

Title

Composition and method of manufacture of biodiesel metalworking fluid.

Description

The use of biofuels as alternatives to currently petroleum base oils to produce metalworking fluid has been an area of considerable research and investigation. This invention relates to the composition and method of manufacture of biodiesel metalworking fluid by blending a major portion biodiesel with extreme pressure agent, anti-wear agent, emulsifiers, corrosion inhibitors, anti-oxidant, and biocides.

BACKGROUND OF THE INVENTION

Shrinking crude oil reserves and the escalating cost of crude oil have led to renewed interest in using biodiesel as an alternative to petroleum base oil for the production metalworking fluids. These metalworking fluids are produced from biodiesel derived from methyl and ethyl ester having C-14 to C-18 carbon atoms.

Advantages of said metalworking fluids include that they are renewable, less environmentally hazardous and safer to human contact unlike the petroleum-based metalworking fluids.

Metalworking fluids produced from the above composition exhibits excellent lubricating, corrosion inhibition, anti-rancid and load carrying capability properties over conventional mineral based metalworking fluids.

They are useful as heavy metalworking fluids in many machining applications including turning, milling, broaching, drawing, tapping, drilling, grinding, and high speed cutting processes.

From an economic or commercial perspective, there continues to be a need for metalworking fluids produced from biodiesel that provide improvements in the above mentioned properties which are economic to manufacture. That is, with the cost of raw materials and manufacturing processes affecting the pocket of the consumer, there continues to be a need for metalworking fluids produced from biodiesel. In particular, there is a need for metalworking fluids produced from biodiesel that are manufactured through a simplified and reliable process using readily available, economical and non-hazardous raw materials with simplified equipment and production times.



SUMMARY OF THE INVENTION

Patentee has discovered the composition and a novel process of manufacturing biodiesel metalworking fluids, even when diluted with water will exhibit exceptionally high load carrying capabilities, anti-foam, anti-rancid and excellent cooling properties. Using biodiesel of C-14 to C-18 carbon atoms as main composition materials derived from methyl or ethyl ester, chlorine extreme pressure additives, sulfur anti-wear additives, corrosion inhibitors, and aminic or zinc phosphate anti-oxidant.

In an embodiment of the invention wherein the biodiesel is used as a replacement for the conventional based oils for making metalworking fluids.

In another embodiment of the invention the chlorine extreme pressure additives is used to enhance the load carrying capabilities of the metalworking fluids.

In yet another embodiment of the invention sulfur or zinc anti-wear additives is used to enhance the anti-wear properties of the metalworking fluids.

In yet another embodiment of the invention the aminic or zinc phosphate anti-oxidant is used to enhance the anti-oxidant properties of the metalworking fluids.

In yet another embodiment of the invention sulfonate based corrosion inhibitor or amine based corrosion inhibitor is used to enhance the corrosion inhibition properties of the metalworking fluids.

In yet another embodiment of the invention either nonyl phenol or alcohol ethoxylate is used as emulsifier to enhance the emulsification properties of the biodiesel metalworking fluids.

In yet another embodiment of the invention twin-chain quaternary ammonium compound is used as biocide to enhance the antimicrobial properties of the biodiesel metalworking fluids.

DETAILED DESCRIPTION OF THE INVENTION

In accordance with this discovery, it is an object of the invention to provide a method and composition for the manufacturing of metalworking fluids using biodiesel as main proportion of the composition.

The method and composition are herein described.

In accordance with the invention, biodiesel metalworking fluid is produced by using a major proportion of biodiesel (either Methyl or Ethyl Ester) of C-14 to C18 carbon chain and a minor proportion of chlorine extreme pressure additives, sulfur or zinc anti-wear additives, sulfonated or amine base corrosion inhibitor, aminic anti-oxidant, twin-chain quaternary ammonium compound biocide, with emulsifier Nonylphenol or Alcohol ethoxylate in a mixing vessel.

Figure 1 shows biodiesel (either Methyl or Ethyl Ester) of C-14 to C-18 carbon chain is loaded into the mixing vessel at an ambient temperature of 25°C to 30°C.

