 1000, 3000 and 10000 ppm in the diet (calculated daily dose ranges were 0; males 72–89 mg/kg bw/d, females 79–108 mg/kg bw/d; males 221–288 mg/kg bw/d, females 196–292 mg/kg bw/d; males 651–889 mg/kg bw/d, females 449–995 mg/kg bw/d, respectively). Males were treated over four weeks (starting two weeks before mating) and female treatment started two weeks before mating, then through mating until euthanised (after day four of lactation). The parental no observed adverse effect level (NOAEL) is 3000 ppm (males 221–288 mg/kg bw/d, females 196–292 mg/kg bw/d) based on an increase in total bilirubin (both sexes) and decreased adrenal weight and thymic atrophy (females only) observed at the top dose. Reduced body weight gain based on reduced food consumption was observed in the 3000 ppm and 10000 ppm dose groups (IUCLID, 2000; US EPA, 2008; REACHb).

Dermal

No data are available.

Inhalation

No data are available.

Genotoxicity

Based on the available animal test data for maleated rosin (CAS No. 8050-28-0) and fumarated rosin (CAS No. 65997-04-8), the chemicals in this group are considered to have no mutagenic or genotoxic potential.

In vitro

Rosin, maleated (CAS No. 8050-20-28) was reported to be non-mutagenic in *Salmonella typhimurium* (bacterial strains: TA 98, TA 100, TA 1535, TA 1537 and TA 1538), with and without metabolic activation (US EPA, 2008; REACHa).

In several bacterial reverse point mutation tests, rosin, fumarated (CAS No. 65997-04-8) was reported to be non-mutagenic in *S. typhimurium* and *Escherichia coli WP2uvr* (bacterial strains: TA 98, TA 100, TA 1535, TA 1537 and TA 1538), with and without metabolic activation (IUCLID, 2000; US EPA, 2008; REACHb).

In a mammalian cell gene mutation study, rosin, fumarated (CAS No. 65997-04-8) was reported to be non-mutagenic in L5178Y mouse lymphoma cells in two independent experiments. No toxicologically significant dose-related increases in the mutant frequency at any dose level, with or without metabolic activation, were reported (IUCLID, 2000; US EPA, 2008; REACHb).

In another test using Chinese hamster ovary (CHO) cells, rosin, fumarated (CAS No. 65997-04-8) was reported to not have clastogenic effects, with or without metabolic activation, although induced polyploidy (additional sets of chromosomes) was observed at a concentration that was overtly toxic to the cell cultures (IUCLID, 2000; US EPA, 2008; REACHb).

In vivo

No data are available.

Carcinogenicity

While no data are available on the chemicals in this group, two-year dietary toxicity studies reported that several rosin-based chemicals were not considered as carcinogens (NICNAS).

Reproductive and Developmental Toxicity

Based on the available animal test data for fumarated rosin (CAS No. 65997-04-8), the chemicals in this group are not expected to cause specific reproductive or developmental toxicity. Any reproductive and developmental effects were only observed secondary to parental toxicity.

In a combined repeated dose/reproductive/developmental toxicity screening test with fumarated rosin (CAS No. 65997-04-8) (refer to **Repeated dose toxicity** for study details), the NOAEL for reproductive and developmental toxicity was considered to be 3000 ppm (males 221–288 mg/kg bw/d, females 196–292 mg/kg bw/d). Effects observed in the highest dose animals (10000 ppm) were slight increases in time to mating and in the duration of gestation, slight decrease in the mean number of implant sites per pregnancy and a consequent slight reduction in litter size at birth (US EPA, 2008; REACHb). Parental toxicity was also observed at this highest dose (refer to **Repeated dose toxicity**).

Risk Characterisation

Critical Health Effects

The critical health effects for risk characterisation include local effects (skin sensitisation and severe eye irritation).

Public Risk Characterisation

Although the chemicals have the potential to be used in consumer products, based on the available data (refer to **Manufacture, import and use** section), the chemicals do not appear to be widely available for domestic uses. There is no indication that the chemicals are used in consumer products that are heated, e.g. solders. Therefore, the public risk from these chemicals is not considered to be unreasonable.

