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(54) **Composition of water-soluble metal working fluid using distillation residue generated in production of biodiesel**

(57) A composition of a water-soluble metalworking fluid used in metal machining is provided. The water-soluble metalworking fluid is formed by adding 5 to 70wt% additives to 5 to 95wt% distillation residues that is generated in production of biodiesel and used as lubricating base oil, and 0 to 70wt% ion exchange water.

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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of Korean Patent Application No. 10-2007-0003692, filed on Jan. 12, 2007, the disclosure of which are hereby incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to a water-soluble metalworking fluid used in metal machining, and more particularly, to a composition of a water-soluble metalworking fluid produced by adding 5 to 70wt% of additives to 20 to 95wt% of distillation residues that is generated in production of biodiesel and used as lubricating base oil, and 0 to 40wt% of ion exchange water.

2. Description of the Related Art

[0003] Metalworking fluids are fluids which are used to assist metal machining operations. Traditional metal machining requires a machine tool, a cutting tool, a worked metal, and a machining fluid. Metalworking fluids were first used to increase the lifespan of an instrument for metal processing in the early 1900s. The original metalworking fluids were mainly formed of base oil refined from crude oil, and contained a large amount of polyaromatic hydrocarbons (PAHs) that are now known to be carcinogens due to non-development of refinement techniques. Workers can be exposed to these metalworking fluids via many forms and paths while in use, and the fluids may be a cause of cancer, non-malignant respiratory disease, dermatosis, microbial disease, etc. for the workers. Problems caused by oil mists and metalworking fluids were so significant for industrial health that they were even one of the priorities chosen by the U.S. Occupational Safety and Health Administration (OSHA) in 1996.

[0004] These days, according to the characteristics of metal machining, various kind of metalworking fluids are produced and various kind of additives are used. The amount and composition of the additives depend on the kind of the metalworking fluids and the characteristics of the product.

[0005] The metalworking fluids reduce friction and abrasion between a cutting tool and a worked metal, improve machining surface characteristics, reduce adhesion or melting of the surface, remove generated heat, prevent deformation caused by heat, and wash cut pieces, fine powder and residues. In addition, the metalworking fluids also prevent corrosion of machined surfaces, and cool the heated machined surfaces down so as to be more easily handled.

[0006] Functions of the water-soluble metalworking fluids include cooling, prevention of welding between the cutting tool and the machined surfaces, prevention of abrasion at high temperature, and prevention of distortion caused by remaining heat. The water-soluble metalworking fluids are diluted with a water of about 60 to 85% just before using base oil that is more highly refined than cycloparaffin or paraffin-based oils used in a non-water-soluble environment. Since an available concentration of the water-soluble fluid ranges from 1 to 10%, characteristics of water that is used as a base material are important to performance of the fluid. Water is the best cooling agent due to high specific heat, good thermal conductivity and high latent heat. However, water rusts metal, and thus has less wettability and lubrication than oil. To overcome these disadvantages, the water-soluble metalworking fluids include a rust inhibitor or a surfactant, thereby increasing lubrication. A recently developed additive can prevent corrosion for approximately several days to a week, which thus overcomes the poor rust inhibition and poor metal corrosion inhibition of the water-soluble metalworking fluids.

[0007] The water-soluble metalworking fluids are nonflammable like water and non-sticky, so it is preferred by workers due to a clean work environment, but it is corruptible.

[0008] The advantages of the water-soluble metalworking fluids are as follows. It can be used for fast cutting due to good cooling properties, and cleansing, thereby providing safe conditions for workers. Also, it is economical because of the use of water.

[0009] The water-soluble metalworking fluids are classified into two types, which are an emulsion type which is translucent to an emulsion like a milky liquid when diluted with water, and a semi-synthetic and synthetic type. The milky white residue of the dilution indicates that an emulsion particle has a sufficient size to reflect transmitted light, and the clear dilution indicates that the particle is so small that the transmitted light mostly penetrates between the particles. Components and ratios of the conventional water-soluble metalworking fluids are listed below.

