Borage oil from *Borago officinalis* seeds

**Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION**

**PRODUCT NAME**
Borage oil from *Borago officinalis* seeds

**STATEMENT OF HAZARDOUS NATURE**

**NFPA**

<table>
<thead>
<tr>
<th>Flammability</th>
<th>Toxicity</th>
<th>Body Contact</th>
<th>Reactivity</th>
<th>Chronic</th>
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<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**SUPPLIER**
Company: Santa Cruz Biotechnology, Inc.
Address: 2145 Delaware Ave
Santa Cruz, CA 95060
Telephone: 800.457.3801 or 831.457.3800
Emergency Tel: CHEMWATCH: From within the US and Canada: 877-715-9305
Emergency Tel: From outside the US and Canada: +800 2436 2255
(1-800-CHEMCALL) or call +613 9573 3112

**PRODUCT USE**
Oil extracted from *Borago officinalis*. Used in cosmetic preparations as an emollient and moisturiser used medicinally as an anti-inflammatory, for treating arthritis, as well as certain skin conditions (e.g. atopic dermatitis) and respiratory inflammation. It has one of the highest amounts of gamma-linolenic acid (omega-6) of seed oils - higher than blackcurrant seed oil or evening primrose oil, to which it is considered similar.

GLA makes up around 24% of the oil typically. A specific extraction process may offer purified products with 50%+ GLA content.

**SYNONYMS**
“Borago officinalis oil”

**Section 2 - HAZARDS IDENTIFICATION**

**CHEMWATCH HAZARD RATINGS**

<table>
<thead>
<tr>
<th>Flammability</th>
<th>Toxicity</th>
<th>Body Contact</th>
<th>Reactivity</th>
<th>Chronic</th>
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<tr>
<td>1</td>
<td>0</td>
<td>2</td>
<td>1</td>
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</table>

**CANADIAN WHMIS SYMBOLS**
EMERGENCY OVERVIEW

RISK

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

- The material has NOT been classified as "harmful by ingestion". This is because of the lack of corroborating animal or human evidence. The material may still be damaging to the health of the individual, following ingestion, especially where pre-existing organ (e.g. liver, kidney) damage is evident. Present definitions of harmful or toxic substances are generally based on doses producing mortality (death) rather than those producing morbidity (disease, ill-health). Gastrointestinal tract discomfort may produce nausea and vomiting. In an occupational setting however, unintentional ingestion is not thought to be cause for concern.

EYE

- Although the liquid is not thought to be an irritant, direct contact with the eye may produce transient discomfort characterized by tearing or conjunctival redness (as with windburn).

SKIN

- The material is not thought to produce adverse health effects or skin irritation following contact (as classified using animal models). Nevertheless, good hygiene practice requires that exposure be kept to a minimum and that suitable gloves be used in an occupational setting.
- The liquid may be miscible with fats or oils and may degrease the skin, producing a skin reaction described as non-allergic contact dermatitis. The material is unlikely to produce an irritant dermatitis as described in EC Directives.

INHALED

- The material is not thought to produce adverse health effects or irritation of the respiratory tract (as classified using animal models). Nevertheless, good hygiene practice requires that exposure be kept to a minimum and that suitable control measures be used in an occupational setting.
- There is some evidence to suggest that the material can cause respiratory irritation in some persons. The body’s response to such irritation can cause further lung damage.
- The material has NOT been classified as "harmful by inhalation". This is because of the lack of corroborating animal or human evidence. In the absence of such evidence, care should nevertheless be taken to ensure exposure is kept to a minimum and that suitable control measures be used, in an occupational setting to control vapors, fumes and aerosols.
- Not normally a hazard due to non-volatile nature of product.
- Inhalation of oil droplets/ aerosols may cause discomfort and may produce chemical pneumonitis.
- Fine mists generated from plant/ vegetable (or more rarely from animal) oils may be hazardous. Extreme heating for prolonged periods, at high temperatures, may generate breakdown products which include acrolein and acrolein-like substances.
- The vapor may produce discomfort of the upper respiratory tract. Inhalation hazard is increased at higher temperatures.

