EMULSION FOR HOT ROLLING ALUMINUM PRODUCTS

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6 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to the addition of polybutene and saturated fatty alcohols to a neat oil composition comprising hydrocarbon base oils, lubricity agents, emulsifiers and the like. When mixed with water, the neat oil with additives provides an emulsion which minimizes pickup in the hot rolling of aluminum products and provides a rolled product having substantially improved surface characteristics.

BACKGROUND OF THE INVENTION

This invention relates to an improved lubricating composition. More particularly, it relates to an oil-in-water emulsion containing polybutene and fatty alcohols useful in the hot rolling of aluminum products. This application is a continuation-in-part of Ser. No. 199,040 filed Nov. 15, 1971, now abandoned.

In the normal fabrication of aluminum sheet and plate materials, an ingot, at a temperature of from about 650 to about 1000°F., is passed through a breakdown mill to reduce the ingot to a thickness of about 1 inch. After the breakdown passes, the 1 inch thick slab is then rolled on a millstand mill or a reversing mill to a thickness of about 0.1 inch. The final temperature of the product of the rolling operation normally varies between about 500 and 700°F. During the rolling operation on the millstand mill, or the reversing mill, the workpiece and work rolls are normally flooded with a lubricant, usually an oil-in-water emulsion. The primary functions of the oil-in-water emulsion are to reduce the friction, to prevent metal-to-metal contact between the work rolls and the workpiece, and to control the temperature of the work rolls.

One of the major problems encountered with the oil-in-water emulsion is caused by the small particles of aluminum or alloying elements which are removed from the surface of the workpiece and transferred to the working surfaces of the mill roll. The particles, which are highly oxidized, build up on the mill roll surface forming a coating thereon which is commonly termed "roll coating." The particles of aluminum from the roll coating are subsequently retransferred to and embedded in the surface of the workpiece. The embedded particles are commonly termed "pickup." During the subsequent rolling operations, these surface imperfections tend to be hidden, and it is not until the sheet material is subsequently anodized that these imperfections again appear. The imperfections are sometimes noticeable after the etching step which is normally required prior to anodizing. Moreover, the surface imperfections tend to be accentuated during the anodizing process, thus rendering the sheet product unsuitable for many commercial uses. By increasing the lubricity of the oil-in-water emulsion and/or by making it more selective, the pickup deposition can be minimized.

However, the lubrication properties of the oil-in-water emulsion must not be increased to the extent that the aluminum slab refuses to enter the mill rolls. Furthermore, if the friction between the workpiece and the mill rolls is reduced by an excessive amount, the workpiece tends to move laterally, or skid, in the mill which causes a "cobbled" and consequent production loss, or if produced, the product to be misshaped.

In addition to the minimum lubrication and cooling characteristics, the emulsion must also meet other requirements before it has any commercial applicability. The emulsion must be capable of removing the residues of dried emulsion from the surfaces of the workpiece or roll. Otherwise, the residues from the dried emulsion would accelerate roll coating formation and pickup. The emulsion must also prevent rust and keep the coolant piping system clean.

The commercially available neat oil compositions employed to form the emulsion generally comprise 50-90% by weight of a light hydrocarbon oil primarily naphthenic in nature, 5-15% by weight of one or more lubricity agents, such as oleic acid and one of the esters commonly used, 2-20% by weight of emulsifiers, such as triethanolamine oate, and frequently up to 5% by weight of a coupling agent, such as ethylene glycol, to render the emulsifiers and lubricity agents soluble in the base oil. Frequently used neat oils include Prosol 44 and 46, sold by the Mobil Oil Corporation and Tundemol K95A, sold by E. F. Houghton & Company. The oil phase of the emulsion generally comprises from about 1 to 10% by weight of the emulsion. The emulsions prepared with the commercially available neat oils do provide sufficient lubrication and cooling during hot rolling, and compared with the previously used products, they significantly reduce the amount of pickup. However, the surface quality requirements for anodized sheet material have consistently increased over the years to a point where the pickup levels and the rejections therefrom are excessive when employing commercially available lubricants.

Against this background, the present invention was developed.