Kind of Additive	Emulsion Type	Semi-Synthetic Type	Synthetic Type
Emulsifier	20 ~ 30%	20 ~ 30 %	-
Lubricating Additive/ Extreme Pressure Additive	0 ~ 40%	0 ~ 10%	0 ~ 30%
pH booster (Amines, etc.)	3 ~ 10%	3 ~ 10%	10 ~ 25%
Metal Corrosion Inhibitor	1 ~ 5%	1 ~ 5%	1 ~ 8%
Preservative	0 ~ 3%	2 ~ 4%	0 ~ 3%
Defoamer	0 ~ 2%	0 ~ 2%	0 ~ 0.5%
Lubricating Base Oil	~ 100%	5 ~ 30%	-
Ion Exchange Water	-	~ 100%	~ 100%

[0010] Recently, as interest in the importance of environmental protection and health and safety for workers has been increasing around the whole world, research on environmentally-acceptable lubricating base oil which will substitute for hydrocarbon-based lubricating base oil among the metalworking fluids is progressing in North American and Western European nations.

[0011] The present invention is directed to developing a composition of a water-soluble metalworking fluid using a distillation residue generated in production of biodiesel as environmentally-friendly lubricating base oil.

[0012] Biodiesel refers to an alternative energy processed from elemental lipid in vegetables and animals to have similar properties to gasoline, which can be used as a diesel equivalent or for diesel engines by being mixed with the gasoline. In general, biodiesel refers to fatty acid methyl esters having a purity of 95% made from the transesterification between alcohols (generally, methanol) and vegetable oil (rice bran, waste cooking oil, soybean oil, rape oil, etc.). (Ministry of Commerce, Industry and Economy (MOCIE) Announcement No. 2000-57)

[0013] The vegetable oil described above, that is, a compound including a hydrophobic group insoluble in water, is generally composed of triglycerides represented as the following chemical structural formula.

$$\begin{array}{l} CH_2\text{-}O\text{-}CO\,(CH_2)_l\text{-}CH_3 \\ | \\ CH\text{-}O\text{-}CO\,(CH_2)_m\text{-}CH_3 \\ | \\ CH_2\text{-}O\text{-}CO\,(CH_2)_n\text{-}CH_3 \end{array}$$

[0014] The vegetable oil is commonly characterized by the content of the fatty acid, and the length, content and saturation degree of the fatty acid become critical factors in determining physical and chemical characteristics of the oil. Animal oil is less useful than the vegetable oil, and only that made from a pig, a cow and a sheep among land animals, and herring and menhaden among fishes are considered as being commercially important. The animal oils are composed of saturated and unsaturated triglycerides like the vegetable oils, but include a wide distribution of fatty acids and some odd-numbered chain fatty acids, unlike the vegetable oils.

[0015] When methyl ester made from vegetable oil, that is, biodiesel, is spilled on soil, the soil is less polluted than by hydrocarbon-base lubricating base oil, because of lower toxicity and higher biodegradation. Also, corresponding to United Nations Framework Convention on Climate Change (UNFCCC) (Life cycle CO_2: 1/4 of gasoline), one(1) ton of the methyl ester from vegetable oil cuts 2.2 tons of CO_2, which contributes to an increase in global competitiveness. The methyl ester from vegetable oil is mainly made of methyl oleate and methyl linoleate as main components, and exhibits excellent performance in machinability or detergency due to low viscosity (40 °C, 1.9 to 6.0 cSt.) and good lubrication when used instead of petroleum-based hydrocarbon lubricating base oil.

