

Eco-friendly Lubricating grease composition based on waste plastic pyrolysis reformed oil

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to an eco-friendly lubricating grease composition based on waste plastic pyrolysis reformed oil, and particularly, to a lubricating grease composition formulated using lube base oil that combines waste plastic pyrolysis reformed oil with a base oil such as mineral oil.

DESCRIPTION OF THE RELATED ART

In general, lubricants are materials used in various industrial fields such as automobiles, machinery, and production facilities to reduce frictional resistance in friction parts of machine elements, and thus to prevent wear, to prevent foreign substances from entering, and to prevent oxidation. The lubricants can be divided into oil lubricants (lubricating oil) and solid lubricants (lubricating grease).

The solid lubricating grease is a semi-solid or solid-state lubricant manufactured by mixing base oil with a thickener and additives. The base oil is mainly synthetic.

An important point of the selection of the base oil is qualities such as durability and lubricity of the finished lubricating grease, but changes the environmental protection, health, and safety of workers in the world. Accordingly, in replacement of the conventional base oil, various research and developments are required to produce an environmentally acceptable base oil.

An eco-friendly base oil and lubricating grease of the prior art is publicly known in Patent Documents 1 to 3 (Patent Document 1: KR 10-1030355 B, Patent Document 2: KR 10-1771081 B and Patent Document 3: KR 10-2555949 B). In Patent Document 1, a mixed base oil comprises synthetic hydrocarbon base oil, mineral base oil, and ester base oil. The

mixed base oil is blended with additives. The mixed base oil is made by mixing synthetic hydrocarbon base oil, mineral base oil, and ester base oil in a weight ratio of 1:1.5 to 3: 9 to 12. The ester base oil is made by mixing a high viscosity ester base having a kinematic viscosity of 40 to 70 cSt at 40°C and a low viscosity ester base oil having a kinematic viscosity of 20 to 35 cSt at 40°C. The high viscosity ester base oil and the low viscosity ester base oil are mixed in a weight ratio of 1:1 to 1.1. An eco-friendly grease composition with excellent price competitiveness is disclosed.

The Patent Document 2 discloses a method for manufacturing recycled lube base oil using waste grease. The method comprises a first step of adding a solvent to waste grease and heating it to create a waste grease solution with reduced viscosity; a second step of adding additives to the waste grease solution and heating it to create a waste grease solution converted into metallic soap; a third step of adding water to the waste grease solution converted into metallic soap and allowing it to stagnate for a certain period of time to phase separate into a water layer and an oil layer; and a fourth step of removing the water layer and distilling the remaining oil layer under reduced pressure to obtain lubricating base oil. The solvent used in the first step has a boiling point of 150 to 180°C and consists of aromatic hydrocarbon, including a mixture of one or more of trimethyl benzene, propyl benzene, and o-ethyl toluene, and is added in an amount of 500 to 700 parts by weight per 100 parts by weight of waste grease, and the heating temperature is 30 to 40°C.

In addition, Patent Document 3 discloses an eco-friendly lubricating grease. The eco-friendly lubricating grease, a) biodegradable ester as a base oil, and b) a thickener selected from b1) biodegradable calcium soap, b2) bentonite, and b3) their mixtures, c) additives including pyrogenic silicon dioxide and/or polytetrafluoroethylene and/or mixtures thereof, polymers selected from polyisobutylene, polyisobutylene-/butene copolymers, polymethacrylates, polyesters and mixtures thereof, solid lubricants. The lubricating grease and/or ester has thermal stability between 150°C and 200°C through thermogravimetric analysis; <10% by weight volatility determined according to DIN 58397; and/or TAN Delta of 0.0 mg KOH/g to 20 mg KOH/g and/or an acid amount of less than 5 mg

KOH/g, determined according to DIN ASTM D-2619.

The inventors of the present invention have completed an eco-friendly lubricating grease using lubricating base oil, which is a combination of waste plastic pyrolysis reformed oil with base oil such as mineral oil.

PRIOR ART DOCUMENTS

Patent Document 1: KR 10-1030355 B,

Patent Document 2: KR 10-1771081 B

Patent Document 3: KR 10-2555949 B

SUMMARY OF THE INVENTION

The problem to be solved by the present invention relates to the provision of an eco-friendly lubricating grease composition based on waste plastic pyrolysis reformed oil. The purpose of the present invention provide more specifically an eco-friendly lubricating grease composition formulated using lube base oil combined with waste plastic pyrolysis reformed oil produced by pyrolysis and hydroforming of waste plastic to mineral oil, etc.

The above-mentioned 'waste plastic pyrolysis reformed oil' refers to the oil ingredient produced by pyrolysis and hydroforming of waste plastic, and, it is defined and described as 'waste plastic pyrolysis reformed oil' in the description below.

As a means for achieving the purpose of the present invention, an eco-friendly lubricating grease composition based on waste plastic pyrolysis reformed oil comprises a lube base oil composed of plastic pyrolysis reformed oil, mineral base oil and/or synthetic base oil, a thickener and additives. One embodiment of the eco-friendly lubricating grease composition based on waste plastic pyrolysis reformed oil according to the present invention comprises a lube base oil of a kinematic viscosity (40°C) 220cSt composed of a mineral base oil and/or a synthetic base oil, a thickener and additives.