DESCRIPTION OF THE INVENTION

The present invention relates to an improved oil-in-water lubricant which provides for a substantial reduction in the amount of pickup and roll coating experienced in the hot rolling of aluminum products with no diminution of lubrication, cooling, and other properties. Improvements are obtained in accordance with the present invention by the inclusion of polybutene and a fatty alcohol to commercially available neat oils employed in the hot rolling of aluminum products. The polybutene and fatty alcohols are added in amounts of about 2 to 10% and about 0.2 to 5%, respectively, of the total neat oil. Preferably, the ratio of polybutene to fatty alcohol is greater than 2:1. It is believed that the addition of polybutene and fatty alcohols provides an oil film on the workpiece and work rolls which has an improved surface activity which removes the particles of highly oxidized aluminum and/or alloying elements and prevents the redeposition thereof onto the workpiece and work roll surfaces, moreover, the workpiece provides a rolled
product with substantially improved surface characteristics. The oil composition of the present invention consists essentially of about 50 to 80% by weight of a substantially naphthenic hydrocarbon base oil, about 5 to 15% lubricity agents, about 0.2 to 5% long-chain saturated aliphatic monohydric alcohols, about 2 to 10% polybutenes, and up to about 5% coupling agents. The hydrocarbon base oil is preferably naphthenic in nature having a viscosity of from about 100 to 300 SSU at 100°F. The typical lubricity agents, or wear-reducing agents, include oleic acid, tricresyl phosphate, lauric acid, di(2-ethylhexyl)sebacate, and the like. A coupling agent, such as ethylene glycol, is normally added to the neat oil to solubilize the various constituents into the base oil. The emulsifiers are usually anionic emulsifiers, such as triethanolamine olate, with or without additional non-ionic emulsifiers.

The saturated fatty acids are selected from the group consisting of fatty acids having from 10 to 20 carbon atoms, such as n-decyl alcohol (lauryl alcohol), n-tetradecyl alcohol (myristyl alcohol), n-hexadecyl alcohol (cetyl alcohol) and n-octadecyl alcohol (stearyl alcohol). Suitable commercially available fatty acids include Alcof 1216, manufactured by the Continental Oil Company, which is essentially 6% C16 alcohol, 23% C18 alcohol, and 12% C18 alcohol. The polybutene, which will normally be a mixture of polybutenes, must have a viscosity of from 50 to 750 SSU, preferably from 100 to 300 SSU at 100°F. Suitable commercially available polybutenes include Oronite 6, Oronite 8 and Oronite 128, manufactured by the Chevron Chemical Company. In preparing the emulsion, the various organic components are premixed into a neat oil and then the neat oil is subsequently mixed with water in sufficient amounts to form an oil-in-water emulsion in which the oil phase of the emulsion comprises from 1 to 10% by weight of the emulsion. It has been found that the polybutene-fatty alcohol additive must be intimately mixed with the other oil components prior to emulsification because after emulsification addition of the additive to the emulsion provides for no improved results except in excessive amounts.

The various components as a "neat" oil are mixed with water to form an emulsion in which a large fraction, preferably at least 30%, of the oil phase exists as droplets from about 2 to 8 microns in diameter. An emulsion with a particle size predominantly below 2 microns is considered a "tight" emulsion and does not have sufficient lubricity for oiling-in products on multistrand mills. A particle size above 8 microns in diameter provides too much lubricity for the hot rolling of aluminum products, and the workpiece tends to refuse to enter the mill and to skid during rolling. The working temperature of the emulsion is from about 90 to 160°F, preferably between 90 and 140°F. Below 90°F, the emulsion deposits an oil film poorly and work rolls are believed to fire-crack more, and above 160°F, the emulsion tends to break down and separate into separate oil and water phases. The pH of the aqueous phase of the emulsion, which depends upon the composition of the neat oil and the hardness of the water, can range from 7.2 to about 8.5.

In the composition of the present invention, it is preferred to add up to 1% anti-oxidents, such as butylated hydroxytoluene (BHT). These materials are normally added to the neat oil prior to emulsification.

In the process of hot rolling aluminum products with the oil-in-water emulsion of the present invention, the work rolls and the workpiece are normally flooded with the emulsion as the material enters the mill rolls. The emulsion substantially reduces the amount of pickup and roll coating over the known products. For example, employing an arbitrary rating system of 1 to 5 for anodizing quality sheet material (Grade 1 being the highest quality and Grade 5 being the lowest), it has been found that the emulsion of the present invention can improve the surface quality by as much as 2 or 3 units, e.g., from a grade of 4 to a grade of 1 or 2.

