AVASOL

RUBBER REMOVER

HEALTH, SAFETY & ENVIRONMENT MANUAL

Version May 19, 2009

CONTENTS

I. INTRODUCTION

The following report is a comprehensive review of Avasol Rubber Remover and aspects relating to its impact on occupational health and safety, toxicology, ecology and other related environmental issues.

Avasol has been specially developed by EvergreenSolutions to meet the ever-increasing demand for products which deliver effective performance in removing rubber from runways and improved environmental and toxicological properties. While there is much to be said regarding the performance related attributes of Avasol, this report focuses solely on how Avasol has been designed to achieve the highest possible worksite and environmental safety standards in its product class.

During the developmental phase of Avasol Evergreen Solutions looked to a number of regulatory bodies and associations to establish strict health and safety parameters and limits for the product. All of Avasol's components were scrutinized and screened to ensure that the final product would exceed the strictest limits under the general category of 'Industrial Cleaners'. Though this is not an exhaustive list, the following bodies, agencies and associations were referred to or consulted in establishing the health, safety and environmental benchmarks for Avasol:

- **OSHA**
- **WHMIS**
- **NFPA**
- **OECD**
- **NIOSH**
- **Department of Transportation**
- **US. EPA**
- **USDA**
- **Environment Canada**
- **CEPA**
- **Alberta Transportation**
- **Transport Canada**
- **Green Seal**
- **Environmental Choice**

Evergreen Solutions has conducted numerous 'in-house' laboratory tests to ensure that Avasol lives up to its health and safety claims. To provide additional credibility to these claims, a series of toxicity and ecology tests were conducted through various independent laboratories. This report summarizes these lab results, as well as provides detailed lab records for additional analysis. These records can be found in *Schedules B through D.*

II. AVASOL COMPONENTS

Though this report does not provide the reader with a specific ingredient list (for proprietary reasons), it categorically looks at each component and applies them to the scrutiny of toxic chemical reporting regulations. In addition, a confidential ingredient synopsis is available in the *Material Safety Data Sheet, Section 2, under ingredient data. This particular MSDS can be found in Schedule A.*

Each individual component of Avasol has been selected, not only for its ability to penetrate soil and break down heavy oil, but also for its potential to be safe and less toxic to humans, and the ecosystem.

a) All Avasol components are listed on the following inventories:

- **Canada DSL** (Canadian Domestic Substance List)
- **U.S.A. TSCA** (Toxic Substances Control Act)
- **Europe EINECS** (European Inventory of Existing Commercial Chemicals)
- **Australian AICS** (Inventory of Chemical Substances)
- **Japan ENCS** (Existing and New Chemical Substances)

b) SARA (Superfund Amendments and Reauthorization Act), Section 313 (Toxic Chemical Release Reporting) 40 CFR 372 - None of the ingredients within Avasol are listed.

III. HEALTH & SAFETY RATING

Based on the results shown in the subsequent tests as well as additional information, appropriate health and safety ratings have been established to ensuring the safety of workers.

a) WHMIS (Workplace Hazardous Materials Information System): Class B, Division 3

b) HMIS (Hazardous Materials Information System):

Health	**1**
Flammability	**2**
Reactivity	**0**
PPE	**B**

c) NFPA

d) EU Classification and Labeling

R-phrases: Currently not classified according to EEC Directives however, may be irritant to eyes (Risk phrase R36)
S-phrases: S-25 Avoid contact with eyes

IV. PHYSICAL CHARACTERISTIC

a) Test: Flammability

Test Facility: Evergreen Solutions Laboratory
Tested by: K. Bukasa
Test Method: Cleveland Open Cup

Test Result: 167°F

Description:

Canada Transport of Dangerous Goods (TDG) regulations deem a product to be flammable if it has a flash point equal to or less then 60°C using the close cup test method or a flash point of 65.6°C using the open cup test method. Avasol is classified as non-flammable according to the Department of Transportation and thus can be transported as such. Avasol is not classified as flammable by WHMIS/OSHA criteria. Avasol must be moderately heated or exposed to high ambient temperatures before ignition will occur.

EU Avasol is classified as non-flammable since the flash point is higher than 55°C

b) Test: pH

Test Facility: Evergreen Solutions Laboratory
Tested by: K. Bukasa
Test Method: pH 211 microprocessor pH meter

Test Result: 10.63

c) Test: Odor

Test Facility: Evergreen Solutions Laboratory
Tested by: K. Bukasa
Test Method: Atomization in small enclosed area

Test Result: Though the odor of the product is quite distinct, in an atomized form, the odor most resembles that of peaches.

V. HEALTH AND SAFETY TESTING

1. Acute Toxicity

It is obviously unethical to test for acute toxicity in humans and most acute toxicity data comes from animal testing. However, Evergreen Solutions recognizes the need to protect animal welfare and discourages testing in animals. Since each ingredient of Avasol has been tested according to OECD Guidelines for the testing of chemicals and the current toxicological information of each of them is available the product can be determined by adding the toxicity of individual components of the product. WHIM and the Harmonized Hazard Classification System for Chemical Substances recognize that the mixture is then considered a tested mixture, with the LD50 or LC50 derived from this formula:

$$\frac{1}{LD_{50}\text{ of Mixture}} = \frac{\text{Proportion of ingr. A}}{LD_{50}\text{ of ingr. A}} + \frac{\text{Proportion of ingr. B}}{LD_{50}\text{ of ingr. B}} + \frac{\text{Proportion of ingr. Z}}{LD_{50}\text{ of ingr. Z}}$$

a) Test: Dermal ATEmax (Acute Toxicity Estimate)

Test Facility: Evergreen Solutions Laboratory
Tested by: K. Bukasa
Test Method: The dermal ATE of the mixture is determined by calculation from all relevant ingredients with a known acute toxicity.

