File No: EX/42(NA/976)

3 April 2020

NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME

FULL PUBLIC REPORT

Chemical in F-500

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Director
Chemicals Notification and Assessment

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Chemical in F-500

1. APPLICANT

Original Holder of Assessment Certificate (First Applicant)

An Assessment Certificate for the notified chemical known by the name Chemical in F-500 was granted to Specialised Fire Solutions Pty Ltd of 38 Riverdale Road HELENA VALLEY WA 6056 (ABN 33 095 162 780).

The Assessment Report for Chemical in F-500 is identified by the sequence number NA/976.

Second Applicant

Since granting of the abovementioned Assessment Certificate, Environmental Hazard Management Pty Ltd of Level 1 Airport Terminal Building, Grenier Drive ARCHERFIELD AIRPORT QLD 4106 (ABN 20 102 726 474) has submitted a notification statement in support of their application for an extension of the original Assessment Certificate for Chemical in F-500. Specialised Fire Solutions Pty Ltd has agreed to this extension.

Information submitted by Environmental Hazard Management Pty Ltd pertains to the introduction of the notified polymer for use as a component in fire fighting solution.

As specified in the Recommendations section of this assessment report, a secondary notification is required if the imported volume from all notifiers exceeds 10 tonnes per year.

2. IDENTITY OF THE CHEMICAL

The chemical name, CAS number, molecular and structural formulae, molecular weight, spectral data have been exempted from publication in the Full Public Report and the Summary Report.

Marketing Name: F-500

3. PHYSICAL AND CHEMICAL PROPERTIES

The experimental physico-chemical data supplied with the notification were for F-500, which is a 45% aqueous concentrate of the notified chemical. Some physico-chemical parameters such as partition coefficient, water solubility and dissociation constant were estimated using Quantitative Structure Activity Relationships (QSARs) through a commercial software package known as Advanced Chemical Development (ACD) software.

Appearance at 20°C & 101.3 kPa:	A transparent amber to golden liquid (F-500).
Melting Point:	-3°C
Boiling Point:	118°C (F-500)
Specific Gravity:	990 kg (F-500)
Vapour Pressure:	2.7 kPa at 25°C (F-500)
Water Solubility:	≥ 450 g/L
Partition Co-efficient (n-octanol/water):	log P_{ow}=2 (calculated). (see comments below).
Hydrolysis as a Function of pH:	Not determined (see comments below).
Adsorption/Desorption:	Strongly adsorbent on soils (see comments below).
Dissociation Constant:	Not determined (see comments below).
Flash Point:	Not determined.
Flammability Limits:	Non-flammable.
Autoignition Temperature:	Not determined.
Explosive Properties:	None.
Reactivity/Stability:	Strong oxidiser.
Surface Tension:	Not determined (see comments below).

3.1 Comments on Physico-Chemical Properties

The boiling point result is for the F-500 concentrate, and reflects the high proportion of water present in this formulation. The notified chemical is an ionic salt and would be expected to have a high boiling point, and would probably decompose prior to boiling (GlobalTox International Consultants Inc., 2000).

The vapour pressure was determined using an isoteniscope, and the result reflects the vapour pressure of water rather than the notified chemical. The chemical is an ionic salt with a relatively high molecular weight and consequently is expected to have a low vapour pressure (GlobalTox International Consultants Inc., 2000).

The notified chemical is imported as a 45% solution in water, so while no quantitative data on water solubility is available, it is highly compatible with water. As indicated below in the discussion of the partition coefficient, due to its surfactant properties, the chemical will form

colloidal aggregates known as micelles when mixed with water. Although not truly soluble in the usual sense of the word, the formation of such colloidal structures allows for the accommodation of large quantities of such surfactant compounds into the aqueous phase. In the present case, the high proportion of the notified chemical in the F-500 formulation is probably assisted through the presence of alkyl alcohols and other co-surfactants in the product.

The notified chemical contains no functional groups which are susceptible to hydrolysis under normal environmental pH conditions where 4<pH<9. Consequently no hydrolytic degradation is expected.

The value of Log Kow was apparently estimated using a molecular fragmentation procedure, which is incorporated into the ACD software. However, the chemical has surfactant properties since the polar portion of the molecule (a quaternary amine functional group) will have high water affinity, while the large alkyl group has very high affinity for fats and oils and none for water. As a consequence of the presence of these two types of functional group in the molecule, the notified chemical will form micelles and other colloidal aggregate structures when mixed with water and the concept of partition coefficient (which is defined as the solubility in n-octanol/the solubility in water) has little meaning for this chemical (GlobalTox International Consultants Inc., 2000).

The adsorption/desorption of the F-500 formulation to three soils types (sandy, clay and silt) with a range of clay and organic matter content was investigated (GlobalTox International Consultants Inc., 2000). The organic matter content ranged from 0.4 to 7.8% while the clay content was between 3 and 30% of soil weight. A solution of F-500 at nominal concentration of 1.06 g/L was allowed to equilibrate with each of the soil types for 96 hours, following which the supernatant was analysed for content of the notified chemical using HPLC, and it was found that > 99% of the chemical had become adsorbed to each soil type. The soils were also “washed” for 16.4 hours in 0.01 M $CaCl_2$ solution and the “wash” solutions analysed for the chemical in order to discern the amount desorbed from the soil. In all three cases it was found that < 1% of the notified chemical was desorbed from the soil.

