



JATROPHA HANDBOOK

2D EDITION

JUNE 2009

ANNEX TO CHAPTER 5 (OF 6)

Applications of Jatropha products



ANNEX TO 5.1.1- Stove fact sheets

“Protos” plant oil burner



Source: Report: 'Plant oil cooking stove for developing countries, Elmar Stumpf and Werner Mühlhausen, Institute for Agricultural Engineering in the Tropics and Subtropics, Hohenheim University, Stuttgart, Germany.

[http://w1.siemens.com/responsibility/en/sustainable/"Protos".htm](http://w1.siemens.com/responsibility/en/sustainable/)

<http://www.bsh-group.com/index.php?page=109906>

Introduction:

The “PROTOS” plant oil stove was developed by BSH (Bosch and Siemens Hausgeräte GmbH) in 2004. This unusual stove can be fuelled by unrefined and refined vegetable oils such as coconut oil, sunflower oil, rapeseed oil, jatropha oil, castor oil, cottonseed oil and peanut oil. Except for the burner, this stove can be produced locally thereby creating labour. Over 500 ‘Protos’ stoves have been tested in the Philippines, India, Indonesia, Guatemala and Tanzania. The way the plant oil stove works is quite simple. An air pump builds pressure within a tank filled with oil. As a result, the oil is forced into a stainless steel vaporizer tube, where it is vaporized by the application of heat. An ethanol pre-heater is installed below the nozzle as can also be found in most small burners used by hikers. The now-vaporized fuel is channelled through a nozzle, mixes with ambient air in the combustion chamber and produces a blue flame. The oil-air mixture has to be preheated to 180-260°C before ignition occurs. The flame strength can be regulated by means of a valve in the oil line. Disadvantage of the ‘Protos’ stove is the high noise level when burning (‘Pflanzenölkocher sollen den Regenwald retten’, Handelsblatt, 8 juni, 2006)

Specifications:

Supplier’s data: BSH (Bosch and Siemens Hausgeräte GmbH)

Dealers in countries: The ‘Protos’ has been tested in the Philippines, India, Indonesia, South Africa and Tanzania.

Capacity: 1.6–3.8 kW, fuel efficiency 40-50%

How is quality of output measured and/or checked? Research by supplier.

Required input power: 2 litres oil per week for a family of 4-5 > 100 litres per year

Operational requirements: 1 person during cooking.

Required maintenance and spare parts: frequent cleaning of the burner each time the burner is used.

Downtime for maintenance: unknown

Overall dimensions: approx 30 x 30 x 30 cm

Costs: intended selling price of € 30 (Elmar Stumpf, BSH Bosch)



Emissions: ten times lower than with high quality kerosene



Questions:

How many installed? >500, tested in >100 households in Philippines

How many are operational? unknown

Who is supplying this equipment? BSH Bosch and Siemens Hausgeräte GmbH

Ease, speed and reliability of supply chain, for new equipment and for spare parts? Cooking time reduced 30-40% compared to wood fired stoves ('Protos. The plant oil stove', BSH Bosch and Siemens Hausgeräte GmbH).

Training of operators possible? Given by whom? BSH Bosch and Siemens Hausgeräte GmbH

User experiences? According to BSH Bosch the introduction in Tanzania was successful as people were positive about the 'Protos'.

Kakute stove



Introduction:

The Kakute stove has been developed by Kakute in collaboration with Tirdo (Tanzania Industrial Research and Development Organization). There is no clear information as to whether the stoves have been commercially sold.

GTZ tested the Kakute stoves in Madagascar with Green Mad. The stove was provided by SOLTEC and the oil by ERI located in Fianarantsoa. The main goal of the test was to find wicks that are suitable for jatropha. The best results were obtained with wicks from petroleum lamps and crêpe. Even with these wicks the flame dims after 15-25 minutes. The water temperature in most cases does not increase beyond 80°C (Erik Jan Rodenhuis, Werkgroep Ontwikkelingstechnieken).

Source: <http://www.bioenergylists.org/kakutestove>

Specifications:

Suppliers data: Kakute together with Tirdo

Dealers in countries: Tanzania.

Capacity: unknown

How is quality of output measured and/or checked? unknown

Required input power: unknown

Operational requirements: 1 person during cooking.

Required maintenance and spare parts: unknown

Downtime for maintenance: unknown

Overall dimensions: approx 30 x 30 x 30 cm

Costs: unknown

Questions:

How many installed? none

How many are operational? none

Who is supplying this equipment? Kakute together with Tirdo

Ease, speed and reliability of supply chain, for new equipment and for spare parts? unknown

Training of operators possible? Given by whom? Unknown, probably by Kakute

User experiences? unknown

UB – 16 Jatropha curcas L seeds stove



Introduction:

This stove is fired with Jatropha seeds instead of its oil. The seed hull has to be removed for better burning as the energy content per unit mass is higher for the seed kernel.

Source: <http://www.fierna.com/English/UB-16.htm>

Specifications:

Suppliers data: unknown

Dealers in countries: unknown

Capacity: maximum 300 gr seeds

How is quality of output measured and/or checked? It needs 8 minutes to boil 1500 ml of water. Energy efficiency has been calculated at 58% based on the heating time for 1 liter of water.

Required input power: 200 g of peeled seeds are able to fire 60 minutes. Based on 10-15 liter water boiling per day per family the total energy can be supplied by 100-150 kg of Jatropha Curcas L seeds per family year.

Operational requirements: 1 person during cooking.

Required maintenance and spare parts: unknown

Downtime for maintenance: unknown

Weight: 12kg

Overall dimensions: 27 x 27x 27 cm

Costs: unknown

Questions:

How many installed? none

How many are operational? none

Who is supplying this equipment? unknown

Ease, speed and reliability of supply chain, for new equipment and for spare parts? unknown

Training of operators possible? Given by whom? unknown

User experiences? unknown



In addition to the three stoves mentioned above some information was found on other stove designs. As the detail level of the information was very limited, images of the stoves are represented below in figure 5 in order to provide the reader with creative ideas.

