

Petition to Amend the National List
to Add Distilled Tall Oil to 7 CFR §205.601(m) and 7 CFR §205.603(e)
to Permit Use as an Inert Ingredient and Adjuvant in Organic Crop and Livestock Production
(Amended)

Submitted to:
National Organic Program
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1. INTRODUCTION

1.1. Proposed Amendments of the National List

Distilled tall oil (CAS No. 8002-26-4) is on EPA Inert Ingredient List 3. Distilled tall oil is currently OMRI listed for use in passive pheromone dispensers.

Ingevity Corporation (Ingevity) proposes to expand the permitted use of distilled tall oil in organic crop production to include use as an inert ingredient in pesticide formulations:

- Applied to growing crops [7 CFR §205.601(m)]; and
- Used in livestock production [7 CFR §205.603(e)].

Pesticide adjuvants are substances added to the pesticide spray tank, separate from the pesticide formulation, that will improve the performance of the pesticide formulation. Ingevity also proposes distilled tall oil for use as a pesticide adjuvant for use in organic crop and livestock production.

The proposed amendments are:

7 CFR §205.601(m) As synthetic inert ingredients as classified by the Environmental Protection Agency (EPA), for use with nonsynthetic substances or synthetic substances listed in this section and used as an active pesticide ingredient in accordance with any limitations on the use of such substances.

- (1) EPA List 4 - Inerts of Minimal Concern.
- (2) EPA List 3 - Inerts of unknown toxicity - for use only in passive pheromone dispensers.
- (3) [Distilled tall oil \(CAS No. 8002-26-4\)](#).

7 CFR §205.603(e) As synthetic inert ingredients as classified by the Environmental Protection Agency (EPA), for use with nonsynthetic substances or synthetic substances listed in this section and used as an active pesticide ingredient in accordance with any limitations on the use of such substances.

- (1) EPA List 4 - Inerts of Minimal Concern.
- (2) [Distilled tall oil \(CAS No. 8002-26-4\)](#).

Additional amendments possibly are needed to support use in pesticide adjuvants.

1.2. Functions

Distilled tall oil is a highly versatile inert ingredient proposed for use in products for organic crop and livestock production. Functions of distilled tall oil in pesticide formulations include:

- Solvent;
- Sticker;
- Anti-leaching agent; and
- Time-release agent.

1.3. Anticipated Maximum Field Application Rate

When distilled tall oil is used:

- As an inert ingredient in pesticide formulations applied according to the directions for use; or
- As an adjuvant added to a pesticide spray solution with both the pesticide and the adjuvant used according to the directions for use;

the distilled tall oil is applied as a dilute aqueous solution at an anticipated maximum application rate of 2 lb distilled tall oil/acre.

1.4. Benefits

Benefits to the organic community of the inclusion of distilled tall oil in formulations or as a tank mix adjuvant include:

- Improved product performance;
- Improved worker safety;
- Improved environmental safety, including of water, soil, air, and wildlife;
- Reduced active ingredient seasonal application rates;
- Longer re-treatment intervals;
- Cold weather conveniences; and
- Reduced farm input and labor costs.

1.5. Essentiality

Distilled tall oil is essential for organic crop and livestock production.

- Solvent and sticker uses.
Each of the identified alternatives for use as a solvent and as a sticker are synthetically produced. Distilled tall oil is compared to the alternatives and provides clear advantages.
- Anti-leaching and time-release uses.
There are *no identified alternatives* to distilled tall oil for the anti-leaching and time-release uses.

2. NOP REGULATORY HISTORY

2.1. Key Dates and Documents

Key dates and historical documents regarding distilled tall oil are summarized in Table 1.

Date	Actions and Documents
2008/12/15	Petition submitted by Biomor Israel for the addition of distilled tall oil to 7 CFR §205.601 received by the National Organic Program.
2010/01/13	Technical Advisory Report.
2010/10	Crops subcommittee recommendation.
2010/10/26	NOSB public hearing and recommendation.
Source: https://www.ams.usda.gov/rules-regulations/organic/national-list/t	

2.2. What is New in this Petition?

2.2.1. Complete Knowledge of Distilled Tall Oil Production and Environmental Protections

The 2008 petition was submitted by a producer of a pesticide formulation containing tea tree oil as the active ingredient and distilled tall oil as an inert ingredient. The petitioner was a purchaser of distilled tall oil and had limited knowledge of distilled tall oil.

This petition is submitted by Ingevity Corporation which has produced distilled tall oil for 84 years and is the first commercial producer of distilled tall oil in the United States. Ingevity has complete knowledge of the production of distilled tall oil, including environmental protections.

2.2.2. "Hands On" Experience with Distilled Tall Oil

It is likely that the 2008 petition was prepared based upon Internet searches for "tall oil" with no direct experience or understanding of the chemistry associated with distilled tall oil.

Ingevity has direct knowledge of distilled tall oil and has evaluated distilled tall oil for different uses. Also, Ingevity understands the meaning of different terms that include "tall oil" and their associated differences.

2.2.3. Additional Functions of Distilled Tall Oil in Formulations

Petitioned functions of distilled tall oil included in the 2008 petition and this petition are summarized in Table 2.

Function	2008 Petition	This Petition
Solvent	✓	✓
Sticker		✓ NEW
Anti-leaching agent		✓ NEW
Time-release agent		✓ NEW

2.2.4. Market Analysis

For each function of distilled tall oil in pesticide formulations and/or tank mixes:

- The allowed organic alternatives are identified; and
- The properties and performance of distilled tall oil are compared to the organic alternatives.

3. DISTILLED TALL OIL

3.1. Identity

A UVCB substance is substance of unknown or variable composition, complex reaction products and biological materials. UVCB substances cannot be represented by unique structures and molecular formulas. Distilled tall oil is an example of a UVCB substance derived from pine trees. The primary components of distilled tall oil are fatty acids and rosin acids. Please see Figure 1 and Table 3.

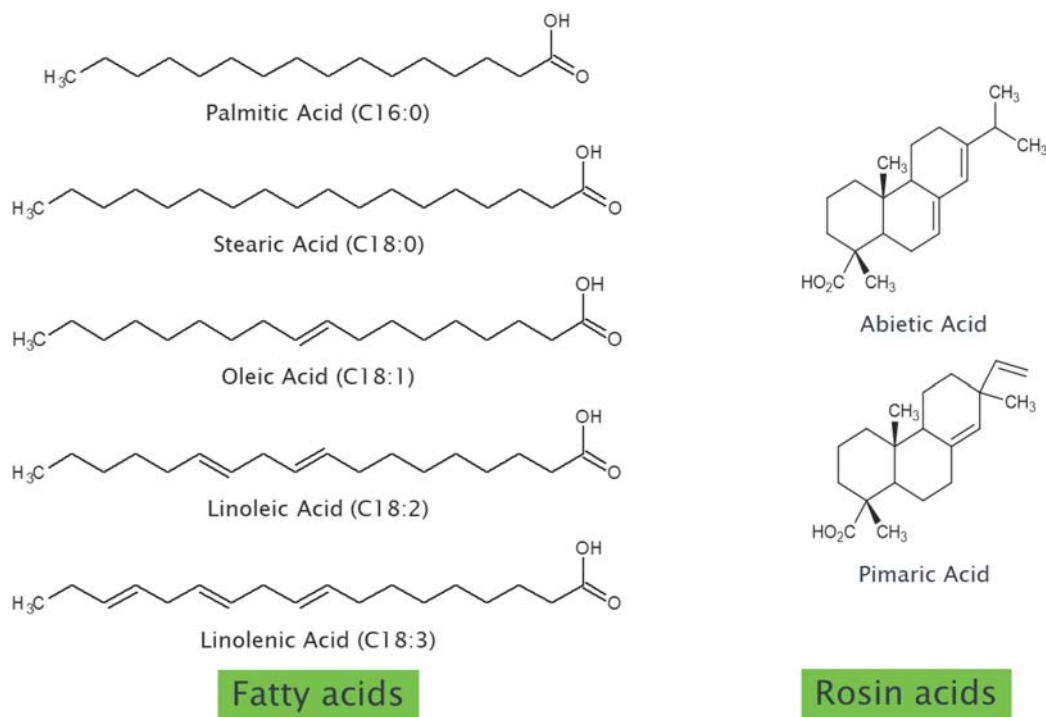


Figure 1. Chemical Structure of Distilled Tall Oil Primary Components

Table 3. Distilled Tall Oil and the Identity of its Primary Components			
Common Chemical Name	CAS No.	EPA Inert Ingredient List No.	SMILES Formula
Distilled tall oil:	8002-26-4	3	Not applicable. UVCB substance. Substance of <u>unknown</u> or <u>variable</u> composition, <u>complex</u> reaction products and <u>biological</u> materials.
• Palmitic acid	373-49-9	Not listed	CCCCCCCCCCCCCCCC(=O)O
• Stearic acid	57-11-4	4A	CCCCCCCCCCCCCCCC(=O)O
• Oleic acid	112-80-1	4A	CCCCCCC/C=C\CCCCCCCC(=O)O
• Linoleic acid	60-33-3	3	CCCCC=CCC=CCCCCCCC(=O)O
• Linolenic acid	463-40-1	Not listed	CCCCC=CCC=CCCCCCCC(=O)O
• Abietic acid	514-10-3	Not listed	CC(C)C1=CC2=CCC3C(C2CC1)(CCC3(C)C(=O)O)C
• Pimaric acid	127-27-5	Not listed	CC(C)C1=CCC2C(=C1)CCC3C2(CCC3(C)C(=O)O)C

European Community Number: 232-304-6

Common name: Distilled tall oil.

EPA product code for "tall oil": 67211.

Chemical Composition: Please see Table 4.

Substance	Typical Composition (% w/w)		
	Fatty Acids	Rosin Acids	References
Distilled tall oil	60% to 90%	10% to 40%	
Pine trees (wood)	0.5% to 1%	1% to 2%	Domineguez (2016) Kjellin and Johnson (2010)

Distilled vs. crude tall oil: "Distilled" and "crude" indicate processing grades. Distilled tall oil is more extensively processed than crude tall oil. Distilled tall oil has been distilled. Crude tall oil has not been distilled. Distillation separates substances based upon physical-chemical properties.

3.2. Physical-Chemical Properties

Distilled tall oil has no significant physical-chemical hazards. Please see Table 5.

Parameter	Distilled Tall Oil Results (Altapyne M-28B Safety Data Sheet; Appendix 1)
Color	Amber / Brown (dark)
Physical state	Liquid
Odor	Bland
Stability	Stable
Flammability	No flammable ingredients
Flash point	Closed cup: 207.2°C (405°F) Cleveland open cup: 207.22°C (405°F) Product does not sustain combustion
Auto-ignition temperature	>365°C (>689°F)
Viscosity	Dynamic (room temperature): 100 mPa·s (100 cP) Kinematic (40°C; 104°F): 0.5 cm ² /s (50 cSt)
Melting point	-20.15°C (-4.3°F)
Boiling point	360.85°C (681.5°F)
Relative Density	0.949 (Water = 1)
Vapor density	>1 (Air = 1)
<i>n</i> -Octanol/Water partition coefficient	3.2 to 6.8
Water solubility	Very slightly soluble in cold water and hot water
Vapor pressure	0 kPa (0 mm Hg) (room temperature)

3.3. Manufacturing Process History

The components of distilled tall oil have been used commercially for hundreds of years. In the early 1900s, it was discovered that a co-product from Kraft paper mills, called black liquor, contains the fatty acids and rosin acid soaps used for naval stores, *i.e.*, a material used for maritime applications including waterproofing of wooden ships, ropes, and tarps.

In 1936, Westvaco (now Ingevity) was the first U.S. producer to operate a continuous distillation plant to produce distilled tall oil from black liquor. This distillation process was the missing piece that allowed for efficient recycling of co-products from paper mills into distilled tall oil and other commercially important naval stores (Zinkle, 1989).

3.4. Manufacturing Process Description

Distilled tall oil is classified by NOP as a synthetic substance, and Ingevity agrees with NOP's synthetic classification. Ingevity notes that distilled tall oil is a substance produced by pine trees. Distilled pine oil is produced commercially by Ingevity via a process that includes a chemical reaction with sulfuric acid. This chemical reaction results in NOP's synthetic classification.

Please see Figure 2 for a simplified overview of the production of distilled tall oil.

- The steps in blue are completed by the Kraft paper mill.
- The steps in orange are the cross-over point between the Kraft paper mill and Ingevity.
- The steps in green are performed by Ingevity.

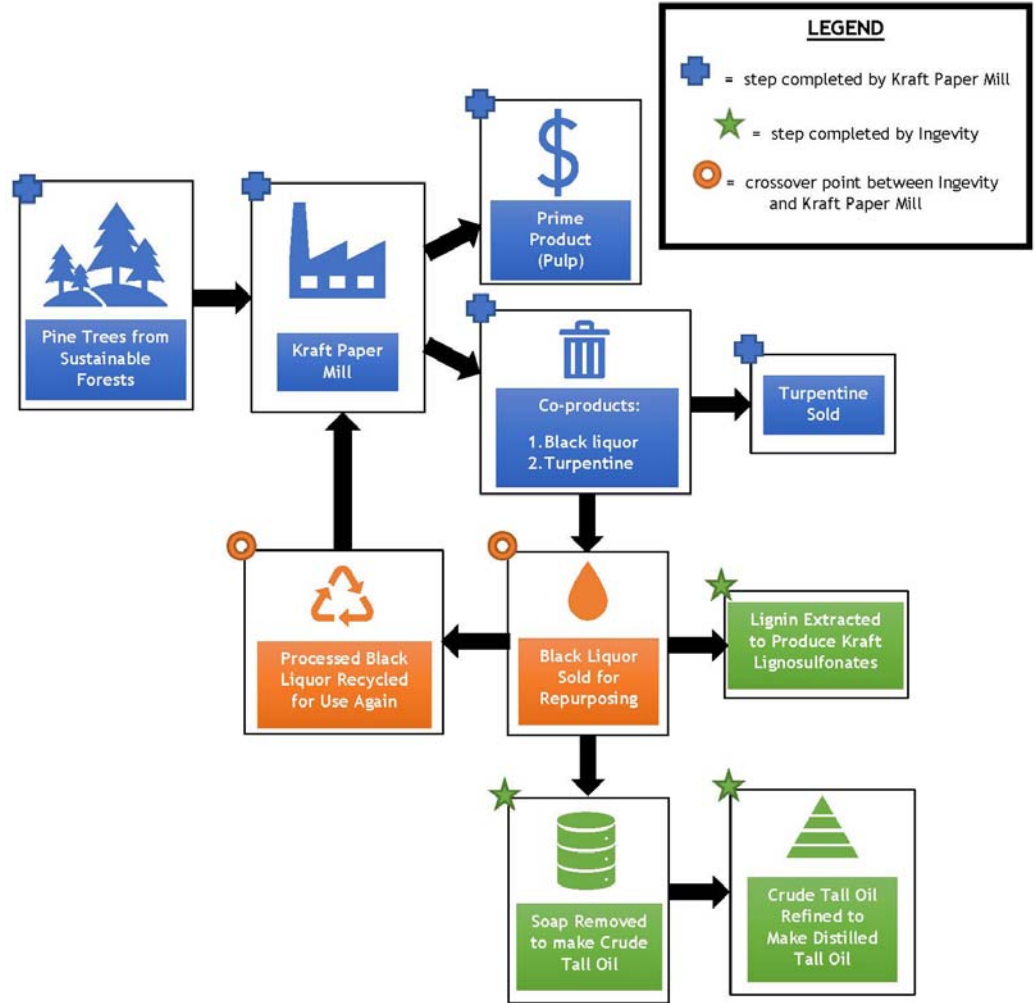


Figure 2. Manufacturing Flow Chart for the Production of Distilled Tall Oil from Pine Trees

3.4.1. Steps Completed by the Kraft Paper Mill

Kraft paper mills are operated to produce pulp and paper. The Kraft paper mill utilizes pine trees from sustainable forests (meaning more trees are planted than are cut down) for paper production.

Two co-products the Kraft paper production process are black liquor and turpentine.

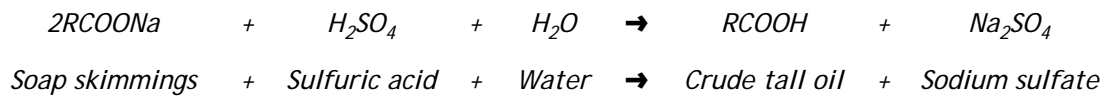
Black liquor is an aqueous solution that is separated from the cellulosic portion of the wood, where the cellulosic portion is used for paper making. The most desirable components from trees for distilled tall oil production (rosins and fatty acids) are present in the black liquor.

Terpentine is an exudate obtained from injured pine trees. This is distilled to give the resin, rosin, and the essential oil, oil of turpentine (also known as turpentine).

Turpentine from Kraft paper mills is also a starting material for the production of the Polyterpene Resins used to make OMRI listed sticker adjuvants such as Ingevity Altastick R (US) Terpene Resin.

3.4.2. Steps Completed by Ingevity

Ingevity buys black liquor from the Kraft paper mill. The black liquor is cooled to concentrate the desirable rosins and fatty acids in the top soap layer which is physically skimmed off. The soap layer is treated with sulfuric acid to form crude tall oil.



Using a continuous process of fractional distillation under vacuum, Ingevity separates crude tall oil into five fractions, each of which has commercial uses:

- Heads (light ends);
- Fatty acids (tall oil fatty acid);
- Distilled tall oil (subject of this petition);
- Rosin; and
- Pitch.

Please see Figure 3.

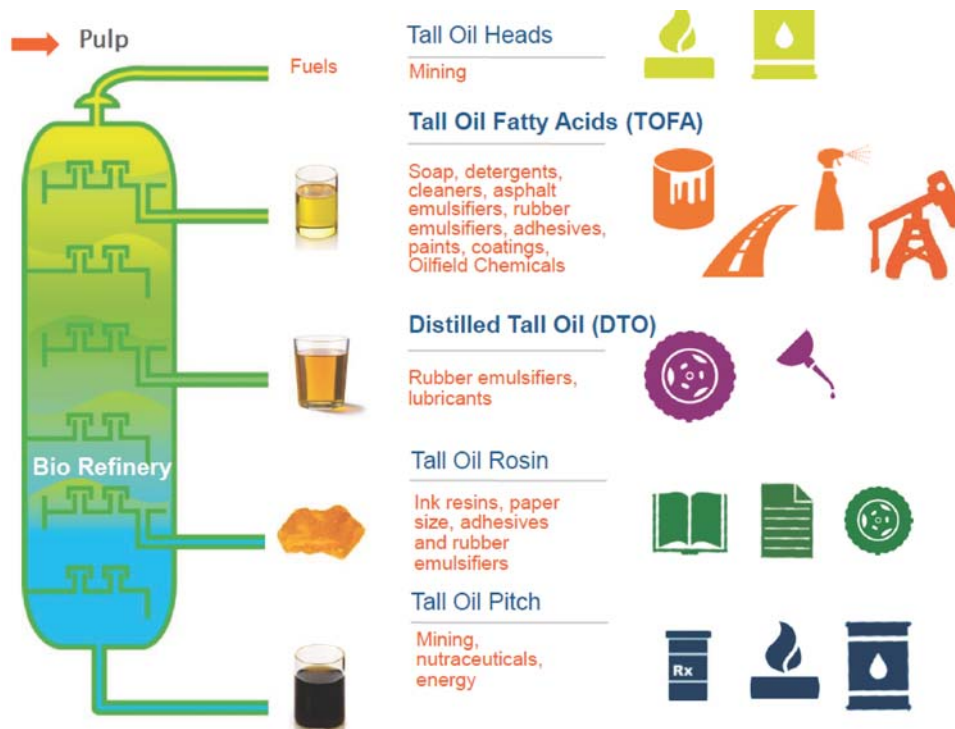


Figure 3. Crude Tall Oil Fractions Separated by the Biorefinery and Uses of the Fractions

Noteworthy for the organic community, as a part of a separate process, Ingevity also produces lignins from black liquor. The lignins are on EPA Inert Ingredient List 4B and are used to make dispersants for use in organic crop production.

3.4.3. Symbiotic Relationship Between Kraft Paper Mill and Ingevity

The Kraft paper mill is in the business of making Kraft paper which is used to make, *e.g.*, cardboard shipping boxes and the packaging for many retail products.

Ingevity's core business involves the production of specialty products derived from pine trees. Ingevity's products include distilled tall oil and a wide range of "green" specialty products including adhesives, agricultural chemicals, detergents, inks, lubricants, metalworking fluids, and soaps.

The Kraft paper mill and Ingevity are independently owned and operated and have very different core products. Nonetheless, the Kraft paper mill and Ingevity have a symbiotic relationship.

Black liquor is a co-product of the paper making process that interferes with the Kraft paper making process. Ingevity buys the Kraft paper mill's black liquor to use as Ingevity's starting material for the production of distilled tall oil and other commercially valuable products.

As noted in the chemical equation in Section 3.4.2, the chemical reaction that produces crude tall oil also produces sodium sulfate. The sodium sulfate is separated by physical means (decanted and centrifuged) and is sold to the Kraft paper mill for use in further production of paper. This reduces the need to the Kraft paper mill to buy "virgin" starting material.

Ingevity and the Kraft paper mill are located adjacent to each other. This allows movement of products between the two companies using industrial pipe systems.

- The Kraft paper mill's co-products, black liquor and weak white liquor, are piped from the paper mill to Ingevity; and
- Ingevity's co-products, *i.e.*, sodium sulfate, processed weak white liquor, and processed black liquor, are separately piped from Ingevity to the Kraft paper mill.

This avoids the need for traditional transportation via trucks or trains and thereby reduces the carbon footprint of the combined operations.