CHRONIC HEALTH EFFECTS

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>NAME</th>
<th>CAS RN</th>
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<tbody>
<tr>
<td>Borage oil</td>
<td>84012-16-8</td>
<td>&gt;60</td>
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<tr>
<td>palmitic acid</td>
<td>57-10-3</td>
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<td>stearic acid</td>
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<td>linoleic acid</td>
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<td>gamma-linolenic acid</td>
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<td>(as triglycerides)</td>
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<td>arachidic acid</td>
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<td>gadoleic acid</td>
<td>29204-02-2</td>
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</table>

Section 4 - FIRST AID MEASURES

SWALLOWED

- Immediately give a glass of water.
- First aid is not generally required. If in doubt, contact a Poisons Information Center or a doctor.

EYE

- If this product comes in contact with eyes:
  - Wash out immediately with water.
  - If irritation continues, seek medical attention.
Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

**SKIN**
- If skin or hair contact occurs:
  - Flush skin and hair with running water (and soap if available).
  - Seek medical attention in event of irritation.

**INHALED**
- If fumes or combustion products are inhaled remove from contaminated area.
- Other measures are usually unnecessary.

**NOTES TO PHYSICIAN**
- Treat symptomatically.

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**Section 5 - FIRE FIGHTING MEASURES**

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<thead>
<tr>
<th>Property</th>
<th>Details</th>
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<tbody>
<tr>
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<tr>
<td>Upper Explosive Limit (%)</td>
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<td>Specific Gravity (water=1)</td>
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<tr>
<td>Lower Explosive Limit (%)</td>
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</table>

**EXTINGUISHING MEDIA**
- Foam.
- Dry chemical powder.
- BCF (where regulations permit).
- Carbon dioxide.
- Water spray or fog - Large fires only.

**FIRE FIGHTING**
- Alert Emergency Responders and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- Use water delivered as a fine spray to control fire and cool adjacent area.
- Avoid spraying water onto liquid pools.
- Do not approach containers suspected to be hot.
- Cool fire exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.

**GENERAL FIRE HAZARDS/HAZARDOUS COMBUSTIBLE PRODUCTS**
- Combustible.
- Slight fire hazard when exposed to heat or flame.
- Heating may cause expansion or decomposition leading to violent rupture of containers.
- On combustion, may emit toxic fumes of carbon monoxide (CO).
- May emit acrid smoke.
- Mists containing combustible materials may be explosive.

Combustion products include: carbon dioxide (CO2), acrolein, other pyrolysis products typical of burning organic material.

May emit corrosive fumes.

CARE: Water in contact with hot liquid may cause foaming and a steam explosion with wide scattering of hot oil and possible severe burns.

Foaming may cause overflow of containers and may result in possible fire.

**FIRE INCOMPATIBILITY**
- Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

**PERSONAL PROTECTION**
- Glasses: Chemical goggles.
- Gloves: Respirator: Type A-P Filter of sufficient capacity

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**Section 6 - ACCIDENTAL RELEASE MEASURES**

**MINOR SPILLS**
- Remove all ignition sources.
- Clean up all spills immediately.
- Avoid breathing vapors and contact with skin and eyes.
• Control personal contact by using protective equipment.
• Contain and absorb spill with sand, earth, inert material or vermiculite.
• Wipe up.
• Place in a suitable labeled container for waste disposal.

MAJOR SPILLS
• CARE: Absorbent material wet with occluded oil must be wet with water as they may auto-oxidize, become self heating and ignite.
Some oils slowly oxidize when spread in a film and oil on cloths, mops, absorbents may auto-oxidize and generate heat, smoulder, ignite and burn. In the workplace oily rags should be collected and immersed in water.

Moderate hazard.
• Clear area of personnel and move upwind.
• Alert Emergency Responders and tell them location and nature of hazard.
• Wear breathing apparatus plus protective gloves.
• Prevent, by any means available, spillage from entering drains or water course.
• Precaution: No smoking, naked lights or ignition sources. Increase ventilation.
• Stop leak if safe to do so.
• Contain spill with sand, earth or vermiculite.
• Collect recoverable product into labeled containers for recycling.
• Absorb remaining product with sand, earth or vermiculite.
• Collect solid residues and seal in labeled drums for disposal.
• Wash area and prevent runoff into drains.
• If contamination of drains or waterways occurs, advise emergency services.