Test Result: LD_{50} (Dermal, rabbit) > 4,425 mg/kg

Description: The dermal toxicity test is probably the most relevant toxicity test relating to health and safety because the exposure to Avasol by the dermal route is most likely, as opposed to other exposure routes. The dermal toxicity test provides useful information on health hazards likely to arise from a short-term exposure by the dermal route.

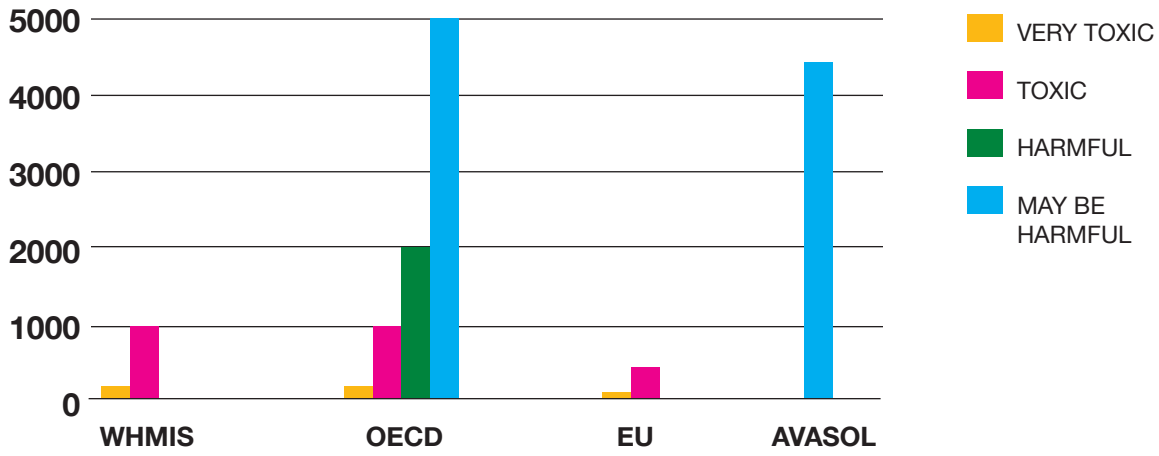
According to WHMIS/OSHA, Avasol is non-toxic. Avasol exceeds WHMIS/OSHA's requirement for a chemical being dermal toxic by at least 400%.

In analyzing Avasol's dermal toxicity, the Harmonized Hazard Classification System for Chemical Substances was also consulted. The basis for the harmonized criteria are those which are currently in use in OECD countries as well as those recommended by the United National Committee of Experts on the Transport of Dangerous Goods (UNCETDG).

According to the OECD, Avasol is classed as a Category 5, (class 1 being the highest toxicity, class 5 being lowest toxicity) as it has a dermal LD50 within the range of 2,000 - 5,000. Criteria for Category 5 are intended to enable identification of substances which are of relatively low acute toxicity hazard. The dermal toxicity value indicates that Avasol is classified as a 'Slightly Toxic' chemical.

Avasol Dermal Toxicity compared to WHMIS/OECD requirements

mg/kg



b) Test: Oral ATEmax (Acute Toxicity Estimate)

Test Facility: Evergreen Solutions Laboratory
Tested by: K. Bukasa
Test Method: The oral ATE of the mixture is determined by calculation from all relevant ingredients with a known acute toxicity.

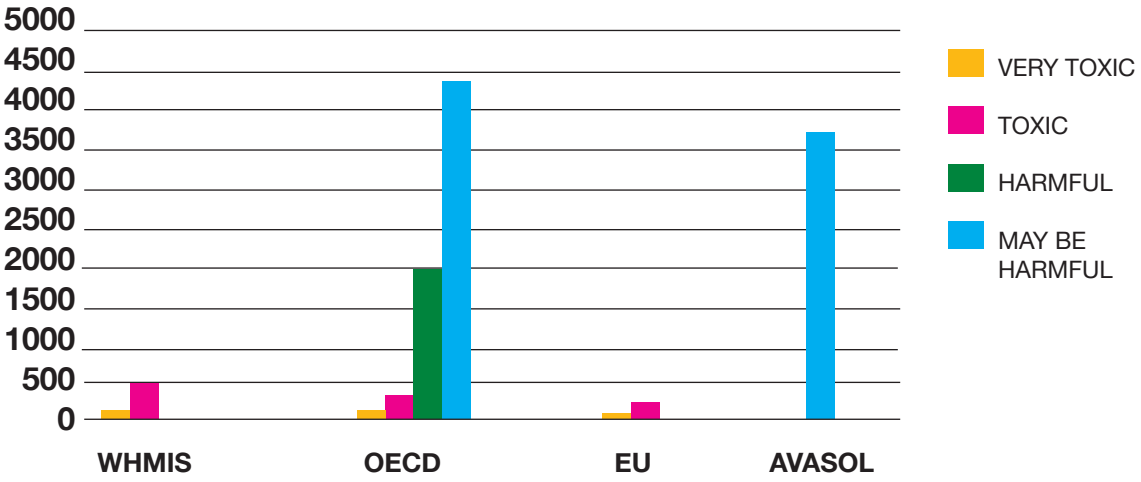
Test Result: LD_{50} (Oral, rat) > 4,236 mg/kg

Description: The oral toxicity test provides useful information on health hazards likely to arise from a short-term exposure by the oral route.

According to WHMIS/OSHA, Avasol is non-toxic. Avasol exceeds WHMIS/OSHA's requirements in relation to oral toxicity by at least 800%.

