

Executive Summary and Technical Report

Exhaust Gas Analysis – Toyota Hilux 150 (09/2005)

By

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EXECUTIVE SUMMARY

FCC is a fuel conditioner produced by ADDFUEL PTY LTD which is a blend of surfactants (detergents), oxygenates and corrosion inhibitors (refer MSDS in Attachment 3) developed to improve fuel efficiency and saving the maintenance costs through cleaner and better combustion process. It's a non-hydrocarbon fuel conditioner that cleans fuel and improves performance whilst lowering emissions and increasing fuel efficiency.

During recent exhaust gas analysis carried out on the Toyota Hilux 150 model, the result shows more than 60% reduction in carbon monoxide (CO) emission. It is however observed that oxides of nitrogen (NO_x) has increased due to the oxygenate effect of the fuel additive.

Carbon monoxide (CO) is a toxic, colourless and odourless gas. CO affects healthy and unhealthy people. Increased levels of carbon monoxide reduce the amount of oxygen carried by haemoglobin around the body in red blood cells. The result is that vital organs, such as the brain, nervous tissues and the heart, do not receive enough oxygen to work properly. No more than 2.5% of haemoglobin can be bound to carbon monoxide before some health effects become noticeable. At very high concentrations of carbon monoxide, up to 40% of the haemoglobin can be bound to carbon monoxide in this way. This level will almost certainly kill humans.

Carbon monoxide is the by-product caused by incomplete combustion where air intake is limited. The relative amount of CO produced depends on the efficiency of combustion. FCC has the effect of improving the combustion process which significantly reduces CO emissions.

NO_x is produced from the reaction of nitrogen and oxygen gases during combustion especially at higher temperatures. The two elements combine to form nitric oxide (NO) and nitrogen dioxide (NO₂). Nitric oxide is not considered to be hazardous to health at typical ambient concentration but nitrogen dioxide can be. As shown in Figure 2b, the increment was mainly contributed by nitric oxide (NO) which is not considered harmful at a typical condition. Therefore the increase amount of NO may not be a critical issue.

As the Australia Government has taken steps to manage and reduce the amount of CO emissions to the environment including implementation of tighter vehicle emission standard, hence using FCC fuel additive could be considered beneficial to achieve cleaner burning of the vehicle's engine.

TECHNICAL REPORT FOR TOYOTA HILUX 150 EXHAUST GAS ANALYSIS

On 16 Nov 2016 and 20 Dec 2016, exhaust gas analysis was carried on Toyota Hilux 150 (09/2005) model to investigate the performance of vehicle emission before and after using FCC respectively. The car was powered by diesel and the FCC was added on 4000:1 ratio. Tests were run on minimum and maximum rated power. The minimum rated power before and after FCC additive were 750 rpm and 600 rpm respectively. Although the both tests were run at different throttling speed however the results are compared as it is not expected a great variation under minimum idling speed.

The maximum idling speed was fixed at 2,500 rpm in both before and after FCC tests. This speed was chosen as the average cruising speed despite the model design maximum torque could goes higher.

The undiluted exhaust gas limit is set at 1,500 ppm CO and 1,000 NOx. The exhaust gas was diluted in a control volume before the emissions concentration was recorded. The test results of the vehicle emissions before and after the FCC fuel additive was added are recorded in the test reports, refer Attachment 1 and 2 respectively.

Carbon Monoxide (CO) Emission

The emission of carbon monoxide (CO) before and after the FCC was added had been investigated and recorded. The CO emission trends are presented graphically in Figure 1, extracted from results obtained from the lab test reports in Attachment 1 and 2.

