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3,483,124

ROLLING OIL EMULSIONS

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No Drawing. Filed June 2, 1967, Ser. No. 643,040

Int. Cl. C10m 1/06, 1/24; B01j 13/00

U.S. Cl. 252-49.5

4 Claims

ABSTRACT OF THE DISCLOSURE

An improved lubricating emulsion consisting of water and animal fats and/or mineral oils for use in the rolling of metals which also contains a short chain fatty acid, which is characterized as being relatively soluble in oil and relatively insoluble in water.

THE DISCLOSURE

Cold reduced flat rolled metal products are used for a variety of purposes and are manufactured in great quantities. These products are made by cold rolling metal strips that have been broken down in a hot rolling operation from a slab or other large section of metal. The hot breakdown of metal into strip and the cold reduction of metal strip to form cold rolled sheets of metal are both processes which are well known to the art and are described in detail in many publications. A thorough treatment of the mechanics of both hot and cold rolling of steel, which processes are typical of the rolling processes of metal in general, is set forth in "The Making, Shaping and Treating of Steel," published by United States Steel Corporation.

In the cold reduction of metals it is necessary to supply both a coolant and a lubricant to the metal as it passes between the rolls in which the cold reduction takes place. The cooling and the lubrication is normally supplied by a water and oil emulsion by means of which the water supplies the cooling action and the oil supplies the lubrication.

It is essential that lubricants for rolling be in a form that is known as a "loose" emulsion. That is, the emulsion must be such that the oil and water separate in use, so that the oil supplies a good coating to the metal strip which is being reduced and the water evaporates to supply the cooling action to the strip.

It is also essential that the dissolved solids in the lubricant be kept at a minimum. The presence of dissolved salts in the lubricant is extremely undesirable, as the salts contribute to the corrosion of the metal strip. Other solids, which may be dissolved or otherwise held in the lubricant, are undesirable as they may result in dirt streaks on the metal sheet or other undesirable surface defects.

Almost all operations in which metal is cold rolled are continuous or semi-continuous and use a recirculating lubrication system. The lubricant is normally supplied to the metal from a sump and the lubricant, which does not remain with the metal, is returned to the sump for reuse. Water and oil are added as needed to keep the lubricant at the desired level. Normally, some quantity of the oil goes with the metal strip as it leaves the cold reduction operation and $\frac{1}{3}$ to $\frac{1}{2}$ of the water from the lubricant emulsion evaporates every 24 hours.

There are two main sources of impurities for the emulsion in a typical recirculation system in a cold reduction operation. As water evaporates from the emulsion and more water is added, any dissolved salts from the make-up water tend to increase the content of salt in the emulsion. This problem is particularly severe when softened water, which contains alkali, is used as make-up

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water in a system. The other source of impurities is the metal itself, as fine metal particles are picked up by the lubricant and returned to the sump.

It is desirable to keep the characteristics of the lubricant emulsion as nearly constant as possible and as close as possible to the ideal characteristics which the lubricant had when first charged into the system. It is desirable to maintain the pH of the emulsion between 5.5 and 7. More preferably the pH should be between 5.5 and 6.8, and the ideal pH is approximately 6 to 6.5.

A satisfactory emulsion can exist below a pH of 5.5, but corrosion problems begin to become severe with most metals below this level. At a pH of above 7 the lubricant emulsions tend to tighten up, or become extremely stable, so that the oil and water do not separate in the desired manner, when the lubricant comes in contact with the metal during reduction.

Dissolved alkaline salts in the make-up water to a lubricant sump have a tendency to raise the pH of the emulsion. Metal particles, particularly from metals such as aluminum, also tend to raise the pH of the lubricant emulsions. Prior art methods for controlling the pH of lubricant emulsions have been to add mineral acids such as phosphoric acid, hydrochloric acid, or sulfuric acid in quantities sufficient to maintain the pH at the desired range. The addition of these acids had the undesirable effect of increasing the salt content and increasing the corrosion problems. All of these prior art acids were relatively soluble in water and so formed salts in the water which changed the characteristics of the lubricant emulsion.

As the level of water soluble salts and metal fines in lubricant emulsion goes up, the point is reached wherein either the salt content is at a point where the corrosion problems presented by the salt become intolerable, or the solids content is at a point where it is no longer possible to maintain a stable emulsion. When one of these points is reached, it is necessary to dump all of the lubricant out of the recirculating system and replace it with new lubricant out of the recirculating system and replace it with new lubricant. When the emulsion becomes stable it is in the terms of the trade said to have been "tightened." This dumping procedure requires that the cold reduction mill be shut down and a loss of production time be suffered.