According to the OECD, Avasol is classed as a Category 5 as it has an oral LD_{50} within the range of 2,000 - 5,000 mg/kg. The oral toxicity value indicates that Avasol is classified as a 'Slightly Toxic' chemical.

Avasol Oral Toxicity compared to WHMIS/OECD requirements



2. Carcinogen and Reproductive Toxins

Test: Carcinogenicity and Reproductive Toxicity
Test Method: Carcinogenicity and reproductive toxicity of the mixture is determined by adding all relevant ingredients which are known as carcinogenic or have reproductive toxicity.

Test Result: Avasol is not carcinogenic and does not have reproductive toxins.

Description: Avasol does not contain any ingredients that are listed as Group 1 (known), Group 2a (probable) or Group 2b (possible) carcinogens in the international Agency for Research on Cancer (IARC) Monographs on the Evaluation of the Carcinogenic Risk of the Chemicals to Humans.

4. Skin Corrosion / Irritation

a) Test: Skin Study

Test Facility: Evergreen Solutions Laboratory
Tested by: K. Bukasa
Test Method: Determining the corrosion and irritation potential of a chemical before testing is undertaken.

Test Result: Avasol is not corrosive to skin.

Description: Based on OECD criteria substances may be viewed as corrosive based simply on pH test. Substances with a demonstrated pH<2 or pH>11.5, especially when buffering capacity is present, are considered being corrosive to skin. Avasol is not corrosive to skin sins its pH is 10.63

IV. ENVIRONMENTAL DATA

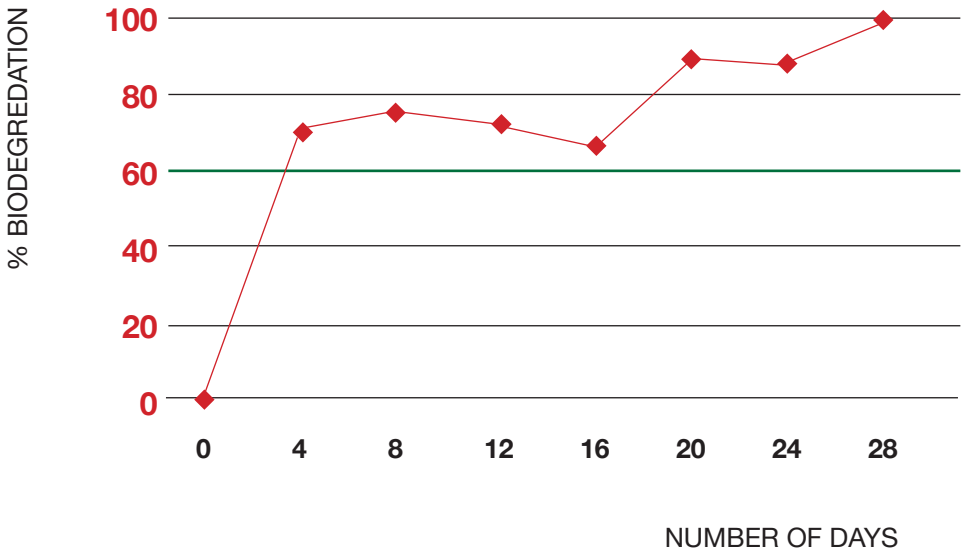
Avasol has been carefully designed to do its job efficiently and allow our customers to obtain outstanding performance, while minimizing the effect of their activities on the environment.

1. Biodegradability

Test: Readily Biodegradability
Test Method: OECD 301D (Organization for Economic Cooperation and Development) Closed Bottle Test
Test Facility: Biodegradation and Ecotoxicity Laboratory, MPOB

Test Result: Readily Biodegradable.
For specific test results, please refer to Schedule B.

Description: Because of product's outstanding success in the industrial market and its extensive use, the ability of Avasol to biodegrade is very critical. Due to this, Avasol was formulated with solvents, surfactants and other chemicals that rapidly biodegrade and can be quickly removed from the environment. While effects can occur, particularly in the event of a spillage or accident, they will be localized and of very short duration. Laboratory studies have shown that Avasol is readily biodegradable. Avasol will undergo readily biodegradation in 4 days. Biodegradation was defined using the OECD301D, Closed Bottle Test.



2. Aquatic Toxicity

Avasol has been formulated to minimize the impact of its discharge to an aquatic ecosystem. It has been establish that the level of toxicity to both fish and lower organisms on the aquatic food chain are very low. Evaluations were conducted on pure product on Tilapia Nilopia (tropical species). Results of this tests is given as LC_{50} (lethal concentration to 50% of the test population over a given time frame).

Acute aquatic toxicity was determined using a fish 96 hour LC_{50}. Based on acute toxicity data and environmental fate data Avasol is slightly toxic to aquatic life with following values.