Occupational Risk Characterisation

During product formulation, dermal, ocular and inhalation exposure of workers to the chemicals may occur, particularly where manual or open processes are used. These may include transfer and blending activities, quality control analysis, and cleaning and maintaining equipment. Worker exposure to the chemicals at lower concentrations might also occur while using formulated products containing the chemicals. The level and route of exposure will vary depending on the method of application and work practices employed.

Given the critical local health effects, the chemicals may pose an unreasonable risk to workers unless adequate control measures to minimise dermal and inhalation exposure to the chemicals are implemented. The chemicals should be appropriately classified and labelled to ensure that a person conducting a business or undertaking (PCBU) at a workplace (such as an employer) has adequate information to determine appropriate controls.

The data available support an amendment to the hazard classification in HSIS (refer to **Recommendation** section).

NICNAS Recommendation

Assessment of the chemical is considered to be sufficient, provided that the recommended amendment to the classification is adopted, and labelling and all other requirements are met under workplace health and safety and poisons legislation as adopted by the relevant state or territory.

If any information becomes available to indicate significant consumer exposure to the chemicals in Australia, risks to public health any safety might have to be managed by changes to poisons scheduling.

Regulatory Control

Work Health and Safety

The chemicals are recommended for classification and labelling under the current approved criteria and adopted GHS as below. This assessment does not consider classification of physical hazards and environmental hazards.

The classification proposed below is based on read across principles. It should be used as a default for all members of the group. If empirical data become available for any member of the group indicating that a lower (or higher) classification is appropriate for the specific chemical, these may be used to amend the default classification for that chemical.

Hazard	Approved Criteria (HSIS)[a]	GHS Classification (HCIS)[b]
Irritation / Corrosivity	Risk of serious eye damage (Xi; R41)	Causes serious eye damage - Cat. 1 (H318)
Sensitisation	May cause sensitisation by skin contact (Xi; R43)	May cause an allergic skin reaction - Cat. 1 (H317)

[a] Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(2004)].

[b] Globally Harmonized System of Classification and Labelling of Chemicals (GHS) United Nations, 2009. Third Edition.

[*] Existing Hazard Classification. No change recommended to this classification

Advice for consumers

Products containing the chemicals should be used according to the instruction on the label.

Advice for industry

Control measures

Control measures to minimise the risk from ocular and inhalation exposure to the chemicals should be implemented in accordance with the hierarchy of controls. Approaches to minimise risk include substitution, isolation and engineering controls. Measures required to eliminate or minimise risk arising from storing, handling and using a hazardous chemical depend on the physical form and the manner in which the chemical is used. Examples of control measures which may minimise the risk include, but are not limited to:

- using closed systems or isolating operations;
- health monitoring for any worker who is at risk of exposure to the chemical if valid techniques are available to monitor the effect on the worker's health;
- minimising manual processes and work tasks through automating processes;
- work procedures that minimise splashes and spills;
- regularly cleaning equipment and work areas; and
- using protective equipment that is designed, constructed, and operated to ensure that the worker does not come into contact with the chemical.

Guidance on managing risks from hazardous chemicals are provided in the *Managing risks of hazardous chemicals in the workplace—Code of practice* available on the Safe Work Australia website.

Personal protective equipment should not solely be relied upon to control risk and should only be used when all other reasonably practicable control measures do not eliminate or sufficiently minimise risk. Guidance in selecting personal protective equipment can be obtained from Australian, Australian/New Zealand or other approved standards.

Obligations under workplace health and safety legislation

Information in this report should be taken into account to assist with meeting obligations under workplace health and safety legislation as adopted by the relevant state or territory. This includes, but is not limited to:

- ensuring that hazardous chemicals are correctly classified and labelled;
- ensuring that (material) safety data sheets ((m)SDS) containing accurate information about the hazards (relating to both health hazards and physicochemical (physical) hazards) of the chemical are prepared; and
- managing risks arising from storing, handling and using a hazardous chemical.

Your work health and safety regulator should be contacted for information on the work health and safety laws in your jurisdiction.

Information on how to prepare an (m)SDS and how to label containers of hazardous chemicals are provided in relevant codes of practice such as the *Preparation of safety data sheets for hazardous chemicals— Code of practice* and *Labelling of workplace hazardous chemicals—Code of practice*, respectively. These codes of practice are available from the Safe Work Australia website.