The data were not analysed to provide conventional values of Log Koc, although the results of this test indicate that the notified chemical is strongly adsorbed to soil, and once sorbed is unlikely to be re-mobilised from these media.

Due to the cationic charge it is expected that the notified chemical would become associated with negatively charged colloidal matter in natural waters, and consequently become associated with sediments (GlobalTox International Consultants Inc., 2000).

Tertiary aliphatic amines typically have pKa values 9.5-10.5 (CRC, 1977) so the notified chemical is expected to remain protonated (and positively charged) in the usual environmental pH region where 4<pH<9.

The notified chemical is a surfactant and as such (by definition) will dramatically decrease the surface tension of water when dissolved. This property is the basis for its fire suppressing activity and potential use as a dispersant for hydrocarbons etc.

4. PURITY OF THE CHEMICAL

Degree of Purity:	100%
Hazardous Impurities:	None.
Non-hazardous Impurities (> 1% by weight):	None.

Additives/Adjuvants:

Chemical name:	Hexanoic acid, 2-ethyl-, compd. with 2,2',2''-nitrilotris[ethanol] (1:1)
CAS No.:	38584-87-1
Weight percentage:	2
Chemical name:	Alcohols, C6-12
CAS No.:	68603-15-6
Weight percentage:	7
Chemical name:	Water
CAS No.:	7732-18-5
Weight percentage:	40

5. USE, VOLUME AND FORMULATION

The notified chemical is not manufactured or formulated in Australia. It will be imported as the main ingredient (45%) of an aqueous solution, F-500. No repackaging, reformulation or modifications of F-500 will occur in Australia.

The notified chemical will be primarily used by local fire departments as a component in fire fighting solution. The chemical is added to water prior to being sprayed or hosed onto the fire, and its surfactant nature promotes the formation of a fire retarding solution as the water is discharged from the nozzles. The solution acts through fast heat reduction, fuel encapsulation and disruption of free radicals to extinguish the fire. This technique for fighting fires is particularly effective for hydrocarbon (e.g. fuel) fires, and fires involving other flammable liquids (e.g. alcohol). Consequently, it is expected that airport authorities will use much of the product and also chemical companies which may be involved with combating hydrocarbon and other flammable liquid fires. The rate at which the compound is added to the water depends on the nature of the fire and its situation. For example a fuel fire in a large storage tank would require different application strategy than a fire in a large wood heap or in a pile of old tyres. Nevertheless it is usual to add the F-500 to the water at a rate of approximately 1-3% corresponding to 0.45-1.4% of the notified chemical. F-500 is expected to be used primarily for class A (general combustibles) and class B (flammable liquid) fires, although some may be used in combating class D (metal fires) in ships or aircraft. When

combating class A fires, the F-500 would be added to the water at a rate of 0.5-1%, while higher application rates are used when fighting class B fires.

While many fire-fighting authorities in a variety of situations would use the F-500 formulation, it is likely that some large fuel storage facilities would have fixed infrastructure designed to deliver pre-mixed F-500/water mixtures into storage tanks for activation in the event of fire. While only a proportion of the chemical may be used in fighting real fires, a large proportion would very likely be used during training exercises for fire fighting personnel.

The surfactant nature of the notified chemical means that it has other potential applications, and these include cleaning out hydrocarbon (eg. petrol/diesel) tanks, soil remediation after fuel spills and as a general dispersant for spilt hydrocarbons and other flammable liquids. However, overseas experience has demonstrated that these applications comprise < 5% of total usage and use as a fire fighting aid is expected to be the major use in Australia.

The end use patters of F-500 and their percentages in volumes are outlined in the table below.

End Use	***Percentage***
Fire fighting applications (class A, B, D and flammable liquid spill control)	96
Tank and pipe cleaning and de-vaporising	2
Soil remediation	1
Dispersant for oil	0.1

The notified chemical will be imported as a 45% aqueous solution in 20 L and 200 L drums and larger quantities may also be imported in 1000 L bulk iso tanks. Transport throughout Australia is expected to be by truck. The notifier estimated the import volumes for the first 5 years.

Year	1	2	3	4	5
Volume (tonne)	4.7	9.7	14.0	17.8	20.4

6. OCCUPATIONAL EXPOSURE

The notifier indicates that in all applications, trained professionals utilising the appropriate regulated protective equipment and safety apparatus will apply the F-500. All users of the F-500 will undergo a complete training course in the proper application, use and safety precautions before they will be allowed to use the products.

Transport, storage and distribution
The notifier estimates that there will be 5 workers involved in importation, storage and distribution.

Exposure to the notified chemical during importation and storage is expected to be low unless spillage occurs after a breach of the package.

The distributors will undertake an intensive 2-week training session on the use of F-500. They will carry on some fire extinguishment demonstrations utilising F-500. They will dilute F-500 with water at 0.5-3%, and apply the diluent to the fire. They may experience some

exposure to the notified chemical via dermal, ocular and inhalation routes. However, the duration, generally, will be very short for each demonstration. To avoid any direct contact to fire, they will wear rubber boots, fire retardant bunker apparel (pants, jacket, gloves), fireproof helmet with eye guard, and self-contained breathing apparatus. This set of personal protective equipment also prevents any occupational exposure to the notified chemical.