The expense of frequent shutdowns when coupled with the expense involved in supplying new lubricant, changing the lubricant in the system, and disposing of the old lubricant without polluting waste systems, has presented a great problem to the industry. It would, therefore, be of great benefit to the art if an acidic reagent could be combined in a lubricant emulsion in such a way that it could neutralize alkali in the water without changing the emulsion characteristics of the lubricant.

It therefore becomes an object of the subject invention to supply an improved lubricant for use in metal rolling which contains a reagent which is capable of neutralizing alkali in water without changing the characteristics of the emulsion.

Another object of the invention is to provide an improved process for the cold reduction of metals which utilizes an improved lubricant emulsion which is characterized as containing an acid reagent which is capable of neutralizing alkali in water without changing the emulsion characteristics.

Another object of the invention is to provide an improved process for the cold reduction of aluminum which involves the use of lubricant emulsion which contains a reagent which is capable of neutralizing alkali in water without changing the emulsion characteristics.

Other objects will appear hereinafter.

THE INVENTION

In accordance with the invention it has been found that an improved lubricant useful in the cold rolling of ferrous and nonferrous metals may be afforded by treating conventional lubricants of the type composed of animal fats and mineral oils with a small yet effective amount of an aliphatic monocarboxylic acid which contains from 5-10 carbon atoms in an aliphatic or branch chain grouping and which is further characterized as being relatively soluble in oil and relatively insoluble in water. These particular acids are employed in the practices of the invention by treating typical rolling oil lubricants with as little as 0.01 to 5% by weight of these acids with excellent results being experienced within the range of 0.1 to about 1% by weight. A typical treating dosage is within the range of 0.3 to 0.5% by weight.

The short chained aliphatic acids described above are illustrated by the well-known monocarboxylic acids such as valeric, isovaleric, caproic, caprylic and capric acids.

As indicated these acids should be only slightly soluble in water whereas they are soluble in the rolling oil formulations used to cold roll metals such as steel, aluminum, copper and the like.

The term "relatively insoluble in water" indicates that the acid should have a greater solubility in oil than in water. Typical of the preferred acids described above is that their water solubility rarely exceeds about 5 parts per 100 parts of distilled water at a temperature of 15° C.

The short chain fatty acids of the invention are compatible with most rolling oil formulations of the type described since they are soluble in most petroleum hydrocarbon oils which are commonly used in the formulation of these rolling oil products. They may be formulated with the basic rolling oil or they may be added separately to already emulsified systems.

To illustrate a typical rolling oil formulation into which the short chain fatty acids may be incorporated, a typical formulation is presented below:

COMPOSITION I

Ingredients:	Percent by weight
Tallow triglyceride	25
Nonyl phenol-Rx 10 moles ethylene oxide	1.5
Nonyl phenol-Rx 4 moles ethylene oxide	1.5
Mineral oil	72

To a composition of the type described above may be added 3% by weight of caprylic acid. This caprylic acid augmented formula is capable of continuously lubricating sheet steel stock for periods of time far in excess than that achieved by using the formula without the adjunct.

To illustrate the benefits achieved by using the practices of the invention the following is presented by way of example.

In a typical rolling mill where sheet steel was being prepared, a rolling oil emulsion was being used which

corresponded to 5% by weight of Composition I dispersed in Chicago tap water which contained approximately 18 grains per gallon hardness. In a typical run this emulsion lasted about two weeks. At such time, due to increased pH, the emulsion tightened to the point that it was rendered useless and had to be discarded.

In a test performed several weeks thereafter, the same emulsion which contained 3% by weight of caprylic acid was used. This emulsion continued to perform satisfactorily for 21 days before its lubricating characteristics became such that it could no longer be used.

Based on the above, it is seen that an improved method for preventing the tightening of loose rolling oil emulsions has been afforded by adding to such emulsions a minor amount of certain short chain fatty acids. Such additions allow emulsions to be used for extremely long periods of time before they are rendered useless due to tightening. Also the corrosive and abrasive tendencies of such emulsions are greatly reduced.

Having thus described my invention it is claimed as follows:

1. An emulsified lubricant useful in the cold rolling of metals, which comprises as the major proportion, water and as the minor component one or more members of the group consisting of animal fats and mineral oils, which contain therein from 0.01-5% by weight of a short chain fatty acid, having from 5-10 carbon atoms in chain length, and being characterized as being relatively soluble in oil and relatively insoluble in water.

2. The improvement of claim 1 in which the short chain fatty acid is caprylic acid.

3. In a process for the cold reduction of metal by rolling which comprises the steps of passing the metal through rollers in which it is compressed and elongated and lubricating the metal during the compression and elongation; the improvement which comprises the use of an emulsified lubricant consisting of the composition of claim 1.

4. The process of claim 3 in which the short chain fatty acid is caprylic acid.

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U.S. Cl. X.R.

252-312