Figure 2 shows extreme pressure additives either chlorine or phosphorus based is added into the mixing vessel and are mixed and agitated for 10 minutes with a mixer.

Figure 3 shows sulfur or zinc anti-wear additives is added into the mixture and mixed for another 10 minutes.

Figure 4 shows the emulsifier either Nonylphenol or Alcohol ethoxylate is added slowly into the mixture.

Figure 5 shows the corrosion inhibitor Amine/ Sulfonate based inhibitors are added into the mixture and mixed for 5 minutes

Figure 6 shows the biocide quaternary and twin-chain quaternary ammonium compound are added into the mixture and mixed for 5 minutes.

It is preferred that the above composition is prepared with 80 % of biodiesel by weight with the remainder 20 % by weight of extreme pressure additives, anti-wear additives, anti-oxidant, corrosion inhibitor and emulsifier.

Biodiesel

Biodiesel can be selected from methyl or ethyl ester with C-14 to C-18 carbon chain. The said esters are derived from transforming vegetable or animal fatty acids with methyl or ethyl alcohols.

Extreme Pressure Additives

Extreme pressure additives can be selected from chlorinated alkanes or ZDDP Zinc dialkyl dithio phosphate. A preferred chlorinated alkane is chlorinated paraffin with a chlorine content of 30 wt% to 52 wt%.

The said preferred Chlorinated paraffin is selected because of its excellent extreme pressure characteristics.

Anti-Wear Additives

Anti-wear additives can be selected from **Polysulfide compound** or Zinc phosphate.

A preferred Zinc phosphate is ZDP, Zinc Dithiophosphate.

Zinc Dithiophosphate is selected for the said composition because of its excellent oxidation and anti-wear characteristics.

Zinc Phosphate based anti-oxidant/ Aminic anti-oxidant

Zinc phosphate based anti-oxidant can be selected from Zinc dithiophosphate or Zinc dialkyldithiophosphate.

Aminic anti-oxidant additives can be selected from one of these; PAN (Phenyl-1-Naphthylamine), ODP (Octylated diphenyl amine), NDPA (Nonylated diphenylamine), ADPA (Alkylated diphenyl amine).

A preferred aminic anti-oxidant is Phenyl-1-Naphthylamine due to its excellent anti-oxidation and higher thermal stability properties.

Amine /Sulfonate based corrosion inhibitor

Corrosion inhibitors used are amine and sulfonate based inhibitors.

Amine based inhibitors are Dicyclohexylamine and Triethanolamine.

Sulfonate base inhibitor can be selected from Barium or Sodium or Calcium sulfonate.

A preferred sulfonate is sodium sulfonate due to its excellent stable emulsion properties and compatibility properties with biodiesel.

Biocides

Biocides can be selected from one or more of these; quaternary ammonium compound, twin-chain quaternary ammonium compound, 1,2-Benzothiazolin-3 (BIT), 2-methyl 4,5-trimethylene-4-isothiazolin-3-one (MTI), Dithio-2,2-bis (benzylmethylamide) and phenolic derivatives compound. Preferred biocides are quaternary and twin-chain quaternary ammonium compound due to their low mammalian toxicity.

Emulsifier

Emulsifier can be selected from Nonylphenol Ethoxylate 6 moles of ethylene oxide or Alcohol Ethoxylate 5 moles of ethylene oxide.

EXAMPLES

In the process of manufacturing said metalworking fluids, biodiesel of C-14 to C-18 carbon chain is used, by way of example and not limitation, the following are illustrative of various embodiments of the foregoing invention.

Example 1

This example illustrates the process of manufacturing high load carrying capabilities biodiesel metalworking fluids. Biodiesel of C-14 to C-18 carbon chain is used as the main ingredient at ambient temperature of 25°C to 30°C.

In a typical process, 80 wt % of biodiesel of C-14 to C-18 carbon chain, a 20 wt % mixture of Sodium Sulfonate, Phenyl-1-Naphthylamine, Zinc Dithiophosphate, Nonyl Phenol 6 moles of ethylene oxide or Alcohol Ethoxylate 5 moles, quaternary and twin-chain quaternary ammonium compound, Chlorinated paraffin were mixed in a stainless steel mixing vessel and with the aid of an industrial mixer.