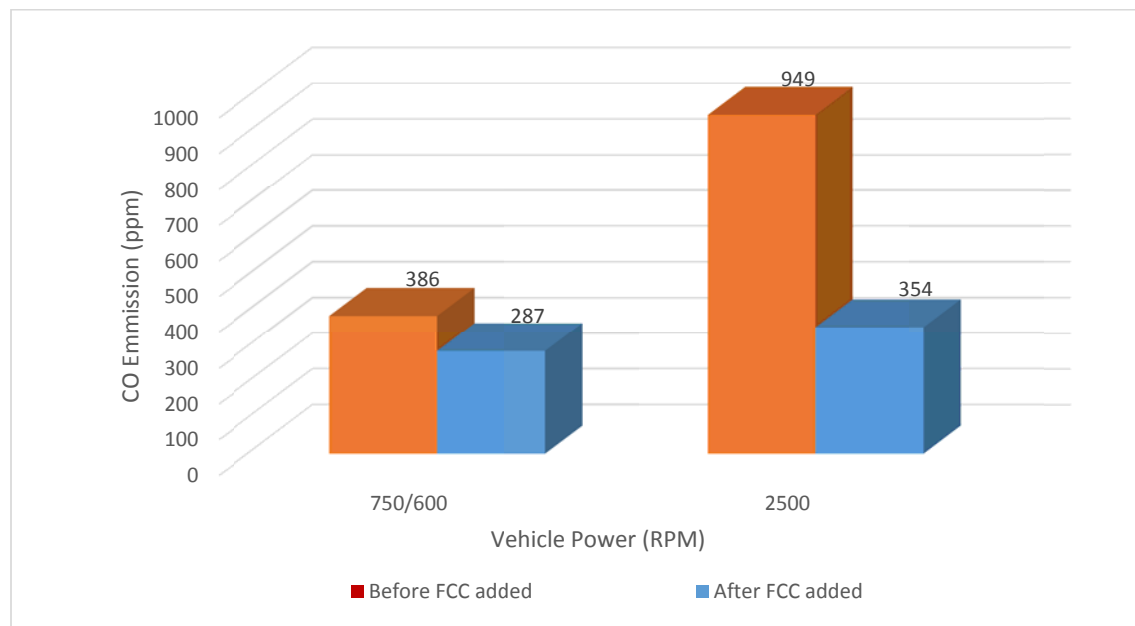


Figure 1: Toyota Hilux 150 - CO Emission Before and After FCC was added

Figure 1 shows the CO emission in the exhaust gas before and after the FCC additive, measure in part per million, during both minimum and maximum engine speeds

At the beginning, when the engine was running at minimum idling speed of 750/600 rpm, approximately 26% reduction of CO emission was observed. When the vehicle was ramped up to its average maximum idling speed of 2,500 rpm, significant CO emission reduction was observed i.e.: approximately 63% after the FCC was added. The results have demonstrated that using FCC additive under the vehicle optimum speed limit could effectively reduce the CO emission from the exhaust gas.

The oxygenated chemical compound i.e.: alkoxy propanols (refer MSDS in Attachment 3) within the FCC contains oxygen as a part of their chemical structure. The exhaust emissions such as CO and HC level were progressively reduced as oxygen content is increased.

Oxide of Nitrogen (NOx) Emission

The graphical summary of the NOx emission is presented in Figure 2a and 2b below.