a) Test: Tropic fish 96h Acute Test

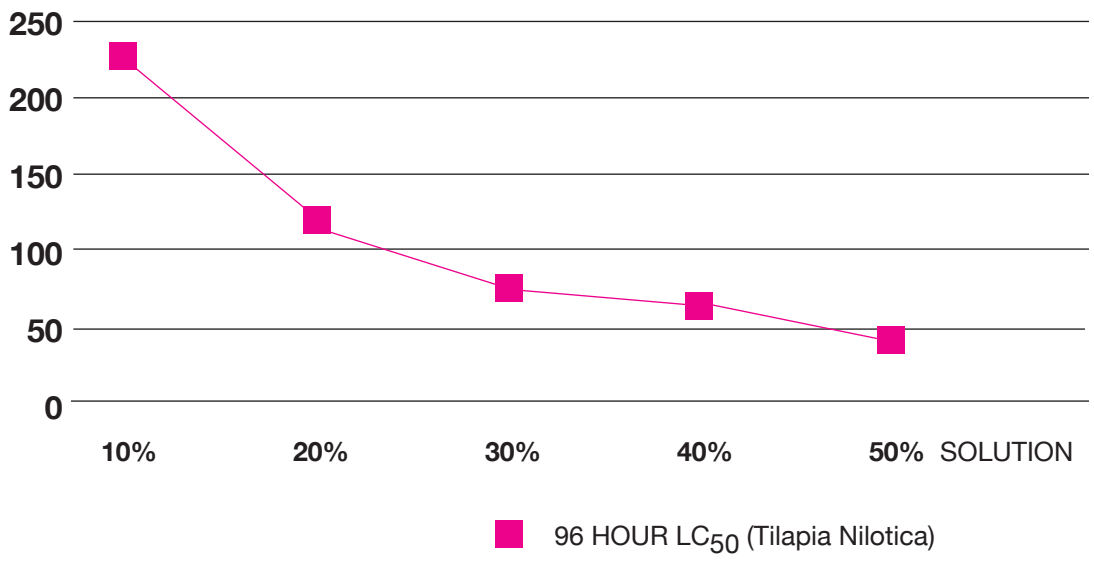
Test Method: OECD 203, Fish, Acute Toxicity
Test Facility: Biodegradation and Ecotoxicity Laboratory, MPOB

Test Result: 96 hour LC_{50} (Tilapia Nilotica) = 22.6 mg/l
For specific test results, please refer to Schedule D.

It should be noted that a number of above studies reflect toxicity for the pure product. It is rare for the full strength product to be released directly to the environment since it requires being rinsed at least with 10 parts of water. We can estimate the aquatic toxicity of this waste solution.

Waste Solution
96 hour LC_{50} (Tilapia Nilotica) = 22.6 mg/l

Eco Toxicity of Different Dilution Concentrations



This is very important because should the waste get into the water during the time it takes to biodegrade, there will not be a negative impact on the environment.

3. Ozone Depletion

Test: Ozone Depleting Potential
Test Method: The ozone depletion content of the mixture is determined by calculation from all relevant ingredients with a known ozone depletion factor.

Test Result: Avasol has ozone-depleting potential of zero.

Description: Ozone depletion describes two distinct, but related observations: a slow, steady decline of about 4 percent per decade in the total amount of ozone in Earth's stratosphere; and a much larger, but seasonal, decrease in stratospheric ozone over Earth's polar regions during the same period. The content of Avasol does not have any ozone depletion chemicals (ODCs) that contribute to decreasing of the ozone layer.

4. Eutrophication

Test: Euprophication Potential
Test Method: The amount of phosphorus and nitrogen of the mixture is determined by adding all relevant ingredients with a known phosphorus and nitrogen content.

Test Result: AvaSol does not contain any phosphorus and nitrogen.

Description: AvaSol does not contain any substances that fertilize water bodies with nitrogen and phosphorus, often leading to changes in animal and plant populations and degradation of water and habitat quality.

VII. Conclusion

It is hoped that the preceding information provides the reader with a relatively good understanding of the health, safety and environmental issues surrounding AvaSol.

Evergreen Solutions has taken great care to ensure that AvaSol will effectively do the job it was intended to do without putting employees or the environment at risk. Furthermore, Evergreen Solutions is committed to providing ongoing technical information and assistance to those who are currently using or are interested in incorporating AvaSol in their operations.

Please feel free to contact **Kabongo Bukasa at 1-800-610-5907** if you have any questions regarding the information in this report.

VIII. QUALITY ASSURANCE PROTOCOL

Evergreen Solutions maintains a strict Quality Assurance Protocol, designed to ensure consistent and reliable quality in every manufactured batch of AvaSol.

1. Baseline Standards and Parameters

The Baseline Standards and Parameters are in essence the very building blocks of the Quality Assurance Protocol. They provide the essential measuring stick and foundation required to ensure the highest level of compliance attainable.

1. pH - The pH parameter for AvaSol is set between **9.98 - 10.98**
2. Density - The density parameter for AvaSol is set between **0.965 - 0.980**
3. Flashpoint - The flashpoint parameter for AvaSol is set between **159ºF - 172ºF (Open Cup)**
4. Color & Clarity - Within the first 48 hours of being blended, AvaSol is light gold in color and is visibly clear. Over a period of 2 weeks, AvaSol will slightly darken into an amber color, but will always remain clear and free of any floating particulate or sediment. Factors that may alter the color or clarity may include product exposure to higher or lower temperature conditions.
5. Refractive Index - The Refractive Index for AvaSol is set between **1.415 - 1.425**

Evidence that a blend of AvaSol is off-spec drives the correction action system to address problems requiring immediate correction and possible additional actions. When a correction to a product takes place, the customer support representatives stay in close contact with the customer until they get the optimum results with the corrected product.

2. Raw Material Quality Assessment and Procedures

The Quality Assurance for AvaSol begins far before the blending process is ever underway.

• Upon the sourcing of the various raw materials that ultimately make up the AvaSol product, strict specification standards for each raw material is established and followed. Evergreen Solutions requires each manufacturer to provide written documentation that all raw materials meet their specification.

• All raw materials are visually inspected for contaminants; density, appearance and odor conformance. In case of “visual’ nonconformance the product is tested in the laboratory.

• In case of nonconformance of one of the vendor’s products, all the incoming raw materials of this vendor are tested in the lab until it is verify that it was one-time defect.

• When Evergreen Solutions take a new supplier all incoming products are tested in the laboratory until it is verify that they are able to support their product

• Evergreen Solutions evaluates its vendors every six months regarding nonconforming products. If nonconformance issue is repeated three times Evergreen Solutions replaces this provider.