$CH_3\text{-}(CH_2)_{14}\text{-}COO\text{-}CH_3$: Methyl Palmitate

$CH_3\text{-}(CH_2)_6\text{-}CH_2\text{-}CH{=}CH\text{-}CH_2\text{-}(CH_2)_6\text{-}COO\text{-}CH_3$: Methyl Oleate

CH_3-$(CH_2)_3$-CH_2-CH=CH-CH_2-CH=CH-CH_2-$(CH_2)_6$-COO-CH3 : Methyl Linoleate

[0016] The methyl ester from vegetable oil is made by the following processes.

<Transesterification>

[0017]

$$\begin{array}{llll}
CH_2\text{-}OCO\text{-}R & & CH_2\text{-}OH & R\ COO\text{-}CH_3 \\
| & & | & \\
CH\text{-}OCO\text{-}R' + 3\ CH_3OH & \xrightarrow[\text{catalyst}]{} & CH\text{-}OH + & R'\ COO\text{-}CH_3 \\
| & & | & \\
CH_2\text{-}OCO\text{-}R'' & & CH_2\text{-}OH & R''\ COO\text{-}CH_3
\end{array}$$

<Esterification>

[0018]

$$R\text{-}COOH + CH_3OH \xrightarrow[\text{catalyst}]{} R\text{-}COO\ CH_3$$

[0019] Here, R, R' and R" are saturated or unsaturated hydrocarbons with alkyl groups. The methyl ester made from vegetable oil has various components and composition ratios depending on components of fatty acid in the vegetable oil and its ratio. Each of the methyl esters of the fatty acids listed in the following table is a component of the methyl ester made from vegetable oil.

<Chemical Structure of Fatty Acid Used in Water-Soluble Metalworking Fluid and Formation of Methyl Ester Made From Vegetable Oil>

[0020]

Name of Fatty Acid	Carbon Number/ Double Bond Number	Chemical Structure
Caprylic	C8	$CH_3(CH_2)_6COOH$
Capric	C10	$CH_3(CH_2)_8COOH$
Lauric	C12	$CH_3(CH_2)_{10}COOH$
Myristric	C14	$CH_3(CH_2)_{12}COOH$
Palmitic	C16:0	$CH_3(CH_2)_{14}COOH$
Palmitoleic	C16:1	$CH_3(CH_2)_5CH{=}CH(CH_2)_7COOH$
Stearic	C18:0	$CH_3(CH_2)_{16}COOH$
Oleic	C18:1	$CH_3(CH_2)_7CH{=}CH(CH_2)_7COOH$
Linoleic	C18:2	$CH_3(CH_2)_4CH{=}CHCH_2CH{=}CH(CH_2)_7COOH$
Linolenic	C18:3	$CH_3(CH_2)_2CH{=}CHCH_2CH{=}CHCH_2CH{=}CH(CH_2)_7COOH$

(continued)

Name of Fatty Acid	Carbon Number/ Double Bond Number	Chemical Structure
Arachidic	C20:0	$CH_3(CH_2)_{18}COOH$
Eicosenoic	C20:1	$CH_3(CH_2)_7CH=CH(CH_2)_9COOH$
Behenic	C22:0	$CH_3(CH_2)_{20}COOH$
Erucic	C22:1	$CH_3(CH_2)_7CH=CH(CH_2)_{11}COOH$

[0021] Vegetable oils capable of synthesizing the methyl esters from vegetable oil which may be used in the present invention are listed in the following table.

<Fatty Acid Components of Vegetable Oil Used in Formation of Biodiesel>

[0022]

Fatty acid, Fatty oil and oil	C8:0	C10:0	C14:0	C16:0	C16:1	C18:0	C18:1	C18:2	C18:3	C20:0 C22:0	C20:1 C22:1	
Coconut oil	5-9	4-10	44-51	13-18	7-10	-	1-4	5-8	1-3	-	-	-
Palm Kernal Oil	2-4	3-7	45-52	14-19	6-9	0-1	1-3	10-18	1-2	-	1-2	-
Palm Oil	-	-	-	1-6	32-47	-	1-6	40-52	2-11	-	-	-
Soybean Oil	-	-	-	0.3	7-11	0-1	3-6	22-34	50-60	2-10	5-10	-
Jatropha Oil	-	-	-	35-50	-	0-10	30-40	5-15	-	-	-	-
Canola Oil	-	-	-	-	2-5	0.2	1-2	10-15	10-20	5-10	0.9	50-60