PROTECTIVE ACTIONS FOR SPILL


From IERG (Canada/Australia)
Isolation Distance -
Downwind Protection Distance -

FOOTNOTES
1 PROTECTIVE ACTION ZONE is defined as the area in which people are at risk of harmful exposure. This zone assumes that random changes in wind direction confines the vapour plume to an area within 30 degrees on either side of the predominant wind direction, resulting in a crosswind protective action distance equal to the downwind protective action distance.
2 PROTECTIVE ACTIONS should be initiated to the extent possible, beginning with those closest to the spill and working away from the site in the downwind direction. Within the protective action zone a level of vapour concentration may exist resulting in nearly all unprotected persons becoming incapacitated and unable to take protective action and/or incurring serious or irreversible health effects.
3 INITIAL ISOLATION ZONE is determined as an area, including upwind of the incident, within which a high probability of localised wind reversal may expose nearly all persons without appropriate protection to life-threatening concentrations of the material.
4 SMALL SPILLS involve a leaking package of 200 litres (55 US gallons) or less, such as a drum (jerican or box with inner containers). Larger packages leaking less than 200 litres and compressed gas leaking from a small cylinder are also considered "small spills". LARGE SPILLS involve many small leaking packages or a leaking package of greater than 200 litres, such as a cargo tank, portable tank or a "one-tonne" compressed gas cylinder.
5 Guide No guide found. is taken from the US DOT emergency response guide book.
6 IERG information is derived from CANUTEC - Transport Canada.

ACUTE EXPOSURE GUIDELINE LEVELS (AEGGL) (in ppm)
AEGGL 1: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.
AEGGL 2: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
AEGGL 3: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.
PROCEDURE FOR HANDLING
- Rags wet / soaked with unsaturated hydrocarbons / drying oils may auto-oxidise; generate heat and, in-time, smoulder and ignite. This is especially the case where oil-soaked materials are folded, bunched, compressed, or piled together - this allows the heat to accumulate or even accelerate the reaction.
- Oily cleaning rags should be collected regularly and immersed in water, or spread to dry in safe-place away from direct sunlight or stored, immersed, in solvents in suitably closed containers.
  - Avoid all personal contact, including inhalation.
  - Wear protective clothing when risk of exposure occurs.
  - Use in a well-ventilated area.
  - Prevent concentration in hollows and sumps.
  - DO NOT enter confined spaces until atmosphere has been checked.
  - Avoid smoking, naked lights or ignition sources.
  - Avoid contact with incompatible materials.
  - When handling, DO NOT eat, drink or smoke.
  - Keep containers securely sealed when not in use.
  - Avoid physical damage to containers.
  - Always wash hands with soap and water after handling.
  - Work clothes should be laundered separately.
  - Use good occupational work practice.
  - Observe manufacturer's storing and handling recommendations.
  - Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

RECOMMENDED STORAGE METHODS
- Metal can or drum
- Packing as recommended by manufacturer.
- Check all containers are clearly labeled and free from leaks.

STORAGE REQUIREMENTS
- Store in original containers.
- Keep containers securely sealed.
- No smoking, naked lights or ignition sources.
- Store in a cool, dry, well-ventilated area.
- Store away from incompatible materials and foodstuff containers.
- Protect containers against physical damage and check regularly for leaks.
- Observe manufacturer's storing and handling recommendations.

SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS

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<td>X</td>
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<td>X</td>
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</table>

X: Must not be stored together
O: May be stored together with specific precautions
+: May be stored together

EXPOSURE CONTROLS

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<th>Source</th>
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The following materials had no OELs on our records

- Borage oil: CAS:84012-16-8
- Linoleic acid: CAS:60-33-3 CAS:121250-47-3
- Gamma-linolenic acid: CAS:506-26-3
- Gadoleic acid: CAS:29204-02-2

MATERIAL DATA
ARACHIDIC ACID:
BORAGE OIL:
GADOLEIC ACID:
LINOLEIC ACID:
OLEIC ACID:
PALMITIC ACID:
STEARIC ACID:

Sensory irritants are chemicals that produce temporary and undesirable side-effects on the eyes, nose or throat. Historically occupational exposure standards for these irritants have been based on observation of workers’ responses to various airborne concentrations. Present day expectations require that nearly every individual should be protected against even minor sensory irritation and exposure standards are established using uncertainty factors or safety factors of 5 to 10 or more. On occasion animal no-observable-effect-levels (NOEL) are used to determine these limits where human results are unavailable. An additional approach, typically used by the TLV committee (USA) in determining respiratory standards for this group of chemicals, has been to assign ceiling values (TLV C) to rapidly acting irritants and to assign short-term exposure limits (TLV STELs) when the weight of evidence from irritation, bioaccumulation and other endpoints combine to warrant such a limit. In contrast the MAK Commission (Germany) uses a five-category system based on intensive odour, local irritation, and elimination half-life. However this system is being replaced to be consistent with the European Union (EU) Scientific Committee for Occupational Exposure Limits (SCOEL); this is more closely allied to that of the USA.