3. Batching & Batch Testing Procedures

The batch testing typically happens within 48 hours of the blend, ensuring that the product meets the baseline standards (as described in Section A) before it is made available for sale.

• A sample is taken from every batch of AvaSol as soon as blending is done and it is analyzed in the laboratory within 6 hours.

• Quality control department produces a certificate of analysis for each batch. All Certificates of Analysis are kept for five years and are provided to Evergreen Solutions' customers if they request it. A sample Certificate of Analysis can be viewed in *Schedule D* of this report.

• Each blend is coded and the code is placed on the container with the sample of AvaSol. The samples are kept for six months.

• A freshly made AvaSol is packed in:

- **64 Gal. (1000L) totes**
- **55 Gal. (205L) drums**
- **5 Gal. (20L) pails**

• Each container has products label with a number of the lot (code) placed on the bottom of it.

• Totes, drums and pails are placed on a sturdy wooden pallet designed for fork lift truck access.

• All pails and cases placed on wooden pallets are bound with a protective stretch wrap cover to prevent damage to the containers during transportation. For additional falling protection they are fastened with a strap on the top and the bottom of the pile.

SCHEDULE A (MSDS)

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MATERIAL SAFETY DATA SHEET

<< N/E = Not established N/AP = Not Applicable N/AV = Not Available C.O.C = Cleveland Open Cup>>

SECTION I: MATERIAL IDENTIFICATION AND USE

Material Name / Identifier:	**Avasol – Rubber Remover**
Material Intended Use:	Rubber Remover
WHMIS Class:	Class B Division 3
TDG Classification:	Not regulated
Chemical Family:	Proprietary complex mixture
Manufacturer's Name:	Evergreen Solutions Inc.
Address:	110, 3506 – 118 Avenue SE
City & Province:	Calgary, Alberta, T2Z 3X1
Emergency Telephone:	1-800-610-5907

SECTION II: INGREDIENT DATA

Ingredients:	**Vol.%**	**CAS No**	**Symbols**	**R Phrase**
Monoethanolamine	< 5%	141-43-5	C	R20/21/23 , R34,
Terpenes hydrocarbons	≥ 5 %	94266-47-4	Xi	R: 10, 38

EEC Label Symbol and Classification: **Currently not classified according to EEC Directives; however, may be irritant to eyes (Risk phrase R36)**

SECTION III: HAZARDS IDENTIFICATION

Route of Entry: Eye
Ingestion
Inhalation

Effects of Exposure (Acute/Chronic): May cause irritation to the eye, skin irritation; may produce gastrointestinal disturbances including irritation, nausea, and diarrhea if ingested in large quantities.

SECTION IV: FIRST AID MEASURES

Eyes:	Do not rub eyes. Immediately flush with warm running water for 5 minutes. Call a physician if irritation develops.
Skin:	Wash with soap and water. See physician if irritation develops.
Ingestion:	No toxic effect is expected Rinse mouths with water and drink 1 glass of water. Do not induce vomiting. Consult a physician.
Inhalation:	Immediately remove the affected victim to fresh air. If symptoms persist, obtain medical attention.

SECTION V: FIRE AND EXPLOSION HAZARD DATA

Flammable:	No
Combustible:	Yes
If yes: - Lower Explosive Limit (% vol) component:	N/A
- Upper Explosive Limit (% vol) component:	N/A
- Means of Extinction:	Water or dry foam.

SECTION VI: ACCIDENTAL RELEASE MEASURES

Small spill:	Use appropriate tools to wipe up the product. Rinse contaminated area with water
Large spill:	Stop the leak if possible. Ventilate the area involved. Block release of hazardous chemicals from sewer or storm drains. Contain and clean-up the spill. Observe all personal protection equipment recommendations
Waste Disposal:	Follow local regulations for discharge of waste effluent.

SECTION VII: SAFE HANDLING AND STORAGE

Storage and Handling:	Store in cool, dry area. Keep container closed when not in use.
Storage Temperature	< 50ºC
Handling	Observe all PPE

SECTION VIII: EXPOSURE CONTROL / PERSONAL PROTCTION

Engineering Control	When product is used in confined space, the use of proper ventilation is required.
Protective Handwear:	Gloves recommended preventing drying of hands.
Protective Eyewear:	Safety glasses with side shields or goggles
Other protective clothing:	Not required.
Respiratory Apparatus:	Adequate fresh air ventilation recommended
Local/mechanical exhaust:	Not normally required if good ventilation is maintained.

SECTION IX: PHYSICAL DATA

Physical State:	Liquid	Odour:	Peach
Appearance:	Gold	Odor Threshold:	n/e
Specific Gravity:	0.972	Vapor Pressure:	n/ap
Vapor Density:(Air=1)	N/A	Evaporation rate:	n/e
Boiling Point: (0C.)	N/A	Freezing Point: (0C.)	
Solubility in Water:	N/A	pH factor:	10.63
Flash Point/Method op. cup: (0C.)	67ºC	% Volatile:	n/e
Explosive	No	Oxidizer	No
Water solubility	N/AVA	Viscosity	N/E

SECTION X: STABILITY AND REACTIVITY DATA

Chemical Stability:	Stable
Incompatible with other Substances?	Yes
If so, which ones?	Strong oxidizing agents, strong reducing acids
Hazardous Decomposition Products:	N/A
Hazardous polymerization:	Will not occur