Fire fighting application

The notifier estimates that there will be 250 municipal fire fighters and 75 industrial fire fighters. When using the notified chemical as a fire fighting aid, the usual procedure is for the container of the F-500 to be connected to the fire hoses through vacuum eduction equipment, which allows for direct injection of the chemical into the water at adjustable rates. They may have similar exposure to the notified chemical as the demonstrators, but the duration of exposure could be longer than the demonstrators. The fire fighters will have an intensive 2-week training session on the safety of using F-500. They will wear rubber boots, fire retardant bunker apparel (pants, jacket, gloves), fireproof helmet with eye guard, and self-contained breathing apparatus. The personal protective equipment minimises occupational exposure to the notified chemical.

Spill control mitigation

There will be 50 workers involved in spill control. Spill control mitigators will handle F-500 and diluted F-500 at 0.5-3%. As aerosol will be generated during the spray application, dermal, ocular and inhalation exposures are possible. Mitigation will undertake an intensive 2-week training session on the use of F-500. During operation, they will wear rubber boots, rubber apron, rubber gloves, splash proof eye protection and self-contained breathing apparatus. The occupational exposure of spill control mitigators is expected to be low.

De-vapour and tank cleaning

During tank cleaning, pipeline cleaning, and/or degassing operations, F-500 is used to encapsulate the hydrocarbon molecules rendering them non-explosive (vapours) or non-flammable (liquids). The encapsulated fuel and/or vapours are collected by utilising a vacuum-truck and transported to an industrial wastewater treatment facility. The workers may handle F-500 and diluted 0.5-3% F-500. Dermal, ocular and inhalation are possible routes for occupational exposure. The notifier indicates that these workers will undertake an intensive 2-week training session on the use of F-500. During operation, they will wear rubber boots, rubber apron, rubber gloves, splash proof eye protection and self-contained breathing apparatus. Considering the PPE used, the occupational exposure in these scenarios are expected to be low.

Soil remediation & Oil dispersion

F-500 can be applied to soil to aid in remediation of the hydrocarbon spill within the soil column. In soil, F-500 encapsulates the hydrocarbon molecules, extracts the hydrocarbon molecules from soil pores, and suspends the hydrocarbon molecules in an aqueous solution throughout the soil column. Therefore, the hydrocarbon molecules and F-500 became more readily available for remediation and biodegradation from naturally occurring microorganisms within soil column.

F-500 can also be sprayed directly on off shore oil spills or slick. F-500 encapsulates the oil molecules in dispersing/suspending them throughout the water column where by reducing the toxicity concentration and making the oil molecules readily available for biodegradation from naturally occurring microorganisms within the seawater.

Workers involved in soil remediation and oil dispersion will prepare diluted F-500 solutions and apply the solutions by spraying. The exposure pattern for these workers is similar to those in spill control mitigation. Although the notifier has not indicated the industrial controls and PPE during these operations, these workers are expected to be skilled professionals and PPE similar to those used in spill control mitigation, and de-vapour and tank cleaning is expected to wear.

7. PUBLIC EXPOSURE

The fire fighting agent F-500 is intended for industrial use only, and applied by trained workers of professional fire authorities. In the case of fire, the public will be evaculated from the sites. The notified chemical has a high vapour pressure (2.7 kPa). However, its high water solubility and expected dissociation in the aquatic environment will likely limit any tendency to partition to air, and concern for inhalation exposure is considered low. Hence, direct public exposure to the notified chemical may not be expected, except for accidental exposure in certain fire situations. Public exposure through drinking water may occur in the event of accidental release of the notified chemical into a river. According to the assessment by Environment Canada (unpublished), potential human exposure to the notified chemical through drinking water was estimated using an exposure scenario based on releases to a river following application during a fire event, and a dose of 0.157 μg/kg bw/event for an adult and 0.49 μg/kg bw/event for a child was calculated. Since the chemical is expected to be biodegradable and will unlikely become persistent, the exposure may be transient.

8. ENVIRONMENTAL EXPOSURE

8.1 Release

Release of Chemical from Use
No manufacturing or re-formulation of the chemical is anticipated to take place in Australia, so the main release of the F-500 compound will be associated with its final uses as a fire fighting aid.

When used as a fire fighting agent, it is expected that the majority of the notified chemical will be released to the environment. While some may be destroyed through incineration in the fire a high proportion would remain in the water/foam and would then be released directly to the soil compartment or may possibly be allowed to run off with storm water.

Disposal
The company indicated that disposal of the unused chemical would normally be through a liquid waste contractor, although in some cases spilt chemical would be soaked up in an adsorbent material and then be placed into landfill or be incinerated.

8.2 Fate

Ready biodegradability
Although the notifier indicated in trade promotional literature that the formulation is 100% biodegradable, no report on the biodegradation of the notified chemical was provided.

However, the chemical will remain dissociated in water and the substantially aliphatic nature of both organic ions indicates that it would be at least ultimately biodegradable. In particular, the long (C16-18) aliphatic chain on the quaternary ammonium cation is expected to be easily attacked and degraded by natural bacteria.

Bioaccumulation
The notified chemical is not expected to have significant potential for bioaccumulation due to the high water solubility (Connell, 1990).

9. EVALUATION OF TOXICOLOGICAL DATA

Three toxicity studies on F-500 containing 45% notified chemical were provided. The notifier applied variation for studies of acute dermal toxicity, acute inhalation toxicity, skin irritation, eye irritation, repeated dose toxicity, induction of germ cell damage and chromosome damage.