Opmerking [J1]:
Appendix



NaturStove

<http://suar-group.indonetwork.net/962986/kompur-minyak-jarak-pagar-naturstove-jatropha-curcas-oil.htm>



Hanjuang stove Java



Stove on Jatropha paste West Nusa Tenggara



Stove from ITB

www.jatropha.de



Butterfly brand stoves

www.jatropha.de



The Kakute stove, Tanzania

Source: <http://www.bioenergylists.org/kakutestove>



Aristo stove from Grupo Ari SA, Santo Domingo, Dominican Republic (Erik Jan Rodenhuis, Werkgroep Ontwikkelings

Technieken).



Figure 6 – Overview of other stove types.

5.1.1.1 Recipe for soap

The outline of the recipe is as follows:

- Prepare a solution of the caustic soda by dissolving the soda into the water (never mix these components the other way around – risk of burning!)
- Stir until everything has dissolved. The bowl will get hot, cool it using cold water at the outside, or just let it cool down for a while.
- Pour the oil into a bowl and put it beside the bowl of caustic soda solution.
- Pour the caustic soda solution slowly into the oil, stirring all the time.

Immediately the mixture will go white and soon it becomes creamy.

- Continue stirring until the mixture is like mayonnaise. This is the moment to add additives like glycerine, perfume etc.

- If the mixture is still creamy, pour it into a mould, where it can harden overnight.

The moulds can be made from a wooden tray or a cardboard box, lined with a plastic sheet. Alternatively, consider using convenient and attractive shapes like small plastic bowls.

- The mixture hardens overnight in tropical temperatures, or in several days in temperate regions. Then it can be released from the mould and cut if necessary. For good sale and use the pieces of soap should not be larger than 150 gram or 6 to 8 to 2 cm.

Opmerking [J2]:
Waarom?

- Even after this first hardening the soap continues to mature for some time. It should be stored for some two weeks on shelf before sale.
- Wrapping the soap into a nice paper or clear plastic will add greatly to its sales value!
- Last but not least, don't forget to clean all the used utensils properly, as caustic soda is rather aggressive and Jatropha PPO is toxic.

5.1.1.2 Rural Soap

Opmerking [J3]:
Wat is het verschil met het andere recept?
Wanneer pas ik welk recept toe?

An other, more rural and worldwide applicable recipe for soap making is as follows¹:

¹ This recipe is based on collected information in rural zone of Honduras: Yoro department



You would need the following objects: (amount in the indicated ratios)

Opmerking [J4]:
ingredients

Milled Jatropha kernel (100)
Nice dry ash (50)
Water (20)
Three pans (one with a hole in the bottom)
A cloth
Fire place
Optional: other oils or animal fats

The actions are according the following description:

Opmerking [J5]:
process

- 1) Heat up a pot with water; it is not necessary to boil it, but it should be quite hot.
- 2) Place a cloth on top of the opening of another pan and fill the cloth with ash (Similar to filling a coffee filter with coffee).
- 3) Slowly pour the hot water on the cloth with the ash to make a strong abstract of ash-water. It is important that the abstract is quite strong. This can be checked simply by tasting the spiciness of the abstract by putting a small drop on the tip of your tongue. (Be carefull, don't swallow)
- 4) Put the milled jatropha kernel in a pan and put it on a low fire
- 5) If desired other types of fats can be add to the jatropha kernel.
- 6) Slowly add the ash abstract to the jatropha kernel
- 7) Mix slowly
- 8) The jatropha kernel will slowly absorb the ash liquid. Keep on adding the ash liquid until the fats are totally converted. This is a patient process which should be done on low fire.
- 9) After it gets a more solid form, balls can be made.
- 10) After three days these soap balls are ready to use.

The soap balls are famous for their dandruff curing effect and their general cleaning properties.

Water content test and acid test

- 1) To test for water content, heat about 0,5 litre of the oil in a saucepan on the stove and monitor the temperature with a thermometer. With more than 30% water in it, it will start to make crackling sounds from about 50 °C. If it's still not crackling by 60-65 °C there should be no need to dewater it. To remove the water, keep the oil at 60 °C for 15 minutes and then pour the oil into a settling tank. Let it settle for at least 24 hours, allowing the water to sink to the bottom. Then pour or drain the oil from above. Make sure you never empty the settling vessel more than 90%.
- 2) To test the acid (FFA) content you need to perform a titration of the oil with lye and an indicator. This means you carefully add small drops of lye to prepared oil until all the acid in the test mixture has been neutralized. Then you can calculate how much extra lye will be needed to neutralize the FFA in the conversion. You'll need some basic kitchen ware as well as a syringe with ml indication and some basic chemicals: de-ionized water, NaOH, isopropanol and phenolphthalein. Here's how to test: Dissolve 1 gram of pure sodium hydroxide lye (NaOH) in 1 litre of distilled or de-ionized water (0,1% w/v NaOH solution) (weight to volume). In a smaller beaker, dissolve 1 ml of dewatered oil in 10 ml of pure isopropyl alcohol (isopropanol). Warm the beaker gently by standing it in some hot water, stir until all the oil dissolves in the alcohol and the mixture turns clear. Add 2 drops of phenolphthalein solution (acidity indicator). Using a graduated syringe, add the 0,1% NaOH solution drop by drop to the oil-alcohol-phenolphthalein solution, stirring all the time. It



might turn a bit cloudy, keep stirring. Keep on carefully adding the lye solution until the solution stays pink (actually magenta) for 15 seconds. Take the number of millilitres of 0,1% lye solution you used and add 3,5 (the basic amount of lye needed for fresh oil). This is the number of grams of lye you'll need per litre of oil to process the oil. For used oil these same precautions and preparations hold, usually used oil's quality is worse than fresh oil's, leading to frequent need for dewatering and determination of acidity.