3.5. Manufacturing Process Impacts

3.5.1. Impacts on Air

Impacts on Air of Crude Tall Oil Production from Black Liquor Soap Skimmings

Hydrogen sulfide gas (H_2S) is a co-product of the reaction of black liquor soap skimmings with sulfuric acid to form crude tall oil. Hydrogen sulfide gas is considered more of a human health hazard than an environmental hazard because it can be easily oxidized and diluted into air at low concentrations. Ingevity produces crude tall oil using a continuous production method which produced much lower levels of hydrogen sulfide gas than a batch production method. However, there is still some hydrogen sulfide gas that forms.

Ingevity eliminates the hydrogen sulfide gas co-product by 98% through the following steps:

- The manufacturing facility where this reaction occurs is equipped with scrubbers designed to remove the hydrogen sulfide gas from the air using a caustic (opposite of acidic) solution.
- This caustic solution is received from the paper mill next door in the form of a material called weak white liquor.
- The weak white liquor reacts with the hydrogen sulfide gas. The sulfur is absorbed into the weak white liquor, and the hydrogen combines with oxygen to form water.
- The processed weak white liquor containing the sulfur is sent to the Kraft paper mill and is extremely beneficial to the mill for achieving the proper sulfur conditions needed for paper production.

The end result is the gasses emitted from the production of crude tall oil are free from hydrogen sulfide, and the associated sulfur is a needed input for the paper mill.

The remaining 2% percent of sulfur dioxide gas is soluble in water present in the scrubber and creates the hydrosulfide anion (HS^-). This anion is easily oxidized by air. (Drew *et al.*, 1981)

There are two installed scrubbers in the crude tall oil production area to ensure that there is always an available backup scrubber. The gasses from the reactor are directed through the scrubber, and clean vapors are directed out of the scrubber vent stack. A scrubber must be on-line and within operating parameters before the conversion of soap skimmings to crude tall oil can begin.

The crude tall oil production area falls under a US Clean Air Act Title V monitoring plan. Title V requires sources of air pollutants to:

- Obtain an operating permit;
- Operate in compliance with that permit; and
- Certify at least annually their compliance with permit requirements.

The Title V permit outlines specific, agreed upon operating parameters for the scrubber. If the scrubber operating parameters are within their specified ranges, then the scrubber is operating properly and the vapors released to the environment are within the permit limits set by the Title V monitoring plan. As seen in the table below, Ingevity goes above and beyond the Title V requirements by using a greater flow rate of water to ensure:

- Constant gas/liquid interface;
- Lower acceptable differential pressure to ensure the scrubber does not plug and restrict flow rates; and
- Increased washing frequency to ensure scrubbing efficiency.

Hydrogen sulfide gas monitors are also positioned throughout the production area. These monitors notify the operators of the presence of hydrogen sulfide gas. If hydrogen sulfide gas is present, crude tall oil production is shut down until the issue is resolved.

Ingevity's distilled tall oil environmental protection systems are summarized in Table 6.

Parameter	US Clean Air Act Title V Plan Range	Ingevity Target
Weak white liquor flow to scrubber	Greater than 35 gallons per minute	40 to 50 gallons per minute
Scrubber fan	On	On
Scrubber differential pressure	Greater than 1 inch water, but less than 10 inches of water	Greater than 1.2 inch water, but less than 5 inches of water
Weak white liquor pH	Greater than 10.5	Greater than 10.5
Offline scrubber washing frequency	24 to 48 hour wash every 14 days	24 to 48 hour wash every 7 days

Impacts on Air of Refining Crude Tall Oil to Produce Distilled Tall Oil

There are a few components of crude tall oil that once separated during distillation can be condensed into product streams. These components are removed from the Biorefinery in the form of vapors and are directed to modern air pollution control devices. The Ingevity Biorefinery where distilled tall oil is produced uses a thermal oxidizing unit to incinerate any minimize fugitive and excess emissions. This thermal oxidizing unit has a 98.6% destruction efficiency. Scrubbers are also used to clean the remaining 1.4% emissions that are not hazardous before being released to the atmosphere.

This Biorefinery also uses clean fuels like natural gas and state of the art controls and programming to minimize energy use and emissions.

3.5.2 Impacts on Water

Impacts on Water of Crude Tall Oil Production from Black Liquor Soap Skimmings

The aqueous co-products from the production of crude tall oil production include black liquor, sodium sulfate, and spent water used in the gas scrubber.

- **Black Liquor**
Prior to reacting the soap skimmings from black liquor, the soap skimmings are allowed to settle in a decanting tank. An aqueous layer containing processed black liquor separates from the soap skimmings. Instead of sending this co-product to the sewer, it is sold to the Kraft paper mill recovery system where it can be reused.
- **Sodium Sulfate (Brine)**
The sodium sulfate (brine) generated in the reaction of soap skimmings to form crude tall oil is sold back to the Kraft paper mill to maintain the proper sulfur conditions for paper productions and for reuse, thereby reducing the need for purchase of “virgin” starting materials.
- **Spent Water**
The spent water used in the gas scrubbing is sent to a water treatment plant adjacent to the production facility. Ingevity does not own this facility and pays the facility to treat the spent water. The water treatment plant utilizes a biological process to treat the water to meet applicable water quality standards and permit limits. The spent water that Ingevity sends to water treatment plant is:
 - Nonhazardous;
 - Continuously sampled for organic materials and solids; and
 - Subject to pretreatment limits to minimize loading to the water treatment facility.

It is also part of the Ingevity plant’s goals each year to reduce Ingevity’s flow volume and the amount of organic co-products that are sent to the treatment facility. The water treatment plant has an 85% destruction efficiency. The discharge from the treatment plant complies with all applicable regulations and the site’s national pollutant discharge elimination system permit.

Impacts on Water of Refining Crude Tall Oil to Produce Distilled Tall Oil

Distillation of crude tall oil is carried out under a vacuum. Steam is introduced into the base of the Biorefinery column to make the separation of the product streams more efficient. The steam leaves the top of the Biorefinery as a vapor and carries some of the low boiling point components of crude tall oil. These vapors are condensed with cooling water. (Drew *et al.*, 1981)

The condensed steam and low boiling point components are non-hazardous and are sent to the same water treatment plant mentioned above. The water streams that Ingevity sends to water treatment are continuously sampled for organic and solid co-products that are subject to pretreatment limits to minimize loading to the water treatment facility. It is also part of the plant’s goals each year to reduce Ingevity’s flow volume and amount of organic co-products that are sent to the water treatment facility. The biological treatment plant has an 85% destruction efficiency, and the discharge from the biological treatment plant complies with all applicable regulations and their site’ national pollutant discharge elimination system permit.

3.5.3. Impacts on Solid Co-Products

Impacts on Solid Co-Products of Crude Tall Oil Production from Black Liquor Soap Skimmings

The only solid co-product involved in producing crude tall oil is non-hazardous and consists of lignin fibers that are removed from black liquor soap skimmings. These lignin fibers are not able to remain in crude tall oil because they would damage the equipment in the Biorefinery. Instead of disposing of these fibers to landfills, they are able to be added to Ingevity's black liquor co-product sold to the Kraft paper mill for use in paper production.

Impacts on Solid Co-Products of Refining Crude Tall Oil to Produce Distilled Tall Oil

There are no solid co-products generated in the refining of crude tall oil to produce distilled tall oil.

3.5.4. Impacts on Energy Usage

Ingevity has regular energy usage reduction initiatives.

Ingevity was recognized by the US Department of Energy as part of their Better Plants/ Better Facilities Program for meeting its energy reduction goal in 2016 to reduce energy intensity by 25 percent over a 10-year period.

In early 2018, Ingevity installed at the distilled tall oil production facility in North Charleston, SC a photovoltaic solar panel system comprised of approximately 1,500 solar modules. It produces approximately 723,000 kilowatt hours of energy per year, offsetting the equivalent of 1.1 million pounds of CO₂ on an annual basis.

A life-cycle study was completed to determine the carbon footprint of producing and distilling crude tall oil to make distilled tall oil (the subject of this petition). In general, the carbon footprint is 40-70% lower than its conventional alternatives. The carbon footprint of distilled tall oil is significantly better than C5 (5-carbon chain) resins. Production of distilled tall oil has a smaller carbon footprint than the production of soybean oil. Please see Figure 4. (Cashman *et al.*, 2016)

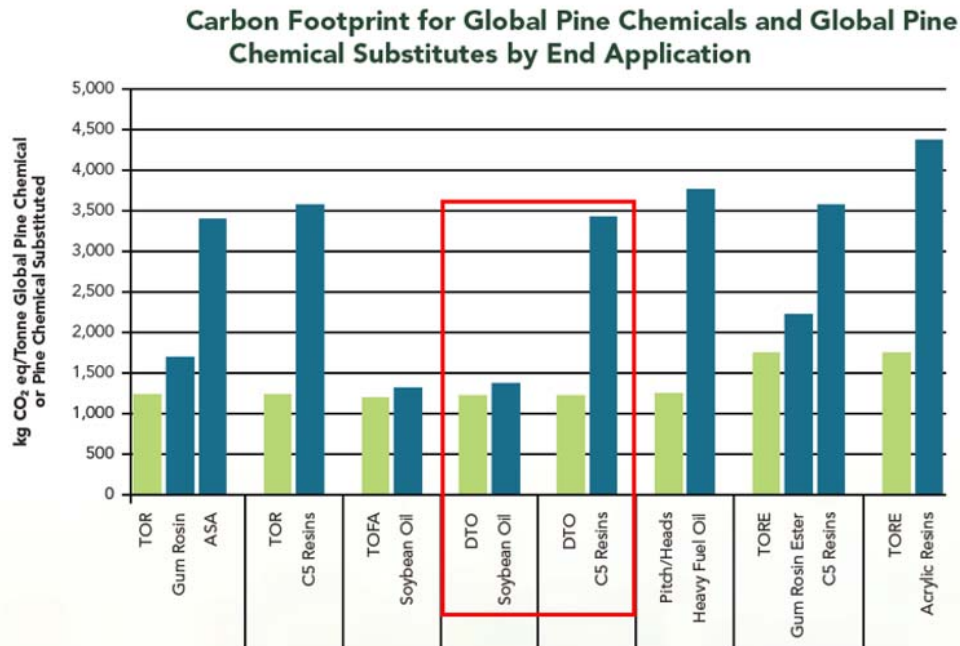


Figure 4. Comparison of Carbon Footprints of Distilled Tall Oil and Alternatives
 Key: TOR = Tall oil rosin.
 ASA = Alkenyl succinic anhydride.
 TOFA = Tall oil fatty acid.
 DTO = Distilled tall oil.
 TORE = Tall oil rosin ester.

3.5.5. Impacts on Sustainable Agriculture

Kraft paper production utilizes sustainable forests (*i.e.*, more trees are planted than used). The trees are typically approximately 17 years old when harvested. These younger trees are extremely efficient at extracting carbon from the air and incorporating the carbon into their biomass. This carbon dioxide sequestration is more efficient than for mature trees.

Production for distilled tall oil from pine frees was compared to hypothetical production from a seed crop, *e.g.*, soybeans. Soybeans are an annual crop that require:

- Annual planting;
- Annual agricultural inputs, *e.g.*, fertilizer and pesticides for weed, insect, and disease control; and
- Annual harvesting.

By comparison, the forestry associated with the Kraft paper production (and thus distilled tall oil production) is an example of low intensity agriculture for the production of a plant-based energy source. (Pugh *et al.*, 2019)

3.6. Mammalian Toxicology

Distilled tall oil has minimal effects from short-term (acute) oral, eye, and dermal (skin) exposures. Based upon the available data, distilled tall oil and substances in crude tall oil have no significant repeat long-term exposure effects. There has been no evidence of carcinogenicity, mutagenicity, developmental (birth defect) effects, or reproductive (infertility) effects.

3.6.1. Acute (Single Dose) Studies

The available published literature regarding the acute toxicity of tall oil is generally for crude tall oil rather than distilled tall oil. Distilled tall oil is considered to be slightly less toxic than crude tall oil which includes some higher molecular weight organic components.

A detailed summary of the acute toxicity data are available at the European Chemical Agency (ECHA) website:

<https://echa.europa.eu/registration-dossier/-/registered-dossier/14967/7/3/1>.

An acute toxicology summary of distilled tall oil is provided as Table 7.

Study Type	Test Species	Test Substance	End-Point	Notes
Acute oral toxicity	Rat	Crude tall oil	LD ₅₀ ≥ 2000 mg/kg body weight	<ul style="list-style-type: none"> No deaths. 14-day observation period. Passes EPA Category III limit test.
Acute dermal toxicity	Rat	Crude tall oil	LD ₅₀ ≥ 2000 mg/kg body weight	<ul style="list-style-type: none"> No deaths. 14-day observation period. Passes EPA Category III limit test.
Eye irritation	Rabbit	Crude tall oil	Not irritating	<ul style="list-style-type: none"> No cornea or iris effects.
Dermal irritation	Rabbit	Crude tall oil	Not irritating	<ul style="list-style-type: none"> No deaths. No redness. No swelling.
Dermal sensitization	Guinea pig	Distilled tall oil	Non-sensitizer	<ul style="list-style-type: none"> No adverse effects.

Source: <https://echa.europa.eu/registration-dossier/-/registered-dossier/14967/7/3/1>.
 LD₅₀: Lethal dose to 50% of the test population.

The above data qualify distilled tall oil for an EPA label with a CAUTION signal word. This is EPA's lowest hazard (safest) signal word. (WARNING and DANGER signal words indicate higher hazard levels.)

3.6.2. Repeat Dose Studies

Based upon the available data, tall oil:

- Does not cause genetic mutations; and
- Does not cause long-term adverse health effects.

Please see Table 8.

Table 8. Tall Oil Repeat Dose Toxicology			
Study Type	Test Species	Test Substance	End-Point
Mutagenicity:			
• Bacteria reverse mutation	<i>S. typhimurium</i> , <i>E. coli</i>	Crude tall oil	Negative. Non-mutagenic.
• Chromosomal aberration	Chinese hamster ovary cells	Crude tall oil	Negative. Non-mutagenic.
• <i>In vitro</i> mammalian cell gene mutation	Mouse lymphoma L5178Y cells	Crude tall oil	Negative. Non-mutagenic.
Combined repeated dose toxicity study with the reproduction / developmental toxicity screening test	Rat (Sprague-Dawley)	Tall oil (grade not specified)	Developmental NOAEL ≥ 20,000 ppm in the diet.
Repeat dose with reproduction toxicity screening	Rat (Sprague-Dawley)	Tall oil (grade not specified)	• Parental NOAEL = 1,000 ppm in the diet. • Reproductive NOAEL = 5,000 ppm in the diet.
2-year chronic oral dosing	Rat	Distilled tall oil	NOAEL ≥ 200 mg/kg/day.
Source: https://echa.europa.eu/registration-dossier/-/registered-dossier/14967/7/3/1 . NOAEL = No Observed Adverse Effect Level.			

3.7. Environmental Toxicology

Distilled tall oil also has no significant harmful biological or chemical interactions in the agro-ecosystem. This includes no harmful significant effects on aquatic plants, invertebrates and fish; earthworms; and honeybees.

3.7.1. Aquatic Species

Based upon the available data, distilled tall oil has low aquatic toxicity. Please see Table 9.

Category	Test Organism Species	Exposure Time	Test Substance	End-Point
Aquatic plant	<i>Desmodemus subspicatus</i> (fresh water species)	72 hours	Distilled tall oil	EC ₅₀ = 3300 mg/L EPA Category: Practically non-toxic.
Aquatic invertebrate	<i>Daphnia magna</i> (fresh water species)	48 hours	Distilled tall oil	EC ₅₀ = 5,000 to 10,000 mg/L EPA Category: Practically non-toxic.
Fish	<i>Danio rerio</i> (fresh water species)	96 hours	Distilled tall oil	LC ₅₀ >100 mg/L EPA Category: Practically non-toxic.

Source: Ingevity, ALTAPYNE M-28B Safety Data Sheet (12/19/2019). Please see Appendix 1.

3.7.2. Earthworms

EPI Suite is the US EPA's web-based structure-activity based modeling tool. ECOSARS is a module within EPI Suite for estimating toxicity to non-target species, including earthworms.

Based upon EPA's ECOSARS structure-activity based modeling program for ecological effects and EPA's toxicity descriptions for terrestrial organisms, the components of distilled tall oil are estimated to be slightly toxic to earthworms. Please see Table 10.

Common Chemical Name	SMILES Formula	Estimated 14-Day LC ₅₀ to Earthworms (Source : ECOSARS)	EPA Toxicity Description
Distilled tall oil:	Not applicable. UVCB substance. Substance of unknown or variable composition, complex reaction products and biological materials.		
• Palmitic acid	CCCCCCCCCCCCCCCC(=O)O	1,363	Slightly toxic
• Stearic acid	CCCCCCCCCCCCCCCC(=O)O	1,196	Slightly toxic
• Oleic acid	CCCCCCC/C=C\CCCCCCCC(=O)O	1,250	Slightly toxic
• Linoleic acid	CCCCC=CCC=CCCCCCCC(=O)O	1,307	Slightly toxic
• Linolenic acid	CCC=CCC=CCC=CCCCCCCC(=O)O	1,366	Slightly toxic
• Abietic acid	CC(C)C1=CC2=CCC3C(C2CC1)(CCCC3(C)C(=O)O)C	No data	
• Pimaric acid	CC(C)C1=CCC2C(=C1)CCC3C2(CCCC3(C)C(=O)O)C	No data	

Please note that EPA’s toxicity categories for terrestrial organisms are as follows:

- Practically nontoxic: Oral LD₅₀ > 2000 mg/kg body weight;
- Slightly toxic: Oral LD₅₀ = 501 to 2000 mg/kg body weight;
- Moderately toxic: Oral LD₅₀ = 51 to 500 mg/kg body weight;
- Highly toxic: Oral LD₅₀ = 10 to 50 mg/kg body weight; and
- Very highly toxic: Oral LD₅₀ > 10 mg/kg body weight.

3.7.3. Honeybees

The fatty acid composition of honeybees, as a percentage of total lipids in honeybees, is summarized in Table 11.

Fatty Acid	Fatty Acid Composition of Honeybees (as Percent of Total Lipid Content)		Primary Component of Distilled Tall Oil
	6-Day Old Larvae (%)	Adults (Drone, Worker and Queen) (%)	
Oleic acid	40.4 to 46.4	60.7 to 64.8	✓
Palmitic acid	40.3 to 42.2	14.2 to 22.6	✓
Stearic acid	7.32 to 11.7	8.95 to 14.3	✓
Linolenic acid	0.19 to 0.97	4.50 to 7.34	✓
Myristic acid	2.35 to 3.15	0.90 to 2.53	
Dodecanoic acid	0.33 to 0.60	0.50 to 1.91	
Linoleic acid	Trace amount	Trace amount	✓
Ref:	Manning (2015)		See Section 3.1.

Based upon the data in Table 11, greater than 88% of the lipids that are naturally occurring in the bodies of honeybees are also primary components of distilled tall oil. We can infer from the above data (Manning, 2001) that the fatty acids that are the primary components of distilled tall oil are not toxic to honeybees and potentially are important nutrients for honeybees.

An omega-3 fatty acid is a fatty acid with multiple double bonds, where the first double bond is between the third and fourth carbon atoms from the end of the carbon atom chain. Linolenic acid is an example of an omega-3 fatty acid. Linolenic acid is one of the primary components of distilled tall oil and was determined by Manning (2001) to be naturally occurring in trace amounts in honeybees.

Arien *et al.* (2015) have reported:

- Honeybee brains contain high omega-3 fatty acid concentrations; and
- Omega-3 fatty acid deficiencies in honeybees greatly impairs honeybee learning.

The data reported by Arien *et al.* (2015) suggest that the linoleic acid present in distilled tall oil may be a significant nutrient for honeybees.

3.8. Environmental Degradation

Distilled tall oil readily degrades based upon the ready degradability manometric respirability test. Seventy-three percent (73%) degradation was observed in 28 days. (Altapyne M28B Safety Data Sheet; Appendix 1).

4. SOLVENTS

4.1. Purpose in Pesticide Formulations

Solvents are included in pesticide formulations to dissolve the active ingredient and other ingredients so that a formulation with uniform composition and concentration can be achieved. Solvents are always required to make a liquid formulation of a solid active ingredient. Solvents are commonly required to provide uniform mixing of pesticide formulations with water before spray applications. Commonly, the active ingredient must be dissolved (in solution) to achieve its intended purpose. Solvents that provide better solvency can achieve comparable product performance at lower active ingredient concentrations.

4.2. Identity of Permitted Alternative Solvents in Organic Crop and Livestock Production

Solvents permitted for use as inert ingredients in pesticide formulations for use in organic crop and livestock production are methylated soybean oil and *n*-butyl lactate. Please see Table 12.

Common Name	EPA Inert Ingredient List			SMILES Formula (Note 3)	Tolerance Exemptions (40 CFR)
	Name	CAS No.	List No.		
Methylated soybean oil (Note 1)	Fatty acids, soya, Me esters	68919-53-9	4B	CCCCCCCC=CCCCCCCC(=O)OC	\$180.910; \$180.930.
<i>n</i> -Butyl lactate (Note 2)	Lactic acid, <i>n</i> -butyl ester	138-22-7	4A	CCCCOC(=O)C(C)O	\$180.950(e).

Note 1. Methylated soybean oil, brand name SoyGold 1000.
Note 2. *n*-Butyl lactate OMRI Listed brand name: Corbion Purasolv BL.
Note 3. SMILES formulae are useful for structure-activity based database searches.

Methylated soybean oil is permitted in organic pesticide formulations because it is on EPA Inert Ingredient List 4B. Based upon Internet searches, no brand name product containing methylated soybean oil has been identified that is labeled or marketed for use in organic formulations. Nonetheless, the US EPA, OMRI, and other organic certifiers would determine that methylated soybean oil is an acceptable inert ingredient in organic formulation because of its inclusion in EPA Inert Ingredient List 4B. An example product containing methylated soybean oil is SoyGold 1000.

