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3,340,194

METAL WORKING LUBRICANT

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This invention relates to a metal working lubricant. More particularly it relates to a low cost non-staining rolling oil for cold rolling of metals such as copper, brass, aluminum, magnesium and stainless steel.

In fabricating metals into plates or sheets, the metal is subjected to a rolling operation wherein it is passed back and forth through a rolling mill to press it into the desired form. In this operation lubricating oil is applied continuously to the rollers to reduce friction and minimize the energy required. In the so called cold rolling technique no external heat is applied to the metal, however, the skin temperatures of the surfaces in contact with the rolls can be as high as 250 to 400° F., due to friction and other forces.

In addition to high film strength, sufficient lubricity, low metal pick-up and corrosion resistance, a good metal rolling oil must be non-staining. During the rolling operation the metal tends to undergo what is called "work hardening" and the rolling operation is usually followed by annealing to restore the physical properties required for the ultimate use of the metal product. Annealing is carried out at temperatures ranging from 400 to 800° F. and since the rolling oil is still on the surface of the metal permanent stains often remain.

The object of this invention is to provide a rolling oil composition which is non-staining and which has the other desirable properties required of this particular type of oil. A further object of the invention is to provide an oil having low cost components since cost is always a prime consideration in making and marketing rolling oils.

We have discovered that straight distillate mineral lubricating oil can be blended with small amounts of atactic polypropylene to provide an excellent low cost rolling oil. Liquid olefin polymers such as polybutenes have been used in rolling oils but it was unexpected that atactic polypropylene, which is a solid polymer, could be blended with a lube oil to produce a clear, stable oil-polymer blend.

According to the invention the polymer and oil are simply heated together at a temperature in the range of 120–200° F. with stirring until the polymer has been taken up in the oil. No special equipment or processing technique is required. The oil-polymer blend is stable under storage conditions and is ready for immediate use in rolling operations. The rolling oil composition can be applied to the rolls from a can, oil feeder tank or from a circulating system.

The petroleum lubricating oil employed in the composition of the invention may be obtained from any suitable type of crude petroleum, e.g. paraffinic, naphthenic, paraffinic-naphthenic (mixed base) crude, by conventional distillation and refining procedures. Excellent base oils for metal working are obtained by distillation of naphthenic crude oils in conjunction with caustic neutralization or similar treatment, to remove acids. The composition can contain from 60 to 99 wt. percent base oil, preferably from 90–97 wt. percent base oil.

The base oil preferably has a gravity of 19–35 degrees A.P.I. and a viscosity of 40–120 Saybolt Universal seconds at 100° F. and after addition of the polymeric bodying agent the final composition preferably has a viscosity of 100–200 SUS. It should be noted that when straight lube oils are blended to make a rolling oil, large amounts of heavy oil are required to obtain the viscosity required.

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Current literature and patents usually use the terms polypropylene with reference to isotactic polypropylene since it is a commercial product having vast market potential. In the past the term polypropylene has meant liquid trimers and tetramers of propylene as well as the liquid polymers made with Friedel-Crafts catalysts—see Sittig Petroleum Refiner, March 1961 pp. 129–136.

The polypropylene component of the composition we have developed is atactic polypropylene. It is formed as a by-product in the stereo-specific polymerization of propylene in the presence of a catalyst comprising a coordination complex of a transition metal halide with an organo metallic compound. The Sittig article, noted previously, contains a discussion of this process and the catalysts employed. In one known process, the polymerization product in the heptane reaction medium is contacted with a solvent consisting of methanol and water to kill the catalyst. The catalyst is then removed in solution leaving behind a heptane slurry. The atactic polypropylene is in solution in the heptane and this solution is removed from the isotactic polymer. The solution is distilled to recover the heptane solvent—which is recycled. The solid material which remains is the atactic polypropylene employed in the composition of this invention.

Atactic polypropylene is an essentially amorphous solid hydrocarbon polymer which has a random chain formation and a resulting disordered internal structure when compared with isotactic, or spatially ordered polypropylene. It is soluble in aromatic, aliphatic and chlorinated hydrocarbons, slightly soluble in methanol, ethanol, acetone and methyl ethyl ketone and insoluble in water. It has a molecular weight in the range of from about 10,000 to about 40,000, specific gravity of about 0.86 and a softening range of 125–200° F. Solid atactic polypropylene having higher or lower values than those shown can be used where circumstances warrant the use of such material.

