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COATING COMPOSITION FOR MOLDS

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This invention relates to a new coating composition, and is primarily concerned with a method of and a composition for coating molds to reduce the surface imperfections and improve the quality of the surface of the metal body formed in the mold.

The present invention will be described more particularly in connection with ingot molds into which molten steel is teemed to produce ingots; although, as will become apparent, it is not limited necessarily to ingot molds and has other uses and purposes in steel foundry operations.

Present day rigid requirements emphasize the long-felt need for the production of ingots free from surface blemishes, such as cracks, fissures, scabs, splashes, occlusions and the like, the presence of which results in defects in the finished products. The presence of such defects in the ingot skin may result in scrapping a relatively large portion of the finished or semi-finished product made therefrom or may cause the entire ingot product to be discarded. These surface defects are at times removed by chipping or scarfing which are expensive operations. A primary cause of surface defects in an ingot is improper action of the molten metal while being teemed into the mold. The stream of molten metal may splash which results in the rapid chilling and adherence of the splashed metal to the mold surface above the body of rising molten metal. An encrustment of deoxidation products and metallics forms on the top of the molten metal and this encrustment, at times, becomes entrapped on the inside mold surface. The rising body molten metal engulfs the chilled splashed metal and entrapped bodies of encrustment which form defects in the ingot surface.

Mold dressings or washes have been applied to the surface of molds to prevent those defects which are caused, in one way or another, by an irregular mold wall condition or by improper action of the molten metal in the mold. A good mold dressing should repulse or prevent adherence of the splashed metal to the mold surface, should prevent entrapment of the encrustment in the surface layer of the ingot and should prevent adherence of the ingot to the mold surface. Different molds will vary widely in residual temperature, i. e., from atmospheric temperature to highly elevated temperatures. The mold dressing should be readily applicable to cold molds or to molds at highly elevated temperatures. The flash point should be high enough to prevent or reduce the fire hazard, and it is desirable that the dressing prevent corrosion of the mold which

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would result in undesirable roughening of the mold surface. In addition to these positive qualities the mold dressing should not form toxic fumes that are irritating or harmful to the skin or respiratory system. Further, the mold dressing should not readily break down and become ineffective or become "coky" when applied to molds at highly elevated temperatures. Any mold wash which forms undesirable residual deposits in the surface metal of the ingot is unsatisfactory.

Slaked lime, tar, pitch, graphite, and other materials have been tried as mold dressings, but for various reasons these substances have not been entirely satisfactory. Some authorities go so far as to state that in the production of high-quality steels, the use of mold washes should be avoided. Refractory materials, such as clay, lime and the like, tend to contaminate the steel, thereby increasing surface defects. Carbonaceous materials, such as tar, are conducive to recarburization of the skin of the ingot thereby increasing the tendency of cracks to form in the surface of the ingot. Pitch, among other drawbacks, does not readily lend itself to uniform application on cold molds and cannot be readily used on hot molds as it tends to form a "coky" deposit and give off obnoxious fumes. Furthermore, pitch is not entirely satisfactory from the standpoint of preventing splash adherence and the entrapment of encrustment.

There is a definite need for a good mold dressing having the above enumerated desirable properties and not having the undesirable properties more or less present in those dressings heretofore used.

We have discovered a new mold dressing which meets these many requirements of a mold dressing. Our new dressing reduces and substantially prevents both the adherence of splashed metal on the mold surface and the entrapment of encrustments in the ingot surface. The coating apparently prevents the entrapment of encrustments by forming a thin vapor shield at the juncture of the top surface of the molten metal pool and the fold wall surface to dam or hold back the body of encrustment on the top of the pool without forming sufficient turbulent vapor to disturb the skin of the ingot and thereby cause surface blemishes in the ingot. The composition does not form any apparent undesirable recarburization of the surface metal or apparent deposits in the ingot skin. Furthermore, as it will be more fully hereinafter described, our mold dressing may be readily applied to molds at very low temperatures or may be readily applied to molds at highly elevated temperatures without the formation of

toxic or harmful gases, and without the formation of an undesirable "coky" deposit. For example, we have successfully and advantageously applied our new wash to hot molds at slightly below a dull red color. The cost of coating molds, in accordance with our invention, is quite low

Our new mold coating composition comprises an emulsion of the water in oil type including certain amounts of the more fully hereinafter described pure still residue produced by the live steam distillation of the sulphuric acid-washed light oil fraction of coke gas and includes carbon and a glycol. Any emulsifying agent may be added to maintain the emulsion, although, as hereinafter pointed out, we prefer to use a higher fatty acid selected from a limited group of such acids.