Example 2

This example illustrates the process of manufacturing high load carrying capabilities biodiesel metalworking fluids. Biodiesel of C-14 to C-18 carbon chain is used as the main ingredient at ambient temperature of 25°C to 30°C.

In a typical process, 80 wt % of biodiesel of C-14 to C-18 carbon chain, a 20 wt % mixture of Sodium Sulfonate, Phenyl-1-Naphthylamine, Zinc Dithiophosphate, Nonyl Phenol 6 moles of ethylene oxide or Alcohol Ethoxylate 5 moles, quaternary and twin-chain quaternary ammonium compound, and 9 wt% of Chlorinated paraffin were mixed in a stainless steel mixing vessel and with the aid of an industrial mixer to enhance the extreme pressure properties of the biodiesel metalworking fluids

Example 3

This example illustrates the process of manufacturing high load carrying capabilities biodiesel metalworking fluids. Biodiesel of C-14 to C-18 carbon chain is used as the main ingredient at ambient temperature of 25°C to 30°C.

In a typical process, 80 wt % of biodiesel of C-14 to C-18 carbon chain, a 20 wt % mixture of Sodium Sulfonate, Phenyl-1-Naphthylamine, Zinc Dithiophosphate, Nonyl Phenol 6 moles of ethylene oxide or Alcohol Ethoxylate 5 moles, 4 wt% of quaternary and twin-chain quaternary ammonium compound, Chlorinated paraffin were mixed in a stainless steel mixing vessel and with the aid of an industrial mixer to enhance the anti-microbial properties of the biodiesel metalworking fluids

The foregoing embodiments are susceptible to considerable variation in its practice. Accordingly, the embodiments are not intended to be limited to the specific exemplifications set forth hereinabove. Rather, the foregoing embodiments are not within the spirit and scope of the appended claims, including the equivalents thereof available as matter of law.

The patentees do not intend to dedicate any disclosed embodiments to the public, and to the extent any disclosed modifications or alterations may not literally fall within the scope of the claims, they are considered to be part hereof under the doctrine of equivalents.

Claims:

What is claimed is:

- 1) A composition and process of manufacturing High Load Carrying Capabilities Biodiesel Metalworking fluids comprising of the steps of:
 - a. A major proportion of biodiesel and with a minor proportion of extreme pressure additives, anti-wear additives, emulsifiers, corrosion inhibitors and anti-oxidant.
 - b. Adding sulfur or zinc salts of dithio organophosphates anti-wear additives to enhance the anti-wear properties of the metalworking fluids.
 - c. Adding Chlorine or Phosphorous Extreme Pressure additives to enhance the load carrying capabilities of the metalworking fluids.
 - d. Adding nonylphenol or alcohol ethoxylate to enhance the emulsion properties of biodiesel metalworking fluids.
 - e. Adding sulfonate and amine based corrosion inhibitors to enhance to corrosion inhibition properties of biodiesel metalworking fluids.
 - f. Adding anti-oxidant additives to enhance the biodiesel metalworking fluids anti-oxidant properties.
 - g. Adding biocides to enhance the biodiesel metalworking fluids antimicrobial and anti-rancid properties.
- 2) A composition and method of manufacture as in claim 1 wherein the biodiesel metalworking fluids are emulsifiable and dilutable with water.
- 3) A composition and method of manufacture as in claim 2 wherein the biodiesel metalworking fluid exhibits excellent cooling and load carrying capabilities even when diluted with 1 to 20 parts of water.
- 4) A composition and manufacturing method as in claim 2 wherein the said metalworking fluid when diluted with water will turn milky-white and exhibits excellent anti-foam properties
- 5) A composition and method of manufacture as in claim 1a wherein the biodiesel is derived from methyl or ethyl ester.
 - a. A method as in claim 1a wherein the carbon chain of the biodiesel is C-14 to C-18
 - b. A method as in claim 1a wherein the Cetane Index of the biodiesel is 50-90.
- 6) A composition and method of manufacture as in claim 1b wherein the sulfur anti-wear additives contain a sulfur content of 0.5% to 38%.
- 7) A composition and method of manufacture as in claim 1b wherein the Zinc anti-wear additives is selected from any one of the combination of ZDDP, ZnDTP or ZDP