1.1. Practical experience and potential problems with PPO in engines

Fuel for diesel engines has to comply with a certain quality to prevent operational problems. Without proper oil cleaning the following can occur in a diesel engine [1]:

- Erosion of piston head and inlet port;
- Increased wear of piston rings;
- Polymerisation of lubrication oil;
- Cavitations and corrosion in the injectors due to too much water in the oil;
- Incomplete combustion with excess noise, smell and emissions due to high viscosity;
- Failure of injectors due to high FFA content;
- Abrasive effect on fuel injectors and combustion chambers due to phosphor;
- Frequent clogging of engine fuel filter due to phosphor and solids;

Some specific experiences have been outlined below [5]:

Netherlands/Mozambique: FACT project

At the end of 2008 Ger Groeneveld from PPO Groeneveld conducted several tests for oil cleaning and engine testing. He has adjusted two engines to run on PPO; a 17 kW Lister ST3 and an 18 kW Feidong 295 GJ. Endurance tests were performed with both engines. A 500 hour test with the Lister on mainly sunflower oil showed no fuel related problems. The viscosity of sunflower (17.1 cS at 38°C) is somewhat lower than that of jatropha (37-54cS at 30°C).

The high viscosity of Jatropha oil can cause engines to run short on fuel. Diesel engines have been designed for viscosities of 1.7-2.4 cS. When the engine runs short of fuel this can damage the pistons en injector nozzles will not spray properly or even clog. The viscosity of vegetable oils can be reduced by heating. Viscosities below 5 cS are acceptable for most diesel engines [5].

If the level of FFA is above 3%, there is a risk of engine damage by corrosion. Corrosion problems are relevant for engines that run intermittent. Oxygen then has a change to catalyze corrosion. The acid in the PPO will etch off any protective layers that normally prevent erosion.

Michael Allan (2002)

Conducted endurance tests with a Kabota diesel on palm oil. On refined palm oil the engine ran perfectly for over 2000 hours. Refining included deguming and neutralization. On crude palm oil however, the engine broke down after 300 hours and again after 550. Both the inlet port and piston head appeared badly eroded, the piston rings were worn and the lubrication oil had polymerized. These are clearly effects of poor fuel quality [5].

Colombia, Aprotec

Mauricio Gnecco found much carbon on the indirect injection pre-chamber when using well filtered palm oil. Users of another 10HP Lister engine reported a burned heat seal when the engine broke down. Analysis by Mauricio again showed high carbon deposits on the indirect injection pre-chamber throat.



Annex bij 5.1.4 : Tables of properties of vegetable oil and bio-diesel

Properties of oil and fats

All vegetable oils and animal fats do contain different mixtures of the following basic oil components:

Acid	Elementary Formula	Constitutional Formula	Systematic name
Lauric	C ₁₂ H ₂₄ O ₂	CH ₃ (CH ₂) ₁₀ COOH	C12:0
Myristic	C ₁₄ H ₂₈ O ₂	CH ₃ (CH ₂) ₁₂ COOH	C14:0
Palmitic	C ₁₆ H ₃₂ O ₂	CH ₃ (CH ₂) ₁₄ COOH	C16:0
Stearic	C ₁₈ H ₃₆ O ₂	CH ₃ (CH ₂) ₁₆ COOH	C18:0
Oleic	C ₁₈ H ₃₄ O ₂	CH ₃ (CH ₂) ₁₄ (CH) ₂ COOH	C18:1
Linoleic	C ₁₈ H ₃₂ O ₂	CH ₃ (CH ₂) ₁₂ (CH) ₄ COOH	C18:2
Linolenic	C ₁₈ H ₃₀ O ₂	CH ₃ (CH ₂) ₁₀ (CH) ₆ COOH	C18:3

Fat or oil	Lauric	Myristic	Palmitic	Stearic	Oleic	Linoleic	Linolenic
Jatropha			10-20	5-10	30-50	30-50	
Coconut	45	20	5	3	6	-	-
Palm kernel	55	12	6	4	10	-	-
Tallow (beef)	-	2	29.0	24.5	44.5	-	-
Tallow (mutton)	-	2	27.2	25.0	43.1	2.7	-
Lard	-	-	24.6	15.0	50.4	10.0	-
Olive	-	-	14.6	-	75.4	10.0	-
Arachis (peanut)	-	-	8.5	6.00	51.6	26.0	-
Cottonseed	-	-	23.4	-	31.6	45.0	-
Maize	-	-	6.0	2.0	44.0	48.0	-
Linseed	-	3	6.0	-	-	74.0	17.0

2 CRC 55th edition of Handbook of chemistry and physics.

3 E. T. Webb, *Oils and Fats in Soap Manufacture*, Soap Gazette and Perfumer, October 1, 1926, xxviii, 302

4 Heller (1996): Physic Nut



Soy bean	-	-	11.0	2.0	20.0	64.0	3.0
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5.2 Properties of biodiesel

The following table gives a summary of biodiesel properties for different feedstock. When fats and oils are converted to biodiesel (FAME or FAEE), its properties do change. The properties in the table are more or less general for a specific feedstock. Other features like acid number and content of ash, sludge and water are highly variable per batch, season or geography. All parameters have their relevance for shelf life, handling and use, engine power and lifetime, fuel consumption, etc. The table shows CN (cetane number) that determines ignition quality, LHV (lower heating value) that states the energy content, viscosity, cold plug point (CP) and pour point (PP) that are relevant for cold weather use, and flash point (FP) that is related to safety.

Fuel-related physical properties of esters of oils and fats ⁵						
Feedstock	CN	LHV (MJ/kg)	Viscosity (mm ² /s)	CP (deg C)	PP (deg C)	FP ⁶ (deg C)
<i>Methyl esters</i>						
Cottonseed ⁷	51.2	-	6.8 (21°C)	-	-4	110
Rapeseed ⁸	54.4	40,4	6.7 (40°C)	-2	-9	84
Safflower ⁹	49.8	40,0	-	-	-6	180
Soybean ¹⁰	46.2	39,8	4.08 (40°C)	2	-1	171
Sunflower ¹¹	46.6	39,8	4.22 (°C)	0	-4	-
Tallow ¹²	-	39,9	4.11 (40°C)	12	9	96
<i>Ethyl esters</i>						
Palm ¹³	56.2	39,1	4.5 (37.8°C)	8	6	190
Soybean	48.2	40,0	4.41 (40°C)	1	-4	174
Tallow ¹⁴	-	-	-	15	12	-

5 G. Knothe, R.O. Dunn, and M.O. Bagby, in *Fuels and Chemicals from Biomass*. Washington, D.C.: American Chemical Society.

6 Some flash points are very low. These may be typographical errors in the references or the materials may have contained residual alcohols.