Purasolv BL produced by Corbion is an OMRI-listed inert ingredient containing *n*-butyl lactate.

4.3. Comparative Product Performance of Distilled Tall Oil as a Solvent

The properties and performance of distilled tall oil as a solvent are compared to the allowed organic alternatives in Table 13.

Property	"Green" Solvents		
	Distilled Tall Oil Based Solvent	Methylated Soybean Oil	<i>n</i> -Butyl Lactate
Green content	100%	> 90%	61%
Water solubility	Very low	Very low	Slight
Weight loss at 105°C	Low to medium	Low	High (Note 1)
Hard water stability	Excellent	Acceptable	Acceptable
Surfactant and solvent compatibility	Good	Good	Good
Solvency of Tebuconazole (Note 2):			
• Initial [129°F (54°C)]	Good. Completely dissolved.	Failure. Less than half of the tebuconazole dissolved.	Good. Completely dissolved.
• Recrystallization observed	No	Not applicable.	Yes
Solvency of Azoxystrobin (Note 3):			
• Initial [129°F (54°C)]	Good. Completely dissolved.	Failure. Minimal azoxystrobin dissolved.	Good. Completely dissolved.
• Recrystallization observed	No	Not applicable.	Yes
<p>Note 1. Indicates loss of solvent from the spray solution under hot field conditions via volatilization. The inside of a spray tank, like a car with closed windows, gets quite hot in the sun.</p> <p>Note 2. Test emulsifiable concentrate formulation: 25% tebuconazole + 10% emulsifier (Surfom R360) + 65% solvent.</p> <p>Note 3. Test emulsifiable concentrate formulation: 8% azoxystrobin + 10% emulsifier (Surfom R360) + 82% solvent.</p>			

4.4. Comparison of Distilled Tall Oil to Permitted Solvent Alternatives

4.4.1. Production

Parameter	Solvent Alternatives		
	Distilled Tall Oil	Methylated Soybean Oil	<i>n</i> -Butyl Lactate
Synthetic or Non-synthetic	Synthetic.	Synthetic.	Synthetic.
Raw Material	Co-product stream from Kraft paper production (non-food source).	Soybean (human and livestock food source).	Human and livestock food source, <i>e.g.</i> , corn.
Green content	100%	> 90%	61%
Production description	Starting from alkaline sodium soap skimmings. Sulfuric acid (H ₂ SO ₄ ; on EPA Inert Ingredient List 4B) is used to acidify the substance. This step returns the building blocks of distilled tall oil to its natural form (fatty acids and rosin acids). Physical separation in fraction columns yield different pine chemical products. Separation is based on physical properties, <i>i.e.</i> , boiling point, polarity and interactions with the column. One of these fractions is distilled tall oil.	Methylated soybean oil is chemically synthesized by reacting soybean oil (a food source) with methanol under high temperature and/or high-pressure treatment.	<i>n</i> -Butyl lactate is chemically synthesized by reacting <i>n</i> -butanol and lactic acid with a catalyst under high temperature and/or high pressure. Lactic acid can be derived from a fermentation process of food sources, <i>e.g.</i> , corn.
Comments	<ul style="list-style-type: none"> Safe process. No highly volatile or flammable chemicals are involved or generated. No human or livestock food source is used to produce distilled tall oil. 	<ul style="list-style-type: none"> Methanol is volatile, flammable, and hazardous. Special personal protective equipment and safety protocols are need. Not every chemical plant has the capability to safely handle methanol. 	<ul style="list-style-type: none"> The fermentation process to produce lactic acid is a relatively expensive process. It depletes valuable food resources. The resulting <i>n</i>-butyl lactate is volatile and flammable.

4.4.2. Physical-Chemical Properties

The physical-chemical properties of distilled tall oil are compared to the allowed organic solvent alternatives in Table 15.

Parameter	Solvent Alternatives		
	Distilled Tall Oil	Methylated Soybean Oil	<i>n</i> -Butyl Lactate
Solvency	High	Poor	Medium
Water solubility	Insoluble	Insoluble	42 g/L at 25°C
Viscosity	100 cP	< 10 cP	3.9 cP
Flash point	Closed cup: 207.2°C (405°F)	> 130°C (>266°F)	Closed cup: 79°C (174.2°F)
Volatile organic carbon (VOC)	0%	0%	100%

The higher viscosity of distilled tall oil is advantageous because it makes possible the sticker property and the anti-leaching property. Also, it reduces pesticide spray drift by reducing the number of extra fine spray particles.

4.4.3. Mammalian Toxicology

The available acute toxicology data for distilled tall oil and the allowed organic alternative solvents included in the appended Safety Data Sheets are summarized in Table 16.

Parameter	Solvent Alternatives		
	Distilled Tall Oil	Methylated Soybean Oil	<i>n</i> -Butyl Lactate
Acute oral LD ₅₀	>2000 mg/kg	>2000 mg/kg	>2000 mg/kg
Eye irritation	Not irritating. (0.1 mL for 24 hours)	Causes eye irritation.	Moderately irritating. (500 mg for 24 hours)
Skin irritation	Not irritating.	Causes skin irritation.	Extremely irritating.
Reference:		Safety Data Sheet (Appendix 2.)	Safety Data Sheet (Appendix 3.)

4.4.4. Environmental Toxicology

The available environmental toxicology data for distilled tall oil and the allowed organic alternative solvents are summarized in Table 17.

Parameter	Solvent Alternatives					
	Distilled Tall Oil		Methylated Soybean Oil (Source: ECOSARS) (Note 1)		<i>n</i> -Butyl Lactate (Source: ECOSARS) (Note 2)	
	Measured or Estimated Value	EPA Category	Measured or Estimated Value	EPA Category	Measured or Estimated Value	EPA Category
Fish 96-hour LC ₅₀	> 100 mg/L	Practically non-toxic	0.015 mg/L	Very highly toxic	97 mg/L	Slightly toxic
Daphnia (water flea) 48-hour LC ₅₀	5,000 to 10,000 mg/L	Practically non-toxic	0.014 mg/L	Very highly toxic	232 mg/L	Practically non-toxic
Green algae 96-hour LC ₅₀	3,300 mg/L	Practically non-toxic	0.003 mg/L	Very highly toxic	112 mg/L	Practically non-toxic
Earthworm 14-day LC ₅₀	1,621 mg/L (average from ECOSARS)	Slightly toxic	44 mg/L	Very highly toxic	4,648 mg/L	Slightly toxic

Note 1: SMILES formula: CCCCCCCC=CCCCCCCC(=O)OC
 Note 2: SMILES formula: CCCOC(=O)C(C)O

The available phytotoxicity data for distilled tall oil and the allowed organic alternative solvents are summarized in Table 18.

Parameter	Solvent Alternatives		
	Distilled Tall Oil	Methylated Soybean Oil	<i>n</i> -Butyl Lactate
Phytotoxicity	No phytotoxicity observed in greenhouse and field trials on chrysanthemum and cabbage following once a week applications of tall oil at a concentration of 1%. (Xie and Isman, 1995)	No data.	No phytotoxicity observed at concentrations up to at least 0.5% (v/v) (typical maximum concentration for most agricultural applications). (Purasolve Technical Data Sheet; please see Appendix 4).

4.5. Organic Producer Benefits and Essentiality

Solvents are included in most liquid pesticide formulations. Benefits of good solvent performance include:

- Improved product performance;
- Improved worker safety;
- Improved environmental safety;
- Reduced active ingredient seasonal application rates;
- Longer re-treatment intervals; and
- Reduced farm input and labor costs.

Ingevity proposes that distilled tall oil is essential for organic crop and livestock production for the reasons summarized in Table 19.

Parameter	Solvent Alternatives		
	Distilled Tall Oil	Methylated Soybean Oil	<i>n</i> -Butyl Lactate
Solvency	High	Poor	Medium
Bio-derived green content	100%	> 90%	61%
Production process	<ul style="list-style-type: none"> • Safe process. • No highly volatile or flammable chemicals are involved or generated. • No human or livestock food source is used to produce distilled tall oil. 	<ul style="list-style-type: none"> • Methanol is volatile, flammable, and hazardous. • Special personal protective equipment and safety protocols are need. • Not every chemical plant has the capability to safely handle methanol. 	<ul style="list-style-type: none"> • The fermentation process to produce lactic acid is a relatively expensive process. • It depletes valuable food resources. • The resulting <i>n</i>-butyl lactate is volatile and flammable.
Hard water stability	Excellent	Acceptable	Acceptable
Skin irritation	Not irritating	Irritating	Extremely irritating
Fish 96-hour LC ₅₀	Practically non-toxic	Very highly toxic	Moderately toxic
Daphnia (water flea) 48-hour LC ₅₀	Practically non-toxic	Very highly toxic	Practically non-toxic
Green algae 96-hour LC ₅₀	Practically non-toxic	Very highly toxic	Practically non-toxic
Earthworm 14-day LC ₅₀	Slightly toxic	Very highly toxic	Slightly toxic

Comparison to Methylated Soybean Oil. Distilled tall oil has clearly superior performance as a solvent compared to methylated soybean oil. Distilled tall oil is generally classified as practically non-toxic to non-target organisms, whereas based upon structure-activity modeling data, methylated soybean oil is very highly toxic to non-target organisms. Distilled tall oil is produced via a low hazard production process. The production of methylated soybean oil has multiple physical hazards, and methylated soybean oil production facilities have a history of fires and explosions.

Comparison to *n*-Butyl Lactate. Distilled tall oil has been demonstrated to be a better solvent than *n*-butyl lactate. Also, distilled tall oil is a 100% green solvent produced from pine trees, whereas *n*-butyl lactate has only approximately 61% bio-derived green content. No human or livestock food are used to produce distilled tall oil. By contrast, production of *n*-butyl lactate begins with fermentation of a human food and/or livestock feed, *e.g.*, corn. Distilled tall oil is not irritating to the skin, whereas *n*-butyl lactate is extremely irritating to the skin.

5. STICKERS

5.1. Purpose in Pesticide Formulations and Tank-Mixes

Stickers are included in pesticide formulations for use on crops or can be added as an adjuvant to a tank-mix to provide rainfastness to cause the active ingredient to stick to the plant surface. Stickers reduce removal of water soluble pesticide active ingredients from plant surfaces by rain and irrigation water. Stickers provide longer resident times of pesticide active ingredients on crop surfaces and thereby provide improved pesticide product performance.

Stickers can also be included in pesticide formulations for use on livestock to control external parasites, *e.g.*, mosquitoes, fleas, ticks, and mites. As with crops, stickers can be added as an adjuvant to spray solution tank-mixes. Inclusion of a sticker can reduce rain wash-off of the pesticide and thereby delay the need for re-treatment.

5.2. Identity of Alternative Stickers Permitted in Organic Production

Polyterpenes (a.k.a. terpene polymers, pinene polymers; CAS No. 31393-98-3) are stickers currently permitted for use in organic crop production for use as an inert ingredient in combination with permitted active pesticidal ingredients.

Ingevity has identified two OMRI listed brand name stickers containing polyterpenes:

- Miller® Nu Film P® Spreader/Sticker; and
- Ingevity Altastick R (US) Terpene Resin.

Please see Appendices 5 to 8 for the Safety Data Sheets and OMRI certificates.

Please note that polyterpenes:

- Have an EPA tolerance exemption for pre-harvest and post-harvest use on crops (40 CFR §180.910); and
- Do not currently have an EPA tolerance exemption that permits use on livestock (40 CFR §180.930).

5.3. Comparative Product Performance of Distilled Tall Oil as a Sticker

Kocide 2000 (EPA Reg. No. 91411-1-70051) is an EPA registered fungicide containing 53.8% copper hydroxide for use on a wide variety of fruit and vegetable crops for the control of a broad spectrum of fungal diseases. Kocide 2000 was used as an example formulation for a study that evaluated the comparative rainfastness of distilled tall oil to that of an OMRI-listed polyterpene sticker. Spray solutions were prepared according to the directions for use. Distilled tall oil and polyterpene stickers were added, mixed, and applied to a representative crop. The spray applications were allowed to dry. Removal of copper hydroxide via simulated irrigation water was measured. The results are provided in Figure 5.

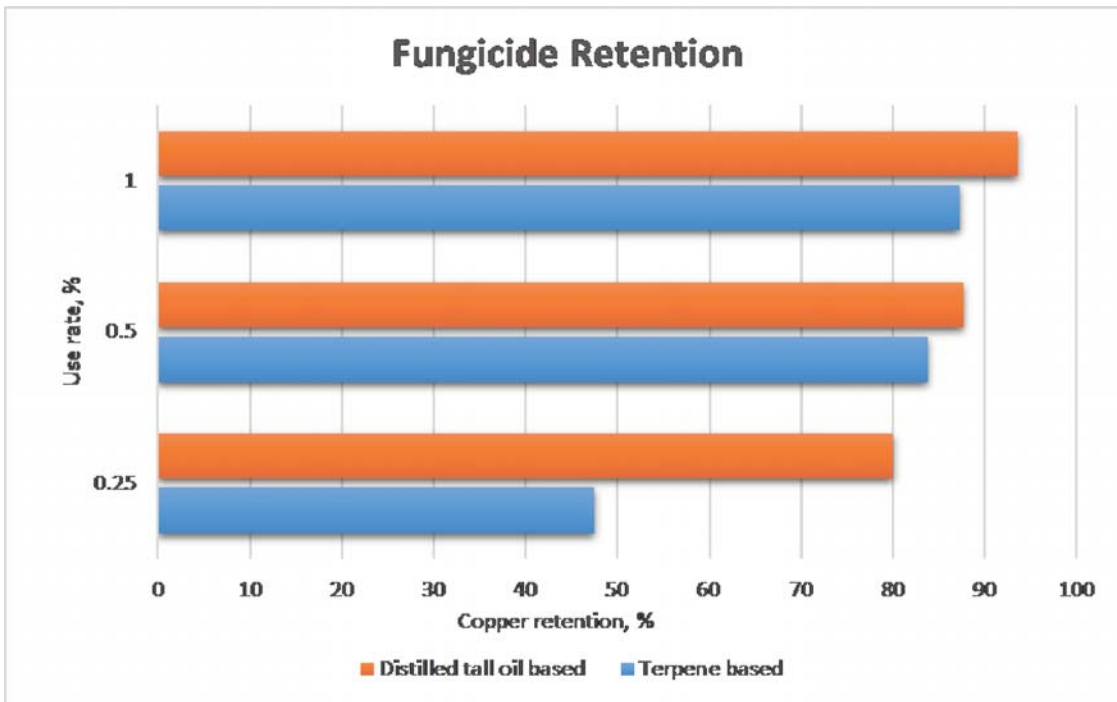


Figure 5. Comparison of Rainfastness of Copper Fungicide with Sticker Treatments

The data in Figure 5 demonstrate that distilled tall oil, especially at the 0.25% application rate:

- Helps to keep copper on the crop where it can perform its intended foliar fungicidal activity; and
- Thereby reduces rainwater wash-off to the soil where copper can accumulate.

Conclusions:

- At low concentrations (0.25% added sticker), distilled tall oil provides almost twice the rainfastness compared to the polyterpene sticker.
- At higher sticker concentrations (0.5% and 1%), distilled tall oil continues to provide greater rainfastness than the polyterpene alternative, though the relative difference in performance is smaller.

5.4. Comparison of Distilled Tall Oil to Permitted Sticker Alternatives

A comparison of a range of properties of distilled tall oil and the allowed organic polyterpene alternative sticker is provided as Table 20.

Property	Distilled Tall Oil	Polyterpenes
EPA tolerance exemption for use on crops	40 CFR §180.910 (pre-harvest and post-harvest crop use)	40 CFR §180.910 (pre-harvest and post-harvest crop use)
EPA tolerance exemption for use on livestock	40 CFR §180.930 (livestock use)	No relevant tolerance exemption for use on livestock. <i>Use on livestock is prohibited.</i>
Bio-derived green content	100% (from pine trees).	100% (from pine trees).
Naturally occurring	Yes. Product of pine trees.	No. Synthesis from terpenes is required.
Production	Made from black liquor from the Kraft paper production process.	Made from black liquor from the Kraft paper production process.
Availability (as % of wood mass)	~ 3%	0.1 to 0.6%
Product performance:		
• Rainfastness, stickiness	• Tunable. Adjustable to fit the needs of the formulation. • Highly effective at low concentrations.	• Not adjustable. • High, sometimes too sticky. • Can cause pesticide residues to exceed the US tolerance. • Can clog spray nozzles, resulting in uneven pesticide application and uneven performance.
• Cold temperature viscosity	Good. Remains pourable and sprayable.	High. At 46°F (8°C), polyterpene becomes a semi-solid thick paste. Not sprayable.
• Cold temperature emulsification	Stable. Emulsified formulations do not separate into layers.	Unstable. Emulsified formulations can separate into layers.
• Hard water stability	Good. Precipitation not observed.	Poor. Precipitation can occur.

5.5. Organic Producer Benefits and Essentiality

Stickers provide significant benefits to organic growers. These include:

- Improved product performance;
- Improved environmental safety;
- Reduced active ingredient seasonal application rates;
- Longer re-treatment intervals;
- Cold weather conveniences;
- Hard water compatibility; and
- Reduced farm input and labor costs.

Ingevity has identified only polyterpenes as an alternative sticker for use in organic crop production. Ingevity has not identified an alternative sticker for use in organic livestock production.

Ingevity proposes that distilled tall oil is an essential inert ingredient for use in organic crop and livestock production for the reasons summarized in section 5.4 above.

6. ANTI-LEACHING AGENTS

6.1. Purpose in Pesticide Formulations

Some pesticide active ingredients have the potential for leaching (moving) through the soil profile and contaminating groundwater. Active ingredients with the highest potential for leaching to groundwater have low binding to soil particles. Anti-leaching inert ingredients can be added to formulations and tank-mixes to reduce the potential for groundwater contamination. Anti-leaching agents help the active ingredient bind to the soil, especially in the upper layers with oxygen, so that beneficial soil organisms can break down the pesticide active ingredient.

6.2. Product Performance of Distilled Tall Oil as an Anti-Leaching Agent

Distilled tall oil acts as a physical and sticky barrier to retain easy-to-leach substances in the soil top layers.

Ingevity has conducted experiments to evaluate anti-leaching properties of distilled tall oil. Pendimethalin (a conventional herbicide active ingredient) is yellow and therefore easy to observe in a sandy soil prone to leaching. A pendimethalin spray solution was evaluated with and without distilled tall oil added. The pendimethalin, as indicated by the yellow color, had less downward movement in the sandy test soil when distilled tall oil was added to the test sample than the test sample with no added distilled tall oil. This demonstrates the anti-leaching properties of distilled tall oil. Please see Figure 6.

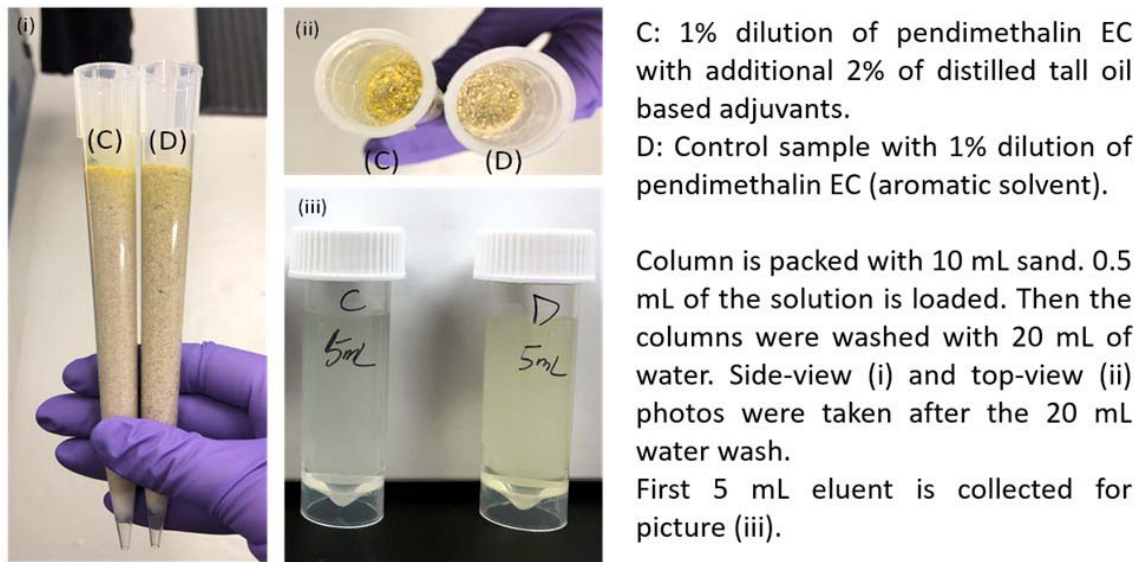


Figure 6. Comparison of Pendimethalin Movement in Sandy Soil with and without Distilled Tall Oil

Ingevity's research also indicates that distilled tall oil can be used to decrease leaching of micronutrients, *i.e.*, zinc sulfate ($ZnSO_4$). The inclusion of distilled tall oil decreased the downward movement of zinc sulfate solution in the soil profile. Inclusion of distilled tall oil helps keep the micronutrient in the crop's root zone and available for root uptake to benefit the crop. Please see Figure 7.

