Pest Management Regulatory Agency
Agence de réglementation de la lutte antiparasitaire

Proposed Regulatory Decision Document PRDD2006-03

Octenol
(1-Octen-3-ol)

Bedoukian Research Inc. has submitted an application to register Bedoukian Octenol Technical (99.7% octenol) as a mosquito attractant. Bedoukian Octenol Technical is proposed for use in lures produced by the following companies: American Biophysics Corporation (Mosquito Magnet™ Octenol Biting Insect Attractant), Armatron International (Flowtron® Mosquito Attractant), Biosensory Corporation (BioSensory Biting Insect Lure), Blue Rhino Consumer Products (SkeeterVac® FineTune™ Biting Insect Lure) and Envirosafe Technologies NZ Limited (Mega-Catch Octenol Fragrance Strip). Fourteen devices that emit octenol have also been proposed for registration.

This Proposed Regulatory Decision Document provides a summary of data received and the rationale for the proposed full registration of these products. The Pest Management Regulatory Agency (PMRA) will accept written comments on this proposal up to 45 days from the date of publication of this document. Please forward all comments to Publications at the address below.

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Foreword

The submissions for full registration of octenol and the associated lures and devices for attracting, trapping and killing certain mosquitoes have been reviewed by Health Canada's PMRA.

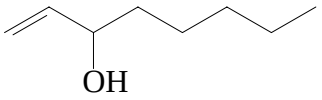
The PMRA has carried out an assessment of the available information in accordance with the Pest Control Products Regulations and has found it sufficient to allow a determination of the safety, merit and value of octenol and the associated lures and devices. The Agency has concluded that the use of octenol and the associated lures and devices in accordance with the label has merit and value consistent with the Pest Control Products Regulations and does not entail an unacceptable risk of harm. Therefore, based on the considerations outlined above, the use of octenol and the associated lures and devices for attracting, trapping and killing mosquitoes is proposed for full registration pursuant to the Pest Control Products Regulations.

Methods for analyzing octenol in environmental media are available to research and monitoring agencies upon request to the PMRA.

Table of Contents

1.0 The Active Substance, its Properties and Uses

1.1 Identity of the Active Substance and Impurities

Active substance		Octenol
Function		Insecticide
Chemical name		
1.	International Union of Pure and Applied Chemistry	Oct-1-en-3-ol
2.	Chemical Abstracts Service (CAS)	1-Octen-3-ol
CAS number		3391-86-4
Molecular formula		$C_8H_{16}O$
Molecular weight		128.2
Structural formula		
Nominal purity of active ingredient		99.7%
Identity of relevant impurities of toxicological, environmental or other significance		The technical grade octenol does not contain any impurities or microcontaminants known to be Toxic Substances Management Policy (TSMP) Track 1 substances

1.2 Physical and Chemical Properties

Technical Product: Bedoukian Octenol Technical

Property	Result	Comment
Colour and physical state	Colourless to pale yellow	
Odour	Earthy, mushroom-like odour	
Melting point or range	The product is a liquid	

Property	Result	Comment
Boiling point or range	174°C	
Density	0.84 g/mL	
Vapour pressure at 25°C	110 Pa	Highly volatile
Henry's law constant	7.68 Pa × m^3 × mol^{-1} at 25°C 7.58 × 10^{-5} atm × m^3 × mol^{-1} at 25°C 1/H = 322	Volatile from a water surface
Ultraviolet (UV) – visible spectrum	λ_{max} = 288 nm	Minimum/no phototransformation expected
Molar absorption coefficient (ε)	0.240	Weak absorbance
Solubility in water at 25°C	1836 g/L	Highly soluble
Solubility (g/L) in organic solvents	Soluble in 95% alcohol at a rate of 1:1	
n-Octanol–water partition coefficient (K_{ow})	Log K_{ow} = 2.6	Limited potential for bioconcentration
Dissociation constant (pK_a)	N/A	
Stability (temperature, metal)	Not compatible with strong oxidizing agents	

End-use Products—BioSensory Biting Insect Lure, Mega-Catch Octenol Fragrance Strip, SkeeterVac FineTune Biting Insect Lure, Mosquito Magnet Octenol Biting Insect Attractant, Flowtron Mosquito Attractant