7 Geyer, S.M.; Jacobus, M.J.; Lestz, S.S. *Trans. ASAE* 1984, 27, 375-381.

8 Peterson, C.L.; Korus, R.A.; Mora, P.G.; Madsen, J.P. *Trans. ASAE*, 1987, 30, 28-35.

9 Isiigür, A.; Karaosmanolu, F.; Aksoy, H.A.; Hamdallahpur, F.; Gülder, Ö.L. *Appl. Biochem. Biotechnol.* 1994, 45-46, 93-102.

10 Bagby, M.O. In *Proc. 9th Int. Conf. Jojoba Uses, 3rd Int. Conf. New Industr. Crops Prod.*; Princen, L.H., Rossi, C., Eds.; Assoc. Advancem. Industr. Crops. publ. 1996; pp. 220-224.

11 Kaufman, K.R.; Ziejewski, M. *Trans. ASAE* 1984, 27, 1626-1633.

12 Ali, Y.; Hanna, M.A.; Cuppett, S.L. *J. Am. Oil Chem. Soc.* 1995, 72, 1557-1564.

13 Avella, F.; Galtieri, A.; Fiumara, A. *Riv. Combust.* 1992, 46, 181-188.

14 Nelson, L.A.; Foglia, T.A.; Dunn, R.O.; Marmer, W.N. submitted for publication.



Many parameters of fossil diesel fuel are about the same. Its viscosity is a bit lower (easier flowing) so heating up of biodiesel will be advantageous to reduce its viscosity. The cold plug point, the point a fuel filter will be blocked by solid fat or wax, is higher for biodiesel, so a heated fuel filter will be advantageous as well. But given the figures of biodiesel compared with daily outside temperatures in for example Honduras, no problems regarding cold-weather properties of biodiesel are to be expected.

ANNEX bij 5.1.5 Annex 1

Material Safety Data Sheet
Methyl Alcohol, Reagent ACS, 99.8% (GC)

ACC# 95294

Section 1 - Chemical Product and Company Identification

MSDS Name: Methyl Alcohol, Reagent ACS, 99.8% (GC)

Catalog Numbers: AC423950000, AC423950010, AC423950020, AC423955000, AC9541632, AC423952

Synonyms: Carbinol; Methanol; Methyl hydroxide; Monohydroxymethane; Pyroxylic spirit; Wood alcohol; Wood naptha; Wood spirit; Monohydroxymethane; Methyl hydrate.

Company Identification:

Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410

For information in North America, call: 800-ACROS-01

For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
67-56-1	Methyl alcohol	99+	200-659-6

Hazard Symbols: T F

Risk Phrases: 11 23/24/25 39/23/24/25

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: clear, colorless. Flash Point: 11 deg C. Poison! Cannot be made non-poisonous. Causes eye and skin irritation. May be absorbed through intact skin. This substance has caused adverse reproductive and fetal effects in animals. **Danger! Flammable liquid and vapor.** Harmful if inhaled. May be fatal or cause blindness if swallowed. May cause central nervous system depression. May cause digestive tract irritation with nausea, vomiting, and diarrhea. Causes respiratory tract irritation. May cause liver, kidney and heart damage.

Target Organs: Kidneys, heart, central nervous system, liver, eyes.

Potential Health Effects

Eye: Produces irritation, characterized by a burning sensation, redness, tearing, inflammation, and possible corneal injury. May cause painful sensitization to light.



Skin: Causes moderate skin irritation. May be absorbed through the skin in harmful amounts. Prolonged and/or repeated contact may cause defatting of the skin and dermatitis.

Ingestion: May be fatal or cause blindness if swallowed. May cause gastrointestinal irritation with nausea, vomiting and diarrhea. May cause systemic toxicity with acidosis. May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure. May cause cardiopulmonary system effects.

Inhalation: Harmful if inhaled. May cause adverse central nervous system effects including headache, convulsions, and possible death. May cause visual impairment and possible permanent blindness. Causes irritation of the mucous membrane.

Chronic: Prolonged or repeated skin contact may cause dermatitis. Chronic inhalation and ingestion may cause effects similar to those of acute inhalation and ingestion. Chronic exposure may cause reproductive disorders and teratogenic effects. Laboratory experiments have resulted in mutagenic effects. Prolonged exposure may cause liver, kidney, and heart damage.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately.

Skin: Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists. Wash clothing before reuse.

Ingestion: If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately. Induce vomiting by giving one teaspoon of Syrup of Ipecac.

Inhalation: Get medical aid immediately. Remove from exposure to fresh air immediately. If breathing is difficult, give oxygen. Do NOT use mouth-to-mouth resuscitation. If breathing has ceased apply artificial respiration using oxygen and a suitable mechanical device such as a bag and a mask.

Notes to Physician: Effects may be delayed. Ethanol may inhibit methanol metabolism.

Section 5 - Fire Fighting Measures

General Information: Containers can build up pressure if exposed to heat and/or fire. As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Water runoff can cause environmental damage. Dike and collect water used to fight fire. Vapors can travel to a source of ignition and flash back. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Flammable Liquid. Can release vapors that form explosive mixtures at temperatures above the flashpoint. Use water spray to keep fire-exposed containers cool. Water may be ineffective. Material is lighter than water and a fire may be spread by the use of water. Vapors may be heavier than air. They can spread along the ground and collect in low or confined areas. May be ignited by heat, sparks, and flame.

Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam. Use water spray to cool fire-exposed containers. Water may be ineffective. For large fires, use water spray, fog or alcohol-resistant foam. Do NOT use straight streams of water.

Section 6 - Accidental Release Measures



General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks: Scoop up with a nonsparking tool, then place into a suitable container for disposal. Use water spray to disperse the gas/vapor. Remove all sources of ignition. Absorb spill using an absorbent, non-combustible material such as earth, sand, or vermiculite. Do not use combustible materials such as saw dust. Provide ventilation. A vapor suppressing foam may be used to reduce vapors. Water spray may reduce vapor but may not prevent ignition in closed spaces.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Ground and bond containers when transferring material. Do not breathe dust, vapor, mist, or gas. Do not get in eyes, on skin, or on clothing. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Keep container tightly closed. Avoid contact with heat, sparks and flame. Do not ingest or inhale. Use only in a chemical fume hood. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames.