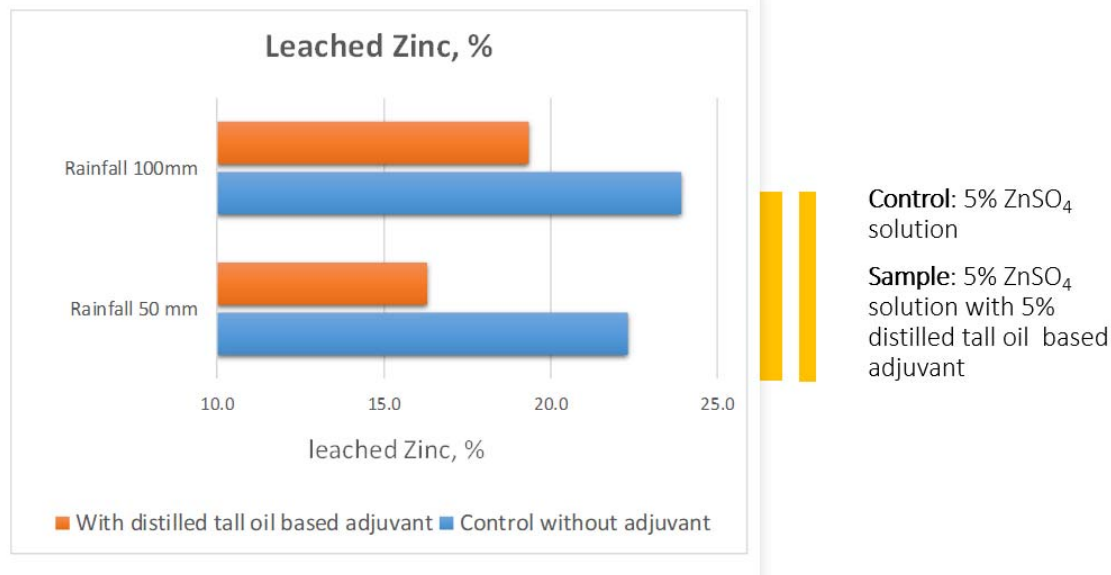


Figure 7. Comparison of Leaching of Zinc Sulfate ($ZnSO_4$) Solution with and without Distilled Tall Oil

6.3. No Identified Permitted Alternative Anti-Leaching Agents in Organic Crop Production

No alternative anti-leaching agents permitted for use in organic crop production has been identified by Ingevity.

6.4. Organic Producer Benefits and Essentiality

Anti-leaching agents benefit organic growers by protecting groundwater from contamination of pesticide active ingredients and plant nutrients that can readily move down the soil profile to groundwater. Anti-leaching agents can be particularly helpful in areas with sandy soils which are prone to leaching.

Ingevity proposes that distilled tall oil is essential for use in organic production as an anti-leaching agent. Ingevity has *not* identified an alternative organic anti-leaching agent.

7. TIME-RELEASE AGENTS

7.1. Purpose in Pesticide Formulations

7.2. Product Performance of Distilled Tall Oil as a Time-Release Agent

The hydrophobic (low affinity for water) nature and film forming properties of distilled tall oil make it a great product for coating water soluble fertilizer granules. Distilled tall oil can be used to adjust the thickness of the fertilizer coating layer to allow for a controlled release of nutrients, thereby:

- Minimizing nitrogen runoff and impacts to waterways and aquatic life; and
- Reducing the need for re-treatments.

7.3. No Identified Permitted Alternative Time-Release Agents in Organic Crop and Livestock Production

No permitted alternative time-release agents for use in organic crop and livestock production has been identified by Ingevity.

7.4. Organic Producer Benefits and Essentiality

Time-release agents offer organic growers many benefits. These include:

- Improved product performance;
- Improved environmental safety;
- Reduced active ingredient seasonal application rates;
- Longer re-treatment intervals; and
- Reduced farm input and labor costs.

Ingevity proposes that distilled tall oil is essential for use in organic production as a time-release agent. Ingevity has not identified an alternative organic time-release agent.

8. INGEVITY'S REPLIES TO PREVIOUS NOP PETITION NEGATIVE COMMENTS AND CONCLUSIONS

8.1. Issues Raised in the January 31, 2010 Technical Report

8.1.1. "Distilled Tall Oil" as the Subject of the Petition

Technical Report Line 3:

"Chemical Name: Crude Tall Oil."

Technical Report Line 10:

"Trade Names: Crude Tall Oil."

Ingevity's Reply:

The Technical Report makes numerous references to "crude tall oil." The author of the Technical report falsely assumes that "crude tall oil" and "distilled tall oil" are the same. "Crude" indicates a less refined product. "Distilled" indicates that the substance has been refined via a distillation process. Though crude tall oil and distilled tall oil have the same CAS number, they have different compositions, physical-chemical properties, and skin sensitization properties. Crude tall oil is a skin sensitizer, whereas distilled tall oil is not a skin sensitizer.

Technical Report Line 6:

"Other Names: Liquid rosin."

Ingevity's Reply:

Rosin is a component of crude tall oil. Ingevity's biorefinery separates crude tall oil into five fractions. These include distilled tall oil and rosin. Please see Section 3.4 and Figure 3. Ingevity's distilled tall oil contains typically 10% to 40% rosin acids. Please see Table 4. "Liquid rosin" is not an appropriate synonym for distilled tall oil.

8.1.2. Technical Report False Claims that Distilled Tall Oil is Insecticidal

Technical Report Lines 63-64:

"Tall oil neutrals applied to plants serves as a natural insecticide and protects plants from insects and mites (US Patent Office, 1989)."

Ingevity's Reply:

Please see Appendix 9 for a copy of the US Patent No. 4,874,610 issued on Oct. 17, 1989.

Column 1 lines 17-21 state:

"Kraft or tall oil soap is one by-product of black liquor for which commercial uses exist. Tall oil soap is converted to crude tall oil by acidification with sulphuric acid. This conversion, however, creates another waste product, namely, tall oil neutrals."

Therefore, "crude tall oil", "distilled tall oil" and "tall oil neutrals" are distinct substances. Distilled tall oil contains fatty acids and rosin acids. Tall oil neutrals are chemically neutral, *i.e.*, not acids. Distilled tall oil contains no significant tall oil neutrals.

Please see Section 3.4 and Figure 3 regarding Ingevity's production process for distilled tall oil and the processing achieved by the biorefinery.

Processed black liquor and other Ingevity co-products are sold back to the Kraft paper mill. Tall oil neutrals are not released to the environment.

The EPA product (database) code for "tall oil" is 67211. The EPA Pesticide Product Information System reports that there are no EPA registered pesticide products containing tall oil (PC Code 67211) as the active ingredient.

<http://npirspublic.ceris.purdue.edu/ppis/chemical.aspx>

Technical Report Lines 119-122:

"Crude tall oil can be used as an insecticide repellent and is approved by the European Food Safety Authorization (EFSA) and is included in EU registration directive, EEC 91/414 Annex I for biopesticides (27 and 28 October 2008) to be accessed at

<http://www.pesticides.gov.uk/approvals.asp?id=2594>"

Ingevity's Reply:

The URL in the Technical Report Line 122 is incorrect. The URL should be:

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01991L0414-20110601>.

Please note:

- The regulation has been superseded by EU 540/2011.
- The crude tall oil EU approval as an active substance that *"repellents by smell of animal or plant origin"* was removed on July 3, 2017 per Reg. (EU) 2017/1186.
- The EU Pesticides Databases entry includes the review report that was used as evidence to remove crude tall oil from the list.
<https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/public/?event=activesubstance.detail&language=EN&selectedID=1826> .

Contrary to the 2010 Technical Report, distilled tall oil is not insecticidal.

Distilled tall oil is proposed for use as an *inert ingredient* and as an *adjuvant* for use in pesticide spray solutions in organic crop and livestock production.

Ingevity notes that oils can be used to suffocate insects.

7 CFR §205.601(e)(7) permits use:

- “(e) as insecticides (including acaricides or mite control)
- (7) Oils, horticultural - narrow range oils as dormant, suffocating, and summer oils”.

When distilled tall oil is used:

- As an inert ingredient in pesticide formulations applied according to the directions for use; or
- As an adjuvant added to a pesticide spray solution with both the pesticide and the adjuvant used according to the directions for use;

the distilled tall oil is applied as a dilute aqueous solution or suspension at an anticipated maximum application rate of 2 lb distilled tall oil/acre. No insect suffocation is anticipated under these anticipated maximum exposure conditions.

8.1.3. Black Liquor and Environmental Contamination

Technical Report Lines 200-205:

“After the tall oil is skimmed off the “black liquor”, the liquor is recycled for further use in the paper making process. The final waste stream (the aqueous layer formed by acidulation of tall oil soap with H₂SO₄) after the tall oil is extracted ends up and is discharged into a pulp mill’s wastewater treatment system. It is either recycled to the pulping process or diverted to wastewater treatment (U.S. EPA, 2008, pg. 2). However, U.S. EPA lists effluent limits and pollution guidelines to wastewater streams from manufacture for tall oil rosin (TOR) are in 40 CFR, part 454, §454.42 to be assessed at <http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=1c0c4500aa79ec12d283ff15fdad2f34&rgn=div8&view=text&node=40:29.0.1.1.25.4.5.3&idno=40> ”

Ingevity’s Reply:

Kraft paper products are familiar and a part of every-day life. They include but are not limited to:

- Food packaging, *e.g.*, cookie and cracker boxes; and
- Corrugate cardboard shipping boxes for many items purchases on-line.

Black liquor is a co-product of the Kraft paper making process. Black liquor contains tall oil soap and other useful substances produced by pine trees. Ingevity buys black liquor from the paper mill as the starting material for the production of distilled tall oil and other Ingevity products derived from pine trees.

Ingevity removes tall oil soap from black liquor using two physical (non-chemical) techniques. The first separation is via settling. The tall oil soap rises to the top, and it is skimmed off, similar to skimming chicken fat off the top of chicken broth. The second separation step is centrifugation. Separation is achieved based upon weight differences. Lighter substances are on top.

Ingevity’s separation steps are also used to isolate two substances from black liquor that are on EPA’s Inert Ingredient List 4B:

- Lignosulfonic acid, calcium salt (CAS No. 8061-52-7); and
- Lignosulfonic acid, sodium salt (CAS No. 8061-51-6).

The processed black liquor, without the components of interest to Ingevity, is sold back to the paper mills for further use in the paper production process. Use of the processed black liquor by the paper mills enables the paper mills to reduce the paper making starting material costs and energy costs.

There is a symbiotic relationship between the Kraft paper mill and Ingevity’s products derived from pine tress, including distilled tall oil.

- The paper mill’s co-product (black liquor) is used to make Ingevity’s distilled tall oil and other commercial products derived from pine trees.
- Ingevity’s co-product (processed black liquor) of the paper mill’s co-product (black liquor) is then sold back to the paper mill for use by the paper mill as a reduced cost starting material and reduced cost energy source for the paper mill’s production of wood pulp.

Ingevity is a good steward of the environment. Spent waters are not directly discharged to the environment. Spent waters are processed before they are recycled as process water or discharged to the environment in compliance with all applicable environmental laws.

Please see sections 3.4 and 3.5 for more details regarding Ingevity's production process for distilled tall oil and associated environmental protections.

8.1.4. Tall Oil Rosin, When Oxidized, is a Skin Sensitizer

Technical Report Lines 424-431:

"P. A. Botham et al., 2008 states that tall oil rosin (a by-product of pulping) when tested in guinea pigs in its non-oxidized form was found to be not a skin sensitizer. However, a guinea pig maximization test (GPMT) showed that tall oil rosin (TOR) in its readily oxidized form can be considered a skin sensitizer and should follow labeling and regulatory requirements of the European Union. A human patch testing study in 1785 patients investigated dermal contact sensitivity to TOR (Johnson and Bonner, 2009). A total of 50 patients (2.8%) tested positive for TOR 48 or 72 hours after application. Males experienced a 1.8% incidence (11/613) and females exhibited a 3.3% incidence (39/1172). Patients at age 50 years or older had a higher incidence (4.4%) of sensitivity to TOR in the study."

Ingevity's Reply:

Distilled tall oil is a UVCB substance (substance of unknown or variable composition, complex reaction products and biological materials) derived from pine trees. Distilled tall oil contains 10% to 40% rosin acids. (Please see Table 4.) *Distilled* tall oil has been determined to *not* be a dermal sensitizer. (Please see Table 7.)

8.1.5. Claimed Organic Alternatives

Technical Report Lines 486-491:

"A substitute is animal tallow, which is obtained wholly naturally as a rendered form of beef or mutton fat. Tallow fatty acids (21 CFR 172.660) like plant derived tall oil fatty acids can be used for the production of soaps and lubricants. About 35% of the United States fatty acid production and more than 50% of the unsaturated fatty acid part comes from tall oil (Goldstein, 1993). Tall oil is a major source of fatty acids (Sheely and Potts, 1958). Another natural substitute for the petitioned substance includes terpene extracts from soft woods (Gershenzon and Dudareva, 2007)."

Ingevity's Reply:

The Technical Report *falsely* assumes that the following are equivalent and interchangeable:

- Animal tallow;
- Beef or mutton fat;
- Tallow fatty acids; and
- Plant derived tall oil fatty acids.

They are chemically and functionally distinct and *not* alternatives for the proposed use of distilled tall oil as a solvent, sticker, anti-leaching agent, and time-release agent.

Technical Report Lines 496-501:

"Neem oil could be substituted for the petitioned substance or distilled tall oil. Organic neem oil of vegetable origin shares several of the uses of distilled tall oil including being allowed as a bio-pesticide for powdery mildew (Green Earth Products, 2009, ref. 1 and Wikipedia, 2009, pg. 2). However, neem oil is not a good source of rosin acids like tall for the petitioned substance include vegetable oils (ICIS, 2003), and white mineral oil. However, neem oil is a good source of fatty acids as tall oil. Other approved substitutes for the petitioned substance include vegetable oils (ICIS, 2003), and white mineral oil (Arizona Chemical, 2009)."

Ingevity's Reply:

Distilled tall oil is the petitioned substance. The Technical Report identifies the petitioned substance as "Tall Oil". The author of the technical report equates "distilled tall oil" and "crude tall oil". "Distilled" and "crude" identify different grades of tall oil. Please see section 3.4 regarding the production of distilled tall oil and the separation of crude tall oil into 5 different products, one of which is distilled tall oil.

Neem oil and distilled tall oil each have "oil" as part of their common names. They are both derived from trees. Pine trees are the source of distilled tall oil. Neem trees are the source of neem oil. Pine trees and neem trees have different habitats and different biochemical compositions.

Distilled tall oil is proposed for use as an inert ingredient and adjuvant for its solvent, sticker, anti-leaching agent, and a time-release agent properties. Distilled tall oil and neem oil are chemically and functionally distinct substances. Neem oil is not an alternative for the proposed use of distilled tall oil as an allowed inert ingredient for use in organic crop and livestock production.

Technical Report Lines 506-511:

"Farmers could use various alternative methods as crop rotation and usage of beneficial insects (Green Earth Products, 2009, ref. 2) which would make the use of the petitioned substance (distilled tall oil) in an organic formulated pesticide product unnecessary. The application of plant sterols as food and beverage ingredients would make the petitioned substance unnecessary (FSANZ, 2009; Cantrill, 2008). The daily intake (ADI) for plant sterols or phytosterols has already been established by FSANZ (2009) to be 40 mg/kg body weight (human)."

Ingevity's Reply:

Distilled tall oil is not an insecticide. Based upon a superseded EU regulation, crude tall oil was previously EU registered as a repellent based upon smell (not as an insecticide). In 2017, crude tall oil was removed from the list of EU registered pesticide active substances. Please see section 8.1.2 for additional information on the history. Please note that crude tall oil has an unpleasant sulfur-like odor than distilled tall oil does not have.

Distilled tall oil is proposed for use as an inert ingredient and adjuvant for use as a solvent, a sticker, an anti-leaching agent, and a time-release agent in products for use in organic crop and livestock production. Alternative crop methods, *e.g.*, crop rotation, are not relevant to the proposed uses. Please see Section 8.1.2.

8.2. Issues Raised in the October 28, 2010 National Organic Standards Board Recommendation to the National Organic Program

8.2.1. Category 1. Adverse Impacts on Humans or the Environment?

Category 1. Adverse Impacts on Humans or the Environment?			
No.	Question	2010 NOSB Answer	Ingevity's Reply
2.	Is there environmental contamination during manufacture, use, misuse, or disposal?	Yes. TR Lines 194-208: environmental contamination with the Kraft papermaking process.	<ul style="list-style-type: none"> • No. • The production of distilled tall oil is a clean process. • Ingevity buys black liquor from paper mills, isolates distilled tall oil and other useful products produced by pine trees, and sells the processed black liquor back to the paper mill for further use in paper pulp production. • Ingevity's spent waters are <i>not</i> directly discharged to the environment. • Water is processed and recycled or discharged to the environment in compliance with all applicable environmental laws. Please see sections 3.4 and 3.5 for additional details.
3.	Is the substance harmful to the environment and biodiversity? [§6517c(1)(A)(I); 6517(c)(2)(A)(I)]	Yes. TR lines 157-167 and 331-341. Tall oil has insecticidal properties.	<ul style="list-style-type: none"> • No. • <i>Distilled</i> tall oil is not and never has been registered for use as an insecticide in the US or in the EU. • <i>Crude</i> tall oil was previously registered as a <i>repellent</i> in the EU based upon its unpleasant sulfur-like smell. The EU repellent registration has been cancelled. • Distilled tall oil contains no significant "tall oil neutrals." • Please see section 8.1.2.

Category 1. Adverse Impacts on Humans or the Environment?			
No.	Question	2010 NOSB Answer	Ingevity's Reply
4.	Does the substance contain List 1, 2, or 3 inerts? [§6517 c(1)(B)(ii); 205.601(m)(2)]	Yes. It was (is?) on the EPA List 3 Inert Substances of Unknown Toxicity	<ul style="list-style-type: none"> • Yes. • The proposed substance is on EPA List 3 which is no longer maintained by EPA. • The required data have been submitted to EPA. The toxicity profile is known. • EPA has determined that there is a reasonable certainty of no harm. • Distilled tall oil has the following current EPA tolerance exemptions: <ul style="list-style-type: none"> • 40 CFR §180.910 (inert ingredients used pre- and post-harvest use); and • 40 CFR §180.930 (inert ingredients applied to animals). • The purpose of this petition is to document that distilled tall oil <u>is</u> appropriate for use in organic crop and livestock production.
6.	Are there adverse biological and chemical interactions in agro-ecosystem? [§6518 m.5]	Yes. TR lines 157-167 and 331-341. Tall oil has insecticidal properties. Insecticidal activity cause unintended adverse interactions.	<ul style="list-style-type: none"> • No. • <u>Distilled</u> tall oil is <u>not</u> registered for use as an insecticide in the US or in the EU. • <u>Crude</u> tall oil was previously registered as a <u>repellent</u> in the EU based upon its unpleasant sulfur-like smell. The EU repellent registration has been cancelled. • Distilled tall oil contains no significant "tall oil neutrals." • Please see section 8.1.2.
7.	Are there detrimental physiological effects on soil organisms, crops, or livestock? [§6518 m.5]	Yes. TR lines 157-167 and 331-341. Tall oil has insecticidal properties. The insecticidal properties may be detrimental to soil organisms, especially insects.	<ul style="list-style-type: none"> • No. • <u>Distilled</u> tall oil is not registered for use as an insecticide in the US or in the EU. • <u>Crude</u> tall oil was previously registered as a <u>repellent</u> in the EU based upon its unpleasant sulfur-like smell. The EU repellent registration has been cancelled. • Based upon modeling data, distilled tall oil is slightly toxic to earthworms. This is comparable to or superior to the earthworm toxicity of alternative organic products. Please see Table 19. • Please see section 8.1.2.

Category 1. Adverse Impacts on Humans or the Environment?			
No.	Question	2010 NOSB Answer	Ingevity's Reply
8.	Is there a toxic or other effect adverse action of the material or its breakdown products?	Yes. TR lines 417-431: Tall oil rosin may cause dermal sensitization.	<ul style="list-style-type: none"> • No. • Rosins are components in crude tall oil. Ingevity's biorefinery separates crude tall oil into distilled tall oil, rosin, and three other products based upon boiling points and other physical-chemical characteristics. • Distilled tall oil and rosin are chemically and functionally distinct substances. • <i>Distilled</i> tall oil has been determined to <i>not</i> be a dermal sensitizer. See Table 7.

8.2.2. Category 2. Is the Substance Essential for Organic Production?

Category 2. Is the Substance Essential for Organic Production?			
No.	Question	2010 NOSB Reply to NOP	Ingevity's Reply
1.	Is the substance formulated or manufactured by a chemical process? [6502 (21)]	Yes. TR lines 129-146.	Yes. Tall oil soap is converted to tall oil via a simple chemical reaction with sulfuric acid.
2.	Is the substance formulated or manufactured by a process that chemically changes a substance extracted from naturally occurring plant, animal or mineral sources? [6502 (21)]	Yes. TR lines 172-181.	Yes. Substances produced by pine trees are extracted via the Kraft paper production process. Tall oil soap is present in black liquor from the Kraft paper production process and is then converted to crude tall oil via a simple chemical reaction with sulfuric acid.
3.	Is the substance created by naturally occurring biological processes? [6502 (21)]	No. TR lines 186-189. It is an extract of trees, which are natural products, but it is not clear whether the tall oil would exist in nature without the pulping and extraction process.	Yes. Distilled tall oil is a substance produced by pine trees. The fatty acids are converted to soap in the paper making process. The soap is separated from the components of black liquor by a physical process (centrifugation).
5.	Is there an organic substitute? [§205.600 b.1]	Yes. Vegetable oil TR Line 500.	Not applicable. The question is in reference to §205.600 b.1 (organic handling). The petitioned substance is for crop and livestock production.

