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## A COOLANT FOR METAL MACHINING PROCESSES

Johan Bjorksten, Chicago, and Thomas C. Crowley, Plainfield, Ill., assignors to Bee Chemical Company, a corporation of Illinois

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1 Claim. (Cl. 252—33)

1

This invention relates to metal machining compounds and particularly coolants for grinding wheels. More specifically, it relates to such compositions having far higher resistance to localized extremely high temperatures than has heretofore been possible in compositions of similar nature.

Heretofore the liquids used as coolants or lubricants in metal machining processes have consisted principally either of straight oils, or of emulsions of oils in aqueous media. Such emulsions have the advantage of combining lubricity with the excellent heat abstracting qualities characteristic to water, and therefore are the preferred coolants or lubricants in many operations. However, the performance of the emulsions, as well as of the straight oils of prior art, has been restricted by the following disadvantages, and because of the following facts:

In metal machining, extremely high temperatures are evolved at the point where the metal is being parted. It can be easily seen, on an abruptly arrested lathe, that at the point where the chips are being parted, the metal has actually been in a molten state. In grinding, this is still more apparent from the numerous sparks of burning or white-hot metals that are thrown off, even when coolant is being applied.

The coolant which contacts this locally incandescent metal usually becomes locally charred whether the operation is cutting or grinding, milling, drilling, reaming or any other similar machining step.

In cutting operations and the like, this has the disadvantage of interfering with the local cooling, since the layer of char or gum reduces heat abstraction and hampers lubrication.

In grinding operations, this gumming, burning, or scorching of machining media is still more serious, and these operations present the principal field of application of this invention. The oils heretofore used, whether used straight or as an emulsion when in contact with locally overheated metal in grinding will cause a gummy deposit to form on and between the grits of the grinding wheel. This gummy mass not only will impair heat transference, but it will also act as a binder for small metal chips, grit, worn down particles of

2

interstices in the wheel structure, and so-called loading or glazing of the wheel.

Because of these disadvantages, particularly in grinding, it has even been attempted to entirely eliminate oils from grinding media and to grind with straight solutions of wetting agents or with emulsions of low boiling solvents such as Stoddard solvent, kerosene and the like. While such steps make possible keeping the wheel clean, they have other serious disadvantages, particularly the lack of any adhesion or lubricating tendencies, and of protective film left on the work. Because of the lack of such protection, metal ground by such oil-free coolants of prior art is left in a state highly susceptible to corrosion unless protected by a separate costly and tedious operation.

An object of this invention is to eliminate these disadvantages.

Another object is to provide metal machining media which are not subject to scorching, gumming or to any kind of undesirable decomposition on rapid contact with extremely high localized temperatures in metal machining operations. Other objects are new and useful compositions of matter. Further objects are emulsions in which the oil phase has an extreme resistance to localized high temperatures. Further objects will become apparent as the following detailed description proceeds.

In accordance with this invention, we employ metal machining compositions comprising as the essential oleaginous ingredient, the non-crackable residual oil from cracking temperature treatment of petroleum products, or equivalent products from other sources, as further defined below.

In cracking operations, a petroleum material to be transformed to commercially more valuable fractions is brought into contact with very high temperatures either in the presence or absence of catalysts. Under the influence of these high temperatures, the hydrocarbon materials decompose in whole or in part, and free radicals thus generated will recombine so as to form other constituents of greater commercial value. However, certain fractions in this cracking operation will not change but remain uninfluenced by the very high temperature of the cracking operations. As the material to be cracked is recycled and the cracking operation repeated many times, the percentage of this non-crackable or "refractory"

