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2,729,992

ROLLING OF METALS

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No Drawing. Application July 19, 1952,
Serial No. 299,927

13 Claims. (Cl. 80-16)

This invention relates to the rolling of metals in contact with an oil and more particularly to the rolling of metals in contact with an oil containing an additive to reduce deleterious effects otherwise encountered.

In the rolling of metals and particularly aluminum and alloys thereof, an oil is used to lubricate the rolls. The oil in many cases serves the dual function of both a lubricant and a coolant. The oil may be applied to the metal in any suitable manner. In one method the oil passes as a stream or spray onto the rollers and/or metal. In other methods the oil may be applied to the metal by brushing, spraying, etc. In some cases and particularly when the rolling is effected at an elevated temperature, discoloration of the aluminum results. The exact cause of such discoloration is not completely understood but it has been found that the incorporation of a particular additive into the oil being used during the rolling operation serves to reduce and in many cases prevent the discoloration.

In one embodiment the present invention relates to a process which comprises rolling metal in contact with an oil containing an additive having the general formula



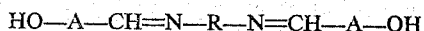
where X is selected from the group consisting of $\text{R}-\text{N}=\text{CH}-\text{A}-\text{OH}$, and $\text{A}-\text{OH}$, where R is an aliphatic radical and where A is an aryl radical with a hydroxy group in a position ortho to the $-\text{CH}=\text{N}-$ group.

In a specific embodiment the present invention relates to the process which comprises rolling an aluminum sheet in contact with an oil containing from about 0.0001% to about 1% by weight of disalicylal diamino propane.

In accordance with the present invention rolling of metal is effected in contact with an oil containing an additive of a particular configuration. As hereinbefore set forth the presence of the additive in the oil reduces and in some cases prevents discoloration of the aluminum sheets. The discoloration is observed particularly when the aluminum sheets are rolled at an elevated temperature, which temperature may range from about 300° to about 900° F. and generally from about 500° to about 700° F.

Any suitable oil may be employed as a lubricant in the rolling of metals. Generally the oil will be a highly refined selected gas oil fraction having a boiling range of from about 500° to about 750° F. The oil preferably is substantially stable at the conditions of use and therefore usually comprises an oil substantially free from olefins, diolefins, or other reactive constituents.

The preferred additive for use in accordance with the present invention comprises a disalicylal diamino alkane and will have the general formula

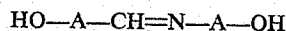


where R is an aliphatic radical and preferably contains from 1 to about 8 carbon atoms. Satisfactory additives in this class include disalicylal diamino methane, disalicylal diamino ethane, disalicylal diamino propane, disalicylal diamino butane, disalicylal diamino pentane, disalicylal diamino hexane, disalicylal diamino heptane, disalicylal diamino octane, etc. A particularly preferred additive comprises 1,2-disalicylal diamino propane.

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It is understood that one or both of the aromatic rings may contain other substituents attached thereto including, for example, hydrocarbon radicals, including alkyl, cycloalkyl, aryl, etc., and/or radicals containing oxygen, nitrogen and/or sulfur.

Another additive for use in accordance with the present invention comprises an ortho-hydroxybenzal aminophenol having the general formula



A preferred additive of this class comprises ortho-hydroxybenzal ortho-aminophenol. Here again it is understood that one or both of the aromatic rings may contain substituents thereto, the substituents being from the radicals hereinbefore set forth. The additive thus may comprise 2-salicylal-amino-4-sec-butylphenol, etc.

The additives of the present invention may be prepared in any suitable manner. For example, disalicylal diamino propane is readily prepared by the condensation of salicylaldehyde with a 1,2-propylene diamine. Other aromatic aldehydes and alkaline polyamines will be utilized in preparing other additives of this class. Ortho-hydroxybenzal ortho-aminophenol may be prepared by the condensation of ortho-hydroxy-benzaldehyde with ortho-aminophenol.

The additives of the present invention generally will be incorporated in the lubricating oil in a concentration of less than about 1% by weight thereof and more specifically in a concentration of from about 0.0001% to about 1% by weight. The additive may be added directly to the oil and is intimately mixed therein or, when desired, the additive may be prepared as a solution in a suitable solvent including alcohols, ketones, etc.