Category 2. Is the Substance Essential for Organic Production?			
No.	Question	2010 NOSB Reply to NOP	Ingevity's Reply
7.	Is there a wholly natural substitute product? [§6517c (1)(A)(ii)]	Yes. TR lines 486-491: Animal tallow, terpene extracts of soft woods.	<p>No.</p> <p>Distilled tall oil is proposed as an inert ingredient and adjuvant for use as a solvent, a sticker, an anti-leaching agent, and a time-release agent. Animal tallow is not a substitute product.</p> <p>Ingevity has identified:</p> <ul style="list-style-type: none"> • Methylated soybean oil and <i>n</i>-butyl lactate as allowed alternative solvents; and • Polyterpenes as an allowed alternative sticker. <p>Each of these alternatives is produced synthetically.</p>
9.	Is there an alternative substance? [§6518 m.6]	Yes. TR lines 496-501, 486-491. Vegetable oils, white mineral oils.	<p>Yes and No.</p> <p>Distilled tall oil is proposed as an inert ingredient and adjuvant for use as a solvent, a sticker, an anti-leaching agent, and a time-release agent.</p> <p>Ingevity has identified:</p> <ul style="list-style-type: none"> • <u>Methylated soybean oil and <i>n</i>-butyl</u> lactate as allowed alternative solvents; • <u>Polyterpenes</u> as an allowed alternative sticker; and • <u>No allowed alternatives</u> for the anti-leaching agent and time-release agent functions of distilled tall oil. <p>Each of the three allowed alternatives is produced synthetically. Vegetable oils and mineral oils, though oils, are <i>not</i> alternative substances. They do <i>not</i> have the needed product performance characteristics.</p>

Category 2. Is the Substance Essential for Organic Production?			
No.	Question	2010 NOSB Reply to NOP	Ingevity's Reply
10.	Is there another practice that would make the substance unnecessary? [§6518 m.6]	Yes. TR lines 506-511. [<i>"Farmers could use various alternative methods as crop rotation and usage of beneficial insects (Green Earth Products, 2009, ref. 2) which would make the use of the petitioned substance (distilled tall oil) in an organic formulated pesticide product unnecessary. The application of plant sterols as food and beverage ingredients would make the petitioned substance unnecessary (FSANZ, 2009; Cantrill, 2008). The daily intake (ADI) for plant sterols or phytosterols has already been established by FSANZ (2009) to be 40 mg/kg body weight (human)."</i>]	<ul style="list-style-type: none"> • No. • <u>Distilled</u> tall oil is not registered for use as an insecticide in the US or in the EU. Please see section 8.1.2. • <u>Crude</u> tall oil was previously registered as a <u>repellent</u> in the EU based upon its unpleasant sulfur-like smell. The EU repellent registration has been cancelled. • Distilled tall oil is proposed for use as: <ul style="list-style-type: none"> • an inert ingredient; and • an adjuvant for use as a: <ul style="list-style-type: none"> • Solvent; • Sticker; • Anti-leaching agent; and • Time-release agent in products for use in organic crop and livestock production. • Alternative crop methods, <i>e.g.</i>, crop rotation, are <u>not relevant</u> to the proposed uses.

8.2.3. Category 3. Is the Substance Compatible with Organic Production Practices?

Category 3. Is the Substance Compatible with Organic Production Practices?			
No.	Question	2010 NOSB Reply to NOP	Ingevity's Reply
2.	Is the substance consistent with organic farming and handling? [§6517 c(1)(A)(iii); 6517 c(2)(A)(ii)]	No. TR lines 157-167 a 331-341. Tall oil has insecticidal properties although it is being petitioned as an inert. Because of its unintentional effects on non-target insects and therefore biodiversity, the Crops Subcommittee felt that it is incompatible with organic farming.	<ul style="list-style-type: none"> • Yes. • <u>Distilled</u> tall oil is not registered for use as an insecticide in the US or in the EU. Please see section 8.1.2. • <u>Crude</u> tall oil was previously registered as a <u>repellent</u> in the EU based upon its unpleasant sulfur-like smell. The EU repellent registration has been cancelled. • Please see section 8.1.2.
3.	Is the substance compatible with a system of sustainable agriculture? [§6518 m.7]	No. TR lines 157-167 a 331-341. Tall oil has insecticidal properties although it is being petitioned as an inert. Because of its unintentional effects on non-target insects and therefore biodiversity, the Crops Subcommittee felt that it is incompatible with sustainable agriculture.	<ul style="list-style-type: none"> • Yes. • <u>Distilled</u> tall oil is not registered for use as an insecticide in the US or in the EU. Please see section 8.1.2. • <u>Crude</u> tall oil was previously registered as a <u>repellent</u> in the EU based upon its unpleasant sulfur-like smell. The EU repellent registration has been cancelled. • Please see section 8.1.2.

7.	Is the substance used in production, and does it contain an active synthetic ingredient in the following categories: a. copper and sulfur compounds; b. toxins derived from bacteria; c. pheromones, soaps, horticultural oils, fish emulsions, treated seeds, vitamins and mineral; d. livestock parasitides and medicines; e. production aids including netting, tree wraps and seals, insect traps, sticky barriers, row covers, and equipment cleaners?	No.	Not applicable. The petitioned substance: <ul style="list-style-type: none">• Is an inert ingredient and adjuvant; and• Does not include an active ingredient. Ingevity proposes to amend 7 CFR §205.601(m) and 7 CFR §205.603(e) to permit use as an inert ingredient and adjuvant in organic crop and livestock production.
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9. OVERALL CONCLUSIONS

Distilled tall oil has an EPA tolerance exemption for use in/on crops both pre-harvest and post-harvest (40 CFR §180.910) and for use on livestock (40 CFR §180.930).

Ingevity proposes to amend the National List to add distilled tall oil to 7 CFR §205.601(m) and 7 CFR §205.603(e) to permit use as an inert ingredient in organic crop and livestock production. The proposed uses as an inert ingredient include use as:

- A solvent;
- A sticker;
- An anti-leaching agent; and
- A time-release agent.

Additional amendments might be need to permit use as an adjuvant for the same purposes.

Distilled tall oil provides many benefits to the organic production community. These include:

- Improved product performance;
- Improved worker safety;
- Improved environmental safety, including of water, soil, air, and wildlife;
- Reduced active ingredient seasonal application rates;
- Longer re-treatment intervals;
- Cold weather conveniences; and
- Reduced farm input and labor costs.

The starting material for the production of distilled tall oil is pine trees. The components of distilled tall oil are produced by pine trees.

Kraft paper production involves the production of black liquor which contains tall oil soap which interferes with the paper production process. Ingevity's distilled tall oil production facility is located next to the Kraft paper mill. Ingevity buys the paper mill's black liquor, reacts it with sulfuric acid, and then separates the components in a biorefinery to produce:

- Heads (light ends);
- Fatty acids (tall oil fatty acid);
- Distilled tall oil (the subject of this petition);
- Rosin; and
- Pitch.

These materials have a broad range of uses. Please see Figure 3.

The production of distilled tall oil is very clean process from an environmental perspective. The co-products from Ingevity's production of distilled tall oil are sold to the Kraft paper mill for the mill's use in paper production. Please see Sections 3.4 and 3.5 for additional details.

Distilled tall oil has low mammalian toxicity and low environmental toxicity. Distilled tall oil is compatible with organic production practices and objectives.

Distilled tall oil is essential for organic crop and livestock production. Each of the identified alternatives for use as a solvent and as a sticker are synthetically produced. Distilled tall oil is compared to the alternatives and provides clear advantages. There are no identified alternatives to distilled tall oil for the anti-leaching and time-release functions.

The petition provides considerable new information relative to the 2008 petition submitted by a different submitter. Also, this petition fully responds to the issues raised by the Technical Reviewer and the National Organic Standard Board.

Ingevity proposes that distilled tall oil will be a very welcomed new inert ingredient available for organic crop and livestock production.

10. REFERENCES

- Arien, Y., Dag, A., Zarchin, S., Masci, T., Shafir, S. (2015).
Omega-3 deficiency impairs honey bee learning. *Proceedings of the National Academy of Science*, 112(51), pp. 15761-15766.
- Cashman, S., Moran, K., and Gaglione, A. (2016).
Greenhouse Gas and Energy Life Cycle Assessment of Pine Chemicals Derived from Crude Tall Oil and Their Substitutes. *Journal of Ecology*, 20(5), pp 1108-1121.
- Drew, J. and Propst, M. (1981).
Tall Oil: A Book on the Processing and Use of Tall Oil, for Chemists, Engineers, Managers, and Producers. Pulp Chemicals Association.
- Domineguez, P. (2016).
Industrial Biorenewables: A Practical ViewPoint. John Wiley and Sons.
- Kjellin, M. and Johansson, I. (2010).
Surfactants from Renewable Resources. John Wiley and Sons.
- Manning, R. (2001).
Fatty acids in pollen: a review of their importance for honey bees. *Bee World*, 82(2), pp. 60-72.
- Pugh, M., Lindeskog, M., Smith, B. *et al.*, (2019).
Proceedings of the National Academy of Sciences, March 2019 116 (10) pp 4382-4387; DOI: 10.1073/pans.181051216
- Xie, Yongshu and Murray B. Isman (1995).
Toxicity and deterrence of depitched tall oil to the green peach aphid, *Myzus persicae*. *Crop Protection* 14(1), pp. 51-56.
- Zinkle, D. F. and Russell, J. (1989).
Naval Stores: Production, Chemistry, Utilization. Pulp Chemicals Association.

11. ACKNOWLEDGMENT

Ingevity has received permission from the European Chemical Agency (ECHA) to cite data on tall oil that is summarized at the following web site:
<https://echa.europa.eu/registration-dossier/-/registered-dossier/14967/7/3/1>.

APPENDICES

Appendix 1. Distilled Tall Oil (ALTAPYNE M28B) Safety Data Sheet



SAFETY DATA SHEET

ALTAPYNE M-28B

Section 1. Identification

GHS product identifier : ALTAPYNE M-28b

Other means of identification : Not available.

Material uses : Emulsifier for oil extended SBR latex and for metal working oils, as a base for alkyd resins, as an anionic floatation reagent, and as an asphalt emulsion additive.

Supplier's details : **Ingevity Corporation**
5255 Virginia Avenue
North Charleston
South Carolina USA
29406-3615

www.ingevity.com
email: sds@ingevity.com

Tel: +1 843 740 2300, +1 800 458 4034
(0800 - 1700 EST)



In case of emergency : +1 800 424 9300 (USA) CHEMTREC

Section 2. Hazards identification

OSHA/HCS status : While this material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200), this SDS contains valuable information critical to the safe handling and proper use of the product. This SDS should be retained and available for employees and other users of this product.

Classification of the substance or mixture : Not classified.

GHS label elements

Signal word : No signal word.

Hazard statements : No known significant effects or critical hazards.

Precautionary statements

Prevention : Not applicable.

Response : Not applicable.

Storage : Not applicable.

Disposal : Not applicable.

Hazards not otherwise classified : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Ingredient name	%	CAS number
Tall oil	100	8002-26-4

Any concentration shown as a range is to protect confidentiality or is due to batch variation.



ALTAPYNE M-28B

Section 3. Composition/information on ingredients

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

- Eye contact** : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Get medical attention if irritation occurs.
- Inhalation** : Remove victim to fresh air and keep at rest in a position comfortable for breathing. Get medical attention if symptoms occur.
- Skin contact** : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.
- Ingestion** : Wash out mouth with water. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Do not induce vomiting unless directed to do so by medical personnel. Get medical attention if symptoms occur.

Most important symptoms/effects, acute and delayed

Potential acute health effects

- Eye contact** : No known significant effects or critical hazards.
- Inhalation** : No known significant effects or critical hazards.
- Skin contact** : No known significant effects or critical hazards.
- Ingestion** : No known significant effects or critical hazards.

Over-exposure signs/symptoms

- Eye contact** : No specific data.
- Inhalation** : No specific data.
- Skin contact** : No specific data.
- Ingestion** : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

- Notes to physician** : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.
- Specific treatments** : No specific treatment.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

- Suitable extinguishing media** : Use an extinguishing agent suitable for the surrounding fire.
- Unsuitable extinguishing media** : None known.

- Specific hazards arising from the chemical** : In a fire or if heated, a pressure increase will occur and the container may burst.

Section 5. Fire-fighting measures

- Hazardous thermal decomposition products** : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
- Special protective actions for fire-fighters** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.
- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.
- Remark** : Non-flammable.
- Remark** : None.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

- For non-emergency personnel** : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Put on appropriate personal protective equipment.
- For emergency responders** : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".
- Environmental precautions** : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

- Small spill** : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.
- Large spill** : Stop leak if without risk. Move containers from spill area. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

- Protective measures** : Put on appropriate personal protective equipment (see Section 8).
- Advice on general occupational hygiene** : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.



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Section 7. Handling and storage

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

None.

Appropriate engineering controls : Good general ventilation should be sufficient to control worker exposure to airborne contaminants.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields. Recommended: safety glasses with side-shields

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. > 8 hours (breakthrough time): Synthetic or rubber gloves

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. Recommended: safety apron

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use.



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Section 9. Physical and chemical properties

Appearance

Physical state	: Liquid.
Color	: Amber. / Brown. [Dark]
Odor	: Bland.
Odor threshold	: Not available.
pH	: Not applicable.
Melting point	: -20.15°C (-4.3°F)
Boiling point	: 360.85°C (681.5°F)
Flash point	: Closed cup: 207.2°C (405°F) Open cup: 207.22°C (405°F) [Cleveland.] [Product does not sustain combustion.]
Burning time	: Not applicable.
Burning rate	: Not applicable.
Evaporation rate	: Not applicable.
Flammability (solid, gas)	: Not applicable.
Lower and upper explosive (flammable) limits	: No flammable ingredients present.
Vapor pressure	: 0 kPa (0 mm Hg) [room temperature]
Vapor density	: >1 [Air = 1]
Relative density	: 0.949 [Water = 1]
Solubility	: Very slightly soluble in the following materials: cold water and hot water.
Solubility in water	: Not available.
Partition coefficient: n-octanol/water	: 3.2 to 6.8
Auto-ignition temperature	: >365°C (>689°F)
Decomposition temperature	: Not available.
SADT	: Not applicable.
Viscosity	: Dynamic (room temperature): 100 mPa·s (100 cP) Kinematic (40°C (104°F)): 0.5 cm ² /s (50 cSt)

Section 10. Stability and reactivity

Reactivity	: No specific test data related to reactivity available for this product or its ingredients.
Chemical stability	: The product is stable.
Possibility of hazardous reactions	: Under normal conditions of storage and use, hazardous reactions will not occur.
Conditions to avoid	: No specific data.
Incompatible materials	: Reactive or incompatible with the following materials: oxidizing materials and reducing materials.
Hazardous decomposition products	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Tall oil	LD50 Dermal	Rat	>2000 mg/kg	-
	LD50 Oral	Rat	66 g/kg	-

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
Tall oil	Skin - Edema	Rabbit	0	4 hours	72 hours
	Skin - Erythema/Eschar	Rabbit	0	4 hours	72 hours
	Eyes - Cornea opacity	Rabbit	0	-	72 hours
	Eyes - Iris lesion	Rabbit	0	-	72 hours
	Eyes - Edema of the conjunctivae	Rabbit	0	-	72 hours
	Eyes - Redness of the conjunctivae	Rabbit	0	-	72 hours

Conclusion/Summary

Skin : Non-irritating to the skin.

Eyes : Non-irritating to the eyes.

Sensitization

Product/ingredient name	Route of exposure	Species	Result
Tall oil	skin	Guinea pig	Not sensitizing

Conclusion/Summary

Skin : Not sensitizing

Mutagenicity

Product/ingredient name	Test	Experiment	Result
Tall oil	OECD 471 Bacterial Reverse Mutation Test	Experiment: In vitro Subject: Bacteria	Negative
	OECD 473 <i>In vitro</i> Mammalian Chromosomal Aberration Test	Experiment: In vitro Subject: Mammalian-Animal	Negative
	OECD 476 <i>In vitro</i> Mammalian Cell Gene Mutation Test	Experiment: In vitro Subject: Mammalian-Human	Negative

Carcinogenicity

Not available.

Conclusion/Summary : No carcinogenic effect.

Reproductive toxicity

Not available.

Conclusion/Summary : Not considered to be toxic to the reproductive system.

Teratogenicity

Product/ingredient name	Result	Species	Dose	Exposure
Tall oil	Negative - Oral	Rat	-	-

Conclusion/Summary : No teratogenic effect.



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Section 11. Toxicological information

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Routes of entry anticipated: Oral, Dermal, Inhalation.

Potential acute health effects

- Eye contact** : No known significant effects or critical hazards.
- Inhalation** : No known significant effects or critical hazards.
- Skin contact** : No known significant effects or critical hazards.
- Ingestion** : No known significant effects or critical hazards.

Symptoms related to the physical, chemical and toxicological characteristics

- Eye contact** : No specific data.
- Inhalation** : No specific data.
- Skin contact** : No specific data.
- Ingestion** : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

- Potential immediate effects** : Not available.
- Potential delayed effects** : Not available.

Long term exposure

- Potential immediate effects** : Not available.
- Potential delayed effects** : Not available.

Potential chronic health effects

Product/ingredient name	Result	Species	Dose	Exposure
Tall oil	Chronic NOAEL Oral	Rat	>200 mg/kg	-
	Chronic NOAEL Dermal	Rat	>50 mg/kg	-

- General** : No known significant effects or critical hazards.
- Carcinogenicity** : No known significant effects or critical hazards.
- Mutagenicity** : No known significant effects or critical hazards.
- Teratogenicity** : No known significant effects or critical hazards.
- Developmental effects** : No known significant effects or critical hazards.
- Fertility effects** : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates



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Section 11. Toxicological information

Route	ATE value
Oral	66000 mg/kg
Dermal	2500 mg/kg

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
Tall oil	EC50 3300 mg/l Fresh water	Algae - <i>Desmodesmus subspicatus</i>	72 hours
	Acute EC50 5000 to 10000 mg/l Fresh water	Daphnia - <i>Daphnia magna</i>	48 hours
	Acute LC50 >100 mg/l Fresh water	Fish - <i>Danio rerio</i>	96 hours

Persistence and degradability

Product/ingredient name	Test	Result	Dose	Inoculum
Tall oil	OECD 301F Ready Biodegradability - Manometric Respirometry Test	73.2 % - Readily - 28 days	-	-

Product/ingredient name	Aquatic half-life	Photolysis	Biodegradability
Tall oil	-	-	Readily

Bioaccumulative potential

Product/ingredient name	LogP _{ow}	BCF	Potential
Tall oil	3.2 to 6.8	-	high

Mobility in soil

Soil/water partition coefficient (K_{oc}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and

Section 13. Disposal considerations

sewers.

Section 14. Transport information

	DOT Classification	IMDG	IATA
UN number	Not regulated.	Not regulated.	Not regulated.
UN proper shipping name	-	-	-
Transport hazard class(es)	-	-	-
Packing group	-	-	-
Environmental hazards	No.	No.	No.
Additional information	-	-	-

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption:** Not determined
United States inventory (TSCA 8b): This material is listed or exempted.

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.



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Section 15. Regulatory information

SARA 311/312

Classification : Not applicable.

Composition/information on ingredients

No products were found.

State regulations

Massachusetts : This material is not listed.

New York : This material is not listed.

New Jersey : This material is not listed.

Pennsylvania : This material is not listed.

California Prop. 65

This product does not require a Safe Harbor warning under California Prop. 65.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

International lists

National inventory

Australia : This material is listed or exempted.

Canada : This material is listed or exempted.

China : This material is listed or exempted.

Japan : **Japan inventory (ENCS)**: This material is listed or exempted.
Japan inventory (ISHL): This material is listed or exempted.

New Zealand : This material is listed or exempted.

Philippines : This material is listed or exempted.

Republic of Korea : This material is listed or exempted.

Taiwan : This material is listed or exempted.

United States : This material is listed or exempted.

Section 16. Other information

Hazardous Material Information System (U.S.A.)

Health	/	1
Flammability		1
Physical hazards		0



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Section 16. Other information

Caution: HMIS® ratings (4th Edition) are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

History

Date of printing : 2019-12-19 .
Date of issue/Date of revision : 2019-12-19
Date of previous issue : 2019-12-19.
Version : 5

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

☑ Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Appendix 2. Methylated Soybean Oil (SoyGold 1000) Safety Data Sheet



Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 05/08/2015

Reviewed on 05/08/2015

* 1 Identification

- **Product identifier**
- **Trade name:** SOYGOLD® 1000
- **CAS Number:**
67784-80-9
- **Relevant identified uses of the substance or mixture and uses advised against**
No further relevant information available.
- **Product description** Solvent
- **Details of the supplier of the safety data sheet**
- **Manufacturer/Supplier:**
Ag Processing Inc
12700 West Dodge Rd.
Omaha, NE 68154
Phone: 402-496-7809
- **Emergency telephone number:** 402-431-5027

* 2 Hazard(s) identification

- **Classification of the substance or mixture**



GHS07

Skin Irrit. 2 H315 Causes skin irritation.

Eye Irrit. 2B H320 Causes eye irritation.

- **Label elements**
- **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
- **Hazard pictograms**



GHS07

- **Signal word** Warning
- **Hazard statements**
May cause skin and eye irritation.
- **Precautionary statements**
Wear protective gloves and safety glasses as needed.
Wash thoroughly after handling.
If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Specific treatment (see supplementary first aid instructions on this Safety Data Sheet).
If skin irritation occurs: Get medical advice/attention.
If eye irritation persists: Get medical advice/attention.
If on skin: Wash with plenty of water.
Take off contaminated clothing and wash it before reuse.
- **Unknown acute toxicity:**
100 percent of the mixture consists of ingredient(s) of unknown toxicity.

(Contd. on page 2)



Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 05/08/2015

Reviewed on 05/08/2015

Trade name: SOYGOLD® 1000

- **Classification system:**
- **NFPA ratings (scale 0 - 4)**



- **HMIS-ratings (scale 0 - 4)**



- **Hazard(s) not otherwise classified (HNOC):** None known

* [Redacted]

- **Chemical characterization: Substances**
- **CAS No. Description**
67784-80-9 Methyl ester, soybean oil

* [Redacted]

- **Description of first aid measures**
- **After inhalation:** Not a normal route of entry.
- **After skin contact:** If irritation occurs, wash area with soap and water.
- **After eye contact:**
Rinse opened eye for at least 15 minutes under running water. If symptoms persist, consult a doctor.
- **After swallowing:** Call a doctor if irritation or symptoms develop.
- **Information for doctor:**
- **Most important symptoms and effects, both acute and delayed:** No further relevant information available.
- **Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

* [Redacted]

- **Extinguishing media**
- **Suitable extinguishing agents:** Use fire fighting measures that suit the environment.
- **Special hazards arising from the substance or mixture**
Rags soaked with any solvent present a fire hazard and should always be stored in UL listed or Factory Mutual approved covered containers. Improperly stored rags can create conditions that lead to oxidation. Oxidation, under certain conditions, can lead to spontaneous combustion.
- **Advice for firefighters** Treat as an oil fire.
- **Protective equipment:**
As in any fire, wear self-contained breathing apparatus pressure-demand (NIOSH approved or equivalent), and full protective gear to prevent contact with skin and eyes.