*Example 2.—A "soluble" cutting compound*

| | | Percent |
|---|---|---|
| Emulsifiers | di butyl phenyl phenol sodium disulfonate | 3.2 |
| | sulph castor oil (75% sulph) | 12 |
| | tall oil | 12 |
| | potassium hydroxide | 1.7 |
| Coupling agents | 2 methyl 2.4 pentane diol | 1 |
| | diethylene glycol mono ethyl ether | 2 |
| | cyclohexanol | 2 |
| Catalyst— | nickel mineral sulfonate | 1 |
| Penetrant— | terpine hydrate | 1 |
| Diluent oil— | paraffinic mineral oil, 100 S. U. viscosity | 40 |
| Refractory oil— | refractory oil, having U. O. P. characterization No. 10.6 and boiling range 630–750° F. | 25 |
| Germicide— | mercury pyridinium acetate | .1 |

The ingredients were heated together ½ hour at 200° F. in a closed vessel, whereafter the composition was "adjusted" in the manner customary and well known in the art by addition of about 1–3% of either alkali, fatty acid or mutual solvent, as is empirically found to further improve emulsibility.

The product is readily emulsifiable on mild agitation with water, and is suitable for use as a soluble cutting oil, in dilutions from 1–1½ up to about 1–150, depending on the severity and nature of the machining operation in view.

*Example 3.—Grinding composition*

| | Percent |
|---|---|
| Dibutylphenyl phenol sodium disulfonate | 1 |
| Water | 9 |
| Iso propanol | 10 |
| Sodium mineral sulfonate | 50 |
| Refractory oil having U. O. P. characterization No. 10.6 and boiling range 630–750° F. | 10 |
| Mineral spirits having boiling range 350–420° F. | 20 |

The ingredients are mixed at room temperature.

The product is suitable for grinding in dilutions from 1–1 to 1–500, depending on the nature and severity of the operation.

While we prefer to employ compositions containing emulsifiers and coupling agents in sufficient proportions to render the compositions self-emulsifying, this is not necessary for the invention. For example, it is possible to obtain a composition suitable as a grinding coolant by passing the following composition, pre-mixed, through a colloid mill or a homogenizer.



*Example 4*

| | Per cent |
|---|---|
| Water | 90 |
| A refractory oil having a boiling range substantially above 600° F. and a U. O. P. characterization No. of 10.5 | 10 |

On passing through a homogenizer, this forms a milky liquid which was used as a grinding coolant, and as a coolant for cutting steel with tungsten carbide tools at a speed of 800 ft./min. The stability of the composition is enhanced if to the refractory oil is added the amount of mineral spirits necessary to give the oil phase the same specific gravity as water. This amount is usually 15 to 30% of the refractory oil, but can be readily calculated in each case from the specific gravities of the ingredients, as obvious to any skilled chemist.

The present invention can also be used in conjunction with other more recent improvements, such as, for example, the use of barium mineral sulfonate corrosion preventive as disclosed in the abandoned application, Serial No. 575,731, filed February 1, 1945, the terpene diols as disclosed in the co-pending application, Serial No. 582,495, filed March 1, 1945 (now abandoned), and particularly in conjunction with a metal machining catalyst disclosed in the co-pending application, Serial No. 575,192, filed January 29, 1945 (now abandoned).

It is thus seen that the invention is fundamentally a broad one, and is not to be restricted except by the claim, in which it is intended to cover all novelty inherent therein as broadly as possible in view of prior art.

Having thus disclosed our invention, we claim:

A self-emulsifying water dispersible coolant for contacting a grinding wheel during a grinding operation consisting essentially of from ½% to 30% of a refractory oil having a U. O. P. characterization number between 9.8 and 10.9 and a boiling point substantially about 575° F.; between 3 and 50% of a water soluble emulsifier, and between 20 and 60% of a volatile solvent selected from the group consisting of saturated aliphatic and naphthenic hydrocarbons having a boiling range substantially between 300° and 500° F.

JOHAN BJORKSTEN.
THOMAS C. CROWLEY.


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## ALLOY ADDITION AGENTS

Arthur Linz, New York, N. Y., assignor to Climax Molybdenum Company, New York, N. Y., a corporation of Delaware

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7 Claims. (Cl. 75—27)

1

The present invention relates to new and useful improvements in alloy addition agents.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the steps, instrumentalities and combinations pointed out in the appended claims.