[0023] Biodiesel may be mixed with gasoline and then used, or 100% pure biodiesel may be used. BD5 refers to a mixture of 95% gasoline and 5% biodiesel, and BD20 refers to a mixture including 20% biodiesel. Biodiesel attracts attention around the world as a future energy source in the aspects of recycling of waste resources, reduction of green-house gas (CO_2), and low emission of air pollutants. Recently, biodiesel is in exemplary use or is expanding its supply through model projects all over the world. Europe, which is very positive towards the use of alternative energy, first established a system for biodiesel. Europe recognizes that biodiesel can be used within a range satisfying the standard of general gasoline, and according to European Fuel Standard (EN590) taken effect in January, 2004, gasoline including 5% biodiesel or less (BD5) is recognized as general gasoline (satisfying the requirements of the EN14214 standard). In the U.S., after National Biodiesel Board was founded in 1992, the Congress and EPA approved BD20 as a fuel for diesel engine vehicles in 1998, and President Bush declared the expansion of new recycled energy including biodiesel in 2001. According to the active announcement of the government, the supply of biodiesel is increasing every year, and biodiesel is used in official vehicles of state governments and buses in addition to the U.S. Army, the U.S. Air Force, the Department of Energy and NASA. In Korea, based on the announcement regarding a model supply project for biodiesel by MOCCC in May, 2002, the government performed the project for two years, and now is investigating market reaction to and problems with biodiesel. The major advantage of biodiesel is a reduction of smoke emitted from vehicles. Although biodiesel also emits the greenhouse gas CO_2, when viewed from an overall cycle of the process (from production to consumption) it yields very low amounts of CO_2, and emits relatively low amounts of sulfur oxide (Sox) and particulate matters (PMs). Biodiesel made from vegetable resources may be self-produced domestically, which is an advantage for energy security, and may reduce environmental pollution by recycling waste resources, such as waste cooking oil. Also, in the aspect of infrastructure, diesel engine or gas station networks may be used, and thus less additional cost is required. However, although such advantages can be expected, biodiesel has several problems in substituting for conventional gasoline and volatile oils. Although biodiesel has to be mixed in a high ratio to reduce toxic chemicals in exhaust gases from vehicles, it may break down engines due to corrosion, and become denatured in long-term storage.

[0024] For these reasons, high purity products are required for methyl esters made from vegetable oil to be used as fuel oils for vehicles, and thus a separate vacuum distillation process is performed after the reaction of methyl esters. The vacuum distillation is performed at 2 to 3 torrs and a maximum temperature of 240 °C. After the vacuum distillation process, the distilled result is used as biodiesel fuel oil, and a distillation residue of about 10% is scrapped. Such a distillation residue generated in the production of biodiesel is a reactant of the vegetable oil with a structure of ester, and may be used as environmentally friendly lubricating base oil.

SUMMARY OF THE INVENTION

[0025] An embodiment of the invention provides a composition of a water-soluble metalworking fluid which uses a distillation residue generated in production of biodiesel as lubricating oil, and is mixed with other additives. The additives include a surfactant, a lubricating additive, a metal corrosion inhibitor, a rust inhibitor, a pH booster, a defoamer, a preservative, a pigment, etc., of which all are less harmful to the environment, and do not include any one of components which have use restrictions, such as nitrite, formaldehyde, boron and derivatives thereof, and an extreme pressure agent.

[0026] In one aspect, the present invention is directed to a composition of a water-soluble metalworking fluid produced by adding 5 to 70wt% of additives to 20 to 95wt% of distillation residues that is generated in production of biodiesel and used as lubricating base oil, and 0 to 40wt% of ion exchange water. The distillation residue of the biodiesel is generated from canola oil, soybean oil, palm oil or jatropha oil.