To further illustrate the advantages of the present invention, the following neat oils were prepared.

<table>
<thead>
<tr>
<th>Lubricant number</th>
<th>Polynbutene</th>
<th>Alcohol</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.8</td>
<td>0.7</td>
<td>55.5</td>
</tr>
<tr>
<td>2</td>
<td>4.8</td>
<td>0.7</td>
<td>45.5</td>
</tr>
<tr>
<td>3</td>
<td>5.8</td>
<td>0.7</td>
<td>35.5</td>
</tr>
<tr>
<td>4</td>
<td>6.8</td>
<td>0.7</td>
<td>25.5</td>
</tr>
</tbody>
</table>

The polybutene, which had a viscosity of 275 SSU at 100°F, was a blend of 48% Oronite Polybutene No. 4 and 52% Oronite Polybutene No. 8. The fatty alcohol was Alcof 1216. Sufficient amounts of the neat oil were mixed with water at a temperature between 90° and 110°F to form the emulsion in which the oil phase amounted to about 4% of the emulsion. Strips of 2024 alloy, 54" thick by 3" wide, were hot rolled at a temperature of 800°F in a 2-high Schmitz mill employing each of the emulsions set forth above. Separate strips were reduced approximately 55% and 65% in thickness with each of the emulsions so that the mill power requirements, expressed as (mill motor-amperes)° could be interpolated to a 60% reduction. As indicated in Table II below, the power requirements were essentially equivalent for hot rolling in both the prior art emulsions and the emulsions of the present invention. However, substantially improved surface characteristics were found in that the pickup and other surface defects were substantially less with those samples which had been hot rolled with the emulsion of the present invention.

<table>
<thead>
<tr>
<th>Lubricant number</th>
<th>Mill power at 60% red. (amps)</th>
<th>Anodizing quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>267</td>
<td>1.5</td>
</tr>
<tr>
<td>2</td>
<td>288</td>
<td>4.5</td>
</tr>
<tr>
<td>3</td>
<td>319</td>
<td>1.6</td>
</tr>
<tr>
<td>4</td>
<td>306</td>
<td>3.5</td>
</tr>
</tbody>
</table>

All percentages given herein are on a weight percent basis unless stated otherwise.

It is obvious that various modifications can be made to the present invention without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. An oil-in-water emulsion for the hot rolling of aluminum products comprising an oil phase containing a substantially naphthenic hydrocarbon oil having a viscosity between about 100 and 300 SSU at 100°F, at least one lubricity agent, and at least one emulsifier, and an aqueous phase consisting essentially of water, the oil phase comprising from 1 to 10% of the emulsion, the improvement comprising the oil phase containing from about 0.2 to 5% of at least one saturated fatty alcohol having from 8 to 20 carbon atoms and from about 2 to 10% by weight polybutene having a viscosity of from about 50 to 70 SSU at 100°F.

2. The oil-in-water emulsion of claim 1 in which at least 30% of the oil phase exists as particles from about 2 to 8 microns in diameter.

3. The oil-in-water emulsion of claim 1 at a temperature of from about 100 to 160°F.

4. In the process of hot rolling aluminum products wherein an aluminum workpiece is passed through working rolls and wherein the surfaces of the aluminum workpiece and the working rolls are contacted with an oil-in-water emulsion comprising an oil phase containing a hydrocarbon oil, at least one lubricity agent, and at least one emulsifier, and an aqueous phase consisting essentially
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of water, the oil phase comprising from 1 to 30% by
weight of the emulsion, the improvement comprising the
oil phase containing from about 0.2 to 5% saturated fatty
alcohols having from 8 to 20 carbon atoms and from
about 2 to 10% by weight of polybutene having a viscosity
of from about 50 to 500 SSU at 100° F.
5. The oil-in-water emulsion of claim 1 in which the
oil phase contains up to 5% of a coupling agent.
6. The oil-in-water emulsion of claim 4 in which the
oil phase contains up to 5% of a coupling agent.

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