9.1 Summary of Toxicological Investigations

Endpoint & Result	*Assessment Conclusion*
Rat, acute oral LD50 >5 000 mg/kg bw	low toxicity
Guinea pig, skin sensitisation - adjuvant test.	No evidence of skin sensitisation
Genotoxicity - bacterial reverse mutation	Non mutagenic

9.2 Acute Toxicity

9.2.1 Acute Oral Toxicity

TEST SUBSTANCE	F-500
METHOD	Unspecified
Species/Strain	Rat/Sprague-Dawley
Vehicle	None
Remarks - Method	Oral by gavage
RESULTS	

Group	*Number & Sex of Animals*	*Dose mg/kg bw*	*Mortality*
Test	5/sex	5 000	0/10
Control (water)	5/sex	-	0/10

LD50	> 5 000 mg/kg bw
Signs of Toxicity	5/10 animals had diarrheal/loose faecal dropping during 24-48 hours post-dose.
Effects in Organs	None
Remarks - Results	None
CONCLUSION	F-500 is of low toxicity via the oral route.
TEST FACILITY	The Institute of Wildlife and Environmental Toxicology (1994).

9.2.2 Skin Sensitisation

TEST SUBSTANCE	F-500
METHOD	OECD 406 Skin Sensitisation - maximisation test.
Species/Strain	Guinea pig/HA(BR)
PRELIMINARY STUDY	Maximum non-irritating concentration: intradermal: <0.1% topical: 0.1% Intradermal injections of F-500 at 0.5-100% in water caused some necrosis. After topical application, 10-100% F-500 caused necrosis and 0.1% F-500 caused mild skin irritation.
MAIN STUDY	
Number of Animals	Test Group: 20 Control Group: 10
INDUCTION PHASE	Induction Concentration intradermal: 0.1% topical: 1%
Signs of Irritation	After intradermal injections, animals of both test and negative control groups had discrete or patchy erythema to moderate and confluent erythema on day 1, and discrete or patchy erythema on day 2. After topical induction, animals of test group had discrete or patchy erythema to moderate and confluent erythema on day 1, and discrete or patchy erythema on day 2. The negative controls had no sings of irritation.
CHALLENGE PHASE	
1st challenge	topical application: 0.1%
Remarks - Method	GLP & QA.

RESULTS

Animal	*Challenge Concentration*	*Number of Animals Showing Skin Reactions after:*			
		1st challenge		*2nd challenge*	
		24 h	*48 h*	*24 h*	*48 h*
Test Group	0.1%	0/20	0/20		
Control Group	0.1%	0/10	0/10		

Remarks - Results	No positive controls were included in the study. The study director provided data of positive control group in the report.
CONCLUSION	There was no evidence of skin sensitisation to F-500 under the conditions of the test.

TEST FACILITY	Nutro-Technics Inc (2001).

9.2.3 Genotoxicity-Bacteria

TEST SUBSTANCE	F-500 (Doses used in this study were based on the notified chemical).
METHOD	OECD 471 Bacterial Reverse Mutation Test.
Species/Strain	*S. typhimurium*: TA1535, TA1537, TA98, TA100. *E. coli*: WP2 uvrA.
Metabolic Activation System	Liver fraction (S9 mix) from rats pretreated with Aroclor 1254.
Concentration Range in Main Test	a) With metabolic activation: 0-10 µg/plate for *S. typhimurium*, and 0-100 µg/plate for *E. coli.* b) Without metabolic activation: 0-10 µg/plate for *S. typhimurium*, and 0-100 µg/plate for *E. coli.*
Vehicle	Water
Remarks - Method	GLP & QA.

RESULTS

Metabolic Activation	*Test Substance Concentration (µg/plate) Resulting in:*			*Genotoxic Effect*
	Cytotoxicity in PreliminaryTest	*Cytotoxicity in Main Test*	*Precipitation*	
Present	≥100 (*S. typhimurium*) ≥5 000 (*E. coli)*		-	
Test 1		Not observed.	-	Not observed.
Test 2		Not observed.	-	Not observed.
Absent	≥50 (*S. typhimurium*) ≥500 (*E. coli)*		-	
Test 1		Not observed.	-	Not observed.
Test 2		Not observed.	-	Not observed.

Remarks - Results	Cytotoxic effects were observed in Salmonella strains between 50-5 000 µg/plate without S9 and 100-5 000 µg/plate with S9, and in E. Coli strain 500-5 000 µg/plate without S9 and 5 000 µg/plate with S9. No precipitation was observed in the preparations.
CONCLUSION	F-500 was not mutagenic to bacteria under the conditions of the test.
TEST FACILITY	Nucro-Technics Inc (2000).

9.3 Overall Assessment of Toxicological Data

F-500 was of low acute oral toxicity in rats (LD50>5 000 mg/kg), and a non-skin sensitiser in guinea pigs. Although no skin irritation study was provided, the preliminary test in the skin sensitisation study in guinea pigs indicated skin necrosis effects at 10% F-500 and higher, and mild skin irritation at 0.1% F-500. It was not mutagenic to bacteria in the presence and absence of S9 metabolic activation system.

F-500 contains 45% notified chemical. Based on the results from F-500, the notified chemical is expected to be of low acute oral toxicity in rats (LD50>2 250 mg/kg), and a non-skin sensitiser in guinea pigs. It would not be mutagenic to bacteria in the presence and absence of S9 metabolic activation system limit information. However, it is considered to be an eye and skin irritant.