Property	Result
BioSensory Biting Insect Lure, Mega-Catch Octenol Fragrance Strip, SkeeterVac FineTune Biting Insect Lure	
Colour	White to off-white
Odour	Herbaceous, mushroom-like
Physical state	Solid waxy mass inside a plastic trough
Formulation type	Slow-release generator
Guarantee	1-octen-3-ol, 3.74 g/lure
Formulants	The product does not contain any PMRA List 1 formulants or formulants known to be TSMP Track 1 substances.
Container material and description	Individually sealed polypropylene cartridges
Density	0.930–0.970 g/mL
pH of 1% dispersion in water	Not water dispersible
Oxidizing or reducing action	Not reactive
Storage stability	Not yet complete: results expected in mid-2006
Explodability	Not expected to be explosive
Mosquito Magnet Octenol Biting Insect Attractant	
Colour	White
Odour	Earthy, herbaceous
Physical state	Solid porous polyethylene wafer with the liquid inside a groove
Formulation type	Slow-release generator
Guarantee	1-octen-3-ol, 1.66 g/wafer
Formulants	The product does not contain any PMRA List 1 formulants or formulants known to be TSMP Track 1 substances.

Property	Result
Container material and description	Individual polyethylene terephthalate (PET) cartridges, with up to three in a polyethylene bag
Bulk density of liquid	0.84 g/mL
pH of 1% dispersion in water	pH of wafer cannot be measured
Oxidizing or reducing action	Wafer is an unreactive polymer
Storage stability	Stable over 16 months in the commercial container at ambient temperature
Explodability	Not expected to be explosive
Flowtron Mosquito Attractant	
Colour	White
Odour	Earthy, mushroom-like
Physical state	Solid porous polyethylene strip with the liquid inside pores
Formulation type	Slow-release generator
Guarantee	1-octen-3-ol, 1.66 g/strip
Formulants	The product does not contain any PMRA List 1 formulants or formulants known to be TSMP Track 1 substances.
Container material and description	Vinyl container with polyester film cover, in a polypropylene bag
Bulk density of liquid	0.84 g/mL
pH of 1% dispersion in water	pH of strip cannot be measured
Oxidizing or reducing action	Strip is an unreactive polymer
Storage stability	Not yet complete: results expected in mid-2006
Explodability	Not expected to be explosive

1.3 Details of Uses

Bedoukian Research Inc. has submitted an application to register Bedoukian Octenol Technical (99.7% octenol) as a mosquito attractant. The Bedoukian Octenol Technical is proposed for use in lures produced by the following companies: American Biophysics Corporation (Mosquito Magnet™ Octenol Biting Insect Attractant), Armatron International (Flowtron® Mosquito Attractant), Biosensory Corporation (BioSensory Biting Insect Lure), Blue Rhino Consumer Products (SkeeterVac® FineTune™ Biting Insect Lure) and Envirosafe Technologies NZ Limited (Mega-Catch Octenol Fragrance Strip). Fourteen devices that emit octenol and/or carbon dioxide have also been proposed for registration.

2.0 Methods of Analysis

Not applicable.

3.0 Impact on Human and Animal Health

3.1 Integrated Toxicological Summary

A critical review of the toxicological database was conducted for Bedoukian Octenol Technical and its associated end-use formulations. The database consisted of acute toxicity studies, published scientific literature and scientific rationales to support requests to waive certain testing. The acute toxicity studies were carried out in accordance with currently accepted international testing protocols and good laboratory practices. The scientific quality of the data was high, and the database was considered adequate to define fully the potential toxic effects that may result from exposure to this chemical.

Bedoukian Octenol Technical was highly acutely toxic via the oral route of exposure. It was moderately irritating to the eye, mildly irritating to the skin and was not a dermal sensitizer. No acute dermal or inhalation studies were submitted for review. Instead, requests to waive testing were submitted along with published literature and surrogate data as a scientific rationale. The requests were accepted.

No acute toxicity studies were submitted for any of the lures and associated devices. Instead, requests were submitted to waive testing based on the proposed use of the end-use formulations and the identity and the innocuous nature of the formulation ingredients. As none of the formulation ingredients were of toxicological concern, the requests to waive all acute toxicity testing were accepted for all the lures and their associated devices.

According to published literature, aliphatic secondary alcohols and ketones are absorbed through the gastrointestinal tract (peak 1–2 hours) following oral exposure and are subsequently rapidly eliminated from the blood. Octenol is primarily metabolized by conjugation with glucuronic acid and excreted in the urine or bile. However, octenol can

also be oxidized to the corresponding α,β-unsaturated ketone, 1-octen-3-one, and then conjugated with glutathione and excreted in the bile or undergo additional transformations: hydrolysis and *N*-acetylation yielding a *N*-acetyl-L-cysteine derivative (i.e., a mercapturic acid derivative); and the ketone group is reduced to the corresponding alcohol. Other potential metabolites include DNA adducts and other metabolites from epoxide intermediates. Information on location of metabolites and on kinetics were not provided.