Another embodiment of the eco-friendly lubricating grease composition based on waste plastic pyrolysis reformed oil according to the present invention comprises a lube base oil of a kinematic viscosity (40°C) 220cSt composed of a mineral base oil and/or a synthetic base oil and waste plastic pyrolysis reformed oil with a kinematic viscosity (40°C) 100 to 200cSt and a viscosity index of 80 or more; 5.5 to 25 parts by weight a thickener composed of isocyanate-based compounds and amine-based compounds; 0.1 to 0.8 parts by weight of corrosion inhibitors; 0.1 to 2.5 parts by weight of an anti-wear agent; and 1 to 4.5 parts by weight of an antioxidant, in relation to 100 parts by weight of the lube base oil.

The lubricating grease composition based on waste plastic pyrolysis reformed oil according to the present invention has an excellent heat resistance with an available temperature of -30 to 180°C and thus can be used at high temperatures and is suitable for elements that require permanent lubrication such as steelmaking facilities, textile machinery, washing machines, and papermaking facilities. It is especially suitable for a high-temperature grease for driving rollers in continuous casting facilities and plain bearings in casting cranes.

The lubricating grease of the present invention is a grease made by a base oil based on waste plastic pyrolysis reformed oil, so it is more eco-friendly, has excellent anti-corrosion and oxidation stability, and maintains excellent wear resistance even at high temperatures. In particular, it has the advantage of being suitable as a high-temperature grease for driving rollers of continuous casting equipment and plain bearings of casting cranes.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Hereinafter, the present invention will be described in more detail through specific details for carrying out the invention, but the present invention is not limited by the description below.

The eco-friendly lubricating grease composition based on waste plastic pyrolysis reformed oil according to the present invention comprises a lube base oil of a kinematic viscosity (40°C) 220cSt composed of a

mineral base oil and/or a synthetic base oil and waste plastic pyrolysis reformed oil with a kinematic viscosity (40°C) 100 to 200cSt and a viscosity index of 80 or more; a thickener with 5.5 to 25 parts by weight of isocyanate-based compounds and amine-based compounds; 0.1 to 0.8 parts by weight of corrosion inhibitors; 0.1 to 2.5 parts by weight of an anti-wear agent; and 1 to 4.5 parts by weight of an antioxidant for 100 parts by weight of the lube base oil.

The lube base oil of the lubricating grease composition according to the present invention preferably comprises a lube base oil of a kinematic viscosity (40°C) 220cSt which mixed a mineral base oil and/or a synthetic base oil and waste plastic pyrolysis reformed oil with a kinematic viscosity (40°C) 100 to 200cSt and a viscosity index of 80 or more.

The mineral base oil and synthetic base oil are ingredients widely known as base oils for lubricants in the technical field to which the present invention pertains. For example, the mineral base is the substance remaining after atmospheric distillation of crude oil and is produced through reduced pressure distillation and impurity treatment processes.

The synthetic base oil is a base oil produced separately from the mineral base oil, and is known for example, as PAO type (poly alpha olefine type), PAG type (poly alkylene glycol type), and ester type (ester type), etc.

The waste plastic pyrolysis reformed oil is composed of oil ingredients, with a high content of C₂₀ to C₃₀ of paraffinic oil, a kinematic viscosity (40°C) of 100 to 200 cSt, a viscosity index of 80 or more, and a saturation of 90 w% or more by pyrolysis and hydroforming (hydrolysis) of waste plastic.

The technology based on pyrolysis and hydroforming(hydrolysis) of waste plastic is a known technology in the technical field to which the present invention relates. For example, a liquid oil is obtained by heating waste plastic to a temperature of 350 to 450°C in the absence of oxygen. The purified and recovered liquid oil can be recovered into liquid pyrolysis reformed oil by hydroforming under addition of hydrogen.

The isocyanate-based compound and amine-based compound composed of the thickener according to the present invention are a thickener ingredient and particularly suitable for the high temperature stability characteristics of lubricating grease manufactured using the pyrolysis and hydroforming (hydrolysis) of waste plastic as lubricating base oil. It is preferably the isocyanate-based compound and amine-based compound are in a weight ratio of 1:1.

The isocyanate-based compound is one or more ingredients selected from hexamethylene diisocyanate(HDI), methylenediphenyl diisocyanate(MDI), and toluene diisocyanate(TDI), and preferably methylenediphenyl diisocyanate(MDI). The amine compound is one or more ingredients selected from aniline, oleylamine, octylamine, stearylamine, and cyclo-hexylamine, and preferably octylamine and cyclo-hexylamine.

The corrosion inhibitor according to the present invention comprises N,N-bis(2-ethylhexyl)-5-methyl-1H-benzotriazole-1-methanamine, which is a known substance used as a passivation ingredient for metals and acts to prevent corrosion of metals in contact with lubricating grease.

And the lubricating grease ingredient according to the present invention is composed of P,P'-Dioctyldiphenylamine as a wear resistance agent and antioxidant of the triphenyl phosphate (TPP) series or zinc-diphosphate (Zn-DTP) series.