* [Redacted]

- **Personal precautions, protective equipment and emergency procedures**
Wear protective equipment. Keep unprotected persons away.
- **Environmental precautions:**
Do not allow to enter sewers/ surface or ground water.
Inform respective authorities in case of seepage into water course or sewage system.
- **Methods and material for containment and cleaning up:**
Absorb with liquid-binding material (ie. sand, diatomite, acid binders, universal binders, sawdust).

(Contd. on page 3)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 05/08/2015

Reviewed on 05/08/2015

Trade name: SOYGOLD® 1000

- Ensure adequate ventilation.
- Dispose of the collected material according to regulations.
- **Reference to other sections**
 - See Section 7 for information on safe handling.
 - See Section 8 for information on personal protection equipment.
 - See Section 13 for disposal information.

* 7 Handling and storage

- **Handling:**
- **Precautions for safe handling**
 - Ensure good ventilation/exhaustion at the workplace.
 - Prevent formation of aerosols.
- **Information about protection against explosions and fires:** No special measures required.
- **Conditions for safe storage, including any incompatibilities**
- **Storage:**
- **Requirements to be met by storerooms and receptacles:**
 - Store in a cool, dry, well ventilated area away from direct sunlight and any incompatible materials (see section 10).
- **Information about storage in one common storage facility:** Not required.
- **Further information about storage conditions:** Keep receptacle tightly sealed.
- **Specific end use(s)** No further relevant information available.

* 8 Exposure controls/personal protection

- **Additional information about design of technical systems:** No further data; see section 7.
- **Control parameters**
- **Components with occupational exposure limits:**
- **Additional information:** The lists that were valid during the creation of this SDS were used as basis.
- **Exposure controls**
- **Personal protective equipment:**
- **General protective and hygienic measures:**
 - The usual precautionary measures for handling chemicals should be followed.
 - Keep away from foodstuffs, beverages and feed.
 - Immediately remove all soiled and contaminated clothing and wash before reuse.
 - Wash hands before breaks and at the end of work.
 - Avoid contact with the eyes and skin.
- **Breathing equipment:** Not required.
- **Protection of hands:**



Protective gloves

- The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
- Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
- Select glove material based on penetration times, rates of diffusion and degradation.
- **Material of gloves**
 - The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer.

(Contd. on page 4)



Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 05/08/2015

Reviewed on 05/08/2015

Trade name: SOYGOLD® 1000

· **Penetration time of glove material**

The exact break-through time has to be determined and observed by the manufacturer of the protective gloves.

· **Eye protection:**



Safety glasses

* 9 Physical and chemical properties

· **Information on basic physical and chemical properties**

· **General Information**

· **Appearance:**

Form: Liquid
Color: Light yellow
Odor: Light vegetable oil
Odor threshold: Not determined.

· **pH-value:** 6.5-7

· **Change in condition**

Melting point/Melting range: Not determined.
Boiling point/Boiling range: 351 °C (664 °F) (@760 mm Hg)

· **Flash point:** >130 °C (>266 °F) (PPMC)

· **Flammability (solid, gaseous):** Not applicable.

· **Ignition temperature:**

Decomposition temperature: Not determined.

· **Auto igniting:** Not determined.

· **Danger of explosion:** Product does not present an explosion hazard.

· **Explosion limits:**

Lower: Not determined.
Upper: Not determined.

· **Vapor pressure:** 0.38 psi (2.6 kPa)

· **Density @ 20 °C (68 °F):** 0.88 g/ml

· **Relative density** Not determined.

· **Vapor density** Not determined.

· **Evaporation rate** Not determined.

· **Solubility in / Miscibility with**

Water: Insoluble.

· **Partition coefficient (n-octanol/water):** Not determined.

· **Viscosity:**

Dynamic: Not determined.

Kinematic: Not determined.

· **Other information** No further relevant information available.

(Contd. on page 5)



Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 05/08/2015

Reviewed on 05/08/2015

Trade name: SOYGOLD® 1000

* 10 Stability and reactivity

- **Reactivity** No further relevant information available.
- **Chemical stability** Stable under normal conditions.
- **Thermal decomposition / conditions to be avoided:**
Thermal decomposition will produce toxic oxides of carbon.
- **Possibility of hazardous reactions** No dangerous reactions known.
- **Conditions to avoid** Strong oxidizers, acids and alkalis.
- **Incompatible materials:** Strong oxidizers, acids and alkalis.
- **Hazardous decomposition products:** Oxides of carbon (COx)

* 11 Toxicological information

- **Information on toxicological effects**
- **Acute toxicity:**
- **Primary irritant effect:**
- **on the skin:** May be irritating.
- **on the eye:** May be irritating.
- **Additional toxicological information:**
- **Carcinogenic categories**
- **IARC (International Agency for Research on Cancer)** Substance is not listed.

· **NTP (National Toxicology Program)**

Substance is not listed.

· **OSHA-Ca (Occupational Safety & Health Administration)**

Substance is not listed.

* 12 Ecological information

- **Toxicity**
- **Aquatic toxicity:** No further relevant information available.
- **Persistence and degradability** No further relevant information available.
- **Behavior in environmental systems:**
- **Bioaccumulative potential** No further relevant information available.
- **Mobility in soil** No further relevant information available.
- **Additional ecological information:**
- **General notes:** Not known to be hazardous to water.
- **Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.
- **Other adverse effects** No further relevant information available.

* 13 Disposal considerations

- **Waste treatment methods**
- **Recommendation:**
Must not be disposed of together with household garbage. Do not allow product to reach sewage system.
- **Uncleaned packagings:**
- **Recommendation:** Disposal must be made according to official regulations.

(Contd. on page 6)



Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 05/08/2015

Reviewed on 05/08/2015

Trade name: SOYGOLD® 1000

* 14 Transport information

· UN-Number	
· DOT, ADR, ADN, IMDG, IATA	Non-Regulated Material
· UN proper shipping name	
· DOT, ADR, ADN, IMDG, IATA	Non-Regulated Material
· Transport hazard class(es)	
· DOT, ADR, ADN, IMDG, IATA	
· Class	Non-Regulated Material
· Packing group	
· DOT, ADR, IMDG, IATA	Non-Regulated Material
· Environmental hazards:	Not applicable.
· Special precautions for user	Not applicable.
· Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code	Not applicable.
· UN "Model Regulation":	-

* 15 Regulatory information

- **Safety, health and environmental regulations/legislation specific for the substance or mixture**
- **Sara**

· **Section 355 (extremely hazardous substances):**

Substance is not listed.

· **Section 313 (Specific toxic chemical listings):**

Substance is not listed.

· **TSCA (Toxic Substances Control Act):**

Substance is listed.

· **California Proposition 65**

· **Chemicals known to cause cancer:**

Substance is not listed.

· **Chemicals known to cause reproductive toxicity for females:**

Substance is not listed.

· **Chemicals known to cause reproductive toxicity for males:**

Substance is not listed.

· **Chemicals known to cause developmental toxicity:**

Substance is not listed.

· **Carcinogenic categories**

· **EPA (Environmental Protection Agency)**

Substance is not listed.

· **TLV (Threshold Limit Value established by ACGIH)**

Substance is not listed.

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**

Substance is not listed.

· **GHS label elements**

The substance is classified and labeled according to the Globally Harmonized System (GHS).

(Contd. on page 7)



Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 05/08/2015

Reviewed on 05/08/2015

Trade name: SOYGOLD® 1000

· **Hazard pictograms**



GHS07

· **Signal word** Warning

· **Hazard statements**

May cause skin and eye irritation.

· **Precautionary statements**

Wear protective gloves and safety glasses as needed.

Wash thoroughly after handling.

If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Specific treatment (see supplementary first aid instructions on this Safety Data Sheet).

If skin irritation occurs: Get medical advice/attention.

If eye irritation persists: Get medical advice/attention.

If on skin: Wash with plenty of water.

Take off contaminated clothing and wash it before reuse.

· **National regulations:**

Non-Regulated Material

· **State Right to Know**

67784-80-9	Methyl ester, soybean oil	Skin Irrit. 2, H315; Eye Irrit. 2B, H320	100%
------------	---------------------------	--	------

None of the ingredients are listed

· **Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

16 Other information

The information and recommendations in this safety data sheet are, to the best of our knowledge, accurate as of the date of issue. Nothing herein shall be deemed to create warranty, expressed or implied and shall not establish a legally valid contractual relationship. It is the responsibility of the user to determine applicability of this information and the suitability of the material or product for any particular purpose.

· **Date of preparation / last revision** 05/08/2015 / 5

· **Abbreviations and acronyms:**

ADR: The European Agreement concerning the International Carriage of Dangerous Goods by Road

ADN: The European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways

IMDG: International Maritime Code for Dangerous Goods

DOT: US Department of Transportation

IATA: International Air Transport Association

ACGIH: American Conference of Governmental Industrial Hygienists

CAS: Chemical Abstracts Service (division of the American Chemical Society)

NFPA: National Fire Protection Association (USA)

HMIS: Hazardous Materials Identification System (USA)

Skin Irrit. 2: Skin corrosion/irritation, Hazard Category 2

Eye Irrit. 2B: Serious eye damage/eye irritation, Hazard Category 2B

· *** Data compared to the previous version altered.**

SDS created by MSDS Authoring Services www.msdsauthoring.com (877) 204-9106

Appendix 3. *n*-Butyl lactate (Corbion Purasolv BL) Safety Data Sheet



SAFETY DATA SHEET

n-Butyl-(S)-Lactate, PURASOLV® BL

REVISION DATE 07/05/07
REF. SD0340/2007-01

1. IDENTIFICATION OF THE SUBSTANCE / PREPARATION AND THE COMPANY / UNDERTAKING

Product name n-Butyl-(S)-Lactate, PURASOLV® BL
Supplier PURAC bioquímica
Gran Vial 19 -25
08160 Montmeló-Barcelona
Spain
Telephone ++34 93 568 6300
Fax ++34 93 568 3955
Emergency telephone ++34 93 568 6300 (Ext 222)

2. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical name of the substance n-Butyl-S-(-)-2-Hydroxy Propionate
Synonyms Lactic Acid n-Butyl Ester n-Butyl Lactate
n-Butyl-S-(-)- Lactate
CAS-No. 34451-19-9 **EC No.** 252-036-3 **RTECS No.** OD4025000

3. HAZARDS IDENTIFICATION

Most important hazards Risk of serious damage to eyes.
Irritating to eyes and skin.
Specific hazards May degrease the skin.
Effects of skin contacts may include erythema.

4. FIRST AID MEASURES

General advice Show this safety data sheet to the doctor in attendance.
Inhalation Move to fresh air.
Skin contact Wash off immediately with plenty of water.
Eye contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.
Ingestion Induce vomiting if person is conscious. Consult a physician.
Major effects of exposure Inhalation of vapors is irritating to the respiratory system, and may cause coughing. Irritating to eyes. May degrease the skin.
Protection of firstaiders Wear tightly fitting safety goggles. Do not breathe fumes

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SAFETY DATA SHEET

n-Butyl-(S)-Lactate, PURASOLV® BL

REVISION DATE 07/05/07
REF. SD0340/2007-01

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media Water spray, carbon dioxide (CO₂), dry powder, AFFF, foam.
Extinguishing media which must not be used for safety reasons None.
Specific hazards Burning produces irritant fumes.
Special protective equipment for firefighters Use personal protective equipment.
Specific methods Standard procedure for chemical fires.
Cool containers / tanks with water spray.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions Remove all sources of ignition. Wear tightly fitting safety goggles.
Environmental precautions No special environmental precautions required.
Methods for cleaning up Soak up with inert absorbent material (e.g. sand, silica gel, universal binder, sawdust). Shovel into suitable container for disposal. After cleaning, flush away traces with water.

7. HANDLING AND STORAGE

Handling Technical measures/ Precautions Safe handling advice Remove all sources of ignition. Avoid temperatures above 140°F (60°C). Wear tightly fitting safety goggles. Handle in accordance with good industrial hygiene and safety practice.
Storage Technical measures/ Storage conditions Keep container tightly closed. In order to prevent oxidation, the product is supplied under a nitrogen or argon blanket. After opening the packaging, it is recommended to use or store the product under inert conditions (e.g. nitrogen or argon).
Packaging material High density polyethylene containers.

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SAFETY DATA SHEET

n-Butyl-(S)-Lactate, PURASOLV® BL

REVISION DATE 07/05/07
REF. SD0340/2007-01

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering measures to reduce exposure	Insure adequate ventilation, especially in confined areas.
Control parameters	TLV max. 25 mg/m ³ (5 ppm)
Personal protection equipment	
Respiratory protection	In case of insufficient ventilation wear suitable respiratory equipment.
Hand protection	Solvent-resistant gloves (PVA / H4).
Eye protection	Tightly fitting safety goggles.
Skin and body protection	Solvent-resistant apron.
Hygiene measures	When using, do not eat, drink or smoke. Remove and wash contaminated clothing before re-use.

9. PHYSICAL AND CHEMICAL PROPERTIES

Form	liquid
Color	colorless / light yellow
Odor	mild, characteristic
Odor Threshold	0.095mg/m ³
pH	not applicable
Molecular Weight	146.2
Boiling point/range	372.2°F (189°C)
Melting point/range	5°F (-15°C)
Decomposition temperature	>372.2°F (>189°C)
Autoignition temperature	716°F (380°C)
Flash point	174.2°F (79°C) (Tested according to: ISO 3679, closed cup)
Explosion limits	- lower: 1.0% @ 212°F (100°C); - upper: 7.9% @ 302°F (150°C)
Density	964 kg/m ³ @ 68°F (20°C)
Vapor density	5.0 (Air = 1)
Vapor pressure	0.3 mbar @ 68°F (20°C), 50 mbar @ 212°F (100°C)
Solubility	Water solubility:partly miscible Partition coefficient (n-octanol/water) log Pow = 1.10
Viscosity	3.9 mPa.S @ 77°F (25°C)
Surface Tension	29.5 mN/m @ 77°F (25°C)

10. STABILITY AND REACTIVITY

Stability	Stable at normal conditions. Hydrolyses in presence of water, acids, bases.
Conditions to avoid	Avoid temperatures above 174.2°F (79°C).
Materials to avoid	None.
Hazardous decomposition products	Carbon oxides.

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SAFETY DATA SHEET

n-Butyl-(S)-Lactate, PURASOLV® BL

REVISION DATE 07/05/07
REF. SD0340/2007-01

11. TOXICOLOGICAL INFORMATION

Acute toxicity	LD50/oral/rat > 5000 mg/kg LC50/inhalation//rat > 5140 mg/m ³
Local effects	Irritating to eyes and skin. Risk of serious damage to eyes. High concentration of vapors may cause irritation to respiratory system and produce narcotic effects.
Specific effects	Based on tests with L-lactic acid and its esters, there is no evidence to suggest carcinogenic nor mutagenic properties from lactic acid itself nor from the lactate portion of its esters.
Long term toxicity	Repeated or prolonged exposure may cause irritation of eyes and skin.
Further information	Lactate esters are readily hydrolyzed in vivo.

12. ECOLOGICAL INFORMATION

Mobility	Partly miscible in water.
Persistence / degradability	Readily biodegradable. Biochemical oxygen demand (BOD) ₅ = 0.76 mg O ₂ / mg Chemical oxygen demand (COD) = 1.97 mg O ₂ /mg
Bioaccumulation	Unlikely, hydrolyses in presence of: water, acids, bases.
Ecotoxicity	EC50/48h/Daphnia = 423mg/l LC50/48h/Fish = 75 mg/l EC50/Algae = 0.93 g/l

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products	Subject to disposal regulations US EPA 40 CFR 2 62.
Contaminated packaging	Clean container with water. Empty containers should be taken for local recycling, recovery or waste disposal.

14. TRANSPORT INFORMATION

Not classified as dangerous in the meaning of European transport regulations.

US DOT Combustible Liquid

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SAFETY DATA SHEET

n-Butyl-(S)-Lactate, PURASOLV® BL

REVISION DATE 07/05/07
REF. SD0340/2007-01

15. REGULATORY INFORMATION

US Regulations	TSCA Inventory Status: Y SARA III: N California Proposition 65:N Carcinogen status: OSHA: N. NTP: N, IARC: N FDA: GRAS as flavor Massachusetts Substances List: Y Pennsylvania Right to Know List: Y Toxic Substances List of Illinois Dept. of Labor: Y
EU Status	According to National equivalent of EC-Dir. 67/548, as amended, the product is labeled as follows:
Symbol	Xi - Irritant
R- Phrases	R41 - Risk of serious damage to eyes. R38 - Irritating to skin.
S-Phrases	S24 - Avoid contact with skin. S26 - In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S37/39 - Wear suitable gloves and eye/face protection.

16. OTHER INFORMATION

NFPA Ratings (Scale 0-4): 1(health)-1(flammability)-0(reactivity)
HMIS Rating: 1(health)-2(flammability)-0(reactivity)-B(protective equipment)

CAS-No. 138-22-7 (general) **EC-No.** 205-316-4 (general)

For further information on the safety assessment of lactic acid esters, see the paper titled: Safety Assessment of Lactate Esters, published in Regulatory Toxicology and Pharmacology, 27, 88-97, 1998.

Additional data on the calculated ecotoxicity of lactic acid and its salts and esters can be obtained in a report entitled 'The ecotoxicity and biodegradability of lactic acid, alkyl lactate esters and lactic acid salts' by Bowmer et al. (Reference: Chemosphere 37: 1317-1333 (1998)).

Indicates updated section.

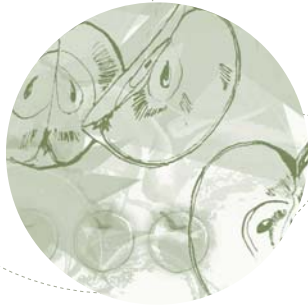
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Appendix 4. *n*-Butyl lactate (Corbion Purasolv BL) OMRI Certificate



OMRI Listed®

The following product is OMRI Listed. It may be used in certified organic production or food processing and handling according to the USDA National Organic Program regulations.

Product

Corbion Purasolv BL

Company

Corbion
Corporate Communications
P.O. Box 21
Gorinchem Zuid-Holland 4200 AA Netherlands

Status

Allowed with Restrictions

Category

NOP: Adjuvants, for use in pesticides

Issue date

02-Oct-2019

Product number

cbn-12847

Class

Crop Management Tools
and Production Aids

Expiration date

01-Dec-2020

Restrictions

For use as an inert ingredient in combination with permitted active pesticidal ingredients.

Executive Director/CEO

Product review is conducted according to the policies in the current *OMRI Policy Manual*® and based on the standards in the current *OMRI Standards Manual*®. To verify the current status of this or any OMRI Listed product, view the most current version of the *OMRI Products List*® at OMRI.org. OMRI listing is not equivalent to organic certification and is not a product endorsement. It cannot be construed as such. Final decisions on the acceptability of a product for use in a certified organic system are the responsibility of a USDA accredited certification agent. It is the operator's responsibility to properly use the product, including following any restrictions.



Organic Materials Review Institute
P.O. Box 11558, Eugene, OR 97440-3758, USA
541.343.7600 · info@omri.org · OMRI.org

Appendix 5. Polyterpene (ALTASTICK R) Safety Data Sheet



SAFETY DATA SHEET

ALTASTICK R

Section 1. Identification

GHS product identifier : ALTASTICK R
Other means of identification : Not available.
Code : ALTASTICK_RFR1
Material uses : Sticker/Adjuvant
Supplier's details : **Ingevity Corporation**
5255 Virginia Avenue
North Charleston
South Carolina USA
29406-3615

www.ingevity.com
email: sds@ingevity.com

Tel: +1 843 740 2300, +1 800 458 4034
(0800 - 1700 EST)



In case of emergency : +1 800 424 9300 (USA) CHEMTREC

Section 2. Hazards identification

OSHA/HCS status : While this material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200), this SDS contains valuable information critical to the safe handling and proper use of the product. This SDS should be retained and available for employees and other users of this product.

Classification of the substance or mixture : Not classified.

GHS label elements

Signal word : No signal word.
Hazard statements : No known significant effects or critical hazards.

Precautionary statements

Prevention : Not applicable.
Response : Not applicable.
Storage : Not applicable.
Disposal : Not applicable.

Hazards not otherwise classified : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Ingredient name	%	CAS number
Terpene resin	100	Proprietary

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health and hence require reporting in this section.



ALTASTICK R

Section 3. Composition/information on ingredients

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

- Eye contact** : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Get medical attention if irritation occurs.
- Inhalation** : Remove victim to fresh air and keep at rest in a position comfortable for breathing. Get medical attention if symptoms occur.
- Skin contact** : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.
- Ingestion** : Wash out mouth with water. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Do not induce vomiting unless directed to do so by medical personnel. Get medical attention if symptoms occur.

Most important symptoms/effects, acute and delayed

Potential acute health effects

- Eye contact** : No known significant effects or critical hazards.
- Inhalation** : No known significant effects or critical hazards.
- Skin contact** : No known significant effects or critical hazards.
- Ingestion** : No known significant effects or critical hazards.