No genotoxicity studies were submitted for review. Instead, a request to waive testing was submitted along with published scientific literature and surrogate data showing no genotoxic effects for two structurally similar chemicals, 1-decen-3-ol and linalool. The α,β-unsaturated secondary alcohol group in octenol, however, is considered to be a structural alert by Joint FAO/WHO Expert Committee on Food Additives. Octenol can be oxidized to its corresponding α,β-unsaturated ketone, a chemical compound that can bind to DNA or cause oxidative stress at high cellular concentrations, i.e., under glutathione-limiting conditions. The Committee also noted potential genotoxic effects resulting from reactive epoxide intermediates at high cellular concentrations. However, such concentrations are not likely to occur with the proposed use of octenol. The request to waive testing was accepted.

No subchronic, chronic, reproductive or developmental toxicity studies were submitted. A search of published scientific literature yielded no information in this regard. The request to waive these requirements was considered acceptable in recognition of the negligible exposure potential associated with this specific outdoor use pattern (see Section 3.5.3).

3.2 Determination of Acceptable Daily Intake

Not applicable.

3.3 Acute Reference Dose

Not applicable.

3.4 Toxicological Endpoint Selection—Occupational and Bystander Risk Assessment

Given the very limited toxicity data available for octenol, toxicological endpoints were not selected and a qualitative risk characterization approach was taken.

3.5 Impact on Human and Animal Health Arising from Exposure to the Active Substance or to its Impurities

3.5.1 Operator Exposure Assessment

Not applicable as the product is a domestic class product.

3.5.2 Residential Exposure and Risk

3.5.2.1 Handler Exposure and Risk

Limited handler exposure by the dermal and inhalation routes may occur when handlers insert the octenol lure into the mosquito trapping device. The active ingredient is contained within a sealed plastic cassette containing perforations to allow the slow release of octenol vapours. Exposure and risk to the handler is expected to be negligible when inserting the lure into the trapping device and changing spent lure cassettes because the packaging limits access to the octenol.

3.5.3 Bystander Exposure and Risk

Exposure and risk to bystanders is expected to be negligible because the number of units set up in a given area will be limited, the handlers are directed to set up the units in areas away from where people congregate. Moreover, the octenol is released slowly over a period of time and is quickly diluted by ambient air.

4.0 Residues

Not applicable.

5.0 Fate and Behaviour in the Environment

Octenol is very soluble in water (1836 mg/L) at 25°C, indicating a potential for leaching into groundwater. The vapour pressure (110 Pa at 25°C) indicates octenol is highly volatile. The Henry's law constant (1/H = 322) indicates that octenol is volatile from a water surface. The log K_{ow} is 2.6, which indicates a limited potential for bioconcentration. These data are summarized in Section 1.2.

Semiochemicals generally dissipate rapidly in the terrestrial and aquatic environments, primarily by volatilization and degradation. Octenol, with a Henry's law constant of 1/H = 322 and a volatility of 110 Pa at 25°C, is expected to volatilize from soil and water surfaces rapidly. However, the end-use products are designed to control the release of the octanol and are not intended for use in aquatic environments.

Depending on the release device and age of the octenol cartridge, octenol release rates may vary from 0.0076 to 0.075 g a.i./day. Considering the continuous use of the Mosquito Magnet Octenol Insect Attractant, which releases the highest amount of octenol (0.048 g/day on average) relative to the other devices being considered, the maximum total octenol released over a 12-week mosquito season was estimated to be 20.2 g a.i./ha/season (see calculation below). The calculated octenol release was based on the label rate of 1 device per 0.2 ha. The amount of octenol to be emitted may also be user-defined, depending on the release device, when the included automatic release timer are used. In this case, the amount of octenol released would be less than

20.2 g a.i./ha/season.

0.048 g a.i./day/device × 5 devices/ha × 7 days/week × 12 weeks/season =
20.2 g a.i./ha/season

This amount of pheromone is far below the 375 g a.i./ha/season threshold that the PMRA considers to be the limit, above which there may be concern for impacts on non-target organisms or the environment.

6.0 Effects on Non-target Species

6.1 Effects on Terrestrial Organisms

Arthropod semiochemicals are inherently different from conventional pesticides in their non-toxic, target-specific mode of action and natural occurrence. Also, they are generally effective in controlling pests at very low rates, comparable to levels that occur naturally. Octenol is a naturally occurring volatile alcohol, produced and released by many species of plants, animals and mushrooms. Although no toxicology data were submitted for birds, earthworms and wild mammals, toxicity of octenol to these species is expected to be negligible at the proposed release rates. The target pest species known to be attracted to octenol; however, it is not entirely clear what non-target insects would also be attracted to an electronic flying insect killer device by the presence of octenol (see Section 6.3).