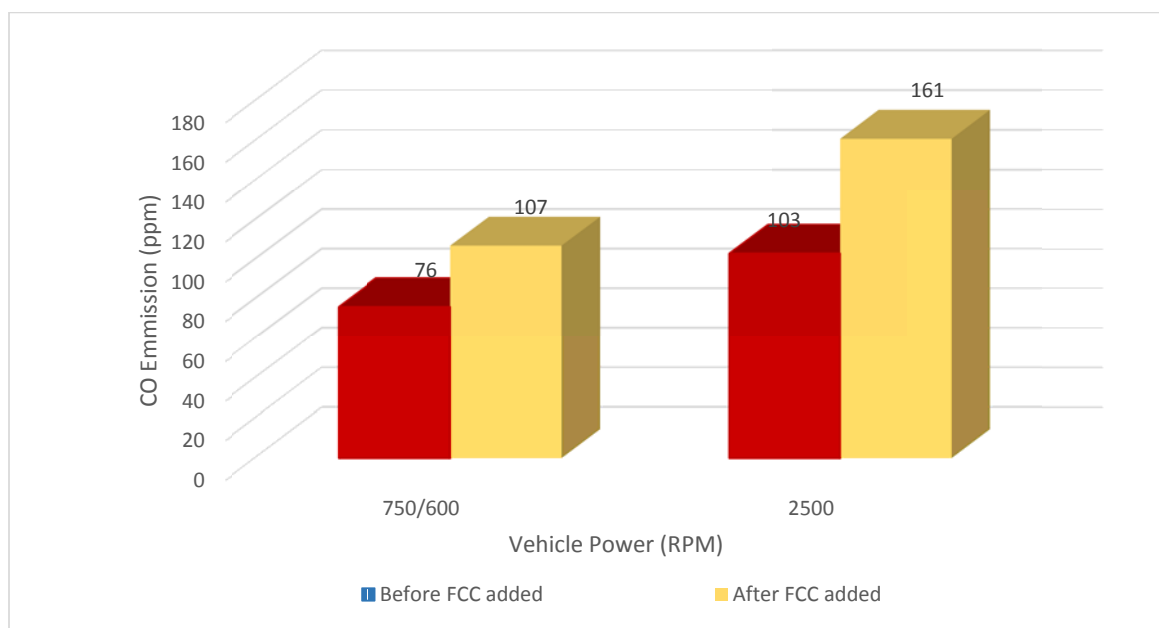


Figure 2a: Toyota Hilux 150 - NOx Emission Before and After FCC was added

On the other hand, Figure 2a compares NOx emission before and after FCC additive was added during both minimum and maximum rated power, in part per million. The oxide of nitrogen (NOx) emissions has increased i.e.: circa 40-56% increment. NOx is produced during the combustion process when nitrogen and oxygen are present at elevated temperatures. But at high temperatures, they undergo an endothermic reaction producing various oxides of nitrogen. Such temperatures can arise inside an internal combustion engine within the vehicle. The two elements combine to form nitric oxide (NO) and nitrogen dioxide (NO₂). It

combines with other pollutants in the atmosphere and creates O_3 , a substance known as ground level ozone. The NO and NO_2 element released to atmosphere in this case were also recorded and presented in Figure 2b below.

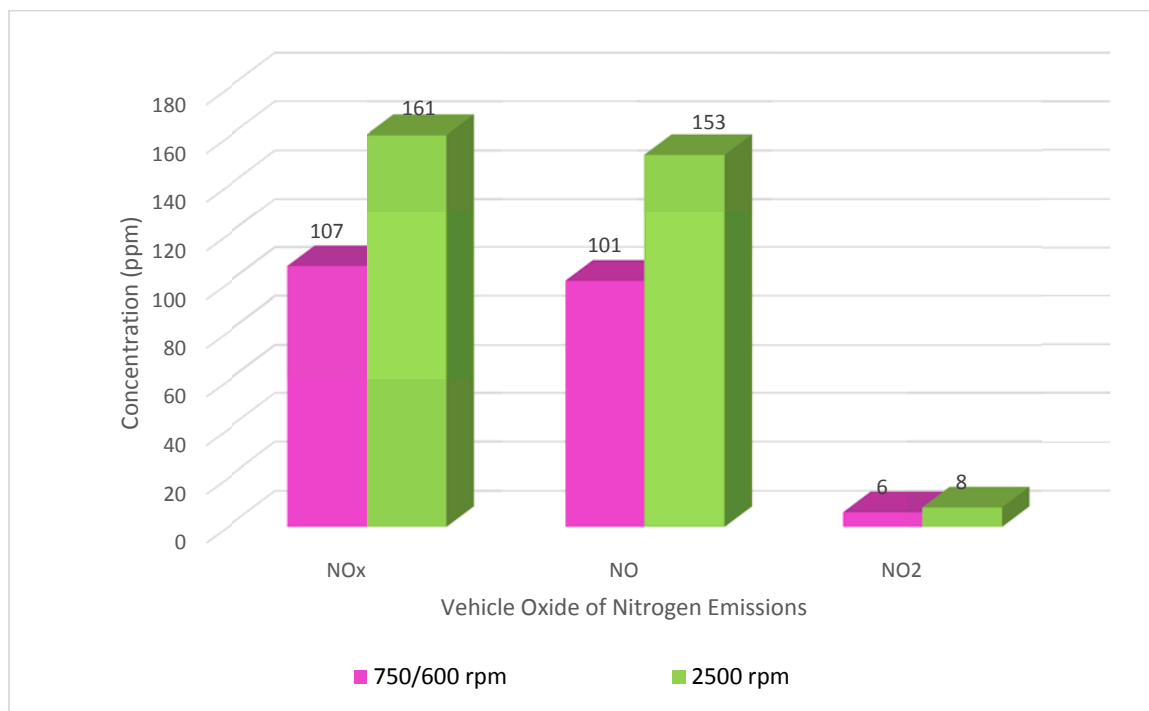


Figure 2b: Toyota Hilux 150 – NOx Element Emissions After FCC was added

By referring the results in Figure 2b, the oxide of nitrogen had mainly converted into nitric oxide (NO) i.e.: circa 95%. Only a minimum amount had been converted to nitrogen dioxide (NO_2). Nitric oxide is not considered to be hazardous to health at typical ambient concentration but nitrogen dioxide can be. As shown in Figure 2b, the increment was mainly contributed by nitric oxide (NO) which is not considered harmful at a typical condition. Therefore the increase amount of NO may not be a critical issue

To conclude, high level of carbon monoxide CO are poisonous to humans, and unfortunately cannot be detected by humans as it has no taste or smell and cannot be seen. Increased levels of carbon monoxide reduce the amount of oxygen carried by haemoglobin around the body in red blood cells. The result is that vital organs such as the brain, nervous tissues and the heart, do not receive enough oxygen to work properly, in a very worst case it can cause casualty.