SECTION XI: TOXICOLOGICAL INFORMATION

Acute Oral Toxicity Estimate	LD_{50} (Oral, rat) > 4,230 mg / kg
Carcinogenicity Data:	The ingredients of this product is not classed as carcinogenic by ACGIH, IARC, OSHA
Reproductive Data:	No adverse reproductive effects are anticipated
Mutagenicity Data:	No adverse reproductive effects are anticipated
Skin sensitization:	N/AV

SECTION XII: ECOLOGICAL INFORMATION

Ecotoxicology:	96 hour LC_{50} (Tilapia Nilotica) = 22 mg/l
Biodegradability:	Readily biodegradable

SECTION XIII: DISPOSAL CONSIDERATIONS

Consult your local regional authority for disposal options

SECTION XIV: TRANSPORTATION INFORMATION

ADR Classification	Not Regulated
DOT (Department of Transportation)	Not Regulated
TDG (Canada Transport of Dangerous Goods)	Not Regulated
ICAO/IATA	Not Regulated
IMO/IMDG	Not Regulated

SECTION XV: REGULATORY INFORMATION

European Labeling R-phrases: Currently not classified according to EEC Directives however, may be irritant to eyes (Risk phrase R36)
S-phrases: S-25 Avoid contact with eyes

United State / Canada

HMIS Rating	Health:1 Flammability: 2 Reactivity: 0 PPE: B
WHMIS	Class B Division 3

SECTION IX: ADDITIONAL INFORMATION

Risk phrases: Full l text of the R-phrases indicated in this safety data sheet.
The labeling of the product is indicated in Section XV

R10: Flammable
R38: Irritating to skin
R20/21/22: Harmful by inhalation, in contact with skin and if swallowed.

Further information: Information for this Material Safety Data Sheet was prepared from sources considered reliable. While every effort has been made to ensure full disclosure of product hazards, data is not available in some cases and is so stated where applicable.The manufacturer assumes no liability or responsibility, and no warranty is expressed or implied, in cases where products are mishandled, misused or instructions are not strictly observed. Each recipient of this MSDS is encouraged to study it carefully to fully understand this product.

SECTION X: PREPARATION INFORMATION

Prepared by:	**Evergreen Solutions**
Telephone:	1-800-610-5907
Date:	08-Jan-029
Replaces:	07-Jan-01

SCHEDULE B (Biodegradability)

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BIODEGRADATION AND ECOTOXICITY LABORATORY
AOTD, MPOB

Biodegradation Test Report
Report No.: OPS/BDT/EXT/NAC/27-08

Biodegradation of Avasol

Summary

The biodegradability of Avasol was determined using method OECD 301D, Closed Bottle Test. The whole test followed a few steps according to the OECD (Organization for Economic Cooperation and Development) test method.

The solution of the test substance in mineral medium, usually at 2 – 5 mg/l, is inoculated with a relatively small number of microorganisms and kept in completely full, closed bottles in the dark at constant temperature. Biodegradation is followed by analysis of dissolved oxygen over a 28-day period. The amount of oxygen taken up by the microbial population during biodegradation of the test substance, corrected for uptake by the blank inoculums run in parallel, is expressed as a percentage of THOD (Theoretical Oxygen Demand).

The dissolved oxygen of the samples was measured every 4 days to allow the construction of biodegradation curve.

Avasol is biodegradable when tested according to OECD 301D Closed Bottle Test method. It reaches the 60% pass level after 4 days and therefore can be regarded as readily biodegradable in the aquatic environment.

Introduction

Biodegradation test was conducted on Avasol to obtain biodegradation data for this product.

This study assessed the biodegradation of the above-mentioned sample by inoculating the sample with a small number of microorganisms. Media preparation and biodegradation test were conducted according to OECD (Organization for Economic Cooperation and Development) standard method.

The sample was tested with test method OECD 301D Closed Bottle Test. The test period was 35 days, which included pre-conditioning period for the inoculums (7 days) and the actual test (28 days). The result will be discussed in detail below.

Methods

Test sample

Upon receipt, the sample was stored at room temperature until used.

Preparation of test media

Mineral medium were prepared from stock solutions of appropriate concentrations of mineral components, namely, potassium and sodium phosphates plus ammonium chloride, calcium chloride, magnesium sulphate and iron (III) chloride.

Since the sample was soluble in water, stock solutions of the samples at 5 g/l were prepared and aliquots were used to prepare the final test solutions.

Biodegradation Tests

- *Test Guideline*

Test were carried out according to the following test guideline:
OECD 301D Closed Bottle Test (OECD Guidelines for testing of chemicals, 1992).

- *Inoculum*

The inoculum (microorganisms) was derived from a secondary effluent from a domestic wastewater treatment plant. The inoculums was pre-conditioned to the experimental conditions by aerating the effluent for 5 – 7 days at the test temperature.

- *Preparation of BOD bottles*

The mineral medium was strongly aerated for 20 minutes and allowed to stand for 20 hours at the test temperature. Parallel groups of BOD bottles were prepared for the determination of test substance, reference substance (sodium acetate), blank and toxicity control in simultaneous experimental series.

The test solutions were prepared by adding sufficient amount of stock solutions of test and reference substances to the mineral medium (using separate large bottles) so that the final concentration of the substance is 2 mg/l.

For toxicity control (to check whether the test substance is inhibitory to the inoculums), both test and reference substances were added together to the mineral medium at final concentration of 2 mg/l.

Number of BOD bottles

In a typical run, the following bottles were used:

- *16 containing test substance and inoculums (test suspension)*
- *16 containing only inoculums (blank)*
- *16 containing reference substance and inoculum (procedure control)*
- *16 containing test substanace, reference substance and inoculums (toxicity control)*

All bottles were stored in the dark at 22^{O}C – 25^{O}C for 28 days.