Storage: Keep away from heat, sparks, and flame. Keep away from sources of ignition. Store in a cool, dry, well-ventilated area away from incompatible substances. Flammables-area. Keep containers tightly closed. Do not store in aluminum or lead containers.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Use explosion-proof ventilation equipment. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits. Use only under a chemical fume hood.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Methyl alcohol	200 ppm TWA; 250 ppm STEL; skin - potential for cutaneous absorption	200 ppm TWA; 260 mg/m3 TWA 6000 ppm IDLH	200 ppm TWA; 260 mg/m3 TWA

OSHA Vacated PELs: Methyl alcohol: 200 ppm TWA; 260 mg/m3 TWA; 250 ppm STEL; 325 mg/m3 STEL

Personal Protective Equipment

Eyes: Wear chemical goggles.

Skin: Wear appropriate protective gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant a respirator's use.

Section 9 - Physical and Chemical Properties

Physical State: Liquid

Appearance: clear, colorless

Odor: alcohol-like - weak odor



pH: Not available.
Vapor Pressure: 128 mm Hg @ 20 deg C
Vapor Density: 1.11 (Air=1)
Evaporation Rate:5.2 (Ether=1)
Viscosity: 0.55 cP 20 deg C
Boiling Point: 64.7 deg C @ 760.00mm Hg
Freezing/Melting Point:-98 deg C
Autoignition Temperature: 464 deg C (867.20 deg F)
Flash Point: 11 deg C (51.80 deg F)
Decomposition Temperature:Not available.
NFPA Rating: (estimated) Health: 1; Flammability: 3; Reactivity: 0
Explosion Limits, Lower:6.0 vol %
Upper: 36.00 vol %
Solubility: miscible
Specific Gravity/Density:.7910g/cm³
Molecular Formula:CH₄O
Molecular Weight:32.04

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.

Conditions to Avoid: High temperatures, incompatible materials, ignition sources, oxidizers.

Incompatibilities with Other Materials: Acids (mineral, non-oxidizing, e.g. hydrochloric acid, hydrofluoric acid, muriatic acid, phosphoric acid), acids (mineral, oxidizing, e.g. chromic acid, hypochlorous acid, nitric acid, sulfuric acid), acids (organic, e.g. acetic acid, benzoic acid, formic acid, methanoic acid, oxalic acid), azo, diazo, and hydrazines (e.g. dimethyl hydrazine, hydrazine, methyl hydrazine), isocyanates (e.g. methyl isocyanate), nitrides (e.g. potassium nitride, sodium nitride), peroxides and hydroperoxides (organic, e.g. acetyl peroxide, benzoyl peroxide, butyl peroxide, methyl ethyl ketone peroxide), epoxides (e.g. butyl glycidyl ether), Oxidants (such as barium perchlorate, bromine, chlorine, hydrogen peroxide, lead perchlorate, perchloric acid, sodium hypochlorite), Active metals (such as potassium and magnesium), acetyl bromide, alkyl aluminum salts, beryllium dihydride, carbontetrachloride, carbon tetrachloride + metals, chloroform + heat, chloroform + sodium hydroxide, cyanuric chloride, diethyl zinc, nitric acid, potassium-tert-butoxide, chloroform + hydroxide, water reactive substances (e.g. acetic anhydride, alkyl aluminum chloride, calcium carbide, ethyl dichlorosilane).

Hazardous Decomposition Products: Carbon monoxide, irritating and toxic fumes and gases, carbon dioxide, formaldehyde.

Hazardous Polymerization: Will not occur.

Section 11 - Toxicological Information

RTECS#:

CAS# 67-56-1: PC1400000

LD50/LC50:

CAS# 67-56-1:

Draize test, rabbit, eye: 40 mg Moderate;

Draize test, rabbit, eye: 100 mg/24H Moderate;

Draize test, rabbit, skin: 20 mg/24H Moderate;

Inhalation, rat: LC50 = 64000 ppm/4H;

Oral, mouse: LD50 = 7300 mg/kg;



Oral, rabbit: LD50 = 14200 mg/kg;
Oral, rat: LD50 = 5628 mg/kg;
Skin, rabbit: LD50 = 15800 mg/kg;

Carcinogenicity:

CAS# 67-56-1: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.

Epidemiology: Methanol has been shown to produce fetotoxicity in the embryo or fetus of laboratory animals. Specific developmental abnormalities include cardiovascular, musculoskeletal, and urogenital systems.

Teratogenicity: Effects on Newborn: Behavioral, Oral, rat: TDLo=7500 mg/kg (female 17-19 days after conception). Effects on Embryo or Fetus: Fetotoxicity, Inhalation, rat: TCLo=10000 ppm/7H (female 7-15 days after conception). Specific Developmental Abnormalities: Cardiovascular, Musculoskeletal, Urogenital, Inhalation, rat: TCLo=20000 ppm/7H (7-14 days after conception).

Reproductive Effects: Paternal Effects: Spermatogenesis: Intraperitoneal, mouse TDLo=5 g/kg (male 5 days pre-mating). Fertility: Oral, rat: TDLo = 35295 mg/kg (female 1-15 days after conception). Paternal Effects: Testes, Epididymis, Sperm duct: Oral, rat: TDLo = 200 ppm/20H (male 78 weeks pre-mating).

Neurotoxicity: No information available.

Mutagenicity: DNA inhibition: Human Lymphocyte = 300 mmol/L. DNA damage: Oral, rat = 10 umol/kg. Mutation in microorganisms: Mouse Lymphocyte = 7900 mg/L. Cytogenetic analysis: Oral, mouse = 1 gm/kg.

Other Studies: Standard Draize Test (Skin, rabbit) = 20 mg/24H (Moderate) Standard Draize Test: Administration into the eye (rabbit) = 40 mg (Moderate). Standard Draize test: Administration into the eye (rabbit) = 100 mg/24H (Moderate).