The notified chemical is an ethylhexanoic salt. 2-Ethylhexanoic acid (CAS No. 149-57-5), its esters and its salts are of concern to human health because of their potential to induce carcinogenicity, liver toxicity and developmental/reproductive toxicity. 2-Ethylhexanoic acid is on the NOHSC *List of Designated Hazardous Substances* (NOHSC, 1999a) based on its developmental toxicological effects (category 3 with cut-off concentration of 5%) with R63 (Possible risk of harm to the unborn child). 2-Ethylhexanoic acid is of low acute oral and dermal toxicity, is a mild skin irritant and a severe eye irritant. It is not mutagenic in Ames test, but is capable of inducing chromosome aberration and sister chromatid exchanges in vitro, liver toxicity and liver tumours after repeated dose treatment, In addition, 2-ethylhexanoic acid has been associated with reproductive and developmental toxicity in experimental animals. The notified chemical is therefore expected to display a similar toxicological profile.

Based on the available experimental results and relevant toxicological data, the notified chemical in F-500 is classified as a hazardous substance with risk phrases R36/38 (Irritating to eyes and skin) according to the NOHSC *Approved Criteria for Classifying Hazardous Substances (*NOHSC, 1999b). If the proportion of 2-ethylhexanoates in the notified chemical is greaster than 5%, the notified chemical should also carry the risk phrase R63 (Possible risk of harm to the unborn child).

10. ASSESSMENT OF ENVIRONMENTAL EFFECTS

10.1. Acute toxicity to fish

Test Substance	F-500
Method	This test was apparently conducted using the general procedures of OECD TG 203, but the summary report supplied with the notification did not contain all details of the test conditions employed.
Species	Fathead minnow (*Pimephales promelas*)

Remarks – Method

The test was conducted with 4-day-old juvenile fathead minnow over a 96-hour period at 22±1ºC at neutral pH (actual range not specified). The F-500 test material (45% of the notified chemical) was added to the test media at five nominal levels between 0 (control) and 4.63 mg/L corresponding to nominal concentrations of the test material between 0 (control) and 2.08 mg/L of the new compound. While the exact statistical procedures employed were not indicated the mortality data were analysed to provide a 96 h LC50 of 0.92 mg/L. Examination of the mortality data (see table) supports this and also indicates a No Observed Effect Concentration (NOEC) of 0.045 mg/L.

Results

Concentration mg/L		Number of Fish	Mortality			
Nominal	Actual		1 h	24 h	48 h	72 h	96 h
0	ND	10		1	1	1	1
0.045	ND	10		0	0	0	0
0.45	ND	10		1	3	4	4
0.75	ND	10		6	8	9	10
1.25	ND	10		7	9	9	9
2.08	ND	10		10	10	10	10

LC50 0.92 mg/L (nominal) at 96 hours.
NOEC 0.045 mg/L (nominal) at 96 hours.

Conclusion

The results of this test indicate that the F-500 formulation is highly toxic to this species of freshwater fish. However, since the F-500 contains around 15% of alcohol and surfactant compounds other than the notified chemical, it is not possible to definitively ascribe the toxicity to the notified chemical.

Test Facility/Report Reference Clemson University undated report – summary report only provided by the notifier.

10.2. Acute/chronic toxicity to aquatic invertebrates

Test Substance F-500

Method The exact protocols employed in this test were not specified, but from the report provided appear very similar to OECD TG 202 *Daphnia sp*. Acute Immobilisation Test.

Species *Daphnia magna*

Remarks - Method

The test was conducted with *Daphnia magna* using a semi-static renewal methodology over a 48 hour period at 20±1ºC at pH 7.55-7.88, dissolved oxygen 8-8.7 mg/L and water hardness 84 mg/L as $CaCO_3$. The F-500 test material (45% of the new compound) was added to the test media at five nominal levels between 0 (control) and 4 mg/L corresponding to nominal concentrations of the test material between 0 (control) and 1.8 mg/L of the new compound. The test at each nominal loading was conducted in duplicate using 10 *Daphnia* in each test vessel, and the mortality data were analysed using the Spearman-Karber procedure to provide a 48 h LC50 of 1.19 mg/L. Examination of the mortality data (see table) also indicates a No Observed Effect Concentration (NOEC) of 0.22 mg/L.

Results

Concentration mg/L		Number of D. magna	Number Immobilised	
Nominal	Actual		24 h	48 h
0	ND	20 (10 for each replicate)	0	0
0.11	ND	20	0	0
0.22	ND	20	0	0
0.45	ND	20	1	4
0.9	ND	20	8	20
1.8	ND	20	17	20

LC50 1.19 mg/L at 48 hours (95% Confidence interval 1.04-1.36 mg/L).

NOEC 0.22 mg/L at 48 hours.

Conclusion

The results of this test indicate that the F-500 formulation is moderately to highly toxic to *Daphnia*, but since the F-500 contains around 15% of alcohol and surfactant compounds other than the notified chemical, it is not possible to definitively ascribe the toxicity to the notified chemical.

Test Facility/Report Reference Aquatox Research Inc. (2001a)

10.3. Algal growth inhibition test

Test Substance F-500

Method The exact protocols employed in this test were not specified, but from the report provided appear very similar to OECD TG 201 Algal Growth Inhibition Test.