6.2 Effects on Aquatic Organisms

Pheromones and other semiochemicals have been characterized as toxic to aquatic invertebrates (*Daphnia*) and fish, although these results may reflect a suffocating effect of the oily surface film formed by high test concentrations of many pheromones. However, given its widespread distribution in nature, octenol is expected to have limited toxicity to aquatic organisms.

6.3 Risk Assessment

As octenol is applied at very low rates (~20 g a.i./ha/year) over land through fixed-point release devices, minimal exposure of aquatic and terrestrial organisms to the active ingredient is expected. Therefore, risks to aquatic and terrestrial organisms are expected to be minimal. Exposure to aquatic organisms from product disposal can be mitigated by product label statements.

With regards to the unknown effects of octenol emitted by electrostatic flying insect traps to non-target arthropods, non-target insect exposure to the electric shock may be limited to small flying insects. Notwithstanding these concerns and considering the domestic application in which the end-use products are intended, the risk to species at risk (lepidopterans) is expected to be minimal. Should the applicant wish to register octenol

for commercial and/or agricultural uses in the future, additional environmental data may be required.

6.4 Risk Mitigation

The following label amendments are required to mitigate the risk to the environment.

The following statement to the must be added to the **PRECAUTIONS** section of the Bedoukian Octenol Technical label:

> DO NOT contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes.

The following statements must appear on the label of all end-use products (see annotations):

> DO NOT contaminate irrigation or drinking water supplies or aquatic habitats by disposal of wastes
>
> GENERAL: DO NOT reuse the spent cartridges. Dispose in household garbage. Unused or partially used products should be disposed at provincially or municipally designated hazardous waste disposal sites.

No buffer zone is necessary.

7.0 Efficacy

7.1 Effectiveness Against Target Organisms or with Respect to the Effect Achieved

7.1.1 Intended Use

Bedoukian Research Inc. has submitted an application to register Bedoukian Octenol Technical (99.7% octenol) as a mosquito attractant. The Bedoukian Octenol Technical is proposed for use in lures produced by the following companies: American Biophysics Corporation (Mosquito Magnet™ Octenol Biting Insect Attractant), Armatron International (Flowtron® Mosquito Attractant), Biosensory Corporation (BioSensory Biting Insect Lure), Blue Rhino Consumer Products (SkeeterVac® FineTune™ Biting Insect Lure) and Envirosafe Technologies NZ Limited (Mega-Catch Octenol Fragrance Strip). Fourteen devices that emit carbon dioxide and/or octenol have also been proposed for registration.

7.1.2 Mode of Action

Octenol mimics a component of mammalian breath and is capable of attracting mosquitoes, but has no insecticidal properties.

7.1.3 Crops

This product is not used on crops.

7.1.4 Effectiveness Against Pest

Submissions for registration of 14 mosquito devices containing octenol have been submitted to the PMRA. The submitted efficacy data demonstrated that devices emitting carbon dioxide and/or octenol are capable of trapping and killing mosquitoes.

The scientifically demonstrated value of these devices is limited to trapping and killing mosquitoes. However, no deleterious effect to using these devices was observed in the available data because there was no increase in the number of bites in an area with a device compared to an area without a device.

The submitted data support the registration of the mosquito devices that emit carbon dioxide and/or octenol with a claim of “traps and kills mosquitoes”. Any other proposed label claims like population reduction, reduction of the nuisance caused by mosquitoes or protection from mosquito bites would require supporting data.

7.2 Phytotoxicity to Target Plants or Target Plant Products

Not applicable.

7.3 Impact on Succeeding Crops, Adjacent Crops and on Treated Plants or Plant Products Used for Propagation

Not applicable.

7.4 Economics

None identified.

7.5 Sustainability

7.5.1 Survey of Alternatives

Several active ingredients are registered to kill adult mosquitoes, including malathion, lambda-cyhalothrin, d-trans allethrin, proproxur, permethrin, tetramethrin and d-cis/trans allethrin. Non-chemical practices that domestic users can adopt to kill mosquito larvae users include removing standing water.

7.5.2 Compatibility with Current Management Practices Including Integrated Pest Management

The devices that emit carbon dioxide and/or octenol proposed for registration are capable of trapping and killing mosquitoes. These devices could be used in conjunction with current mosquito control practices like the removal of mosquito larvae development sites (i.e., standing water).