A review of the physical hazards of the chemicals has not been undertaken as part of this assessment.

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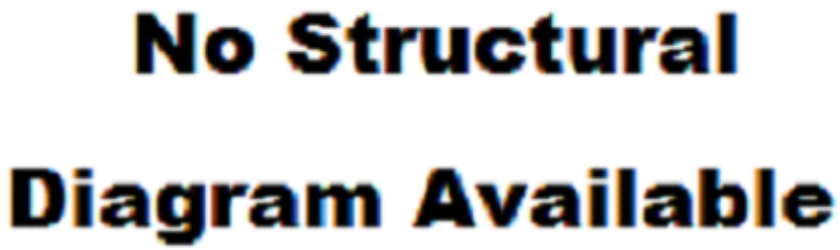
Last Update 04 July 2014

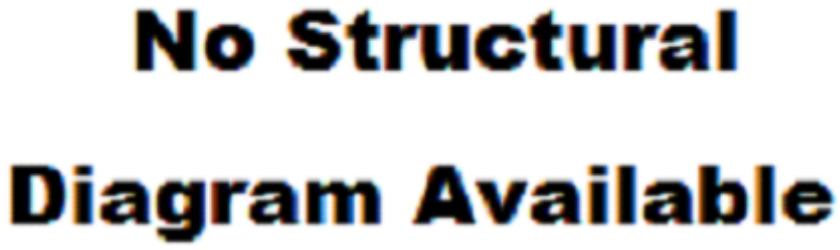
Chemical Identities

Chemical Name in the Inventory and Synonyms	**Rosin, maleated** Rosin, maleic acid polymer Rosin, maleic anhydride, reaction products Gum rosin, maleic anhydride resin Rosin,maleic anhydride adduct
CAS Number	8050-28-0
Structural Formula	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Rosin, polymer with acrylic acid and pentaerythritol** Rosin, acrylic acid adduct, pentaerythritol ester Rosin, acrylic acid, pentaerythritol polymer Rosin, polymer with acrylic acid and pentaerythritol
CAS Number	68425-05-8
Structural Formula	No Structural Diagram Available
Molecular Formula	(C5H12O4.C3H4O2.)x
Molecular Weight	Unspecified

Chemical Name in the	**Resin acids and rosin acids, maleated, ammonium salts**

Inventory and Synonyms	Rosin, maleic acid adduct, ammonium salt
CAS Number	68911-89-7
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

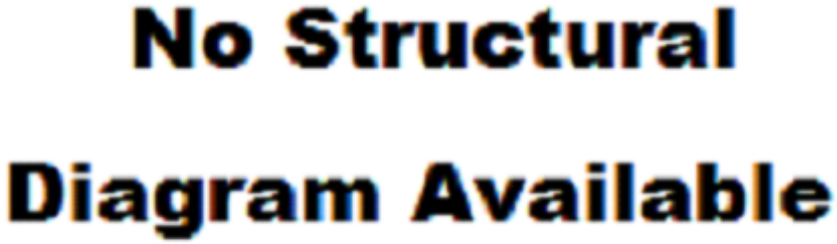
Chemical Name in the Inventory and Synonyms	**Rosin, fumarated** Fumaric acid modified rosin Fumaric modified rosin Rosin, fumaric acid reaction products Fumaric acid, rosin polymer Rosin, fumaric acid adduct
CAS Number	65997-04-8
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

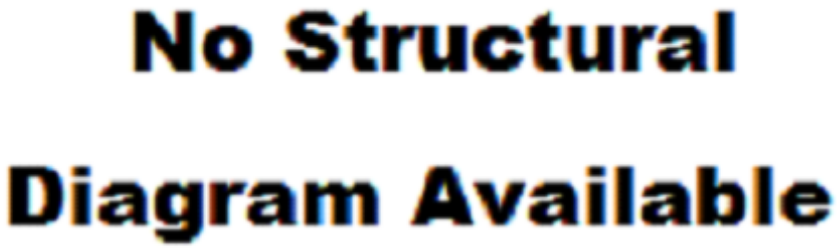
Chemical Name in the Inventory and Synonyms	**Rosin, fumarated, polymer with pentaerythritol** Rosin, fumaric acid adduct, pentaerythritol ester