While hydrocarbon oil generally is preferred for use as a lubricant in the rolling of aluminum, it is understood that the novel features of the present invention may be employed in other oils used for lubrication, including those of animal and/or vegetable origin.

The hereinbefore description has been directed primarily to the rolling of aluminum, including various alloys thereof. It is understood that the present invention may be utilized in the rolling of any metal which suffers undesirable effects and particularly discoloration during the rolling operation. The rolling of other metals in the presence of a lubricating oil may include steel, iron, copper, zinc, nickel, brass, etc. Furthermore, the novel features of the present invention may be utilized in any other working of metals which is effected in the presence of a lubricating oil and thus may include sawing, grinding, cutting, stamping, etc., particularly when these operations are effected at an elevated temperature.

The following examples are introduced to illustrate further the novelty and utility of the present invention but not with the intention of unduly limiting the same.

EXAMPLE I

This test was devised to simulate commercial scale rolling of aluminum sheets at 600° F. The oil used in this test was one commercially employed as a lubricant during the rolling of steel and had an A. P. I. gravity of 27.2°, a boiling range of from 566° to about 700° F., a kinematic viscosity at 100° F. of 10.04 centistokes and a Saybolt Universal viscosity at 100° F. of 58.9 seconds. A 3½ inch square sheet of aluminum is thoroughly cleaned, and the lubricating oil is applied thereto by means of a pad of cotton. Excess oil is drained and the sheet is then placed horizontally in a muffle furnace which is maintained at 650° F. The aluminum sheet is heated at this temperature for 30 minutes and then is removed for inspection.

In the first series of runs, discoloration of the sheet was observed visually. In this series of runs, three sheets were used. The control sample was coated with oil

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containing no additive. A second aluminum sheet was coated with oil containing 0.5% by weight of disalicylal diamino propane. A third aluminum sample was coated with oil containing 0.1% by weight of disalicylal diamino propane.

After heating in the manner hereinbefore set forth, the control sample was discolored and had a bad uniform stain. The other two samples were only very slightly stained. These results show that the use of the additive in the lubricating oil served to considerably reduce the discoloration otherwise encountered during heating of the aluminum at this temperature.

EXAMPLE II

In order to confirm the visual observation and also to measure quantitatively the discoloration, the aluminum sheets were examined using a reflectance meter. The reflectance of magnesium oxide is 100%. The plain polished aluminum sheet before heating had a reflectance of 85%.

Samples of aluminum sheets were coated with different samples of the oil and heated at 650° F. in the manner described in Example I. Three different aluminum sheets of each sample were prepared and tested. The control samples were coated with oil containing no additive. One series of samples was coated with oil containing 0.05% by weight of disalicylal diamino propane, and the third series of samples was coated with oil containing 0.1% by weight of disalicylal diamino propane. The results of these tests are shown in the following table.

Table I

Additive	Percent Reflectance		
	Sample 1	Sample 2	Sample 3
None.....	56	47	53
0.05%.....	83	74	79
0.1%.....	83	83	82

It will be noted from the data in the above table that the aluminum sheets coated with oil containing the additive were of a considerably higher per cent reflectance as compared to the aluminum sheet coated with oil containing no additive. It is apparent that the per cent reflectance decreases with discoloration or staining of the aluminum.

Particular attention is called to the fact that the use of 0.1% by weight of disalicylal diamino propane in the oil resulted in a reflectance of 82-83% and that the plain polished sheet before heating had a reflectance of 85%. Thus it is noted that the additive substantially prevented discoloration of the aluminum sheet.

EXAMPLE III

The particular additives as hereinbefore set forth are effective in retarding or preventing discoloration of aluminum. Apparently the particular configuration in the additives as hereinbefore set forth is peculiar in its ability to retard discoloration of the aluminum. A number of other additives were tested and found either to be of no benefit or in some cases to actually increase discoloration. The additives reported in the following table were tested in the same manner as described in Example II.