Therefore, the significant reduction in CO is deemed outweigh the disadvantage from the increase of NOx as the harmful element NO_2 increment is relatively trivial compared to the advantage of greatly minimising CO emission to the atmosphere.

ATTACHMENT 1 – EXHAUST GAS ANALYSIS BEFORE
FUEL ADDITIVE

CERTIFICATE OF EXHAUST GAS ANALYSIS

SERIAL No. MROEZ12G304001259

MINING COMPANY: N/A (emissions test before fuel additive)

TEST DATE: 16/11/2016

UNIT OWNER: SIAM Group

EXPIRY DATE: 16/11/2017

SITE CONTRACTOR OPERATING UNIT: N/A (emissions test before fuel additive)

NAME OF MINE/DECLINE: N/A (emissions test before fuel additive)

CONTACT PERSON: Stuart Martin (ADDFUEL)

PHONE: 0488 678 046

FAX: TBA

UNIT MAKE: Toyota

REGO No.: ICCI 583

MODEL No: Hilux 150 (09/2005)

ASSET No.: N/A

ENGINE MAKE: Toyota

ENGINE No.: MROEZ12G304001259

ENGINE CAPACITY: 2982cc

ENGINE kW: 127

TOTAL HOURS/KM RUN: TBA kms

ORIGINAL ENGINE: Yes

EXHAUST TREATMENT TYPE: Standard

BANK: Straight 4 Cylinder

ANALYSIS RESULTS

UNDILUTED EXHAUST GAS – Maximum level of exhaust gases permitted ; 1000ppm NOx 1500 ppm CO

ALTITUDE m	Rpm	TEMP °C	O2%	CO2%	Effg%	Effn%	CO ppm	NOx ppm	NO ppm	NO ² ppm
Min Rated Power (idle)	750	35					386	76	75	1
Max Rated Power No Load (High idle)	2500	83					949	103	98	5
Max Rated Power Load Condition										

OPACITY TEST DATA

Opacity Meter calibrated before use (yes/no)?

- N/A

Average peak opacity registered at snap idle

- N/A % Maximum Opacity 50%

Average base opacity at idle

- N/A %

Speed of engine during snap idle test, if available?

- N/A rpm

Was opacity reading & procedure used representative?

- N/A

Location of test, Surface or Underground?

- Surface

EVALUATOR's NAME: S. Niederberger

SIGNATURE:



COMMENTS: Results Acceptable

DATE: 16/11/2016

Notes: Effn% = overall efficiency of combustion system Effg% = efficiency of gases existing the exhaust related by ratios of CO₂ to CO and O₂ in the exhaust gases.

KALGOORLIE

Phone: (08) 9021 8399 Fax: (08) 9021 6901

10 Broadwood Street, West Kalgoorlie

Western Australia 6430

PO Box 1123, Kalgoorlie WA 6433

Exhaust Gas Test Cert - Toyota Hilux 1CCCE 583 diesel 16.11.16.docx

PERTH

Phone: (08) 6279 0900 Fax: (08) 6279 0950

10 Elmsfield Road, Midvale

Western Australia 6056

ATTACHMENT 2 – EXHAUST GAS ANALYSIS AFTER
FUEL ADDITIVE

CERTIFICATE OF EXHAUST GAS ANALYSIS

SERIAL No. MROEZ12G304001259

MINING COMPANY: N/A (emissions test after fuel additive)

TEST DATE: 20/12/2016

UNIT OWNER: SIAM Group

EXPIRY DATE: 20/12/2017

SITE CONTRACTOR OPERATING UNIT: N/A (emissions test after fuel additive)

NAME OF MINE/DECLINE: N/A (emissions test after fuel additive)

CONTACT PERSON: Stuart Martin (ADDFUEL)