The invention consists in the novel steps, compositions and improvements herein shown and described.

Heretofore, many different addition agents have been proposed for the addition of alloying elements, such as molybdenum, chromium, tungsten, vanadium to ferrous alloys. Among such addition agents are the ferro-metal agents, such as ferro-molybdenum and ferro-chromium, briquettes formed from the metal oxide and a reducing agents, such as ferro-silicon, silicon, aluminum, calcium silicide and other reducing metals or carbon, bound together with a binder which may be a carbonaceous material such as pitch. Many of these addition agents are relatively expensive to produce, while others introduce a relatively large amount of foreign matter into the alloy and which may appear in the finished alloy as inclusions of slag, while other addition agents give a poor recovery of the alloying metal in the finished alloy and are thus relatively expensive to use.

The present invention has for its object the provision of a novel and improved alloy addition agent which can be produced with very little expense beyond the cost of the alloying metal contained in the addition agent, does not require elaborate equipment for their production, gives good recovery of the alloying metal in the finished alloy, can be used without radical change in alloying technique, and does not result in the addition of abnormal large amounts of foreign material such as slag-forming ingredients. The invention has for a further object the provision of novel and improved alloy addition agents which are economical to produce, are economical to use, are of general application and give excellent results in use.

In accordance with the present invention the alloying addition agent comprises a proportioned mixture of an oxide of the alloying metal to be added to the ferrous alloy and a reducing agent comprising a stable form of calcium carbide, which agent may be formed into convenient briquettes by briquetting under powerful pressure with or without a carbonaceous binder,

2

or may be merely packaged in bags of convenient size or in packages and added to the molten iron or steel in the ladle or otherwise as desired. Calcium carbide, as such, is not suitable for use in such alloying addition agents as the calcium carbide contained therein is so unstable and when briquetted, there is a danger that the briquettes will explode or disintegrate due to the accumulation of gas therein caused by the decomposition of the carbide. However, the calcium carbide reducing agent may be economically and effectively protected against premature decomposition without deleteriously affecting its reducing action on the metallic oxide or the effect of the alloying addition agent as a whole on the ferrous alloy to be produced.

In accordance with the present invention this protection is afforded by treating the calcium carbide particles, whether lumps, grains or dust, with a waterproofing material which is preferably a film-forming material and is in itself a reducing agent and generally a binder of sufficient adhesive force to materially assist in holding the metallic oxide and calcium carbide in intimate contact until the reducing action takes place. The quantity of binder used is from about 1% to about 5% based on the weight of the calcium carbide, and the amount of calcium carbide is generally approximately the stoichiometric quantity required to convert the oxygen of the metallic oxide into carbonmonoxide.

Suitable stabilizing agents for the calcium carbide are crude petroleum, refined mineral oil, paraffin and other mineral waxes, drying and non-drying vegetable oils, rosin, asphalt, still pitch, all of which are film-forming and waterproofing carbonaceous materials which in themselves can serve as reducing agents of a mild kind for the metallic oxide. Other carbonaceous reducing agents which are waterproof may also be used, but I prefer to use the petroleum materials, such as crude petroleum, mineral oil or mineral wax, as these materials may be easily applied to the calcium carbide, as by spraying, to completely coat the external surfaces of the calcium carbide particles and serve to impregnate at least the outer portion of the particles sufficiently so that the particles are effectively waterproofed and thus rendered immune to the action of atmospheric moisture, even to the extent that the particles will withstand immersion in water for a considerable period without reacting with the water.

From about 1% to about 5% of the stabilizing agent is added to the calcium carbide, but I

prefer to use about 3% of the stabilizing agent and apply it to the calcium carbide by spraying it on the carbide at that rate, care being taken that the particles are substantially completely coated with the stabilizing material.