- *Measurements of dissolved oxygen*

All measurements were done in duplicate. The zero-time bottles were analyzed immediately using the Dissolved Oxygen meter. Duplicate bottles of all series were withdrawn at 4 days interval for measurement of dissolved oxygen.

- *Treatment of Results*

The BOD at each interval was calculated by substracting the oxygen depletion (mg O_2/l) of the blank from that exhibited by the test substance. Divided this corrected depletion by the concentration (mg/l) of test substance, to obtain the specitic BOD as mg O_2/mg test substance.

$$\text{BOD} = \frac{\text{mg } O_2\text{/l uptake by test substance} - O_2\text{/l uptake by blank}}{\text{Mg test substance/l vessel}} = \frac{\text{mg } O_2\text{/mg test}}{\text{substance}}$$

The percentage biodegradation was calculated by dividing the specific BOD by the specific THOD.

$$\%\text{biodegradation} = \frac{\text{BOD (mg } O_2\text{/mg test substance)}}{\text{THOD (mg } O_2\text{/mg test substance)}} \times 100$$

The THOD for the reference substance (sodium scetate) and all test substances are as follows.

Substance	THOD
Sodium acetate	0.78
Avasol	0.4321

Results

• Avasol

The dissolved oxygen data are given in Table 1 and the biodegradation curves in Figure 1.

TABLE 1. DISSOLVED OXYGEN SATA FOR BLANK, REFERENCE SUBSTANCE, TEST SUBSTANCE AND TOXICITY CONTROL

Dissolved oxygen (mg/O_2/l)*

Sample	0	4	8	12	16	20	24	28
Blank	8.37	7.91	7.78	7.46	7.15	7.21	7.29	7.23
Reference substance	8.34	7.05	6.67	6.43	6.35	6.32	6.21	5.16
Avasol	8.32	4.56	2.04	1.55	1.42	1.00	0.84	0.48
Toxicity control	8.33	5.63	4.25	4.08	3.40	2.84	3.65	3.30

**Mean of 2 readings*

In order to check the procedure, reference compound, which meet the criteria for ready biodegradability is tested in parallel as part of normal test runs. The pass level for ready biodegradability is 60% removal of THOD or 60% biodegradability. Test substance that reach this pass level within 28 days period can be considered to be rapidly and completely biodegrade in aquatic environments under aerobic conditions. In order to check whether the test substance inhibit the activity of microorganisms, the toxicity control bottles containing both the test and reference substances were run in parallel as part of normal test runs. If less than 25% biodegradation occurred within 144 days, the test substance can be assumed to be inhibitory.

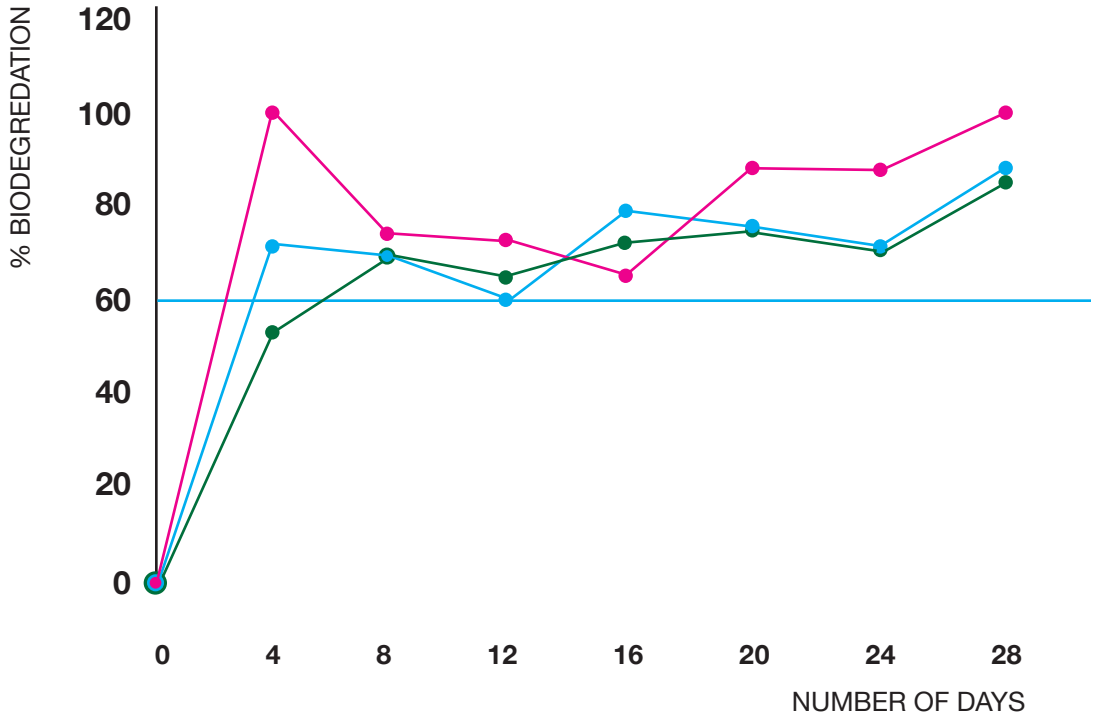
Sample Avasol is a readily biodegradable product when tested according to standard test method OECD 301D. It reaches the pass level (60%) in 4 days.

Conclusion

Avasol is biodegradable when tested according to OECD 301D Closed Bottle Test method. It reaches the 60% pass level after 4 days and therefore can be regarded as readily biodegradable in the aquatic environment.

Reference

OECD 301D Closed Bottle Test (OECD Guidelines for testing of chemicals, 1992).