PHONE: 0488 678 046

FAX: TBA

UNIT MAKE: Toyota

REGO No.: 1CCE 583

MODEL No: Hilux 150 (09/2005)

ASSET No.: N/A

ENGINE MAKE: Toyota

ENGINE No.: MROEZ12G304001259

ENGINE CAPACITY: 2982cc

ENGINE kW: 127

TOTAL HOURS/KM RUN: 226,684 kms

ORIGINAL ENGINE: Yes

EXHAUST TREATMENT TYPE: Standard

BANK: Straight 4 Cylinder

ANALYSIS RESULTS

UNDILUTED EXHAUST GAS – Maximum level of exhaust gases permitted ; 1000ppm NOx 1500 ppm CO

ALTITUDE m	Rpm	TEMP °C	O2%	CO2%	Effg%	Effn%	CO ppm	NOx ppm	NO ppm	NO ² ppm
Min Rated Power (idle)	600	52					287	107	101	6
Max Rated Power No Load (High idle)	2500	105					354	161	153	8
Max Rated Power Load Condition										

OPACITY TEST DATA

Opacity Meter calibrated before use (yes/no)?

- N/A

Average peak opacity registered at snap idle

- N/A % Maximum Opacity 50%

Average base opacity at idle

- N/A %

Speed of engine during snap idle test, if available?

- N/A rpm

Was opacity reading & procedure used representative?

- N/A

Location of test, Surface or Underground?

- Surface

EVALUATOR's NAME: S. Niederberger

SIGNATURE:



COMMENTS: Results Acceptable

DATE: 20/12/2016

Notes: Effn% = overall efficiency of combustion system Effg% = efficiency of gases existing the exhaust related by ratios of CO₂ to CO and O₂ in the exhaust gases.

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Phone: (08) 9021 8399 Fax: (08) 9021 6901

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Exhaust Gas Test Cert - Toyota Hilux 1CCE 583 diesel 18.11.16 - Copy.docx

PERTH

Phone: (08) 6279 0900 Fax: (08) 6279 0950

10 Elmsfield Road, Midvale

Western Australia 6056

ATTACHMENT 3 – FCC MSDS



Material Safety Data Sheet

1. IDENTIFICATION of MATERIAL and SUPPLIER

Product Name: FUEL CONDITIONER CONCENTRATE
Other Names: FCC, Fuels Gold & Fuel Set EU
Recommended Use: Fuel additive for petrol and Diesel fuels
Supplier: GND Holdings Pty Ltd trading as Choice Chem
ABN: 16 122 257 176
Address: 27 Boulder Road,
Malaga Western Australia 6090
Telephone: (618) 9248 9590
Facsimile: (618) 9249 4810
Emergency Telephone: +61 400 015 083

2. HAZARDS IDENTIFICATION

Hazard Classification: This material is not considered **hazardous** according to the criteria of ASCC. However prolonged skin or eye contact can cause irritations.
Hazard Category: N/A
Risk Phrases: N/A
Safety Phrases: N/A

3. COMPOSITION/INFORMATION on INGREDIENTS

<u>Chemical Name</u>	<u>CAS No</u>	<u>Proportion (%w/w)</u>
Non Ionic surfactants (not considered hazardous)	N/A	30-60%
Alkoxy propanols		30-60%
Dye	Proprietary	<10%
Fragrance	Proprietary	<10%

4. FIRST AID MEASURES

FIRST AID

Swallowed: If swallowed, do NOT induce vomiting. Give a glass of water. Seek medical advice. For advice, contact a Poisons Information Centre (Phone Australia 131126) or a doctor.

Eye: If in eyes, hold eyelids apart and flush the eye continuously with running water. Continue flushing until advised to stop by the Poisons Information Centre or a doctor, or for at least 15 minutes.

Skin: If skin or hair contact occurs, remove contaminated clothing and flush skin and hair thoroughly with running water. Continue flushing until advised to stop by the Poisons Information Centre or a doctor.

Inhaled: Remove the victim from the source of exposure to fresh air. Avoid becoming a casualty. Seek medical advice if effects persist.