[0027] The additive used in the present invention is at least one selected from the group consisting of a surfactant, a lubricating additive, a metal corrosion inhibitor, a rust inhibitor, a pH booster, a defoamer and a preservative. The surfactant used in the present invention is selected from ethoxide of lauryl alcohol or oleyl alcohol, ethoxide of castor oil, ethoxide of laurylamine or oleylamine, amine salt of oleic acid, amine salt of tall oil, amine salt of erucic acid, sulfonate, Hypermer A 70, Targat V 20, Veg Ester GY-112, Addconate H, Addconate M, succinic acid derivatives, amine salt of succinic acid and PEG-fatty acid ester. The lubricating base oil used in the present invention is at least one selected from the group consisting of petroleum-based hydrocarbon, vegetable oil and synthetic ester. Here, the petroleum-based hydrocarbon is a distilled mineral oil and has a kinematic viscosity of about 5 to 1000 cSt at 40 , and the vegetable oil and the synthetic ester are soybean oil, canola oil, sunflower oil, jatropha oil, palm oil, neopentyl glycol dioleate, trimethylolpropane trioleate, pentaerythritol tetraoleate, propylene glycol dioleate, ricinoleic acid condensate, or methyl ester of soybean oil, canola oil, jatropha oil or palm oil. The pH booster used in the present invention includes monoethanolamine, diethanolamine, triethanolamine, monoisopropanolamine, diisopropanolamine, triisopropanolamine, aminomethyl propanol or diglycolamine. The metal corrosion inhibitor used in the present invention includes benzotriazol, tolytriazol or derivatives thereof. The rust inhibitor used in the present invention includes sebacic acid, Corfree M1, Irgacor 190 plus or derivatives thereof. The defoamer used in the present invention includes polydimethyl siloxane, denatured polydimethyl siloxane, organic silicon derivatives or a silicon-based defoamer of silica. The preservative used in the present invention includes thiazoline, pyridine, morpholine, phenol, a nitro- or IPBC-based preservative.

DETAILED DESCRIPTION OF THE INVENTION

[Exemplary Embodiment 1]

[0028] Water-soluble metalworking fluids were manufactured from a distillation residue generated in production of biodiesel, ion exchange water, a lubricating additive 1 (soybean oil, canola oil, palm oil, trimethylolpropane trioleate, pentaerythritol tetraoleate, or ricinoleic acid condensate), a surfactant, a metal corrosion inhibitor, a rust inhibitor, a pH booster, a defoamer and a preservative.

[0029] Contents of the water and the biodiesel distillation residue depend on application ranges of the product. As the product has a higher content of water, the diluted solution is clearer, while as the product has a higher content of the distillation residue, the diluted solution is milky white and has better lubrication performance.

Table 1. Composition of Water-soluble Metalworking Fluid

Name	S-1	S-2	S-3	S-4	S-5
Biodiesel distillation residue	51.3	67.8	37.3	61.0	91.0
Ion exchange water	17.5	5.0	28.0	9.0	0
Lubricating additive 1	4.5	1.5	6.0	3.5	0.7

(continued)

Name	S-1	S-2	S-3	S-4	S-5
Surfactant	15.0	15.6	17.0	16.3	6.3
pH booster	8.0	6.5	8.0	5.5	1.5
Metal corrosion inhibitor	0.5	0.2	0.5	0.5	-
Rust inhibitor	2.0	2.2	2.0	3.0	0.5
Preservative	1.0	1.0	1.0	1.0	-
Defoamer	0.2	0.2	0.2	0.2	-

[Exemplary Embodiment 2]

[0030] Water-soluble metalworking fluids were produced from a distillation residue generated in production of biodiesel, a lubricating additive 2 (petroleum-based hydrocarbon, methyl ester of soybean oil or canola oil, soybean oil, canola oil, or palm oil), a surfactant, a metal corrosion inhibitor, a rust inhibitor, a pH booster, a defoamer and a preservative.