OSHA (USA) concluded that exposure to sensory irritants can:
- cause inflammation
- cause increased susceptibility to other irritants and infectious agents
- lead to permanent injury or dysfunction
- permit greater absorption of hazardous substances and
acclimate the worker to the irritant warning properties of these substances thus increasing the risk of overexposure.

ARACHIDIC ACID:
BORAGE OIL:
GAMMA-LINOLENIC ACID:
LINOLEIC ACID:
OLEIC ACID:
vegetable oil mists (except castor, cashew nut and similar irritant oils)TLV TWA: 10 mg/m³ ES TWA: 10 mg/m³ OSHA PEL TWA: 15 mg/m³, total particulate; 5 mg/m³, respirable particulate The common vegetable oil mists are considered "nuisance" particulates which have little adverse effect on the lung. They do not produce toxic effects or significant organic disease when exposures are kept under reasonable control. Direct instillation of vegetable oils into rabbit lungs produces acute bronchitis whilst high oral doses are laxatives.

ARACHIDIC ACID:
PALMITIC ACID:
STEARIC ACID:
It is the goal of the ACGIH (and other Agencies) to recommend TLVs (or their equivalent) for all substances for which there is evidence of health effects at airborne concentrations encountered in the workplace. At this time no TLV has been established, even though this material may produce adverse health effects (as evidenced in animal experiments or clinical experience). Airborne concentrations must be maintained as low as is practically possible and occupational exposure must be kept to a minimum.

NOTE: The ACGIH occupational exposure standard for Particles Not Otherwise Specified (P.N.O.S) does NOT apply.

STEARIC ACID:
The stearates have a low order of acute and chronic toxicity. Intratracheal administration of relatively large doses in rats produce varying degrees of pulmonary damage. Acute, gross inhalation exposure has been associated with clinical pneumonitis. A case of "pneumoconiosis with probable heart failure" has been reported in a rubber worker occupationally exposed to zinc stearate dust for 29 years. Several cases of infants developing respiratory distress and in some instances, acute fatal pneumonitis on aspiration of zinc stearate powder, have been reported.

PERSONAL PROTECTION

Safety glasses with side shields.
Chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. DO NOT wear contact lenses.

HANDS/FEET
Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include: such as:
- frequency and duration of contact,
- chemical resistance of glove material,
- glove thickness and 
- dexterity
Select gloves tested to a relevant standard (e.g. Europe EN 374, US F739).
- When prolonged or frequently repeated contact may occur, a glove with a protection class of 5 or higher (breakthrough time greater than 240 minutes according to EN 374) is recommended.
- When only brief contact is expected, a glove with a protection class of 3 or higher (breakthrough time greater than 60 minutes according to EN 374) is recommended.
- Contaminated gloves should be replaced.
Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.
- Polyethylene gloves
Wear chemical protective gloves, eg. PVC.
Wear safety footwear or safety gumboots, eg. Rubber.

OTHER
- Overalls.
- P.V.C. apron.
- Barrier cream.
- Skin cleansing cream.
- Eye wash unit.

RESPIRATOR
Selection of the Class and Type of respirator will depend upon the level of breathing zone contaminant and the chemical nature of the contaminant. Protection Factors (defined as the ratio of contaminant outside and inside the mask) may also be important.

<table>
<thead>
<tr>
<th>Breathing Zone Level ppm (volume)</th>
<th>Maximum Protection Factor</th>
<th>Half-face Respirator</th>
<th>Full-Face Respirator</th>
</tr>
</thead>
</table>

8 of 14
The local concentration of material, quantity and conditions of use determine the type of personal protective equipment required. Use appropriate NIOSH-certified respirator based on informed professional judgement. In conditions where no reasonable estimate of exposure can be made, assume the exposure is in a concentration IDLH and use NIOSH-certified full face pressure demand SCBA with a minimum service life of 30 minutes, or a combination full facepiece pressure demand SAR with auxiliary self-contained air supply. Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.