Atactic polymer is not recovered from stereo-specific polymerization in a pure state and the pentane solubility can range from 90.0 to 99.9%. The presence of up to 10% impurities does not materially affect the utility of atactic polypropylene in the rolling oils of our invention.

The final metal working oil composition can contain from about 1 to about 30 wt. percent polymer, preferably 2.5 to 10.0 wt. percent polymer.

The following examples serve to illustrate the invention.

Example 1

95 grams of a caustic neutralized naphthenic distillate lube oil having a viscosity of 55 SUS at 100° F. was thickened with 5 grams of atactic polypropylene having a specific gravity of 0.86, a molecular weight range of 20,000–40,000, a softening range of 125–200° F. and a pentane solubility of 95.5 plus. The base oil was heated to 225° F. and the polymer blended in with stirring. After cooling a clear oil having a viscosity of 170 SUS at 100° F. was obtained.

Example 2

The rolling oil of Example 1 was used in a single stand, four high reversing mill on brass. Rolling was conducted at ambient temperature. Little or no film or residue was left on the brass after annealing. The same metal was rolled and annealed using a mixture of light and heavy distillate lube oils blended to a viscosity of 160–170 SUS at 100° F. Due to the heavy components in the oil, the blank was stained and discolored following annealing.

Substantially equivalent results are obtained when the rolling oil of the invention is used to roll aluminum, magnesium and other metals.

If desired functional additives such as anti-oxidants, corrosion inhibitors, oiliness agents, film strength and extreme pressure agents, anti-wear agents, dyes, antiseptics and the like can be added to the oil-polymer blend.

It is particularly desirable to add oiliness agents to the base oil-polymer rolling oil compositions of our invention. The function of oiliness agents and many examples of prior art agents are described in National Petroleum News, July 14, 1937, pp. R-3 to R-8. Any oiliness agent which is compatible with the base oil and atactic polypropylene polymer can be employed including fatty acids, fatty alcohols, fatty amines, fatty amides and fatty esters. These materials can contain from 12 to 18 carbon atoms in the alkyl radical. Oleic acid, stearic acid, lauric acid, palmitic acid and the C_{12} - C_{18} alkyl esters thereof represent suitable examples of oiliness agents with oleic acid, stearic acid and butyl stearate being particularly preferred. From 0.5-10.0 wt. percent of the oiliness agent can be used.

We claim:

1. A non-staining rolling oil for the cold rolling of metals consisting essentially of a petroleum lubricating oil having a viscosity of 40-120 SUS at 100° F. selected from the group consisting of naphthenic, paraffinic and mixed base lubricating oils, from 2.5 to 10.0 wt. percent of an oiliness agent.

2. A non-staining rolling oil composition for the cold rolling of metals consisting essentially of a petroleum lubricating oil having a viscosity of 40 to 120 SUS at 100° F. selected from the group consisting of naphthenic, paraffinic and mixed base lubricating oils, and from 1.0 to 30.0 wt. percent based on the final composition of atactic polypropylene having a molecular weight of from about 10,000 to about 40,000 and a softening range of 125° F. to 200° F., said rolling oil composition having a viscosity of 100 to 200 SUS at 100° F.

3. A non-staining rolling oil composition for the cold rolling of metals consisting essentially of a petroleum

lubricating oil having a viscosity of 40 to 120 SUS at 100° F. selected from the group consisting of naphthenic, paraffinic and mixed base lubricating oils, from 2.5 to 10.0 wt. percent atactic polypropylene having a molecular weight of from about 10,000 to about 40,000 and a softening range of 125° F. to 200° F. and from 0.5 to 10.0 wt. percent of an oiliness agent selected from the group consisting of oleic acid, stearic acid and butyl stearate.

4. In cold rolling metals subsequently to be annealed, the improvement which comprises lubricating the surfaces of the metal being rolled by establishing and maintaining thereon a film of non-staining lubricant comprising a petroleum lubricating oil having a viscosity of 40 to 120 SUS at 100° F. selected from the group consisting of naphthenic, paraffinic and mixed base lubricating oils, and from 1.0 to 30.0 wt. percent based on the final composition of atactic polypropylene having a molecular weight of from about 10,000 to about 40,000 and a softening range of 125° F. to 200° F., said lubricant having a viscosity of 100 to 200 SUS at 100° F.

5. The process according to claim 4 in which the metal is selected from the group consisting of copper, brass, aluminum, magnesium and stainless steel.

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