Table 2. Composition of Water-soluble Metalworking Fluid

Name	S-6	S-7	S-8	S-9	S-10
Biodiesel distillation residue	43.0	44.8	25.3	40.8	52.0
Ion exchange water	13.6	10.0	28.5	16.5	0
Lubricating additive 2	18.0	19.5	18.3	12.0	16.0
Surfactant	15.8	15.6	15.7	15.5	20.3
pH booster	6.5	6.5	8.0	11.5	9.0
Metal corrosion inhibitor	0.3	0.2	0.5	0.5	0.1
Rust inhibitor	2.2	2.2	2.0	2.0	2.0
Preservative	0.5	1.0	1.5	1.0	0.5
Defoamer	0.1	0.2	0.2	0.2	0.1

[Exemplary Embodiment 3]

[0031] Water-soluble metalworking fluids were produced from a distillation residue generated in production of biodiesel, a lubricating additive 3 (petroleum-based hydrocarbon, methyl ester of soybean oil, canola oil or palm oil, trimethylol-propane trioleate, pentaerythritol tetraoleate or ricinoleic acid condensate), a surfactant, a metal corrosion inhibitor, a rust inhibitor, a pH booster, a defoamer and a preservative.

Table. 3 Composition of Water-soluble Metalworking Fluid

Name	S-11	S-12	S-13	S-14	S-15
Biodiesel distillation residue	23.0	56.8	25.3	39.8	50.0
Ion exchange water	18.6	10.0	32.0	17.5	5.0
Lubricating additive 3	30.8	7.0	14.1	15.0	16.0
Surfactant	16.9	15.2	13.9	13.5	16.3
pH booster	6.5	7.0	10.5	10.5	9.0
Metal corrosion inhibitor	0.3	0.3	0.5	0.5	0.5
Rust inhibitor	2.2	2.5	2.0	2.0	2.0
Preservative	1.5	1.0	1.5	1.0	1.0
Defoamer	0.2	0.2	0.2	0.2	0.2

[Exemplary Embodiment 4]

[0032] Water-soluble metalworking fluids were produced from a distillation residue generated in production of biodiesel, a lubricating additive 4 (methyl ester of soybean oil, canola oil, jatropha oil or palm oil, soybean oil, canola oil, palm oil, jatropha oil or sunflower oil), a surfactant, a metal corrosion inhibitor, a rust inhibitor, a pH booster, a defoamer and a preservative.

Table. 4 Composition of Water-soluble Metalworking Fluid

Name	S-16	S-17	S-18	S-19	S-20
Biodiesel distillation residue	62.3	57.7	42.9	40.0	67.3
Ion exchange water	10.0	10.0	18.0	24.0	0
Lubricating additive 4	4.0	2.5	6.0	5.0	4.0
Surfactant	15.0	16.4	15.7	13.0	20.0
pH booster	6.0	10.0	14.0	14.6	6.0
Metal corrosion inhibitor	0.1	0.2	0.2	0.2	0.1
Rust inhibitor	2.0	2.0	2.0	2.0	2.0
Preservative	0.5	1.0	1.0	1.0	0.5
Defoamer	0.1	0.2	0.2	0.2	0.1

Example 1

[0033]

Table 5. Characteristics of Water-soluble Metalworking Fluid

Item		S-1	S-2	S-3	S-4	S-5
Color/ Clearness	Crude Liquid	Dark Brown Translucent	Dark Brown Translucent	Brown Translucent	Dark Brown Translucent	Dark Brown Translucent
	Diluted Liquid	White opaque	White opaque	White opaque	White opaque	White opaque
pH (10%)		9.8	9.5	9.7	9.5	9.1
Rust Inhibition		24 hrs	24 hrs	24 hrs	24 hrs	24 hrs
(brix 3 %)		No rust	No rust	No rust	No rust	No rust
Nonferrous Metal discoloration Test (3 %)	Al	None	None	None	None	None
	Cu	None	None	None	None	None