Over-exposure signs/symptoms

- Eye contact** : No specific data.
- Inhalation** : No specific data.
- Skin contact** : No specific data.
- Ingestion** : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

- Notes to physician** : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.
- Specific treatments** : No specific treatment.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

- Suitable extinguishing media** : Use an extinguishing agent suitable for the surrounding fire.
- Unsuitable extinguishing media** : None known.

- Specific hazards arising from the chemical** : In a fire or if heated, a pressure increase will occur and the container may burst.

Section 5. Fire-fighting measures

- Hazardous thermal decomposition products** : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
- Special protective actions for fire-fighters** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.
- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.
- Remark** : Keep away from sources of ignition.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

- For non-emergency personnel** : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Put on appropriate personal protective equipment.
- For emergency responders** : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

- Environmental precautions** : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

- Small spill** : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.
- Large spill** : Stop leak if without risk. Move containers from spill area. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

- Protective measures** : Put on appropriate personal protective equipment (see Section 8).
- Advice on general occupational hygiene** : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.



ALTASTICK R

Section 7. Handling and storage

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

None.

Appropriate engineering controls : Good general ventilation should be sufficient to control worker exposure to airborne contaminants.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use.



ALTASTICK R

Section 9. Physical and chemical properties

Appearance

Physical state	: Liquid.
Color	: Yellow.
Odor	: Odorless.
Odor threshold	: Not available.
pH	: Not applicable.
Melting point	: -6°C (21.2°F)
Boiling point	: >200°C (>392°F)
Flash point	: Closed cup: 117°C (242.6°F)
Burning time	: Not applicable.
Burning rate	: Not applicable.
Evaporation rate	: Not available.
Flammability (solid, gas)	: Keep away from sources of ignition.
Lower and upper explosive (flammable) limits	: Not available.
Vapor pressure	: Not available.
Vapor density	: Not available.
Relative density	: 0.9519 [Water = 1]
Solubility	: Insoluble in the following materials: cold water and hot water.
Solubility in water	: Not available.
Partition coefficient: n-octanol/water	: Not available.
Auto-ignition temperature	: Not available.
Decomposition temperature	: Not available.
SADT	: Not available.
Viscosity	: Dynamic (room temperature): 2035 mPa·s (2035 cP)

Aerosol product

Section 10. Stability and reactivity

Reactivity	: No specific test data related to reactivity available for this product or its ingredients.
Chemical stability	: The product is stable.
Possibility of hazardous reactions	: Under normal conditions of storage and use, hazardous reactions will not occur.
Conditions to avoid	: No specific data.
Incompatible materials	: Reactive or incompatible with the following materials: oxidizing materials, reducing materials and acids.
Hazardous decomposition products	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : No known significant effects or critical hazards.
Inhalation : No known significant effects or critical hazards.
Skin contact : No known significant effects or critical hazards.
Ingestion : No known significant effects or critical hazards.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.
Inhalation : No specific data.
Skin contact : No specific data.
Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.



ALTAStICK R

Section 11. Toxicological information

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Not available.

Mobility in soil

Soil/water partition coefficient (K_{oc}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and



ALTAStick R

Section 13. Disposal considerations

sewers.

Section 14. Transport information

	DOT Classification	IMDG	IATA
UN number	Not regulated.	Not regulated.	Not regulated.
UN proper shipping name	-	-	-
Transport hazard class(es)	-	-	-
Packing group	-	-	-
Environmental hazards	No.	No.	No.
Additional information	-	-	-

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption:** This material is listed or exempted.
United States inventory (TSCA 8b): This material is listed or exempted.

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

Section 15. Regulatory information

SARA 311/312

Classification : Not applicable.

Composition/information on ingredients

No products were found.

State regulations

Massachusetts : This material is not listed.

New York : This material is not listed.

New Jersey : This material is not listed.

Pennsylvania : This material is not listed.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

International lists

National inventory

Australia : This material is listed or exempted.

Canada : This material is listed or exempted.

China : This material is listed or exempted.

Japan : **Japan inventory (ENCS):** Not determined.
Japan inventory (ISHL): Not determined.

New Zealand : This material is listed or exempted.

Philippines : This material is listed or exempted.

Republic of Korea : This material is listed or exempted.

Taiwan : This material is listed or exempted.

United States : This material is listed or exempted.

Section 16. Other information

Hazardous Material Information System (U.S.A.)

Health	/	0
Flammability		0
Physical hazards		0



Section 16. Other information

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

History

Date of printing : 2018-08-30 .
Date of issue/Date of revision : 2018-08-30
Date of previous issue : 2018-08-02 .
Version : 1.06

Key to abbreviations

: ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References

: Not available.

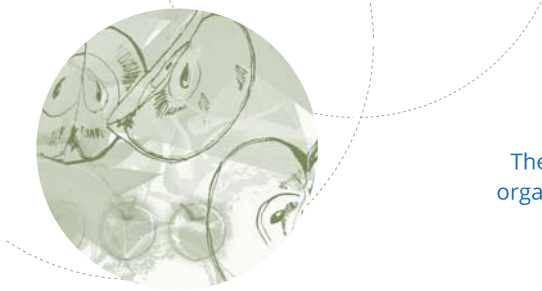
▣ Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Appendix 6. Polyterpene (ALTASTICK R) OMRI Certificate



OMRI Listed®

The following product is OMRI Listed. It may be used in certified organic production or food processing and handling according to the USDA National Organic Program regulations.

Product

Ingevity Altastick R (US) Terpene Resin

Company

Ingevity
Mariola Kopcinski
5255 Virginia Ave
North Charleston South Carolina 29406 United States

Status

Allowed with Restrictions

Category

NOP: Adjuvants, for use in pesticides

Issue date

17-Apr-2018

Product number

igv-10668

Class

Crop Management Tools
and Production Aids

Expiration date

1-Jun-2021

Restrictions

For use as an inert ingredient in combination with permitted active pesticidal ingredients.

Executive Director/CEO

Product review is conducted according to the policies in the current *OMRI Policy Manual*® and based on the standards in the current *OMRI Standards Manual*®. To verify the current status of this or any OMRI Listed product, view the most current version of the *OMRI Products List*® at OMRI.org. OMRI listing is not equivalent to organic certification and is not a product endorsement. It cannot be construed as such. Final decisions on the acceptability of a product for use in a certified organic system are the responsibility of a USDA accredited certification agent. It is the operator's responsibility to properly use the product, including following any restrictions.



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Appendix 7. Polyterpene (Nu Film P) Safety Data Sheet



CHEMICAL & FERTILIZER, LLC

Safety Data Sheet

Section 1 – Chemical Product and Company Identification

Product Name: Nu Film P®

Chemical Name: Adjuvant

Common Name, Synonym: Mixture of Terpene polymers and emulsifiers

Material Uses: Agricultural Adjuvant

Manufacturer/Manufactured For: Miller Chemical and Fertilizer, LLC

Phone: (717) 632-8921 FAX: (717) 646-1104 CHEMTREC: (800) 424-9300

Section 2 – Hazard Identification

2.1 Classification of the substance or mixture

GHS Classification (29 CFR 1910.1200)

Not a hazardous substance or mixture according to 29 CFR 1910.1200 (OSHA HCS)

2.2 Label elements

GHS Labeling Elements

Pictogram: Not Applicable

Signal Word: Not applicable

Hazard Statements: Not applicable

Precautionary Statements: Not Applicable

Section 3 – Composition/Information of Ingredients

Ingredient Name	CAS Number	%
This product has been tested as a whole to determine its hazard – see section 11		100

Section 4 – First Aid Measures

EYE CONTACT

Immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart to ensure flushing of entire surface. Call a physician.

SKIN CONTACT



Product Name: Nu Film P®

Immediately flush skin with plenty of water for at least 15 minutes, while removing contaminated clothing and shoes. Thoroughly clean clothing and shoes before reuse. Call a physician.

INHALATION

Remove to fresh air. If not breathing give artificial respiration, preferably mouth to mouth. If breathing is difficult give oxygen. Call a physician.

INGESTION

If swallowed, DO NOT induce vomiting. Rinse mouth with water. Dilute stomach contents by drinking water. If vomiting occurs spontaneously, keep head below hips to prevent breathing vomit into lungs. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. Call a physician immediately!

Section 5 – Fire-Fighting Measures

Flash Point (METHOD):	> 100°C
Auto-Ignition:	Not Available
Flammable Limits:	Not Available
Extinguishing Media:	Dry chemical, carbon dioxide (CO ₂), water spray or Sand/Earth
Special Fire Fighting Procedures:	None currently known.
Unusual Fire and Explosion Hazards:	Generates CO ₂ , CO and smoke. Combustion products may be toxic

Section 6 – Accidental Release Measures

Personal precautions

Evacuate non-essential personnel, eliminate ignition sources, and wear protective equipment (See Section VIII). Shut off source of leak only if safe to do so. Wear respiratory equipment if exposure limits are exceeded.

Contain spill

Shut off leak if safe to do so. Dike area, recover and reclaim material if possible. This material should be prevented from contaminating soil or from entering sewage and drainage systems and bodies of water. Absorb the liquid on material such as sand, vermiculite, or other inert, noncombustible absorbent and place in a clean, dry container suitable for disposal. Containers should be closed and segregated for later disposal. Scrub the area with detergent and water.

Section 6 – Accidental Release Measures *continued*

Disposal Method

Solids must be disposed of in a permitted waste management facility. Recovered liquids may be reprocessed or incinerated. Incineration must be handled in a permitted facility. Dispose of material in accordance with all Federal, State and Local regulations. Local regulations may be more stringent than Federal or State.



Product Name: Nu Film P®

Section 7 – Handling and Storage

- Handling:** Wear protective equipment when handling. Wash thoroughly after handling. Do not get in eyes. Do not breathe vapor, mist, or dust. Avoid prolonged or repeated contact with skin. Do not swallow.
- Storage:** For industrial use only. Keep container closed when not in use. Store at temperatures between 41°F and 104°F (5°C and 40°C) and in well-ventilated areas away from heat or flame. Keep out of reach of children.

Section 8 – Exposure Controls/Personal Protection

- Engineering Controls:
Mechanical: General ventilation is usually adequate.
- Respiratory Protection:** If exposure limits are exceeded, or if exposure may occur, use a NIOSHA/MSHA respirator approved for your conditions of exposure. Refer to the most recent NIOSHA publications concerning chemical hazards, or consult your safety equipment supplier. Respiratory protection programs must be in compliance with OSHA requirements in 29 CFR 1910.134. For emergencies, a NIOSHA/MSHA approved positive pressure-breathing apparatus should be readily available.
- Eye Protection:** Chemical goggles or face shield. Always wear eye protection when working with chemicals. Never wear contact lenses when working with chemicals.
- Skin Protection:** Rubber gloves. Clean protective body covering, rubber apron, and rubber boots.
- Work Hygienic Practices:** Avoid contact with skin, eyes, and clothing. After handling this product, wash hands before eating, drinking or smoking. If contact occurs, remove contaminated clothing. If needed, take First Aid action shown in Section IV. Launder contaminated clothing before use.
- Other Protective Equipment:** Safety shower, eye wash fountain, and washing facilities should be readily available.

Section 9 – Physical and Chemical Properties

- Appearance:** Red – Reddish Amber liquid
- Odor:** Moderate Terpene
- pH (aqueous approx. 5% in DW):** 6.0 – 7.0 @ 20°C
- Boiling point/Boiling range:** Not Determined
- Freeze Point:** Not Determined



Product Name: Nu Film P®

Flash Point:	> 100°C
Vapor Pressure (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Solubility in Water:	Emulsifies
Density:	7.71 – 7.75 lbs/gal @ 68°F (20°C)
Specific Gravity (H ₂ O=1 @ 4°C):	0.92 - 0.93 g/mL @ 68°F (20°C)
Evaporation Rate (NA=1):	Not Determined
Percent Volatile by Volume:	Not Determined

Section 10 – Stability and Reactivity

Chemical Stability:	Stable
Materials/Conditions to Avoid:	Strong oxidizing agents, excessive heat and sources of ignition.
Hazardous Decomposition or Byproducts:	At high temperatures may release oxides of carbon
Hazardous Polymerization:	Will not occur

Section 11- Toxicological Information

Toxicity Data:

Acute Eye Irritation: May cause irritation
Acute Dermal Effects: LD₅₀ >5050 mg/kg (rabbit); May cause skin irritation.
Acute Oral Effects: LD₅₀ >5050 mg/kg (rat): Large doses may cause nausea, vomiting, and stomach pain or cramps.
Acute Inhalation Effects: LC₅₀ >5260 mg/m³ (rat): May cause slight irritation if mist occurs
Carcinogenicity: None found
Mutagenicity: None found
Teratogenicity: None found
Chronic Effects: Not known

Section 12 – Ecological Information

Ecotoxicity: This product is a spray adjuvant. Large spills could possible damage vegetation. Contamination of waterways could possibly cause fish kills. Prevent spread of runoff into drains, storm sewers, and ditches that lead to waterways.
Aquatic Toxicity: Data not available
Environmental Fate: Data not available



Product Name: Nu Film P®

Section 13 – Disposal Considerations

Disposal:	If uncontaminated, recover and reuse as product. If contaminated with other materials, the nature and extent of contamination may require use of specialized disposal methods. Consult local, county, state, or federal regulatory agencies for acceptable disposal procedures and disposal locations
Disposal Regulatory Requirements:	Consult local, county, state, or federal regulatory agencies for acceptable disposal procedures and disposal locations
Container Cleaning and Disposal:	Consult local, county, state, or federal regulatory agencies for acceptable disposal procedures and disposal locations

Section 14 – Transport Information

U.S. DEPARTMENT OF TRANSPORTATION

PROPER SHIPPING NAME:
PACKING GROUP:
HAZARD CLASS:
LABEL/PLACARD REQUIRED:
UN/NA No.:

WATER TRANSPORTATION

PROPER SHIPPING NAME:
PACKING GROUP:
HAZARD CLASS:
LABEL/PLACARD REQUIRED:
UN/NA No.:

AIR TRANSPORTATION

PROPER SHIPPING NAME:
PACKING GROUP:
HAZARD CLASS:
LABEL/PLACARD REQUIRED:
UN/NA No.:

OTHER AGENCIES:

SECTION 14 NOTES: This product is not considered a hazard



Product Name: Nu Film P®

Section 15 – Regulatory Information

EPA Regulations:

- Reportable Quantity –CERCLA: Not applicable**
- SARA Title III (EPCRA): Not applicable**
- RCRA Waste Code: Not applicable**

State Regulations:

- PA Right to Know: This product contains proprietary ingredients**
This product contains the following chemicals subject to the reporting requirements of Section 13 Title III of the Superfund Amendments and Reauthorization act of 1986 and 40 CFR part 372 (the corresponding CAS numbers and typical percent by weight are also provided): None

CA Proposition 65: Not applicable

EPA National Response Center (800) 424-8802

Section 16 – Other Information

Preparation Date: 09/26/2012

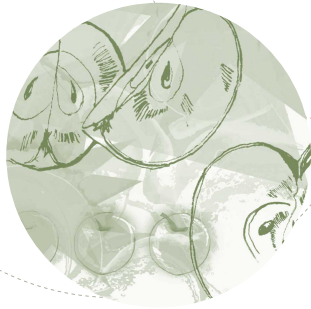
Prepared By: Miller Chemical Compliance Officer

Revision Date: 09/12/2016

Revision Notes: GHS Compliance

NOTICE TO READER: THE INFORMATION CONTAINED IN THIS SAFETY DATA SHEET (“SDS”) RELATES ONLY TO THE SPECIFIC PRODUCT(S) DESIGNATED HEREIN (THE “PRODUCT”). THE INFORMATION AND RECOMMENDATIONS CONTAINED HEREIN ARE BASED UPON DATA BELIEVED TO BE CURRENT AND CORRECT AS OF THE DATE OF THIS SDS, AND OBTAINED FROM SOURCES THAT ARE BELIEVED TO BE RELIABLE. HOWEVER, THIS INFORMATION IS FURNISHED WITHOUT WARRANTY, REPRESENTATIONS OR LICENSE OF ANY KIND, EXPRESS OR IMPLIED, WITH RESPECT TO ACCURACY, CORRECTNESS, OR COMPLETENESS, AND NEITHER MILLER CHEMICAL AND FERTILIZER, LLC. NOR ITS MARKETING AFFILIATES (EACH, A “SELLER”) ASSUME ANY LEGAL RESPONSIBILITY FOR THE USE OR RELIANCE UPON SAME.

Appendix 8. Polyterpene (Nu Film P) OMRI Certificate



OMRI Listed®

The following product is OMRI Listed. It may be used in certified organic production or food processing and handling according to the USDA National Organic Program regulations.

Product

Miller® Nu Film P® Spreader/Sticker

Company

Miller Chemical & Fertilizer LLC
Miller Chemical and Fertilizer, LLC
P.O. Box 333
Hanover PA 17331 United States

Status

Allowed with Restrictions

Category

NOP: Adjuvants, for use in pesticides

Issue date

17-Dec-2007

Product number

mcf-0695

Class

Crop Management Tools
and Production Aids

Expiration date

1-Mar-2021

Restrictions

For use as an inert ingredient in combination with permitted active pesticidal ingredients.

Executive Director/CEO

Product review is conducted according to the policies in the current *OMRI Policy Manual*® and based on the standards in the current *OMRI Standards Manual*®. To verify the current status of this or any OMRI Listed product, view the most current version of the *OMRI Products List*® at OMRI.org. OMRI listing is not equivalent to organic certification and is not a product endorsement. It cannot be construed as such. Final decisions on the acceptability of a product for use in a certified organic system are the responsibility of a USDA accredited certification agent. It is the operator's responsibility to properly use the product, including following any restrictions.



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Appendix 9. US Patent No. 4,874,610 (OCT. 17, 1989) Regarding Tall Oil Neutrals

United States Patent [19]

[11] **Patent Number:** **4,874,610**

Cousin

[45] **Date of Patent:** **Oct. 17, 1989**

[54] **TALL OIL NEUTRALS TO PROTECT PLANTS FROM INSECTS AND THE LIKE**

[75] **Inventor:** Michael J. Cousin, Circleville, Ohio

[73] **Assignee:** The Mead Corporation, Dayton, Ohio

[21] **Appl. No.:** 65,434

[22] **Filed:** Jun. 23, 1987

[51] **Int. Cl.⁴** A01N 65/00

[52] **U.S. Cl.** 424/196.1; 424/DIG. 10; 514/919

[58] **Field of Search** 424/196.1, DIG. 10; 514/919

[56] **References Cited**

PUBLICATIONS

"The Effect of a Purified Extract of Fruits of *Azadirachta Indica* on *Leptinotarsa Decemlineata* Say (Cole-

optera, Chrysomelidae)." L. ang. Ent. 82 (1976) 169-176 R. Steets.

"Effect of Some Pure Fractions of Extracts from *Neem* (*Azadirachta Indica*) Seeds on the Feeding Activity and Metamorphosis of *Epilachna Varivestis* (Col. Coccinellidae)" *Z. Angew. Entomologie*: vol. 89; 179-188 (1980) H. Schmutterer and H. Rembold.

Primary Examiner—John W. Rollins
Attorney, Agent, or Firm—Smith & Schnacke

[57] **ABSTRACT**

Plants are protected from insects and mites by the application of tall oil neutrals to the plants. The method can prevent insects and mites from eating on the plants, sterilize the insects and mites, or destroy the insects and mites.

8 Claims, No Drawings

TALL OIL NEUTRALS TO PROTECT PLANTS FROM INSECTS AND THE LIKE

BACKGROUND OF THE INVENTION

The present invention relates to a method for protecting plants from insects, mites, and similar plant pests, and more particularly, to a method for protecting plants through the application of tall oil neutrals to the plants.

For years, the paper making industry has been faced with the problem of what to do with the black liquor created during the Kraft pulping of pine. In order to make the pulping process as economical as possible, the industry has strived to seek applications for the various black liquor components and products derived therefrom.

Kraft or tall oil soap is one by-product of black liquor for which commercial uses exist. Tall oil soap is converted to crude tall oil by acidification with sulphuric acid. This conversion, however, creates another waste product, namely, tall oil neutrals.

SUMMARY OF THE INVENTION

The present invention is advantageous because it provides a method for protecting plants from insects, mites, and similar pests which comprises the step of applying tall oil neutrals to plants. It responds to the paper making industry's need to establish commercially viable applications for black liquor components.

The exact composition of tall oil neutrals will vary with their source and method of isolation. As a general rule, however, they are characterized in that they are the tall oil soap fraction which is insoluble in acid or basic solutions. Commercially, tall oil neutrals are isolated from tall oil soap by extraction of tall oil soap with an organic solvent such as a mixture of acetone and methanol. The tall oil neutrals comprise diterpene alcohols, diterpene, aldehydes, fatty alcohols, sterols, and triterpene alcohols. The insecticidally active component of the tall oil neutrals is believed to be diterpene alcohols and/or diterpene aldehydes.

Canadian crude tall oil is a preferred source of neutrals for the present method because Canadian crude contains a higher percentage of neutrals than other sources. Typically, Canadian crude tall oil contains 17-40 percent rosin acids, 33-44 percent fatty acids, 13-32 percent neutrals, and 13-19 percent unknown acids. In contrast, southern tall oil contains only about 5 percent neutrals.

Thus, an object of the present invention is to provide a useful application for tall oil neutrals.

An additional object of the present invention is to provide a method for protecting plants from insects.

In one embodiment, the present invention provides a method for protecting plants from insects, mites, and similar pests which comprises the step of applying tall oil neutrals to the plants.

Other objects and advantages of the present invention will be apparent from the following description and the appended claims.

DETAILED DESCRIPTION OF THE INVENTION

The method of the present invention for protecting plants from insects, mites, and similar pests comprises the step of applying tall oil neutrals to plants. The plants are believed to be protected by one or more of the following actions: by preventing feeding on the plants,

by preventing reproduction, and/or by killing the insects, their larvae, or eggs.