ENGINEERING CONTROLS

- Care: Atmospheres in bulk storages and even apparently empty tanks may be hazardous by oxygen depletion. Atmosphere must be checked before entry.
- Requirements of State Authorities concerning conditions for tank entry must be met. Particularly with regard to training of crews for tank entry; work permits; sampling of atmosphere; provision of rescue harness and protective gear as needed.
- General exhaust is adequate under normal operating conditions. Local exhaust ventilation may be required in special circumstances. If risk of overexposure exists, wear an approved respirator An approved respirator (supplied air type) may be required in special circumstances.
- Correct fit is essential to ensure adequate protection. Provide adequate ventilation in warehouses and enclosed storage areas.
- Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant.

<table>
<thead>
<tr>
<th>Type of Contaminant</th>
<th>Air Speed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>solvent, vapors, degreasing etc., evaporating from tank (in still air)</td>
<td>0.25-0.5 m/s (50-100 f/min)</td>
</tr>
<tr>
<td>aerosols, fumes from pouring operations, intermittent container filling, low speed conveyer transfers, welding, spray drift, plating acid fumes, picking (released at low velocity into zone of active generation)</td>
<td>0.5-1 m/s (100-200 f/min.)</td>
</tr>
<tr>
<td>direct spray, spray painting in shallow booths, drum filling, conveyer loading, crusher dusts, gas discharge (active generation into zone of rapid air motion)</td>
<td>1.25 m/s (200-500 f/min.)</td>
</tr>
<tr>
<td>grinding, abrasive blasting, tumbling, high speed wheel generated dusts (released at high initial velocity into zone of very high rapid air motion)</td>
<td>2.5-10 m/s (500-2000 f/min.)</td>
</tr>
</tbody>
</table>

Within each range the appropriate value depends on:

- Lower end of the range
- Upper end of the range

1: Room air currents minimal or favorable to capture
1: Disturbing room air currents
2: Contaminants of low toxicity or of nuisance value only
2: Contaminants of high toxicity
3: Intermittent, low production.
3: High production, heavy use
4: Large hood or large air mass in motion
4: Small hood-local control only

Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 1-2 m/s (200-400 f/min) for extraction of solvents generated in a tank 2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL PROPERTIES

- Liquid.
- Does not mix with water.
- Floats on water.

<table>
<thead>
<tr>
<th>State</th>
<th>Liquid</th>
<th>Molecular Weight</th>
<th>pH (as supplied)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melting Range (°F)</td>
<td>Not available</td>
<td>Viscosity</td>
<td>Not available</td>
</tr>
<tr>
<td>Boiling Range (°F)</td>
<td>&gt;302</td>
<td>Solubility in water (g/L)</td>
<td>Immiscible</td>
</tr>
<tr>
<td>Flash Point (°F)</td>
<td>&gt;284</td>
<td>pH (1% solution)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Decomposition Temp (°F)</td>
<td>Not available</td>
<td>pVapour Pressure (mmHG)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Autoignition Temp (°F)</td>
<td>Not available</td>
<td>Specific Gravity (water=1)</td>
<td>0.916-0.928</td>
</tr>
<tr>
<td>Upper Explosive Limit (%)</td>
<td>Not available</td>
<td>Relative Vapor Density (air=1)</td>
<td>Not available</td>
</tr>
<tr>
<td>Lower Explosive Limit (%)</td>
<td>Not available</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPEARANCE
Clear oil with characteristic odour; does not mix with water.

log Kow 7.18

STORAGE INCOMPATIBILITY
- Materials soaked with plant/vegetable derived (and rarely, animal) oils may undergo spontaneous combustion
- Protect from light.
  Avoid reaction with oxidizing agents.
  For incompatible materials - refer to Section 7 - Handling and Storage.

Section 11 - TOXICOLOGICAL INFORMATION
BORAGE OIL
TOXICITY AND IRRITATION
- Not available. Refer to individual constituents.

GAMMA-LINOLENIC ACID:
- No significant acute toxicological data identified in literature search.