Species *Selenastrum capricornutum*

Exposure Period 96 hours

Remarks - Method

The test was conducted with *Selenastrum capricornutum* using a static methodology over a 96-hour period. The F-500 test material (45% of the new compound) was added to the test media at seven nominal levels between 0 (control) and 2 mg/L corresponding to nominal concentrations of the test material between 0 (control) and 0.9 mg/L of the new compound. The test at each nominal loading was conducted in triplicate, and the growth in algal biomass was monitored using turbidity measurements over the 96-hour test duration. The growth of the algae was impaired at all test concentrations, ranging from 9.1% inhibition at 96 hours exposure for the most dilute solution containing 0.0312 mg/L F-500 (corresponding to nominally 0.014 mg/L of the new compound) to 99% inhibition for the solutions containing nominally 1.0 mg/L of F-500 (corresponding to 0.45 mg/L of the compound). The data were analysed using probit analysis to provide the 72-hour EC50 of 0.19 mg/L (0.09 mg/L of notified compound) and a 96-hour EC50 of 0.24 mg/L of F-500 (0.11 mg/L of notified compound). The corresponding No Observed Effect Concentrations (NOEC) of F-500 were 0.06 and 0.12 mg/L. These results

indicate that F-500 formulation is very highly toxic to this species of algae.

Conclusion

The results of this test indicate that the F-500 formulation is very highly toxic to green algae, but since the F-500 contains around 15% of alcohol and surfactant compounds other than the notified chemical, it is not possible to definitively ascribe the toxicity to the notified chemical.

Test Facility/Report Reference Aquatox Research Inc. (2001b)

10.4. Additional Tests

The notifier also supplied summary reports on the toxicity of F-500 concentrate to two estuarine species – the crustacean *Mysidopsis bahia* and the fish *Menidia beryllina* (EFEH and Associates, undated). The summary report did not give specific details of the test methodology employed, and indeed these tests seemed to be primarily directed at assessing the effectiveness of the F-500 when used as a dispersant for diesel oil in increasing survival of these species compared with the situation when the animals were exposed to spilt diesel. Nevertheless, the results indicated that the LC50 of F-500 against *Mysidopsis bahia* is 32 mg/L (14.5 mg/L notified chemical) while that against *Menidia beryllina* is < 10 mg/L (4.4 mg/L notified chemical).

11. ASSESSMENT OF ENVIRONMENTAL HAZARD

11.1. Environment – exposure assessment

Up to 40 tonnes of the notified chemical will be used throughout Australia each year in fire fighting activities, primarily by organisations involved in combating fuel (hydrocarbon) fires. The chemical is moderately to highly toxic to fish and *Daphnia* and is very highly toxic to green algae. Consequently, if released to the water compartment in quantity, the chemical has potential to cause significant local environmental damage. While it is likely that in many situations much of the released material would be captured on adsorbent materials and then be placed into landfill, this will not always be the case. Due to the toxicity of the chemical to aquatic organisms at all trophic levels it is likely that some localised environmental damage will be a consequence of its intended use.

The notified chemical would be released at the scene of large fires (as well as during training exercises), and while much is expected to become adsorbed into soil, it is likely that in some cases,it would drain into curbside gutters and nearby storm watercourses and hence enter the wider water compartment. However, the cationic charge on the molecule indicates that the chemical would become associated with negatively charged humic and colloidal material in natural waters, and would then become incorporated into sediments. Once adsorbed onto soils or sediments the chemical is not expected to be re-mobilised and would slowly degrade through bacterial and other biological processes. The results of adsorption/desorption tests of the F-500 formulation on three types of soils with a range of clay and organic matter content support this conclusion, with >99% of the material adsorbed to each type of soil, and < 1% desorbed in subsequent washing procedures. Adsorption of the chemical onto soils and sediments would significantly reduce exposure to the water compartment and may go some way in mitigating adverse environmental effects in some situations.

11.2. Environment – effects assessment

The notified chemical is very highly toxic to green algae, is toxic to fish and is moderately toxic to *Daphnia*. Consequently, if released to the water compartment in quantity the chemical has potential to cause significant local environmental damage. Using an assessment factor of 100, and the EC50 for algae (the most sensitive species for which data is available) of 0.09 mg/L the predicted No Observed Effect Concentration (PNEC) = 0.09/100 mg/L = 0.9 μg/L

As indicated earlier, while in some cases the foam and waste would be collected and removed from the fire scene to landfill, this may not be practical in all situations and the use of the notified chemical has the potential to cause some environmental damage.

11.3. Environment – risk characterisation

The rate at which the F-500 concentrate would be applied to fires is very variable, and it is not possible to define a "typical" application and release scenario. However, information supplied by the notifier (Hazard Control Technologies, 2001) indicated that a large fire in a fuel tank with surface area of around 1000 m^2 (i.e. tank diameter approximately 32 m) applied at a 3% eduction rate to the foam would require approximately 57 L of F-500 which is equivalent to around 25 kg of the chemical.