The pure still residue, which we use, is the residue obtained from the live steam distillation of primary light oil in which the polymerizable unsaturates have been subjected to a polymerization treatment and from which the major portion of these unsaturates have been removed by separation of the heavy sludge layer which forms when the unsaturates are polymerized. The primary light oil is a product obtained by scrubbing raw coke oven gas with a petroleum absorbent oil. The primary light oil is removed from the absorbent oil by stripping with live steam and the condensed vapor is separated by decantation to remove the water of condensation from the light oil. The resulting primary light oil consists of a mixture of aromatic hydrocarbons including benzene, toluene, xylene, trimethylbenzene, other alkylbenzenes and napthalene. It also contains relatively smaller amounts of olefines up to and including heptane or octane, some di-olefines such as cyclopentadiene and cyclohexadiene and various sulphur compounds including CS_2. There are also present some of the more complex unsaturates including styrene, coumarone and indene.

The treated light oil is produced by agitating the primary light oil with sulphuric acid. The acid tends to cause polymerization of the unsaturated compounds and most of them are extracted along with other impurities by the separation of the heavy sludge layer which forms and is drawn off and discarded. Any residual acid in the washed light oil is neutralized by agitating the oil with an aqueous alkaline solution such as a sodium hydroxide solution which is thereafter separated from the oil by decantation. The resulting treated light oil includes the aromatic hydrocarbons mentioned above along with some resinous polymerized unsaturates and other impurities. After being washed, the light oil is subjected to the action of live steam in a distillation column which vaporizes and removes most of the aromatic hydrocarbons. In one method, the live steam at a pressure of 115 pounds per square inch and a temperature of about 415° F. is admitted to the base of the column and the temperature of the vapors passing from the column is about 214° F. The pure still residue which is not vaporized is drawn off from the base of the distillation column. This residue is an emulsion of polymerized resinous material dissolved in or admixed with other hydrocarbon material including some higher boiling aromatics, such as napthalene and trimethylbenzenes. The exact chemical nature of this residue is not fully understood and will vary, especially in water content. The action of the live steam during distillation does produce a product different from that

obtained by other usual methods of distillation where the steam does not come into direct contact with the materials being distilled.

For purposes of brevity, this pure still residue produced as described above, will hereinafter be referred to in the specification as "residue." The term "treated light oil" means primary light oil which has been subjected to a treatment that tends to polymerize the polymerizable unsaturates and from which the major portion of these unsaturates have been removed by separation of the heavy sludge layer which forms as a result of the polymerization treatment.

This residue includes water and other volatile matter which is removable by distillation at or slightly above 212° to 214° F. The remaining solids portion hereinafter referred to as "solids," is a relatively viscous substance. It has been found that this volatile fraction includes some ingredient or ingredients besides water which are quite essential in producing a satisfactory mold wash, for equivalent results are not obtainable by re-emulsifying the solids with water. This residue may be used when containing from 30% to 85% by weight of solids and may be used in amounts ranging from 50 to 85 parts by weight. When the percentage of solids falls within the lower portion of this range, it is preferable to use a relatively larger quantity of residue. For example, when the residue contains from 30% to 50% solids, better results are obtained when 60 to 85 parts by weight of residue are used and when the residue contains from 50% to 85% of solids, better results are obtained when using from 50 to 65 parts by weight of residue. We prefer to use 50 to 65 parts by weight of residue containing from 50% to 65% by weight of solids for optimum results. From the foregoing, it will be apparent that the residue is an oil and water emulsion. Accordingly it will be understood that the use of the term "residue" herein is meant to define an oil and water emulsion in which the oil content is the above-mentioned "treated light oil."

Our mold dressing contains a glycol such as ethylene glycol, diethylene glycol, propylene glycol, trimethylene glycol or triethylene glycol, or mixtures thereof. The glycol serves two important purposes: it reduces the freezing point of the emulsion so that dressing may be applied to cold ingot molds which have been subjected to winter atmospheric conditions and also apparently acts to neutralize the sulphur present in the residue so that when the dressing is applied to hot molds, the gases evolved are non-toxic and non-irritating to the skin and respiratory system. Furthermore, the glycol, in its apparent roll of desulphurizer, prevents the undesirable effects normally produced by the presence of sulphur. A glycol may be employed in an amount ranging from 1½ to 8 parts by weight.

Finely divided carbon is added to the mold dressing to improve the mold wall preservative features and to facilitate ingot removal from the ingot mold. Good results are obtained when using carbon in an amount between about 5 to 25 parts by weight, although we prefer to use from 10 to 20 parts by weight of carbon. Carbon particles which will pass through a 100 mesh screen may be used though carbon of finer physical particle size is preferred.