	Rosin, fumaric acid, pentaerythritol polymer Rosin, fumarated, pentaerythritol ester Fumaric acid-pentaerythritol-rosin copolymer
CAS Number	65997-11-7
Structural Formula	No Structural Diagram Available
Molecular Formula	(C5H12O4.)x
Molecular Weight	Unspecified

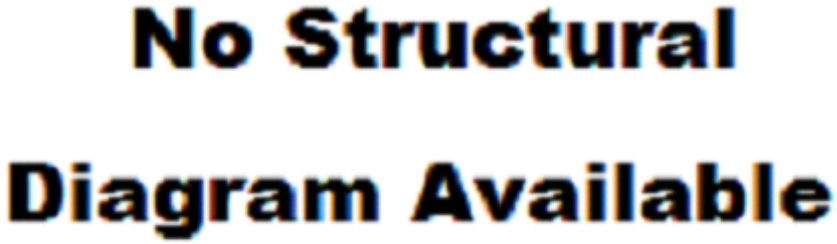
Chemical Name in the Inventory and Synonyms	**Tall oil rosin, maleated, polymer with pentaerythritol** Tall oil rosin, maleic anhydride, 2,2-bis(hydroxymethyl)-1,3-propanediol polymer
CAS Number	68188-28-3
Structural Formula	No Structural Diagram Available
Molecular Formula	(C5H12O4.)x
Molecular Weight	Unspecified

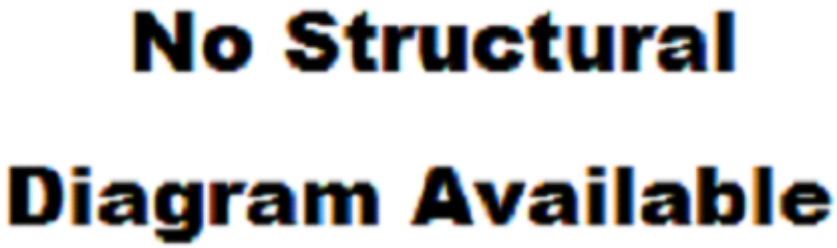
Chemical Name in the Inventory and Synonyms	**Resin acids and rosin acids, fumarated, sodium salt** Rosin, fumarated, sodium salt Rosin, fumaric acid adduct, sodium salt

CAS Number	68201-59-2
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

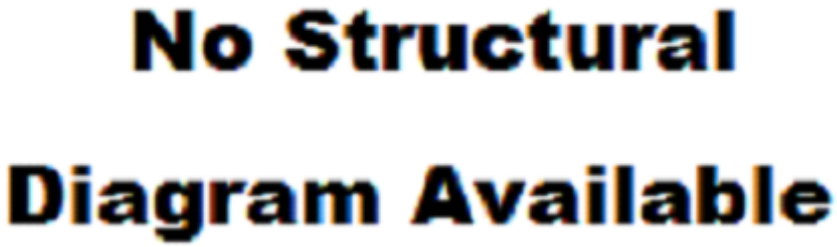
Chemical Name in the Inventory and Synonyms	**Resin acids and rosin acids, maleated, sodium salts** Rosin, maleated, sodium salt
CAS Number	68201-60-5
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Rosin, maleated, polymer with pentaerythritol** Gum rosin, maleic anhydride, pentaerythritol polymer Pentaerythritol ester of maleic anhydride adduct of rosin Pentaerythritol ester of rosin maleic acid adduct

	Pentaerythritol, rosin, maleic acid polymer Rosin, maleic anhydride adduct, pentaerythritol ester
CAS Number	68333-69-7
Structural Formula	
Molecular Formula	(C5H12O4.)x
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Resin acids and rosin acids, fumarated, potassium salt** Rosin, fumarated, potassium salt Rosin, fumaric acid adduct, potassium salt Tall oil rosin, fumarated, potassium salt
CAS Number	68649-83-2
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Resin acids and rosin acids, maleated, potassium salts**

CAS Number	85409-27-4
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

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