Table II

Additive	Percent Reflectance		
	Sample 1	Sample 2	Sample 3
None.....	56	47	53
0.1% by weight of 2,4-dimethyl-6-tertiary butyl phenol.....	52	56	53
0.5% by weight of butylated hydroxy anisole.....	45	44	41
0.5% by weight of lauryl bromide.....	42	43	41

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From the above data, it will be noted that all of these additives were of no effect in preventing discoloration of the aluminum sheets and that the last two additives actually were harmful because they increased the discoloration.

EXAMPLE IV

Carbon steel may be rolled at 700° F. in contact with a hydrocarbon oil containing 0.08% by weight of ortho-hydroxybenzal ortho-aminophenol. This will serve to reduce discoloration of the carbon steel during the rolling operation.

EXAMPLE V

The additives used in this example are ortho-hydroxybenzal ortho-aminophenol (salicylal-ortho-aminophenol) and 2-salicylal-amino-4-sec-butylphenol. These additives were tested in other samples of the same oil described in Example I and in substantially the same manner except that the reflectances are based on a standard of 100% reflectance for the cleaned aluminum sheets. In Examples II and III, these cleaned aluminum sheets had a reflectance of 85%.

After heating of the samples at 650° F. for 30 minutes the reflectances obtained are shown in the following table.

Table III

Additive	Percent Reflectance
None.....	52
0.1% by weight of salicylal-ortho-aminophenol.....	65
0.2% by weight of salicylal-amino-4-sec-butylphenol.....	68

Here again it will be noted that the additives of the present invention served to retard discoloration of the aluminum sheets.

I claim as my invention:

1. In a process of rolling metal in contact with a lubricating oil, wherein the metal normally becomes discolored during the rolling thereof, the improvement which comprises adding to the lubricating oil, in a small but sufficient amount to reduce discoloration of the metal, a compound selected from the group consisting of a disalicylal diamino alkane and an ortho-hydroxybenzal aminophenol.

2. The process of claim 1 further characterized in that said metal comprises aluminum.

3. The process of claim 1 further characterized in that said compound is a disalicylal diamino alkane.

4. The process of claim 3 further characterized in that said compound comprises disalicylal diamino propane.

5. The process of claim 1 further characterized in that said compound comprises an ortho-hydroxy-benzal amino-phenol.

6. The process of claim 5 further characterized in that said compound comprises ortho-hydroxybenzal ortho-aminophenol.

7. A process which comprises rolling aluminum at a temperature of from about 500° to about 700° F. in contact with a mineral lubricating oil containing from about 0.0001% to about 1% by weight of a compound selected from the group consisting of a disalicylal diamino alkane and an ortho-hydroxybenzal aminophenol.

8. A process which comprises rolling aluminum at a temperature of from about 300° F. to about 900° F. in contact with a mineral lubricating oil containing from about 0.0001% to about 1% by weight of 1,2-disalicylal diamino propane.

9. A process which comprises rolling aluminum at a temperature of from about 300° F. to about 900° F. in contact with a mineral lubricating oil containing from about 0.0001% to about 1% by weight of ortho-hydroxybenzal ortho-aminophenol.

10. In the working of metal in contact with a lubri-

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cating oil, wherein the metal normally becomes discolored during the working thereof, the improvement which comprises adding to the lubricating oil, in a small but sufficient amount to reduce discoloration of the metal, a compound selected from the group consisting of a disalicylal diamino alkane and an ortho-hydroxybenzal aminophenol.

11. In the working of aluminum in contact with a lubricating oil at an elevated temperature such that the aluminum normally becomes discolored, the improvement which comprises adding to the lubricating oil, in a small but sufficient amount to reduce discoloration of the metal, a compound selected from the group consisting of a disalicylal diamino alkane and an ortho-hydroxybenzal aminophenol.

12. In the working of metal in contact with a mineral lubricating oil at an elevated temperature such that the metal normally becomes discolored, the improvement which comprises adding to the lubricating oil, in a small but sufficient amount to reduce discoloration of the metal, a compound selected from the group consisting of a di-

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salicylal diamino alkane and an ortho-hydroxybenzal aminophenol.

13. In the working of aluminum in contact with a mineral lubricating oil at a temperature of from about 300° F. to about 900° F., the improvement which comprises adding to the lubricating oil, in a small but sufficient amount to reduce discoloration of the aluminum, a compound selected from the group consisting of a disalicylal diamino alkane and an ortho-hydroxybenzal aminophenol.

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