The method of the present invention is useful against various insects and mites including cabbage loopers such as *Trichoplusia ni*, aphids, spidermites such as *Tetranychus urticae* etc. The method is useful in protecting numerous growing plants including woody plants such as ficus, schefflera and jade. The formulations used in the present invention appear to be toxic to foliage plants such as beans and chrysanthemums.

Typically, the tall oil neutrals are applied to the plants in diluted form, and more particularly, as a solution or an oil-in-water dispersion. The solution or dispersion may contain about 5 to 40 percent by weight tall oil neutrals. To form a solution, the tall oil neutrals may be dissolved in a non-phytotoxic solvent such as kerosene. Other plant-safe solvents may also be used such as benzene, toluene, xylene, kerosene, diesel fuel, fuel oil, petroleum naphtha, acetone, methyl ethyl ketone, cyclohexanone, carbon tetrachloride, chloroform, trichloroethylene, perchloroethylene, ethyl acetate, amyl acetate, butyl acetate, ethylene glycol monomethyl ether, diethylene glycol monomethyl ether, methanol, ethanol, isopropanol, amyl alcohol, isopropyl alcohol, ethylene glycol, propylene glycol, butyl carbitol acetate, and glycerine. A preferred solvent is isopropyl alcohol and water.

To form a dispersion in accordance with the present invention, the tall oil neutrals may be dispersed directly or pre-dissolved in one of the above solutions. A dispersant or surfactant is typically used. Any conventionally used dispersant can be used in the present invention. The dispersant can be anionic, cationic, or nonionic in character. A preferred surfactant is potassium oleate.

A typical dispersion comprises tall oil neutrals, water, and surfactant. Typically, the surfactant is dissolved in the water and a solution of the tall oil neutrals in a solvent is then added. The amount of tall oil neutrals present in the dispersion can range from about 5 to 40% by weight. The surfactant is present in an amount of up to about 6% by weight of the dispersion.

The solution or dispersion can be one which is used directly or one which is further diluted in a sprayer prior to application. It is also possible to add the tall oil neutrals to a horticultural spray oil such as available from Sun Petroleum Products Company. The amount of tall oil neutrals present in the horticultural spray oil may range from about 5 to 40% by weight. Other conventional additives can be added to the solutions or dispersions.

While the neutrals will typically be applied as a solution or dispersion, the present invention also embraces the use of the tall oil neutrals with an inert solid carrier such as talc, silica, clay, etc.; or as aerosols by dispersing them in air by means of a compressed gas.

The solution or dispersion of the tall oil neutrals may be applied to plant leaves, stems, roots, or surrounding soil which may be accessible to insects and mites. The solution or dispersion can be applied to the plants in a variety of ways. The preferred application technique is spraying the dispersion or solution onto the plants. The plant roots can also be dipped into the solution or dispersion. When spraying, it is usually sufficient to apply the solution or dispersion to plants at about 1 to 3 pounds per acre. The application rate will vary with the type of plant and the means of application. When apply-

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3

ing to individual plants larger quantities may be used providing they are not phytotoxic.

The effectiveness of the method varies depending upon numerous factors including insect type, plant type, and plant location. Typically, application of the solution or dispersion may be repeated as needed. Factors such as an outdoor versus an indoor plant control the frequency of application.

The present invention is illustrated in more detail by the following non-limiting Examples:

EXAMPLE 1

The twelve test formulations as shown in Table 1 were evaluated for their effects on second-instar cabbage looper, *Trichoplusia ni*, larva on chrysanthemum leaf discs. T. O. stands for tall oil, IPA stands for isopropyl alcohol, and K-oleate stands for potassium oleate.

TABLE 1

FORMULATIONS EVALUATED		
Formulation Number	Composition	% T.O. Fraction
1	IPA, 85%; water, 15%	0
2	IPA, 76.5%; water, 13.5%	10
3	IPA, 68%; water, 12%	20
4	IPA, 59.5%; water, 10.5%	30
5	K-oleate, 2.5%; water, 97.5%	0
6	K-oleate, 2.5%; water, 87.5%	10
7	K-oleate, 2.5%; water, 82.5%	15
8	K-oleate, 2.5%; water, 77.5%	20
9	K-oleate, 2.5%; water, 72.5%	25
10	Untreated check	
11	100% 6E horticultural oil	0
12	90% 6E horticultural oil	10
13	80% 6E horticultural oil	20

Both contact/residual and residual activity were measured. Two tests were conducted. Test 2 was simply a repeat of Test 1. In the contact/residual experiment, leaf discs were dipped in the various formulations of Table 1 and placed on paper toweling to drain off excess solution. The leaf discs (four/treatment) were then placed in small petri dishes, having a 6 centimeter diameter, on moistened filter paper.

In the contact/residual experiment, five larvae were placed directly on each of the treated leaf discs immediately after treatment. For measuring residual effects, the larvae (again, 5/leaf disc) were placed on untreated discs adjacent to treated discs in each petri dish. It was assumed that the larvae would eat the untreated discs before attacking the treated discs.

The results were measured by recording the number of larvae dead and alive on or off the leaf discs. The results are shown in Tables 2-8 below. Also, the feeding damage was recorded by estimating the percentage of leaf disc consumed by the larvae.

TABLE 2

CONTACT/LOOPERS TEST 1 24 HOURS AFTER TREATMENT			
Formulation #	# Live	% Live Off Disc	% Feeding Damage
1	4.75	38	12.5
2	3.25	90	2.5
3	3.25	67	1.25
4	4	95	1.25
5	5	25	80
6	4.5	68	22.5
7	3	79	7.5
8	3.5	88	1.25
9	3	100	0
10	4.75	25	63.75

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TABLE 2-continued

CONTACT/LOOPERS TEST 1 24 HOURS AFTER TREATMENT			
	# Dead	% Dead on Disc	Total (live + dead) off Disc
11	1.5	78	0
12	0		0
13	.25	100	0
1	.25	0	2
2	1.75	8	4.25
3	1.25	0	3.5
4	1	83	4
5	0		1.25
6	.25	0	3.5
7	1.5	25	3.25
8	1	83	3.25
9	2	83	3.5
10	.25	0	1.5
11	3.5	56	2.25
12	5	80	1
13	4.75	100	.25

TABLE 3

CONTACT/LOOPERS TEST 1 48 HOURS AFTER TREATMENT			
Formulation #	# Live	% Live Off Disc	% Feeding Damage
1	4	21	68.75
2	1.75	100	5
3	3	77	26.25
4	1	50	1.25
5	4.5	100	100
6	4.75	59	50
7	2.5	100	12.5
8	1.25	100	2.5
9	1.75	72	5
10	4	13	95
11	.5	100	0
12	0		0
13	.25	100	0
	# Dead	% Dead on Disc	Total (live + dead) off Disc
1	.75	50	1.5
2	1.75	46	2.75
3	.25	0	2.5
4	3.5	42	2.75
5	.25	39	4.75
6	0	0	2.75
7	1	67	3
8	2.75	22	3.25
9	2.5	56	2.5
10	.5	50	.25
11	4.5	54	2.5
12	4.5	73	1.25
13	4.5	100	.25

TABLE 4

CONTACT/LOOPERS TEST 1 72 HOURS AFTER TREATMENT			
Formulation #	# Live	% Live Off Disc	% Feeding Damage
1	4	25	77.5
2	.75	100	15
3	1.5	100	18.75
4	.25	100	1.25
5	3.25	25	100
6	3	100	66.25
7	1.25	100	25
8	.5	50	5
9	0		7.5
10	3.25	0	100
11	0		0
12	0		0

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TABLE 4-continued

CONTACT/LOOPERS TEST 1 72 HOURS AFTER TREATMENT			
13	0	0	0
	# Dead	% Dead on Disc	Total (live + dead) off Disc
1	0		1.25
2	1.75	0	2.5
3	1.25	0	2.75
4	4.25	42	2.75
5	.75		.75
6	.75	0	3.75
7	1.5	22	2.25
8	3.25	45	2
9	4	35	2.75
10	0		0
11	5	50	2.5
12	5	75	1.25
13	5	85	.75

TABLE 5

CONTACT/LOOPERS TEST 2			
Formulation #	% Feeding Injury		
	After 24 Hours	After 48 Hours	After 72 Hours
1	0	0	25
2	0	3.75	7.5
3	0	0	1.25
4	0	0	0
5	45	75	100
6	3.75	45	37.5
7	0	5	15
8	1.25	1.25	5
9	0	0	0
10	81.25	96.25	100
11	0	0	0
12	0	0	0
13	0	0	0

TABLE 6

RESIDUE/LOOPERS TEST 1			
Formulation #	# Live After 24 Hours	# Live After 48 Hours	# Live After 72 Hours
1	4.5	4	3
2	4.5	4.25	3.75
3	5	4.75	3.25
4	4.75	3.25	3.5
5	4.75	4	3
6	5	4.5	4.25
7	4.5	4	3.25
8	4.75	4.5	3.75
9	4.75	4	2.75
10	5	5	2.25
11	5	2.75	1.25
12	3.75	2.25	1
13	4.75	2	1

TREATED LEAF DISCS:

Formulation	% Feeding Damage		
	After 24 Hours	After 48 Hours	After 72 Hours
1	22.5	87.5	100
2	2.5	77.5	97.5
3	3.75	37.5	66.25
4	1.25	31.25	55
5	27.5	97.5	100
6	1.25	77.5	97.5
7	0	48.75	70
8	3.75	26.25	40
9	0	11.25	21.25
10	38.75	100	100
11	3.75	16.25	16.25
12	1.25	3.75	7.5

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TABLE 6-continued

RESIDUE/LOOPERS TEST 1			
13	5	5	5
UNTREATED LEAF DISCS:			
Formulation	% Feeding Damage After 24 Hours		
	1		
2			72.5
3			82.5
4			73.75
5			57.5
6			90
7			88.75
8			81.25
9			86.25
10			72.5
11			90
12			67.5
13			83.75

TABLE 7

RESIDUE/LOOPERS TEST 2 TREATED LEAF DISCS:			
Formulation #	% Feeding Damage		
	After 24 Hours	After 48 Hours	After 72 Hours
1	58.75	93.75	100
2	2.5	26.25	37.75
3	3.75	23.75	50
4	1.25	11.25	21.25
5	85	98.75	100
6	16.25	25	31.25
7	6.25	16.25	37.5
8	7.5	8.75	5
9	6.25	11.25	8.75
10	85	82.5	82.5
11	2.5	5	3.75
12	3.75	1.25	0
13	1.25	1.25	1.25

TABLE 8

RESIDUE/LOOPERS				
Formulation #	Drying Time (Min)	# Live	# Dead	% Feeding Injury
				1
4	0	0	5	0
5	0	1.75	2	60
9	0	1.25	3.75	8.75
11	0	1	4	5
13	0	0	5	0
1	5	.5	4.5	2.5
4	5	2.5	2.5	3.75
5	5	2	2.5	30
9	5	.25	4.75	2.5
11	5	0	4.75	0
13	5	.25	4.75	0
1	2	2.5	2.25	38.75
4	2	2	2	5
5	2	4	.75	66.25
9	2	2	2.5	6.25
11	2	1.75	3.25	3.75
13	2	.5	4.5	1.25
10	0	4	.75	81.25

Table 2 shows the results for the contact test of Test 1 after 24 hours. Table 3 shows the results for the same contact test for Test 1 after 48 hours. Table 4 shows the results for the contact test for Test 1 after 72 hours. Table 5 shows the results of a contact test for Test 2 which was conducted similarly to Test 1. Table 6 shows the results for the residue test for Test 1. Table 7 shows

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the results of the residue test for Test 2. Table 8 shows the results of the residue test for leaf drying time.

The contact looper experiments demonstrate that the formulations are effective in killing loopers and reducing feeding injury. Percent feeding damage was evaluated over a 3-day period after the day of treatment; damage did not increase with time. In most cases, all the loopers, both on and off the discs, were dead by the fourth day as shown in Tables 2-4. In Test 2 as shown in Table 5, the data show that feeding injury had increased by the third day. However, all treatments were statistically better than the controls.

In the residual tests, mortality was considerably lower and feeding injury greater than on the contact treated loopers. However, feeding injury (measure of antifeedant property) was again rate related. Table 6 shows the percentage damage over a 4-day period. The Formulations having a higher % T.O. fraction fared better on the third day, with the Formulations having T.O. and K-oleate being the best. Table 8 shows the leaf drying time before the insects were placed on the leaf discs. These data also show the effectiveness of all treatments after one day's observation.

EXAMPLE 2

One contact efficacy test and two residue tests were made using aphids as the target pests and chrysanthemum as the host plant. All tests were made by cutting 2.5 centimeter leaf discs from the treated plant material or by cutting leaf discs from untreated plant material and then dipping the leaf discs into the indicated formulations of Table 1 above. After treatment, the discs were maintained on moist filter paper in small petri dishes.

In the contrast test, five aphids were placed on untreated leaf discs and then the discs were dipped directly into the formulations. In the short term residual experiment, Test 1, the leaf discs were dipped and allowed to drain and "dry," and then five aphids were placed on each leaf disc. The other residue test, Test 2, involved dipping leaves still intact on plants into the Formulations. At 2, 5, and 7 days post-treatment, the leaf discs were removed from the treated plant material and placed in petri dishes. Five aphids were then placed on each leaf disc. Mortality, reproduction, and repellency were recorded 24 and 48 hours after aphids were placed on the leaf discs. The results are shown in Tables 9-12 below. In Tables 9-12, * means that the aphids were placed on the discs at this time, NS means that no sample was taken because of the lack of healthy plant tissue, and PT means post-treatment.

TABLE 9

RESIDUE/APHIDS TEST 1				
Formulation #	24 hrs PT # live	24 hrs PT # missing	24 hrs PT # nymphs	24 hrs PT # off
1	3.8	.8	0	1.8
2	3.4	1	0	2.8
3	2.6	.8	0	2.6
4	.6	1.2	0	1
5	2	.6	0	1.2
6	1.2	1.2	0	1.4
7	.6	1.4	0	.6
8	.2	1	0	.2
9	.2	.6	0	.2
10	4.6	.2	.8	.2

Formulation #	48 hrs PT # live	48 hrs PT # missing	48 hrs PT # nymphs	48 hrs PT # off
1	2.2	1.6	.8	.6
2	1.4	1.4	0	2.4
3	.4	1.2	0	1.2

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TABLE 9-continued

RESIDUE/APHIDS TEST 1				
4	.8	1.4	0	.8
5	3	.6	.8	2.2
6	1.8	1	0	2.4
7	.2	1.4	0	.4
8	.2	1	0	.2
9	.2	.6	0	.4
10	4.4	4	2.8	.2

TABLE 10

RESIDUE/APHIDS TEST 2				
Formulation #	Samples Taken			48 Hrs PT
	2 Days PT # Live	5 Days PT # Live	7 Days PT* # Live	
	24 Hrs PT	24 Hours PT	24 Hours PT	
1	NS**	4.2	NS	
2	NS	4.8	NS	
3	NS	3.4	NS	
4	NS	3	NS	
5	3.6	4.4	4.4	
6	1.2	.8	4.4	
7	1	1.6	2.4	
8	.4	1.4	3	
9	0	1.4	1.2	
10	4.4	5	4.8	
48 Hrs PT				
1	NS	2.2	NS	
2	NS	4.4	NS	
3	NS	1	NS	
4	NS	.8	NS	
5	NS	2.4	3.6	
6	NS	1.4	3.2	
7	NS	.2	2.6	
8	NS	1	1	
9	NS	.4	.6	
10	NS	4.4	5	

TABLE 11

RESIDUE/APHIDS TEST 2				
Formulation #	Samples Taken			48 Hrs PT
	2 Days PT # nymphs	5 Days PT # nymphs	7 Days PT* # nymphs	
	24 Hrs PT	24 Hours PT	24 Hours PT	
1	NS**	.2	NS	
2	NS	2.6	NS	
3	NS	.6	NS	
4	NS	.4	NS	
5	.6	1.8	2	
6	0	0	1.8	
7	0	0	.4	
8	0	0	0	
9	0	0	0	
10	2.2	1.6	2.4	
48 Hrs PT				
1	NS	.2	NS	
2	NS	2.4	NS	
3	NS	.4	NS	
4	NS	0	NS	
5	NS	2	1.6	
6	NS	0	1.8	
7	NS	0	0	
8	NS	0	.4	
9	NS	0	0	
10	NS	4.8	5.4	

TABLE 12

RESIDUE/APHIDS TEST 2			
Formulation #	Samples Taken		
	2 Days PT # missing	5 Days PT # missing	7 Days PT* # missing
1			
2			
3			

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TABLE 12-continued

RESIDUE/APHIDS TEST 2			
Formulation #	24 Hrs PT	24 Hours PT	24 Hours PT
1	NS**	.8	NS
2	NS	0	NS
3	NS	1.2	NS
4	NS	.8	NS
5	1	.6	.6
6	1.2	2.6	.4
7	.4	3.2	2.4
8	.6	1.8	1.8
9	0	2.4	2
10	.6	0	.2
48 Hrs PT			
Formulation #	48 Hrs PT	48 Hrs PT	48 Hrs PT
1	NS	2.2	NS
2	NS	.2	NS
3	NS	2.6	NS
4	NS	2	NS
5	NS	2.4	1.2
6	NS	2.4	1.8
7	NS	4	2.4
8	NS	2.6	2.2
9	NS	3.4	1.8
10	NS	.6	0

All Formulations were phytotoxic to chrysanthemum, especially Formulations 1-4, and thus, testing capabilities were limited. When the leaf discs were dipped and allowed to drain and dry for several minutes before the aphids were placed on them in Test 1, only control Formulations 1 and 5 allowed any survival with much of this occurring off the leaf discs. When the aphids were placed on the leaf discs taken from treated plants 2, 4, and 7 days post-treatment in Test 2, considerable survival occurred but little or no reproduction occurred on any of the treatments except those with the lowest amount of the active ingredient. All aphids were killed when treated directly with the Formulations.

EXAMPLE 3

Several experiments were conducted to evaluate the efficacy of the Formulations on *Tetranychus urticae* using bean as the host plant. The first test involved placing five adults female mites on leaf discs, allowing them to lay eggs for 24 hours, and then dipping the entire disc including the adult mites into the Formulations. All Formulations except the water checks caused 100% mortality within a very short time.

The discs were maintained on moist irrigation matting for five additional days to check the effect of the Formulations on egg hatch. The results indicated that the addition of tall oil neutrals at all the rates tested caused 100% egg mortality as shown in Table 13 below. Some egg hatch did occur in all the "carrier" checks although the number of nymphs in the potassium oleate Formulations 5 was very low and was not significantly different from those with no egg hatch.

TABLE 13

RESIDUE/MITES TEST 1 5 DAY POST TREATMENT	
Formulation #	# nymphs per disc
1	13
2	0
3	0
4	0
5	2.33
6	0
7	0
8	0
9	0

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TABLE 13-continued

RESIDUE/MITES TEST 1 5 DAY POST TREATMENT	
Formulation #	# nymphs per disc
10	16.33

Severe phytotoxicity to bean prevented normal residual testing in which the leaf discs are dipped or plants treated and then leaf disc taken, or mites confined on them at regular post-treatment intervals. However, a residual test was conducted using microliter applicators to apply the Formulations to leaf discs. The Formulations were applied and five female adults were confined to each disc 24 hours later. The results are summarized in Table 14 below.

A total of ten microliters of each Formulation included in this test was applied to the lower surface of leaf discs. Each Formulation used was applied in two different droplet sizes, 0.001 mls and 0.002 mls.

TABLE 14

MICROLITER/MITES TEST 1 5 DAYS POST-TREATMENT				
No. and size of drops	Formulation #	# Dead Per Disc	# Eggs Per Disc	
10-.001 mls	1	.5	91.75	
5-.002 mls		0	111.75	
10-.001 mls	2	1.25	91.75	
5-.002 mls		.75	87.75	
10-.001 mls	6	.5	81.5	
5-.002 mls		1	72	
10-.001 mls	5	0	93.25	
5-.002 mls		.5	67	
10-.001 mls	H ₂ O check	.25	91.75	
7 DAYS POST-TREATMENT				
No. and size of drops	Formulation #	# Dead Per Disc	# Missing Per Disc	# nymphs Per Disc
10-.001 mls	1	.5	1	21.75
5-.002 mls		.5	.5	28.5
10-.001 mls	2	1.5	1.25	18.75
5-.002 mls		.75	1.75	18
10-.001 mls	6	.5	1.5	12.25
5-.002 mls		1.25	1	11
10-.001 mls	5	0	.5	13
5-.002 mls		.75	1.25	11.5
10-.001 mls	H ₂ O check	.5	.5	17.25

The Formulations tested in this manner caused very little mortality to adults and did not appear to deter feeding on the leaf discs although mites did not appear to feed in the area that droplets were applied. After one week, the number of nymphs present on each disc was probably not significantly different when the number of live adults present were taken into account. This test indicates that the entire leaf surface should be sprayed to ensure efficacy.

Having described the invention in detail and by reference to preferred embodiments thereof, it will be apparent that modifications and variations are possible without departing from the scope of the invention defined in the appended claims.

What is claimed is:

1. A method for protecting plants from insects, mites, and similar pests which comprises the step of applying tall oil neutrals to plants in an amount effective to protect said plants from said insects, mites, and similar pests.

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2. The method of claim 1 wherein said tall oil neutrals are applied to said plants as a solution or an oil-in-water dispersion.

3. The method of claim 2 wherein said tall oil neutrals are present in said solution or dispersion in an amount of about 5 to 30% by weight.

4. The method of claim 3 wherein said solution or dispersion includes isopropyl alcohol.

5. The method of claim 3 wherein said dispersion includes potassium oleate.

6. The method of claim 1 wherein said tall oil neutrals are applied to said plants as a solution formed by the addition of said tall oil neutrals to a horticultural oil.

7. The method of claim 2 wherein said solution or dispersion is applied to said plants by spraying said solution or dispersion on said plants.

8. The method of claim 7 wherein said solution or dispersion is applied to the leaves of said plant.

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