SKIN
<table>
<thead>
<tr>
<th>Fatty Acid</th>
<th>Value</th>
<th>Notes</th>
<th>Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>palmitic acid</td>
<td>ND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>palmitic acid</td>
<td>ND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>palmitic acid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>stearic acid</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Section 12 - ECOLOGICAL INFORMATION
Refer to data for ingredients, which follows:
LINOLEIC ACID:
GAMMA-LINOLENIC ACID:
ARACHIDIC ACID:
OLEIC ACID:
- Unsaturated vegetable oils are often used in paints which upon "drying" produce a polymeric network formed of the constituent fatty acids. During the drying process, a number of compounds are produced that do not contribute to the polymer network. These include unstable hydroperoxide (ROOH) the major by-product of the reaction of oxygen with unsaturated fatty acids. The hydroperoxides quickly decompose, forming carbon dioxide and water, as well as a variety of aldehydes, acids and hydrocarbons. Many of these compounds are volatile, and in an unpigmented oil, they would be quickly lost to the environment. However, in paints, such volatiles may react with lead, zinc, copper or iron compounds in the pigment, and remain in the paint film as coordination complexes or salts. A large number of the original ester bonds in the oil molecules undergo hydrolysis releasing individual fatty acids. Some portion of the free fatty acids react with metals in the pigment, producing metal carboxylates. Together, the various non-cross-linking substances associated with the polymer network constitute the mobile phases. Unlike the molecules that are part of the network itself, they are capable of moving and diffusing within the film, and can be removed using heat or a solvent. The mobile phase may play a role in plasticising the paint film, preventing it from becoming too brittle.

One simple technique for monitoring the early stages of the drying process is to measure weight change in an oil film over time. Initially, the film becomes heavier, as it absorbs large amounts of oxygen. Then oxygen uptake ceases, and the weight of the film declines as volatile compounds are lost to the environment.

As the oil ages, a further transition occurs. Carboxyl groups in the polymers of the stationary phase lose a hydrogen ion, becoming negatively charged, and form complexes with metal cations present in the pigment. The original network, with its nonpolar, covalent bonds is replaced by an ionomeric structure, held together by ionic interactions. At present, the structure of these ionomeric networks is not well understood.

STEARIC ACID:
LINOLEIC ACID:
ARACHIDIC ACID:
PALMITIC ACID:
- DO NOT discharge into sewer or waterways.
GAMMA-LINOLENIC ACID:
OLEIC ACID:
- Substances containing unsaturated carbons are ubiquitous in indoor environments. They result from many sources (see below). Most are reactive with environmental ozone and many produce stable products which are thought to adversely affect human health. The potential for surfaces in an enclosed space to facilitate reactions should be considered.