Examples of the metal oxides suitable for use in the alloy addition agents of the present invention are the various oxides of chromium, molybdenum, tungsten, vanadium, comprising the ferrous-alloying metals of the fifth, and sixth periodic groups. These oxides include the trioxide and all the lower oxides of molybdenum, the trioxide and lower oxides of chromium, tungsten trioxide and its lower oxides, and the pentoxide and the lower oxides of vanadium, some of which are not ordinarily desirable in view of their relative high cost on the basis of the metal contained in them.

Impure oxides, usually in the form of ores of the alloying metals are useful and may be mixed directly with the stabilized calcium carbide without preliminary reduction or extensive chemical treatment of the ore, the ore of course being concentrated to remove from it most or all of the mechanically separable impurities and other undesirable impurities such as sulfur. Among the natural impure oxides which are useful are the following: wolframite, scheelite, hubnerite and ferberite. Of course, many ores may contain impurities which are undesirable from one point of view or another, such as lead, sulfur, arsenic, tin and the like, and the choice of such naturally impure oxides will be determined by the effect of the impurities on the eventual alloy.

In the event that a more active reducing agent is desired than that furnished by the stabilized calcium carbide alone, a portion of the stabilized calcium carbide may be replaced with a more high active reducing agent such as silicon, ferrosilicon, aluminum, magnesium or calcium silicide the amount of such more active reducing agent being less than one-quarter of the total amount of reducing agent.

Where molybdenum trioxide is used as the metallic oxide, 144 pounds of it are mixed with about 75 pounds of the stabilized calcium carbide and preferably formed into briquettes which are added in the desired quantity to the molten iron or steel in the ladle. Under the heat of the molten metal, the oxide is reduced according to the equation:

$$MoO_3+CaC_2\rightarrow CaO+2CO+Mo$$

If molybdenum dioxide is used, 384 pounds of it are mixed with about 75 pounds of the stable calcium carbide and the reaction proceeds according to the equation:

$$3MoO_2+CaC_2\rightarrow 2CaO+4CO+3Mo$$

Using about 75 pounds of the stable calcium carbide in each of the following instances, the equations are:

Using 232 pounds of tungsten trioxide

$$WO_3+CaC_2\rightarrow CaO+2CO+W$$



Using 150 pounds of vanadium sesquioxide

$$V_2O_3+CaC_2\rightarrow CaO+2CO+2V$$

Using 166 pounds of chromite, calculated as pure $FeCr_2O_4$

$$3FeCr_2O_4+4CaC_2\rightarrow 4CaO+8CO+3Fe+6Cr$$

In each instance it will be noted that the quantity of calcium carbide is substantially the quantity needed on a stoichiometric basis to convert the metallic oxide into metal with the resulting reaction products of carbon monoxide, and lime. The carbonaceous material forming the stabilizing agent for the calcium carbide has been disregarded in the above calculations but introduces no great change in the calculations due to its relatively small quantity.

The invention in its broader aspects is not limited to the specific steps shown and described but departures may be made therefrom within the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

What is claimed is:

1. A self-reducing alloy addition agent comprising a mixture of an oxide of a metal selected from the group consisting of molybdenum, chromium, tungsten and vanadium, and calcium carbide, said particles of calcium carbide being stabilized by a coating of a waterproofing carbonaceous material which acts as a reducing agent for the metal oxide.

2. A composition as claimed in claim 1 in which the quantity of stabilized calcium carbide is approximately the quantity necessary to reduce the metal oxide with the formation of lime and carbon monoxide.

3. A composition as claimed in claim 2 in which the calcium carbide is stabilized by coating the particles with a substantially nonvolatile petroleum oil.

4. A composition as claimed in claim 1 in which the calcium carbide is stabilized by coating the particles with a substantially nonvolatile petroleum oil.

5. A composition as claimed in claim 1 in which the metal oxide is a molybdenum oxide.

6. A composition as claimed in claim 1 in which the metal oxide is a chromium oxide.

7. A composition as claimed in claim 1 in which the metal oxide is chromite.

ARTHUR LINZ.


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