Example 2

[0034]

Table 6. Characteristics of Water-soluble Metalworking Fluid

Item		S-6	S-7	S-8	S-9	S-10
Color/ Clearness	Crude Liquid	Dark Brown Translucent	Dark Brown Translucent	Brown Translucent	Dark Brown Translucent	Dark Brown Translucent
	Diluted Liquid	White opaque	White opaque	White opaque	White opaque	White opaque

(continued)

Item		S-6	S-7	S-8	S-9	S-10
pH (10%)		9.5	9.6	9.5	9.8	9.7
Rust Inhibition (brix 3 %)		24 hrs No rust	24 hrs No rust	24 hrs No rust	24 hrs No rust	24 hrs No rust
Nonferrous Metal discoloration Test (3%)	Al	None	None	None	None	None
	Cu	None	None	None	None	None

Example 3

[0035]

Table 7. Characteristics of Water-soluble Metalworking Fluid

Item		S-11	S-12	S-13	S-14	S-15
Color/ Clearness	Crude Liquid	Dark Brown Translucent	Dark Brown Translucent	Brown Translucent	Dark Brown Translucent	Dark Brown Translucent
Color/ Clearness	Crude Liquid	Dark Brown Translucent	Dark Brown Translucent	Brown Translucent	Dark Brown Translucent	Dark Brown Translucent
	Diluted Liquid	White opaque	White opaque	White opaque	White opaque	White opaque
pH (10%)		9.4	9.5	9.8	9.8	9.7
Rust Inhibition (brix 3 %)		24 hrs No rust	24 hrs No rust	24 hrs No rust	24 hrs No rust	24 hrs No rust
Nonferrous Metal discoloration Test (3%)	Al	None	None	None	None	None
	Cu	None	None	None	None	None

Example 4

[0036]

Table 8. Characteristics of Water-soluble Metalworking Fluid

Item		S-16	S-17	S-18	S-19	S-20
Color/ Clearness	Crude Liquid	Dark Brown Translucent	Dark Brown Translucent	Dark Brown Translucent	Dark Brown Translucent	Dark Brown Translucent
	Diluted Liquid	White opaque	White opaque	White opaque	White opaque	White opaque
pH (10%)		9.6	9.6	9.7	9.7	9.4
Rust Inhibition (brix 3 %)		24 hrs No rust	24 hrs No rust	24 hrs No rust	24 hrs No rust	24 hrs No rust
Nonferrous Metal discoloration Test (3%)	Al	None	None	None	None	None
	Cu	None	None	None	None	None

[0037] A composition of a water-soluble metalworking fluid, using a biodiesel distillation residue that can be used as environmentally acceptable lubricating base oil, has good biodegradation, excellent lubrication and less toxicity bionomically. The water-soluble metalworking fluid may be very useful in business and recycling resources.

[0038] Exemplary embodiments of the present invention have been disclosed herein and, although specific terms are employed, they are used and are to be interpreted in a generic and descriptive sense only and not for purposes of limitation. Accordingly, it will be understood by those of ordinary skill in the art that various changes in form and details may be made without departing from the spirit and scope of the present invention as set forth in the following claims.

Claims

1. A composition of a water-soluble metalworking fluid prepared by adding 5 to 70wt% of additives to 20 to 95wt% of distillation residues that is generated in production of biodiesel and used as lubricating base oil, and 0 to 40wt% of ion exchange water.

2. The composition according to claim 1, wherein the distillation residue of the biodiesel is produced from canola oil, soybean oil, palm oil or jatropha oil.

3. The composition according to claim 1, wherein the additive comprises one or more selected from the group consisting of petroleum-based hydrocarbon, vegetable oil and synthetic ester.