Section 12 - Ecological Information

Ecotoxicity: Fish: Fathead Minnow: 29.4 g/L; 96 Hr; LC50 (unspecified) Goldfish: 250 ppm; 11 Hr; resulted in death Rainbow trout: 8000 mg/L; 48 Hr; LC50 (unspecified) Rainbow trout: LC50 = 13-68 mg/L; 96 Hr.; 12 degrees C Fathead Minnow: LC50 = 29400 mg/L; 96 Hr.; 25 degrees C, pH 7.63 Rainbow trout: LC50 = 8000 mg/L; 48 Hr.; Unspecified ria: Phytobacterium phosphoreum: EC50 = 51,000-320,000 mg/L; 30 minutes; Microtox test No data available.

Environmental: Dangerous to aquatic life in high concentrations. Aquatic toxicity rating: TLM 96>1000 ppm. May be dangerous if it enters water intakes. Methyl alcohol is expected to biodegrade in soil and water very rapidly. This product will show high soil mobility and will be degraded from the ambient atmosphere by the reaction with photochemically produced hydroxyl radicals with an estimated half-life of 17.8 days. Bioconcentration factor for fish (golden ide) < 10. Based on a log Kow of -0.77, the BCF value for methanol can be estimated to be 0.2.

Physical: No information available.

Other: None.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.

RCRA P-Series: None listed.

RCRA U-Series: CAS# 67-56-1: waste number U154; (Ignitable waste).



Section 14 - Transport Information

	US DOT	IATA	RID/ADR	IMO	Canada TDG
Shipping Name:	METHANOL				METHANOL
Hazard Class:	3				3(6.1)
UN Number:	UN1230				UN1230
Packing Group:	II				II
Additional Info:					FLASHPOINT 11 C

Section 15 - Regulatory Information

US FEDERAL

TSCA

CAS# 67-56-1 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

SARA

Section 302 (RQ)

CAS# 67-56-1: final RQ = 5000 pounds (2270 kg)

Section 302 (TPQ)

None of the chemicals in this product have a TPQ.

SARA Codes

CAS # 67-56-1: acute, flammable.

Section 313

This material contains Methyl alcohol (CAS# 67-56-1, 99%), which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

CAS# 67-56-1 is listed as a hazardous air pollutant (HAP). This material does not contain any Class 1 Ozone depleters. This material does not contain any Class 2 Ozone depleters.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA. None of the chemicals in this product are listed as Priority Pollutants under the CWA. None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 67-56-1 can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

California No Significant Risk Level: None of the chemicals in this product are listed.



European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

T F

Risk Phrases:

R 11 Highly flammable.

R 23/24/25 Toxic by inhalation, in contact with skin and if swallowed.

R 39/23/24/25 Toxic : danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed.

Safety Phrases:

S 16 Keep away from sources of ignition - No smoking.

S 36/37 Wear suitable protective clothing and gloves.

S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

S 7 Keep container tightly closed.

WGK (Water Danger/Protection)

CAS# 67-56-1: 1

Canada

CAS# 67-56-1 is listed on Canada's DSL List. CAS# 67-56-1 is listed on Canada's DSL List.

This product has a WHMIS classification of B2, D1A, D2B.

CAS# 67-56-1 is listed on Canada's Ingredient Disclosure List.

Exposure Limits

CAS# 67-56-1: OEL-ARAB Republic of Egypt:TWA 200 ppm (260 mg/m³);Skin OEL-AUSTRALIA:TWA 200 ppm (260 mg/m³);STEL 250 ppm;Skin OEL-BELGIUM:TWA 200 ppm (262 mg/m³);STEL 250 ppm;Skin OEL-CZECHOSLOVAKIA:TWA 100 mg/m³;STEL 500 mg/m³ OEL-DENMARK:TWA 200 ppm (260 mg/m³);Skin OEL-FINLAND:TWA 200 ppm (260 mg/m³);STEL 250 ppm;Skin OEL-FRANCE:TWA 200 ppm (260 mg/m³);STEL 1000 ppm (1300 mg/m³) OEL-GERMANY:TWA 200 ppm (260 mg/m³);Skin OEL-HUNGARY:TWA 50 mg/m³;STEL 100 mg/m³;Skin JAN9 OEL -JAPAN:TWA 200 ppm (260 mg/m³);Skin OEL-THE NETHERLANDS:TWA 200 ppm (260 mg/m³);Skin OEL-THE PHILIPPINES:TWA 200 ppm (260 mg/m³) OEL-POLAND:TWA 100 mg/m³ OEL-RUSSIA:TWA 200 ppm;STEL 5 mg/m³;Skin OEL-SWEDEN:TWA 200 ppm (250 mg/m³);STEL 250 ppm (350 mg/m³);Skin OEL-SWITZERLAND:TWA 200 ppm (260 mg/m³);STEL 400 ppm;Skin OEL-THAILAND:TWA 200 ppm (260 mg/m³) OEL-TURKEY:TWA 200 ppm (260 mg/m³) OEL-UNITED KINGDOM:TWA 200 ppm (260 mg/m³);STEL 250 ppm;Skin OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

Section 16 - Additional Information

MSDS Creation Date: 7/21/1999

Revision #4 Date: 3/14/2001

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or



implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.



Annex 2 bij 5.1.5

Material Safety Data Sheet
Potassium Hydroxide

ACC# 19431

Section 1 - Chemical Product and Company Identification

MSDS Name: Potassium Hydroxide

Catalog Numbers: S71978, S71979, S71979-1, S71979-2, P246-3, P250-1, P250-10, P250-3, P250-50, P250-500, P250-50LC, P251-3, P251-50, P251-500, P251-50KG, P25812, P258212, P25850, P25850LC, PFP25050LC, S71977, S72221D

Synonyms: Caustic potash, Lye, Potassium hydrate

Company Identification:

Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410

For information, call: 201-796-7100

Emergency Number: 201-796-7100

For CHEMTREC assistance, call: 800-424-9300

For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
1310-58-3	Potassium hydroxide (KOH)	100.0	215-181-3

Hazard Symbols: C

Risk Phrases: 22 35

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: white or yellow. **Danger!** Corrosive. Water-Reactive. Harmful if swallowed. Causes severe eye and skin burns. Causes severe digestive and respiratory tract burns.

Target Organs: None.

Potential Health Effects

Eye: Causes severe eye burns. May cause irreversible eye injury. Contact may cause ulceration of the conjunctiva and cornea. Eye damage may be delayed.