7.5.3 Contribution to Risk Reduction

There is not enough information available to be able to assess the impact of the devices on risk reduction.

7.5.4 Information on the Occurrence or Possible Occurrence of the Development of Resistance

Resistance by mammalian-feeding mosquitoes to octenol is unlikely.

7.6 Conclusions

Submitted efficacy data support the registration of the mosquito devices that emit carbon dioxide and/or octenol with a claim of “traps and kills mosquitoes”.

8.0 Toxic Substances Management Policy

During the review of technical grade octenol, the PMRA has taken into account the federal Toxic Substances Management Policy and has followed its Regulatory Directive DIR99-03. It has been determined that technical grade octenol does not meet TSMP Track 1 criteria because of its non-persistence and low toxicity. The formulated products do not contain any formulants that are known to be TSMP Track 1 substances.

9.0 Proposed Regulatory Decision

The active ingredient octenol and the associated lures and devices are proposed for full registration, pursuant to the Pest Control Products Regulations, to attract, trap and kill mosquitoes.

List of Abbreviations

°C	degrees Celcius
1/H	Henry's law constant
a.i.	active ingredient
bw	body weight
g	gram
ha	hectare
kg	kilogram
K_{ow}	*n*-octanol–water partition coefficient
L	litre
LD_{50}	lethal dose to 50%
m^3	cubic metre
MAS	maximum average score
mg	milligram
MIS	maximum irritation score
mL	millimetre
mol	mole
nm	nanometre
Pa	Pascal
p*Ka*	dissociation constant
PMRA	Pest Management Regulatory Agency
TSMP	Toxic Substances Management Policy
UV	ultraviolet

Appendix I Toxicology

Study	Species, Strain and Doses	LD_{50} mg/kg bw	Target Organ, Significant Effects, Comments
Acute Studies—Bedoukian Octenol Technical			
Oral (Up and down method)	Rat, outbred albino rat 6 females 99 mg/kg bw, 175 mg/kg bw and 310 mg/kg bw	175 mg/kg bw	High Toxicity **99 mg/kg bw—1 animal** – Piloerection was noted throughout Day 1. **175 mg/kg bw—3 animals** – One animal was found moribund (catelepsy and dyspnea) after 4 hours. Necropsy findings included bright red liver and dark kidneys (inside). – Another animal displayed piloerection throughout Day 1. **310 mg/kg bw—2 animals** – Both animals were found dead after 4 hours. Necropsy findings included bright red livers and dark kidneys (inside). Label recommendation: DANGER POISON
Dermal	Waiver rationale was submitted instead of data.		Accepted.
Inhalation	Waiver rationale was submitted instead of data.		Accepted
Skin Irritation	Rabbit, New Zealand white 1 male and 2 females 0.5 mL for 4 hours	MIS = 3/8 (72 hours) MAS = 2.44/8	Mildly irritating. Label recommendation: CAUTION - SKIN IRRITANT
Eye Irritation	Rabbit, New Zealand white 1 male and 2 females 0.1 mL	MIS = 18.7/110 (24 hours) MAS = 14.9/110	Moderately irritating. Label recommendation: WARNING - EYE IRRITANT

Study	Species, Strain and Doses	LD_{50} mg/kg bw	Target Organ, Significant Effects, Comments
Skin Sensitization (Buehler)	Guinea pig, albino 10/sex Induction: undiluted octenol Challenge: 50% octenol in 80% ethanol	Negative	Not a dermal sensitizer.
Acute Studies—All Lures and Devices			
Oral	Waiver rationale was submitted instead of data.		Accepted. Label recommendation: DANGER POISON CAUTION - SKIN IRRITANT WARNING - EYE IRRITANT
Dermal			
Inhalation			
Skin Irritation			
Eye Irritation			
Skin Sensitization (Test method)			
Subchronic, Chronic, Reproductive and Developmental Toxicity			
21-day dermal	Waiver rationale was submitted instead of data.		Accepted.
28-day dietary			
90-day dietary			
12-month dietary/capsule			
78-week dietary			
2-year dietary			
Multigeneration			
Developmental toxicity			
Genotoxicity			
Gene mutations in bacteria	Waiver rationale was submitted instead of data.		Accepted.

Study	Species, Strain and Doses	LD_{50} mg/kg bw	Target Organ, Significant Effects, Comments
Gene mutations in mammalian cells in vitro			
Unscheduled DNA synthesis			
Chromosome aberrations in vitro			
Unscheduled DNA synthesis in vitro			
Micronucleus assay (in vivo)			

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