ADVICE TO DOCTOR Treat symptomatically.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media:	Water spray, foam, carbon dioxide or dry chemical powder.
Fire / Explosion Hazard:	The product is a combustible liquid. Thermal decomposition may generate oxides of carbon.
Precautions for fire fighters and special protection equipment:	Fire Fighters should wear self-contained breathing apparatus to minimise the risk of exposure to the fumes.
Hazchem Code:	None

6. ACCIDENTAL RELEASE MEASURES

Spills:	Spills are slippery. Ensure adequate ventilation. Avoid accidents, clean up immediately. Wear protective equipment to prevent skin and eye contamination. Contain the spill and prevent contamination into drains and waterways. Absorb with sand or other similar material. Collect and seal in properly labelled drums for disposal in an area approved by local authority by-laws. Wash excess with plenty of water.
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7. HANDLING and STORAGE

Handling Advice:	Keep containers closed at all times - check regularly for leaks or spills. Transport and store upright. Avoid eye contact and repeated or prolonged skin contact. Do not eat, drink or smoke in handling areas. Always remove contaminated clothing and wash hands before eating, drinking, smoking or using the toilet. Wash contaminated clothing and other protective equipment before storage or re-use.
Storage Advice:	Classified as a Combustible Liquid for the purposes of storage and handling. Refer to the appropriate Regulations for storage and transport requirements. Store in the original container, in a cool, dry, well-ventilated area out of sunlight and away from heat, strong oxidising agents and open flame. Do not combine part drums of the same product, as this may cause of contamination. Do not mix with other chemicals.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Standards:	No value assigned for this specific material by ASCC.
Ventilation:	Natural or local exhaust ventilation should be adequate under normal use conditions. Keep containers closed when not in use.
Personal Protection:	Protective equipment is recommended, including gloves, safety glasses and safety shoes. Observe good standards of hygiene and cleanliness. Trousers, long sleeved shirt and closed in safety footwear should be worn as a general precaution. If there is a risk of inhalation of vapour or spray mists, wear an organic vapour respirator meeting the requirements of AS1715 and AS1716.

9. PHYSICAL and CHEMICAL PROPERTIES

Appearance:	Clear green mobile liquid.
Odour:	Mild Eucalyptus odour
pH (Neat)	Not applicable.
S.G.:	1.0
Boiling Point (°C):	No data.
Solubility:	The product is fully soluble in water and solvents.
Flash Point (°C):	>67°C (Closed Cup).

10. STABILITY and REACTIVITY

Stability:	No data.
Conditions To Avoid:	Do not combine part drums of the same product, as this may be a source of contamination.

Product Name: Fuel Conditioner Concentrate FCC



Material Safety Data Sheet

Incompatible Materials: Incompatible with strong oxidising agents.
Hazardous Decomposition Products: Thermal decomposition may generate oxides of carbon.
Hazardous Reactions: None known.

11. TOXICOLOGICAL INFORMATION

No adverse health effects expected if the product is handled in accordance with this Material Safety Data Sheet and the product label. Symptoms and effects that may arise if the product is mishandled and over exposure occurs are:

ACUTE EFFECTS

Swallowed: May cause nausea, vomiting, headache, drowsiness and central nervous system depression
Eye: May cause irritation.
Skin: May cause irritation to skin with long and repeated contact.
Inhalation: Breathing in mist or aerosols may cause respiratory irritation.

12. ECOLOGICAL INFORMATION

Ecotoxicity Data: Avoid contaminating waterways.

13. DISPOSAL CONSIDERATIONS

Disposal: Avoid unauthorised discharge to sewer. The product is suitable for disposal by landfill through an approved agent.

14. TRANSPORT INFORMATION

AIR, SEA, ROAD AND RAIL TRANSPORT: Not Classified as Dangerous Goods by the criteria of the Australian Dangerous Goods Code (ADG Code) for transport by Air, Road and Rail.

UN Number: None
UN Proper Shipping Name: None
Class & Subsidiary Risk: None
Hazchem Code: None
Packaging Group: None

15. REGULATORY INFORMATION

Poisons Schedule (AUST): None
Other: None.

16. OTHER INFORMATION

None.

This MSDS summarises to our best knowledge, at the date of issue, the chemical health and safety hazards of the material and general guidance on how to handle the material in the workplace. Since Choice Chem cannot anticipate or control the conditions under which the product may be used, each user must, prior to usage, assess and control the risks arising from its use of the material.

If clarification or further information is needed, the user should contact Choice Chem.

Choice Chem's responsibility for the material as sold is subject to our standard terms and conditions, a copy of which is available on request.

DATE OF ISSUE: Tuesday 14 June. **This MSDS replaces all other issues.** **PREPARED BY:** Peter Spry

Product Name: Fuel Conditioner Concentrate FCC