Skin: Causes skin burns. May cause deep, penetrating ulcers of the skin.

Ingestion: Harmful if swallowed. May cause circulatory system failure. May cause perforation of the digestive tract. Causes severe digestive tract burns with abdominal pain, vomiting, and possible death.

Inhalation: Harmful if inhaled. Irritation may lead to chemical pneumonitis and pulmonary edema. Causes severe irritation of upper respiratory tract with coughing, burns, breathing difficulty, and possible coma.



Chronic: Prolonged or repeated skin contact may cause dermatitis. Prolonged or repeated eye contact may cause conjunctivitis.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately.

Skin: Get medical aid immediately. Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Discard contaminated clothing in a manner which limits further exposure.

Ingestion: Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.

Inhalation: Get medical aid immediately. Remove from exposure to fresh air immediately. If breathing is difficult, give oxygen. If breathing has ceased apply artificial respiration using oxygen and a suitable mechanical device such as a bag and a mask.

Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Use water with caution and in flooding amounts. Contact with moisture or water may generate sufficient heat to ignite nearby combustible materials.

Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam.

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks: Vacuum or sweep up material and place into a suitable disposal container. Avoid generating dusty conditions.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Use with adequate ventilation. Do not allow water to get into the container because of violent reaction. Do not get in eyes, on skin, or on clothing. Do not ingest or inhale.

Storage: Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances. Keep away from strong acids. Keep away from water. Keep away from metals. Keep away from flammable liquids. Keep away from organic halogens.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Use adequate general or local exhaust ventilation to keep airborne



concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Potassium hydroxide (KOH)	C 2 mg/m ³	none listed	none listed

OSHA Vacated PELs: Potassium hydroxide (KOH): C 2 mg/m³

Personal Protective Equipment

Eyes: Wear safety glasses and chemical goggles or face shield if handling liquids.

Skin: Wear appropriate gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

Section 9 - Physical and Chemical Properties

Physical State: Solid

Appearance: white or yellow

Odor: odorless

pH: 13.5 (0.1M solution)

Vapor Pressure: Not available.

Vapor Density: Not available.

Evaporation Rate: Not available.

Viscosity: Not available.

Boiling Point: 2408 deg F

Freezing/Melting Point: 680 deg F

Autoignition Temperature: Not applicable.

Flash Point: Not applicable.

Decomposition Temperature: Not available.

NFPA Rating: (estimated) Health: 3; Flammability: 0; Reactivity: 1

Explosion Limits, Lower: Not available.

Upper: Not available.

Solubility: Soluble in water

Specific Gravity/Density: 2.04

Molecular Formula: KOH

Molecular Weight: 56.1047

Section 10 - Stability and Reactivity

Chemical Stability: Stable. Readily absorbs carbon dioxide and moisture from the air and deliquesces.

Conditions to Avoid: Incompatible materials, moisture, contact with water, acids, metals.

Incompatibilities with Other Materials: Generates large amounts of heat when in contact with water and may steam and splatter. Reacts with chlorine dioxide, nitrobenzene, nitromethane, nitrogen trichloride, peroxidized tetrahydrofuran, 2,4,6-trinitrotoluene, bromoform+ crown ethers, acids alcohols, sugars, germanium cyclopentadiene, maleic dicarbide. Corrosive to metals such as aluminum, tin, and zinc to cause formation of flammable hydrogen gas.

Hazardous Decomposition Products: Oxides of potassium.

Hazardous Polymerization: Has not been reported.



Section 11 - Toxicological Information

RTECS#:

CAS# 1310-58-3: TT2100000

LD50/LC50:

CAS# 1310-58-3:

Draize test, rabbit, skin: 50 mg/24H Severe;

Oral, rat: LD50 = 273 mg/kg;

Carcinogenicity:

CAS# 1310-58-3: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.

Epidemiology: No data available.

Teratogenicity: No information reported.

Reproductive Effects: No data available.

Neurotoxicity: No data available.

Mutagenicity: No data available.

Other Studies: No data available.

Section 12 - Ecological Information

Ecotoxicity: Fish: Mosquito Fish: LC50 = 80.0 mg/L; 24 Hr.; Unspecified No data available.

Environmental: No information found.

Physical: No information found.

Other: No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3.

Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.

RCRA P-Series: None listed.

RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	IATA	RID/ADR	IMO	Canada TDG
Shipping Name:	POTASSIUM HYDROXIDE, SOLID				POTASSIUM HYDROXIDE
Hazard Class:	8				8(9.2)
UN Number:	UN1813				UN1813
Packing Group:	II				II



US FEDERAL

TSCA

CAS# 1310-58-3 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

SARA

Section 302 (RQ)

CAS# 1310-58-3: final RQ = 1000 pounds (454 kg)

Section 302 (TPQ)

None of the chemicals in this product have a TPQ.

SARA Codes

CAS # 1310-58-3: acute, reactive.

Section 313

No chemicals are reportable under Section 313.

Clean Air Act:

This material does not contain any hazardous air pollutants. This material does not contain any Class 1 Ozone depleters. This material does not contain any Class 2 Ozone depleters.

Clean Water Act:

CAS# 1310-58-3 is listed as a Hazardous Substance under the CWA. None of the chemicals in this product are listed as Priority Pollutants under the CWA. None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 1310-58-3 can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

C

Risk Phrases:

R 22 Harmful if swallowed.

R 35 Causes severe burns.

Safety Phrases:

S 26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

S 36/37/39 Wear suitable protective clothing, gloves and eye/face protection.

S 45 In case of accident or if you feel unwell, seek



medical advice immediately (show the label where possible).

WGK (Water Danger/Protection)

CAS# 1310-58-3: 1

Canada

CAS# 1310-58-3 is listed on Canada's DSL List. CAS# 1310-58-3 is listed on Canada's DSL List.

This product has a WHMIS classification of D1B, E.

CAS# 1310-58-3 is listed on Canada's Ingredient Disclosure List.