Hereinafter, the eco-friendly lubricating grease composition based on the waste plastic pyrolysis reformed oil of the present invention will be described in more detail through <Embodiment> and <Test Example> below.

<Embodiment>

-Manufacture of lubricating grease of the present invention-

First, adding a mineral base oil and waste plastic pyrolysis reformed oil into a mixing vessel at a weight ratio of 1:1 and mixing evenly to prepare 100 parts by weight of lube base oil with a kinematic viscosity (40°C) 220 cSt.

Putting 85 parts by weight of the lube base oil prepared above into a reaction tank(1) and heating to 60°C, then adding 10 parts by weight of methylenediphenyl diisocyanate (MDI) to react together.

Next, adding the remaining 15 parts by weight of the lube base oil into a separate reaction tank (2), adding 5 parts by weight of oleylamine and 5 parts by weight of cyclohexylamine and sufficiently stirring to obtain a mixture. Then putting slowly the mixture into the reaction tank(1) for 60 minutes and heating to 180°C at the same time and then cooling.

Thereafter, when the temperature is below 100°C, introducing 0.5 parts by weight of N,N-bis(2-ethylhexyl)-5-methyl-1H-benzotriazole-1-methanamine, 0.5 parts by weight of zinc-diphosphate (Zn-DTP) and 1.5 parts by weight of P,P'-dioctyldaphenylamine, about 100 parts by weight of lube base oil, and then homogenizing them to produce an eco-friendly lubricating grease based on waste plastic pyrolysis reformed oil. [Table 1] in below shows the ingredients and mixing ratio of the lubricating grease of the present invention.

[Table 1]

Ingredients	Mixing ratio (parts by weight)	Remarks
Mineral Oil	50	Lube Base Oil
Plastic pyrolysis reformed oil	50	
MDI	10	Thickener
Oleylamine	5	
Cyclohexylamine	5	
Triazole series	0.5	Corrosion inhibitor
Zn-DTP	0.5	Anti-wear agent
P,P'-dioctyldaphenylamine	1.5	Antioxidant

The lubricating grease of the present invention prepared in the above <Embodiment> was tested for the test items (test example). The results are shown in [Table 2] below.

[Table 2]

Test items	Unit	Test results	Test method
Cone Penetration	0.1mm	325	ASTM 217
Dropping point	°C	242	ASTM 2265
Oil Separation (100°C/24h)	wt%	3.6	ASTM 6184
Evaporation loss (99°C/22h)	wt%	0.2	ASTM 972
Copper corrosion (100°C/24h)	grade	1a	ASTM 4048
Oxidation stability (99°C/100h)	kg/cm ²	0.22	ASTM 942
4-ball wear resistance (75°C 1200rpm x 40kg x 1h)	mm	0.41	ASTM 2266

As shown in [Table 2] above, it can be seen that the properties of the lubricating grease of the present invention meet or improve the corrosion prevention, oxidation stability, and wear resistance at high temperatures. So the lubricating grease of the present invention can be definitely anticipated that it is suitable for providing high-temperature grease for driving rollers of continuous casting equipment and plain bearings of casting cranes. It also has the advantage of being eco-friendly because it uses waste plastic pyrolysis reformed oil as a base oil ingredient.

WHAT IS CLAIMED IS:

1. Method for manufacturing eco-friendly lubricating grease based on waste plastic pyrolysis reformed oil comprising the following stages :-

1st stage : Adding a mineral base oil and waste plastic pyrolysis reformed oil into a mixing vessel at a weight ratio of 1:1 and mixing evenly to prepare 100 parts by weight of lube base oil with a kinematic viscosity (40°C) 220cSt;

2nd stage: Putting 85 parts by weight of the lube base oil prepared above into a reaction tank (1) and heating to 60°C, then adding 10 parts by weight of methylenediphenyl diisocyanate (MDI) to react together;

3rd stage: adding the remaining 15 parts by weight of the lube base oil into a separate reaction tank (2), adding 5 parts by weight of oleylamine and 5 parts by weight of cyclohexylamine and sufficiently stirring to obtain a mixture;

4th stage: putting slowly the mixture into the reaction tank(1) for 60 minutes and heating to 180°C at the same time and then cooling; and

5th stage: when the temperature is below 100°C, introducing 0.5 parts by weight of N,N-bis(2-ethylhexyl)-5-methyl-1H-benzotriazole-1-methanamine, 0.5 parts by weight of zinc-diphosphate (Zn-DTP) and 1.5 parts by weight of P,P'-dioctyldiphenylamine, to the mixture prepared from the 4th stage, and then homogenizing them to produce an eco-friendly lubricating grease based on waste plastic pyrolysis reformed oil.

2. Method of manufacturing according to Claim 1, wherein the waste plastic pyrolysis reformed oil is a recovered oil from a liquid oil that is obtained by pyrolyzing waste plastic in the absence of oxygen and is hydroformed under the addition of hydrogen, with a kinematic viscosity (40°C) of 100 to 200 cSt, a viscosity index of 80 or more, and a saturation of 90 w% or more.