4. The composition according to claim 3, wherein the petroleum-based hydrocarbon is a refined mineral oil, and has a kinematic viscosity of 5 to 1000 cSt at 40°C.

5. The composition according to claim 3, wherein the vegetable oil and the synthetic ester comprise:

   a lubricating additive selected from the group consisting of soybean oil, canola oil, sunflower oil, jatropha oil, palm oil, neopentyl glycol dioleate, trimethylolpropane trioleate, pentaerythritol tetraoleate, propylene glycol dioleate, ricinoleic acid condensate, and methyl ester of soybean oil, canola oil, jatropha oil or palm oil;
   a surfactant selected from the group consisting of ethoxide of lauryl alcohol or oleyl alcohol, ethoxide of castor oil, ethoxide of laurylamine or oleylamine, amine salt of oleic acid, amine salt of tall oil, amine salt of erucic acid, sulfonate, Hypermer A 70, Targat V 20, Veg Ester GY-112, Addconate H, Addconate M, succinic acid derivatives, amine salt of succinic acid and PEG-fatty acid ester;
   a pH booster selected from the group consisting of monoethanolamine, diethanolamine, triethanolamine, monoisopropanolamine, diisopropanolamine, triisopropanolamine, aminomethyl propanol and diglycolamine;
   a metal corrosion inhibitor selected from the group consisting of benzotriazol, tolytriazol and derivatives thereof;
   a rust inhibitor selected from the group consisting of sebacic acid, Corfree M1, Irgacor 190 plus and derivatives thereof;
   a defoamer selected from the group consisting of polydimethyl siloxane, denatured polydimethyl siloxane, organic silicon derivatives and a silicon-based defoamer of silica; and
   a preservative selected from the group consisting of thiazoline, pyridine, morpholine, phenol, nitro- and IPBC-based preservatives.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 11 8301

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	CH 654 020 A5 (SP K BYURO ANALIT PRIBOROSTR) 31 January 1986 (1986-01-31) * claims 1-3; examples *	1,2	INV. C10M173/00 C10M169/04 C10M109/00 C10M177/00 ADD. C10N40/20
A	GB 1 093 959 A (HENRY W PEABODY IND LTD) 6 December 1967 (1967-12-06) * claim 1; examples 1,2 *		
A	EP 0 255 605 A (HENKEL KGAA [DE]) 10 February 1988 (1988-02-10) * example 5 *		
A	US 6 051 538 A (MAJERCZAK VICTORIA ANN [US]) 18 April 2000 (2000-04-18) * claims 1,10 *		
A	WO 03/080771 A (UNITED SOY BEAN BOARD [US]; KING JAMES P [US]; CANTER NEIL M [US]) 2 October 2003 (2003-10-02) * example 50 *		TECHNICAL FIELDS SEARCHED (IPC)
A	AU 626 014 B (PALM OIL RESEARCH AND DEV BOAR) 23 July 1992 (1992-07-23) * page 2, paragraph 1 *		C10M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 December 2007	Pöllmann, Klaus

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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The members are as contained in the European Patent Office EDP file on
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20-12-2007

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
CH 654020	A5	31-01-1986	NONE			
GB 1093959	A	06-12-1967	BE	683912	A	16-12-1966
EP 0255605	A	10-02-1988	CA	1285749	C	09-07-1991
			DE	3622826	A1	21-01-1988
			DK	347187	A	09-01-1988
			NO	872826	A	11-01-1988
			US	4802998	A	07-02-1989
US 6051538	A	18-04-2000	NONE			
WO 03080771	A	02-10-2003	AU	2002367816	A1	08-10-2003
			CA	2457268	A1	02-10-2003
			EP	1425367	A2	09-06-2004
			JP	2005520037	T	07-07-2005
			MX	PA04001356	A	27-10-2004
AU 626014	B	23-07-1992	AU	4351989	A	26-04-1990

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- KR 1020070003692 **[0001]**