- 8) A composition and method of manufacture as in claim 1c wherein the chlorine extreme pressure additives contains a chlorine content of 5% to 52% w/w, wherein the said metalworking fluid has a Timken OK Load of 105 kilograms (ASTM-D-2509)
- 9) A composition and method of manufacture as in claim 1d wherein the sulfonate can be sodium, barium or calcium sulfonate.
- 10) A composition and method of manufacture as in claim 1d wherein Nonylphenol Ethoxylate is 4 to 6 moles of ethylene oxide.
- 11) A composition and method of manufacture as in claim 1d wherein the Non-Ionic Alcohol Ethoxylate is of 4 to 5 moles of ethylene oxide.
- 12) A composition and method of manufacture as in claim 1 e wherein the Sulfonate corrosion inhibitor can be sodium, or barium or calcium.
- 13) A composition and method of manufacture as in claim 1 e wherein the amine based corrosion inhibitors are Dicyclohexylamine and Triethanolamine.
- 14) A composition and method of manufacture as in claim 1f wherein the anti-oxidant is Aminic or Zinc phosphate chemical family.
- 15) A composition and method of manufacture as in claim 1g wherein one or more of the following biocides can be added into the formulation: quaternary ammonium compound, twin-chain quaternary ammonium compound, 1,2-Benzothiazolin-3 (BIT), 2-methyl 4,5-trimethylene-4-isothiazolin-3-one (MTI), Dithio-2,2-bis (benzamide) and phenolic derivatives compound.
- 16) A composition and method of manufacture as in claim 15 wherein the biocide is twin-chain quaternary ammonium compound.
- 17) A composition and method of manufacturing wherein claim 6 wherein the sulfur or zinc anti-wear agent is blended with biodiesel at temperature range of 25° C up to 85° C to increase the anti-wear properties.
- 18) A composition and method of manufacturing as in claim 14 wherein 0.1 to 8 wt % of aminic or zinc phosphate anti-oxidant is added to the biodiesel metalworking fluids.
- 19) A composition method of manufacture as in claim 1 wherein in step b) sulfur or zinc additives is added into the biodiesel at temperature of 25° C to 30° C to increase its anti-wear properties.

20) A composition and method of manufacture as in claim 1 wherein in step c) chlorine or phosphorous additives is added into the biodiesel at temperature of 25° C to 30° C to increase the load bearing carrying capabilities.

21) A method and composition as in claim 1 wherein in step c) aminic anti-oxidant is added to the biodiesel at temperature of 25° C to 30° C.

22) A biodiesel metalworking fluid composition prepared in accordance with the method of claim 1, composition comprising:

- a) 65- 90 wt % biodiesel
- b) 0.1- 4 wt % sulfur or zinc phosphate anti-wear additives
- c) 0.1- 9 wt % of chlorine or phosphorous or boron extreme pressure additives
- d) 3- 12 wt % of emulsifiers
- e) 0.1- 3 wt % anti-oxidant
- f) 0.5 - 12 wt % corrosion inhibitors
- g) 0.5 – 4 wt% of quaternary and twin-chain quaternary ammonium compound

23) A biodiesel metalworking fluid as claim in 22 comprising of

- a) 76 wt % biodiesel.
- b) 1 wt % sulfur or zinc phosphate additives.
- c) 3 wt % chlorine or phosphorous or boron.
- d) 5 wt % Nonyl Phenol 6 moles.
- e) 2 wt % aminic anti-oxidant or Zinc dithiophosphate anti-oxidant.
- f) 3 wt % sodium sulfonate and 4 wt % of Dicyclohexylamine, and 2 wt % of Triethanolamine.
- g) 1% wt % of quaternary and twin-chain quaternary compound consisting of Alkyl Dimethyl Benzyl Ammonium Chloride, Octyl Didecyl Dimethyl Ammonium Chloride, Dioctyl Dimethyl Ammonium Chloride, and Didecyl Dimethyl Ammonium Chloride.