Exposure Limits

CAS# 1310-58-3: OEL-AUSTRALIA:TWA 2 mg/m³ OEL-BELGIUM:STEL 2 mg/m³
OEL-DENMARK:TWA 2 mg/m³ OEL-FINLAND:TWA 2 mg/m³ OEL-FRANCE:STEL 2 m
g/m³ OEL-JAPAN:STEL 2 mg/m³ OEL-THE NETHERLANDS:TWA 2 mg/m³ OEL-SWI
TZERLAND:TWA 2 mg/m³ OEL-UNITED KINGDOM:TWA 2 mg/m³;STEL 2 mg/m³ OEL
IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV OEL IN NEW ZEAL
AND, SINGAPORE, VIETNAM check ACGI TLV

Section 16 - Additional Information

MSDS Creation Date: 6/21/1999

Revision #3 Date: 10/06/2000

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

1.1.1.1.1. Purification of glycerine

Glycerine in its pure form is colourless, odourless and it tastes sweet [12]. Avoid tasting glycerine from the biodiesel process though, because it is never pure. Especially not when the biodiesel and glycerine are produced from Jatropa oil with high free fatty acid levels. Then it contains methanol or ethanol, lye (potassium hydroxide KOH or sodium hydroxide NaOH), water, soap residues, biodiesel, free fatty acids and non-reacted mono, di or tri-glycerides. Most of these residues are dissolved in the methanol and can be filtered out of the glycerine, once the methanol has been distilled off. Others have to be neutralized with acids and will be separated by gravity.

To get 100% pure Glycerine it should be distilled, nevertheless this is a very costly process since the boiling point of glycerine is 290°C [11]. This cost usually doesn't make up for the profit unless at large industrial scale.

Opmerking [J6]:
Welke site

1.1.1.1.2. Practical applications of biodiesel-glycerine

Applications of pure glycerine are mainly in chemistry and pharmacy. Crude Glycerine can be used in more practical applications which will be described below.

1.1.1.1.2.1.soap

Soap can either be made by saponification of fats and lye or with fatty acids and a lye. The final product is to be used with water to gain its cleaning effect. Glycerine contains FFA which can be converted into soap. The presence of glycerine makes the soap feel soft and hydrates the skin while using it. For the saponification process the same lye as used during the transesterification process



should be used. Sodium hydroxide (NaOH) will give a solid bar soap, potassium hydroxide (KOH) makes liquid soap. Before making soap out of glycerine the alcohol (methanol or ethanol) should be distilled off. In the case of methanol it is important that all the methanol is removed since it is a highly toxic and combustible chemical that has an extremely low flash point, which makes it very easy to inhale by accident¹⁵. Then, depending on the FFA level, the amount of lye is to be determined (normally between 40 grams and 80 grams per litre of glycerine). The amount of water to be added is about 40% of the original amount of glycerine. More water makes a more liquid soap. More lye makes the soap feel more corrosive. Then the lye and the water are mixed until the lye is solved totally. Be careful: Sodium hydroxide (NaOH) and potassium hydroxide (KOH) are corrosive substances¹⁶. Add the mixture to the glycerine and mix for 20 minutes. Leave it for three weeks, shaking it daily. In case you are using purified glycerine, colorant and odours can be added for domestic use. Industrial quantities of glycerine soap can be used for car washes or mechanic workshops.

1.1.1.1.2.2.Organic manure

Glycerine is claimed to be an excellent fertilizer. But is this true?

The chemical composition of the glycerine depends indirect on the oil quality and the amount of chemicals added in the transesterification process. The alcohol residues, if methanol, should be distilled off before using glycerine as an organic fertilizer to prevent human health problems. Nevertheless in the environment methanol is bio-degradable. Methyl alcohol is expected to evaporate and biodegrade in soil and water very rapidly. This product will show high soil mobility and will be degraded from the ambient atmosphere by the reaction with photochemically produced hydroxyl radicals with an estimated half-life of 17.8 days. It can be dangerous to aquatic life in high concentrations¹⁷ Also the pure glycerine and the FFA acids are biodegradable. Potash (K) is one of the main elements for plant growth and sodium(Na) is needed to control humidity in cells, in a smaller quantity.

Since the nutrient composition is not in balance with plant requirements, biodiesel glycerine could only serve as an additional fertilizer. Moreover, more economically valuable products can be made out of the glycerine which makes the use of the glycerine as a fertilizer less interesting.

1.1.1.1.2.3.Biogas

Glycerine can also be used as an additional ingredient for biogas production. Biogas is produced within an anaerobic digestion unit. Together with jatropha press cake and fresh cow manure it has shown to be an effective digestible ingredient in the composition of 5% glycerine, 10% jatropha press cake, 35% cow manure and 50% water. More investigation is needed to optimize this anaerobic digestion process. Be careful with the addition of grass as it only digests slowly and can plug the reactor.

1.1.1.1.2.4.Burning

The simplest way to get rid of the bio-glycerine is by burning it. Though, successful burning devices for direct burning of crude glycerine are not available. The high viscosity makes it a difficult fuel for spray burning and for wicks. Mixed with saw dust (16 MJ/kg) it can be pressed into briquettes but well designed furnaces are needed because low combustion temperatures may generate toxic gases like acrolein[13]. At a larger scale Combined Heat and Power (CHP) generators can be considered to generate electricity[14]. Although a PPO converted diesel engine could be able to use some clean glycerine in a fuel mixture with PPO or (bio)diesel, care must be taken that unrefined glycerine is unsuitable for engines because of its high ash content. In large marine diesel

¹⁵ Annex 1: safety sheet methanol

¹⁶ Annex 2: safety sheet Sodium hydroxide (NaOH) and potassium hydroxide (KOH)

¹⁷ Source: Safety sheet methyl alcohol



engines or steam boilers it would be possible to use it to produce both electricity and hot water or steam.

1.1.1.1.2.5.Applications in biodiesel process

Considering the fact that the glycerine contains high contents of alcohol (methanol or ethanol) it can be used as a partial replacer of the alcohol for the transesterification process. The methanol content in glycerine can go up to 35%. Replacing 30% percent of the alcohol by glycerine may result in a 20% methanol saving [15]. An other application of crude glycerine in the biodiesel process is using it as a liquid to execute a prewash of the biodiesel. Soap residues will dissolve in the crude glycerine which results in less use of water of solid purifiers

1.1.1.1.2.6.Industrial applications

Pure glycerine is used for applications in medicines, personal healthcare, toys, food and chemical industry for the making of for example dynamite.