	0	4	8	12	16	20	24	28
Reference	0	52.9	69.6	64.7	72.1	74.4	70.2	84.6
Avasol	0	100.1	74.1	72.3	64.8	87.9	87.4	99.5
Tox. Control	0	71.8	69.7	60.2	79.6	75.5	71	87.9

SCHEDULE C (Tropic fish 96h Acute Test)

HEALTH, SAFETY & ENVIRONMENT MANUAL
Version May 19, 2009

Biodegradation & Ecotoxicity Laboratory
AOTD, MPOB

Ecotoxicity of Avasol/Runway Cleaner

Summary

The ecotoxicity of Avasol/Runway Cleaner were determined using method OECD 203, Fish, Acute Toxicity Test. The whole test followed a few steps according to the OECD (Organization for Economic Cooperation and Development) test method.

The fish were exposed to the test substance in two stages. The first stage, *i.e. range-finding test*, the fish were exposed to various concentrations (in logarithmic series) of the test substance for 24 hours. The concentration range between no mortality and 100% mortality were taken and used in the second stage of the test, i.e. definitive test. The fish were exposed to various concentrations (in geometric series) of the test substance for 96 hours. Mortalities were recorded at 24, 48, 72 and 96 hours and the concentration that kills 50% of fish (LC_{50}) were determined.

Avasol/Runway Cleaner has an LC_{50} value of 22.6 mg/l in the fish, Acute Toxicity Test and based on the rating scheme by the US Fish and Wildlife Services, it is considered as slightly toxic.

1. Introduction

Ecotoxicity test assessed the toxicity of the sample by exposing various concentrations of the sample to fish. The test method used was the OECD 203, Fish, Acute Toxicity Test. Mortality were recorded daily and the LC_{50} values were calculated based on the concentration causing no mortality and 100% mortality after 96 hours. The test period was 12 days, which included pre-conditioning period for the fish (7 days), range-finding test (1 day) and definitive test (4 days). The results will be discussed in detail in Section 3.

2. Methods

2.1 Test sample

Upon receipt, the sample was stored at room temperature until used.

2.2 Ecotoxicity Tests

2.2.1 Holding of fish

The fish (Talapia nilotica) were held in the laboratory for at least 7 days before they were used for testing (pre-conditioning period). They were exposed to 12 to 16 hours photoperiod daily, temperature of 25^{o}C ± 1^{o}C and at least 80% oxygen concentration.

2.2.2 Test Solutions

Test solutions of the chosen concentrations were prepared by dilution of a stock solution. Stock Solution was prepared at 5 g/l

2.2.3 Conditions of Exposure

Conditions of exposure were the same as the pre-conditioning period. The fish were not fed during testing and the oxygen concentration in the test chambers were maintained at more than 60%.

2.2.4 Test Concentrations

At least five concentrations in logarithmic series (range-findding test) or geometric series (definitive test) were used.

2.2.5 Observations

The fish were inspected after 24, 48, 72 and 96 hours. Fish were considered dead if there was no visible movement and if touching of the caudal peduncle produces no reaction. Dead fish were removed when observed and mortalities were recorded.

2.2.6 Treatment of Results

The highest concentration causing no mortality and the lowest concentration causing 100% mortality were used to calculate the LC_{50} (geometric mean of these two concentrations).

Rating scheme used by the United States Fish and Wildlife Services for aquatic toxicity is shown below.

RATING	**LC (mg/l)**
Super toxic	<0.01
Extremely toxic	0.01-0.1
Highly toxic	0.1-1.0
Moderately toxic	1.0-10.0
Slightly toxic	10.0-100.0
Practically non-toxic	100.0-1000.0
Relatively harmless	>1000.0

Source : Drozd, 1991.

3. Results

3.1 Avasol/Runway Cleaner

The toxicity of Avasol/Runway Cleaner is shown in Table 1. The LC_{50} of Avasol/Runway Cleaner Cleaneris calculated as a geometric mean of the highest concentration that kills none/few fish, 16.0 mg/l and the lowest concentration that kills all fish, 32.0 mg/l. The LC_{50} is 22.6 mg/l.

TABLE 1. MORTALITIES OF EVERSOL MSC/RUNWAY CLEANER AFTER 96 HOURS

CONCENTRATION (mg/l)	**NO> OF DEAD FISH***	**% MORTALITY**
0.0	0	0
4.0	0	0
8.0	0	0
16.0	1	10
32.0	10	100

**Mean of two readings*

4. Conclusion

Avasol/Runway Cleaner has an LC_{50} value of 22.6 mg/l in the Fish, Acute Toxicity test and based on the rating scheme by the US Fish and Wildlife Services, it is considered as slightly toxic.

5. Reference

OECD 203 Fish, Acute Toxicty Test (OECD Guildlines For Testing of Chemicals. 1992).

DROZD, J C (1991). Use of Sulfonated Methy1 Esters in Household Cleaning Products. Proceedings of World Conference on Oleochemicals Into the 21st Century. Ed. By Applewhite, T.H. American Oils Chemists' Society:256-268.

SCHEDULE D (Certificate of Analysis)

HEALTH, SAFETY & ENVIRONMENT MANUAL
Version May 19, 2009

EVERGREEN SOLUTIONS INC.
SAFETY…AND PERFORMANCE YOU CAN TRUST

CERTIFICATE OF ANALYSIS

Product Name: **AvaSol**
Lot Number: **13628**
Date: April 9, 2009

PROPERTIES	SPECIFICATIONS	ANALYSIS
Appearance	Liquid	Liquid
pH	9.98 – 10.98	10.46
Flash Point	159ºF - 172ºF	165ºF
Density	0.965 – 0.980	0.969
Color	Gold	Gold
Refractive Index	1,415-1,425	1.418

Research & Development Evergreen Solutions