<table>
<thead>
<tr>
<th>Source of unsaturated substances</th>
<th>Unsaturated substances (Reactive Emissions)</th>
<th>Major Stable Products produced following reaction with ozone.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupants (exhaled breath, ski oils, personal care products)</td>
<td>Isoprene, nitric oxide, squalene, unsaturated sterols, oleic acid and other unsaturated fatty acids, unsaturated oxidation products</td>
<td>Methacrolein, methyl vinyl ketone, nitrogen dioxide, acetone, 6MHQ, geranyl acetone, 4OPA, formaldehyde, nonanal, decanal, 9-oxo-nonanoic acid, azelaic acid, nonanoic acid.</td>
</tr>
<tr>
<td>Soft woods, wood flooring, including cypress, cedar and silver fir boards, houseplants</td>
<td>Isoprene, limonene, alpha-pinene, other terpenes and sesquiterpenes</td>
<td>Formaldehyde, 4-AMC, pinonaldehyde, pinic acid, pinonic acid, fornic acid, methacrolein, methyl vinyl ketone, SOAs including ultrafine particles</td>
</tr>
<tr>
<td>Carpets and carpet backing</td>
<td>4-Phenylcyclohexene, 4-vinylcyclohexene, styrene, 2-ethylhexyl acrylate, unsaturated fatty acids and esters</td>
<td>Formaldehyde, acetaldehyde, benzaldehyde, hexanal, nonanal, 2-nonenal</td>
</tr>
<tr>
<td>Linoleum and paints/polishes containing linseed oil</td>
<td>Linoleic acid, linolenic acid</td>
<td>Propanal, hexanal, nonanal, 2-heptenal, 2-nonenal, 1-pentene-3-one, propionic acid, n-butyric acid</td>
</tr>
<tr>
<td>Latex paint</td>
<td>Residual monomers</td>
<td>Formaldehyde</td>
</tr>
<tr>
<td>Certain cleaning products, polishes, waxes, freseneners</td>
<td>Limonene, alpha-pinene, terpinolene, alpha-terpineol, linalool, linalyl acetate and other terpenoids, longifolene and other sesquiterpenes</td>
<td>Formaldehyde, acetaldehyde, glycolaldehyde, formic acid, acetic acid, hydrogen and organic peroxides, acetone, benzaldehyde, 4-hydroxy-4-methyl-5-hexen-1-ol, 5-ethenyl-dihydro-5-methyl-2(3H)-furanone, 4-AMC, SOAs including ultrafine particles</td>
</tr>
<tr>
<td>Natural rubber adhesive</td>
<td>Isoprene, terpenes</td>
<td>Formaldehyde, methacrolein, methyl vinyl ketone</td>
</tr>
<tr>
<td>Photocopier toner, printed paper, styrene polymers</td>
<td>Styrene</td>
<td>Formaldehyde, benzaldehyde</td>
</tr>
<tr>
<td>Environmental tobacco smoke</td>
<td>Styrene, acrolein, nicotine</td>
<td>Formaldehyde, benzaldehyde, hexanal, glyoxal, N-methylformamide, nicotinaldehyde, cotinine</td>
</tr>
<tr>
<td>Soiled clothing, fabrics, bedding</td>
<td>Squalene, unsaturated sterols, oleic acid and other saturated fatty acids</td>
<td>Acetone, geranyl acetone, 6MHQ, 4OPA, formaldehyde, nonanal, decanal, 9-oxo-nonanoic acid, azelaic acid, nonanoic acid</td>
</tr>
<tr>
<td>Soiled particle filters</td>
<td>Unsaturated fatty acids from plant waxes, leaf litter, and other vegetative debris; soot; diesel particles</td>
<td>Formaldehyde, nonanal, and other aldehydes; azelaic acid; nonanoic acid; 9-oxo-nonanoic acid and other oxo-acids; compounds with mixed functional groups (=O, -OH, and -COOH)</td>
</tr>
<tr>
<td>Ventilation ducts and duct liners</td>
<td>Unsaturated fatty acids and esters, unsaturated oils, neoprene</td>
<td>C5 to C10 aldehydes</td>
</tr>
<tr>
<td>&quot;Urban grime&quot;</td>
<td>Polycyclic aromatic hydrocarbons</td>
<td>Oxidized polycyclic aromatic hydrocarbons</td>
</tr>
<tr>
<td>Perfumes, colognes, essential oils (e.g. lavender, eucalyptus, tea tree)</td>
<td>Limonene, alpha-pinene, linalool, linalyl acetate, terpinene-4-ol, gamma-terpinene</td>
<td>Formaldehyde, 4-AMC, acetone, 4-hydroxy-4-methyl-5-hexen-1-ol, 5-ethenyl-dihydro-5-methyl-2(3H)-furanone, 4-AMC, SOAs including ultrafine particles</td>
</tr>
<tr>
<td>Overall home emissions</td>
<td>Limonene, alpha-pinene, styrene</td>
<td>Formaldehyde, 4-AMC, pinonaldehyde, acetone, pinic acid, pinonic acid, fornic acid, benzaldehyde, SOAs including ultrafine particles</td>
</tr>
</tbody>
</table>

Abbreviations: 4-AMC, 4-acetyl-1-methylcyclohexene; 6MHQ, 6-methyl-5-heptene-2-one; 4OPA, 4-oxopentanal; SOA, Secondary Organic Aerosols
Reference: Charles J Weschler; Environmental Health Perspectives, Vol 114, October 2006.

BORAGE OIL:
PALMITIC ACID:
- Fish LC50 (96hr.) (mg/l):
  - 11
- BOD5:
  - 1.07
- COD:
  - 28%
- ThOD:
  - 2.87
- BOD 5: 1.07%
- COD: 28%
- ThOD: 2.87
- Fish LD50 (96 h): 4200-4450 mg/L

STEARIC ACID:
Fish LC50 (96hr.) (mg/l):
BOD 5 if unstated: 0.8-1.44
COD: 30%
Anaerobic effects: sig degrad
Potential to bioaccumulate
log Pow >7

OLEIC ACID:
Fish LC50 (96hr.) (mg/l):
BOD 5:
COD:
ThOD:
log Kow: 7.18
log Koc: 5.24

LINOLEIC ACID:
GAMMA-LINOLENIC ACID:
ARACHIDIC ACID:
GADOLEIC ACID:

Ecotoxicity

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Persistence: Water/Soil</th>
<th>Persistence: Air</th>
<th>Bioaccumulation</th>
<th>Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td>palmitic acid</td>
<td>LOW</td>
<td>LOW</td>
<td>MED</td>
<td></td>
</tr>
<tr>
<td>stearic acid</td>
<td>LOW</td>
<td>LOW</td>
<td>LOW</td>
<td></td>
</tr>
<tr>
<td>oleic acid</td>
<td>LOW</td>
<td>LOW</td>
<td>LOW</td>
<td></td>
</tr>
<tr>
<td>linoleic acid</td>
<td>LOW</td>
<td>HIGH</td>
<td>LOW</td>
<td></td>
</tr>
<tr>
<td>gamma-linolenic acid</td>
<td>LOW</td>
<td>LOW</td>
<td>LOW</td>
<td></td>
</tr>
<tr>
<td>arachidic acid</td>
<td>LOW</td>
<td>HIGH</td>
<td>LOW</td>
<td></td>
</tr>
</tbody>
</table>

GESAMP/EHS COMPOSITE LIST - GESAMP Hazard Profiles

<table>
<thead>
<tr>
<th>Name / Cas No / RTECS No</th>
<th>EHS</th>
<th>TRN</th>
<th>A1a</th>
<th>A1b</th>
<th>A1</th>
<th>A2</th>
<th>B1</th>
<th>B2</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>E1</th>
<th>E2</th>
<th>E3</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1: INTER</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>F~ / CAS:84012 - 16-8</td>
<td></td>
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</tr>
</tbody>
</table>

Disposal Instructions

All waste must be handled in accordance with local, state and federal regulations. Legislation addressing waste disposal requirements may differ by country, state and/or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked. A Hierarchy of Controls seems to be common - the user should investigate:
- Reduction
- Reuse
- Recycling
- Disposal (if all else fails)

This material may be recycled if unused, or if it has not been contaminated so as to make it unsuitable for its intended use. If it has been contaminated, it may be possible to reclaim the product by filtration, distillation or some other means. Shelf life considerations should also be applied in making decisions of this type. Note that properties of a material may change in use, and recycling or reuse may not always be appropriate.

DO NOT allow wash water from cleaning equipment to enter drains. Collect all wash water for treatment before disposal.

Recycle wherever possible or consult manufacturer for recycling options.

Consult Waste Management Authority for disposal.

Bury or incinerate residue at an approved site.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - TRANSPORTATION INFORMATION

NOT REGULATED FOR TRANSPORT OF DANGEROUS GOODS: DOT, IATA, IMDG

Section 15 - REGULATORY INFORMATION

REGULATIONS

Borage oil (CAS: 84012-16-8) is found on the following regulatory lists;
"Canada Domestic Substances List (DSL)"

Regulations for ingredients

palmitic acid (CAS: 57-10-3) is found on the following regulatory lists;

stearic acid (CAS: 57-11-4) is found on the following regulatory lists;

oleic acid (CAS: 112-80-1) is found on the following regulatory lists;

linoleic acid (CAS: 60-33-3, 121250-47-3) is found on the following regulatory lists;
"Canada Ingredient Disclosure List (SOR/88-64)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (French)","IMO MARPOL 73/78 (Annex II) - List of Noxious Liquid Substances Carried in Bulk","International Council of Chemical Associations (ICCA) - High Production Volume List","OECD Representative List of High Production Volume (HPV) Chemicals","US EPA High Production Volume Program Chemical List","US Food Additive Database","US Toxic Substances Control Act (TSCA) - Inventory"

gamma-linolenic acid (CAS: 506-26-3) is found on the following regulatory lists;
"Canada Domestic Substances List (DSL)"

arachidic acid (CAS: 506-30-9) is found on the following regulatory lists;
"Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (French)","International Council of Chemical Associations (ICCA) - High Production Volume List","OECD Representative List of High Production Volume (HPV) Chemicals","US EPA Toxic Substances Control Act (TSCA) - Inventory"

No data for gadoleic acid (CAS: )

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

- May produce discomfort of the respiratory system*.
  * (limited evidence).

Denmark Advisory list for selfclassification of dangerous substances

<table>
<thead>
<tr>
<th>Substance</th>
<th>CAS</th>
<th>Suggested codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>palmitic acid</td>
<td>57-10-3</td>
<td>N R50</td>
</tr>
<tr>
<td>stearic acid</td>
<td>57-11-4</td>
<td>N R50</td>
</tr>
</tbody>
</table>

Ingredients with multiple CAS Nos

<table>
<thead>
<tr>
<th>Ingredient Name</th>
<th>CAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>linoleic acid</td>
<td>60-33-3, 121250-47-3</td>
</tr>
</tbody>
</table>
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Classification of the mixture and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.

A list of reference resources used to assist the committee may be found at: www.chemwatch.net/references.

The (M)SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

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