For the purpose of gaining some insight into a realistic release scenario, a petrol tanker fire on a bridge over a medium sized river (eg. the Murrumbidgee near Canberra) will be considered. A typical road tanker may haul 25,000 L of fuel and up to 4000 L of water delivered as foam may need to be used to cover the truck to control any fire and/or to prevent re-ignition (information from ACT fire service). Assuming that the water (foam) contains only 1% of the F-500 then around 40 kg of this formulation containing approximately 20 kg of the notified chemical would be used. In this scenario most of this would eventually be washed off the bridge into the river below. The flow rate in this river during summer months is typically around 10,000 m^3/hour (ACT Government, 1999), and if all were to enter the river over a 2 hour period, then the resulting "slug" of contaminated water would have a volume of 30,000 m^3 with a mean concentration of the new chemical

$= 20 \times 10^6$ mg/30×10^6 L
= 0.67 mg/L.

This concentration is three orders of magnitude larger than the Predicted No Observed Effect Concentration (PNEC) of 0.9 μg/L.

In a slow moving river the dissolved pollutants will not be diluted rapidly, and the 0.67 mg/L concentration is very close to the 50% effect concentration for toxic effects against fish, *Daphnia* and algae. Consequently, under this scenario there is no safety margin and while it is expected that the chemical would slowly be removed from the water column through interaction with suspended colloidal material, it is likely that aquatic species at all trophic levels would be exposed for periods sufficiently long to cause significant damage.

Because the notified chemical is at least highly toxic to aquatic organisms and since in some fire situations it is likely to be released to watercourses in some quantity from the fire

vicinity, the chemical is assessed as presenting a risk to the aquatic environment in some use scenarios.

11.4. Conclusions – Assessment level of concern for the environment

The notified chemical is highly toxic to fish and to green algae and toxic to *Daphnia.* When used as an agent to assist the quelling of fires it is likely that a significant proportion will be released from the fire sites in an uncontrolled manner in some cases. Consequently use of the chemical as indicated is likely to lead to some environmental degradation in watercourses close to the scenes of fires.

12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS

Hazard assessment
Limited toxicity studies on F-500 were provided. Based on the results from F-500, the notified chemical in F-500 is expected to be of low acute oral toxicity, and not a skin sensitiser. It would not be mutagenic to bacteria in the presence and absence of S9 metabolic activation system limit information. However, it is considered to be an eye and skin irritant.

The notified chemical is an ethylhexanoic salt. As 2-ethylhexanoic acid has been associated with reproductive and developmental toxicity in experimental animals, the notified chemical is therefore expected to display a similar toxicological profile.

Based on the available experimental results and relevant toxicological data, the notified chemical in F-500 is considered to be as a hazardous substance with risk phrases R36/38 (Irritating to eyes and skin) according to the NOHSC *Approved Criteria for Classifying Hazardous Substances (*NOHSC, 1999b), and also R63 (Possible risk of harm to the unborn child) if the proportion of 2-ethylhexanoates in the notified chemical is greater than 5%.

Occupational health and safety
Health risk during importation and storage of the notified chemical is expected to be low unless spillage occurs after package breathing.

F-500 can be used in fire extinguishment demonstrations, fire fighting application, spill control mitigation, de-vapour and tank cleaning, soil remediation and oil dispersion. The major use (over 95%) is fire fighting.

The distributors, fire fighters will undertake an intensive 2-week training session on the use of F-500. They will handle both F-500 and diluted F-500 at 0.5-3%. The exposure routes for demonstrators and fire fighters include dermal, ocular and inhalation. However, the personal protective equipment (PPE) including rubber boots, fire retardant bunker apparel (pants, jacket, gloves), fireproof helmet with eye guard, and self-contained breathing apparatus minimises any occupational exposure to the notified chemical. Therefore, on the assumption that appropriate PPE will be worn, the health risk for these demonstrators and fire fighters workers is expected to be low.

The other minor applications of F-500 (<5%) include spill control mitigation, de-vapour and tank cleaning, and soil remediation and oil dispersion. In these applications, the workers will handle F-500 and diluted 0.5-3% F-500 solutions. Dermal, ocular and inhalation are possible routes for occupational exposure, special in the spray operations. These workers will undertake an intensive 2-week training session on the safe use of F-500. During operation, they should wear rubber boots, rubber apron, rubber gloves, splash proof eye protection and self-contained breathing apparatus. Considering the PPE used, the health risk in these scenarios are expected to be low.

There has been one report of injury related to, but not a result of, using F-500 during tank cleaning. A worker suffered burning of the lips and mouth from residual sulfuric acid while entering a F-500 treated petrol storage tank without self-contained breathing apparatus. The notifier has advised all of F-500 users to never enter a confined space without proper safety apparel and equipment.

Public health

The fire fighting agent F-500 is intended for industrial use only (municipal fire departments, petrochemical companies, and power companies), and will not be available for the public. In view of its physical and chemical properties, and proposed use pattern, expected accidental human exposure will be transient and at low concentrations. Hence, significant health risks are not likely to occur in the general public for the proposed use pattern.

13. RECOMMENDATIONS

Regulatory controls

- The NOHSC Chemicals Standards Sub-committee should consider the following health hazard classification for the notified chemical:
  - R36/38: Irritating to eyes and skin;

  and, if the proportion of 2-ehtylhexanoates in the notified chemical is greater than 5%,
  - R63: Possible risk of harm to the unborn child

- Use the following risk phrases for products/mixtures containing the notified chemical:
  - ≥5%: Harmful, R36/38
  - if proportion of 2-ethylhexanoates in mixture is ≥5%, R63.

Control Measures

Occupational Health and Safety

- Employers should implement the following safe work practices to minimise occupational exposure during handling of the notified chemical:
  - For use of products containing the notified chemical, minimise occupational exposure during operations.
  - Workers using the products containing the notified chemical should be instructed in their proper handling and use, including information about the health risk posed by the notified chemical.

- Employers should ensure that the following personal protective equipment is used by workers to minimise occupational exposure to the notified chemical:
  - Rubber boots
  - Fire retardant bunker apparel (pants, jacket and gloves)
  - Fireproof helmet with eye guard
  - Self-contained breathing apparatus.

  Guidance in selection of personal protective equipment can be obtained from Australian, Australian/New Zealand or other approved standards.

- A copy of the MSDS should be easily accessible to employees. It should include a statement of hazardous nature "Hazardous according to criteria of NOHSC" and relevant risk phrases.

- If products and mixtures containing the notified chemical are classified as hazardous to health in accordance with the NOHSC *Approved Criteria for Classifying Hazardous Substances*, workplace practices and control procedures consistent with provisions of State and Territory hazardous substances legislation must be in operation.

Environment

- The following control measures should be implemented by fire authorities and other users of the notified chemical to minimise environmental exposure during use as a fire fighting aid or in other applications, and **statements reflecting these control measures should be placed on the label and in the MSDS for the F-500 formulation.**

  - All foam and water resulting from fire fighting activities containing the chemical should be prevented from entering storm watercourses or natural waterways by bunding or other appropriate containment. These liquid wastes should be adsorbed into suitable materials and then be placed into a controlled landfill or preferably be incinerated.

  - If used for cleaning out tanks or for other purposes, all waste liquid should be collected and be disposed of as indicated immediately above.

Disposal

- The notified chemical should be disposed of by incineration.

Emergency procedures

- Spills/release of the notified chemical should be handled by adsorption onto suitable materials and disposed of as above.

Secondary notification

The Director of Chemicals Notification and Assessment must be notified in writing within 28 days by the notifier, other importer or manufacturer:

Under Section 64(2) of the Act:

- additional toxicological reports including acute dermal toxicity, skin and eye irritation, repeat dose with reproductive toxicity, and chromosomal aberration test should be provided when the importation volume becomes greater than 10 tonnes per year.
- If the new chemical is to be used in controlling oil or fuel spills on water further information on the methods of application will be required in order for revision of the Environmental Hazard Assessment.
- if any of the circumstances listed in the subsection arise.

The Director will then decide whether secondary notification is required.

No additional secondary notification conditions are stipulated.

14. MATERIAL SAFETY DATA SHEET

The MSDS for the notified chemical was provided in a format consistent with the *National Code of Practice for the Preparation of Material Safety Data Sheets* (NOHSC, 1994).

This MSDS was provided by the applicant as part of the notification statement. It is reproduced here as a matter of public record. The accuracy of this information remains the responsibility of the applicant.

15. REFERENCES

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Nucro Technics Inc (2000) Salmonella typhimurium and Escherichia coli Reverse mutation assay of F-500, Fire fighting agent, Project No. GLT/0006-4, Canada (unpublished report provided by notifier).

Nucro Technics Inc (2001) Skin sensitisation study in guinea pigs (maximization test) of F-500, Fire fighting agent, Project No. 97419, Canada (unpublished report provided by notifier).

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Attachment 1

The Draize Scale (Draize, 1959) for evaluation of skin reactions is as follows:

Erythema Formation	*Rating*	*Oedema Formation*	*Rating*
No erythema	0	No oedema	0
Very slight erythema (barely perceptible)	1	Very slight oedema (barely perceptible)	1
Well-defined erythema	2	Slight oedema (edges of area well-defined by definite raising	2
Moderate to severe erythema	3	Moderate oedema (raised approx. 1 mm)	3
Severe erythema (beet redness)	4	Severe oedema (raised more than 1 mm and extending beyond area of exposure)	4

The Draize scale (Draize *et al*., 1944) for evaluation of eye reactions is as follows:

CORNEA

Opacity	*Rating*	*Area of Cornea involved*	*Rating*
No opacity	0 none	25% or less (not zero)	1
Diffuse area, details of iris clearly visible	1 slight	25% to 50%	2
Easily visible translucent areas, details of iris slightly obscure	2 mild	50% to 75%	3
Opalescent areas, no details of iris visible, size of pupil barely discernible	3 moderate	Greater than 75%	4
Opaque, iris invisible	4 severe		

CONJUNCTIVAE

Redness	*Rating*	*Chemosis*	*Rating*	*Discharge*	*Rating*
Vessels normal	0 none	No swelling	0 none	No discharge	0 none
Vessels definitely injected above normal	1 slight	Any swelling above normal	1 slight	Any amount different from normal	1 slight
More diffuse, deeper crimson red with individual vessels not easily discernible	2 mod.	Obvious swelling with partial eversion of lids	2 mild	Discharge with moistening of lids and adjacent hairs	2 mod.
Diffuse beefy red	3 severe	Swelling with lids half-closed	3 mod.	Discharge with moistening of lids and hairs and considerable area around eye	3 severe
		Swelling with lids half-closed to completely closed	4 severe		

IRIS

Values	*Rating*
Normal	0 none
Folds above normal, congestion, swelling, circumcorneal injection, iris reacts to light	1 slight
No reaction to light, haemorrhage, gross destruction	2 severe

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