An emulsifying agent is preferably added as an aid in preventing breaking of the emulsion and segregation of the constituents. Although any emulsifying agent may be used, we prefer

to use a higher fatty acid selected from a group consisting of palmitic, oleic, linolenic and linoleic acids, or mixtures thereof. These acids are preferred as they do not break down to form obnoxious fumes when applied to hot molds and as somewhat better results are obtained when the residue emulsion is very slightly acid. About 1½ to 4 parts by weight of acid produces good results.

Other ingredients which do not harmfully affect the coating composition may be added, for example, solvent "cutbacks" for the residue such as an aromatic hydrocarbon oil having a flash point preferably above 100° F. may be added. The primary purpose of such "cutbacks" is to increase the fluidity of the coating composition by lowering the viscosity of the residue. Masking agents which modify the odor may be added if desirable.

The following examples in which all parts are by weight serve to illustrate our invention without limiting it to the exact ingredients or proportions set forth except as stated:

Example 1

A mold dressing was prepared as follows:

	Parts
Residue (83% solids)	60.0
Oleic acid	2.35
Carbon suspension	12.0
Ethylene glycol	2.35
Water	18.0

The carbon suspension is an alkaline, aqueous suspension of colloidal graphite containing about 50% graphite. An emulsion of these ingredients was prepared and applied to the ingot mold. The ingots produced in these molds were compared with ingots produced in uncoated molds and with ingots produced in molds coated with pitch. The ingots from those molds coated with this composition were much better than those produced in either the uncoated molds or the pitch-coated molds.

Example 2

A mold dressing was prepared as follows:

	Parts
Residue (56% solids)	54.0
Oleic acid	3.0
Finely divided graphite	17.0
Ethylene glycol	2.5
"Cutback"	24.0

This "cutback" is an aromatic hydrocarbon oil having a flash point of about 100° F. and is a solvent for the residue. It is available on the market under the trade-mark "Tar Treet." An emulsion of these ingredients was prepared by first preparing a mixture of tar residue, "cutback," and oleic acid, and then adding the water. A second mixture of the graphite and ethylene glycol was prepared and then added to the residue, oleic acid and water mixture.

Example 3

A mold dressing was prepared as follows:

	Parts
Residue (34% solids)	78.0
Oleic acid	2.75
Finely divided graphite	7.5
Ethylene glycol	2.75
Water	

An emulsion of these ingredients was prepared as described in Example 2.

Example 4

A mold dressing was prepared as follows:

	Parts
Residue (34% solids)	70.0
Oleic acid	2.5
Finely divided graphite	16.5
Ethylene glycol	2.5
Water	

An emulsion of these ingredients was prepared as described in Example 2.

Example 5

A mold dressing was prepared as follows:

	Parts
Residue (34% solids)	62.0
Oleic acid	2.5
Finely divided graphite	16.5
Ethylene glycol	2.5
Water	

An emulsion of these ingredients was prepared as described in Example 2.

The coating compositions of Examples 2, 3, 4 and 5 were applied to ingot molds and the characteristics of the ingots cast in these molds were compared with the surface characteristics of ingots cast in uncoated molds and in pitch-coated molds. In all cases the molds coated with any one of the above compositions produced the best results. The coating compositions made in accordance with Examples 2 and 3 produced better results than those compositions prepared according to Examples 4 and 5.

The coating composition of the present invention may be readily applied to molds which are at a low temperature, although in normal practice it is preferable to cast steel into ingot molds having a residual temperature of 200° F. or higher. The present coating compositions may be applied to hot molds. The gases evolved when the coating composition is applied to hot molds are non-toxic, non-irritating to the skin and do not possess such characteristics as would result in respiratory complications. Carbon dioxide, water vapor and a little hydrogen are also present but in much smaller concentrations than possible under any circumstances with powdered pitch. The deposits do not become "coky." In addition to being a good mold dressing in that our composition reduces the surface blemishes of the ingots, it also inhibits or prevents corrosion of various metals, and may, if desirable, be used as a protective coating.

We claim:

1. A new composition of matter for use as a mold wash or mold dressing in casting ferrous metal shapes composed of an oil and water emulsion composed essentially of 50 to 85 parts by weight of the still residue obtained from the live steam distillation of the sulphuric acid treated light oil fraction of coke gas, the still residue containing from 30% to 85% by weight of material not volatile at a temperature of about 212° to 214° F., 5 to 25 parts by weight of finely divided carbon and 1½ to 8 parts by weight of a glycol.

2. A new composition of matter for use as a mold wash or mold dressing in casting ferrous metal shapes composed of an oil and water emulsion composed essentially of 50 to 85 parts by weight of the still residue obtained from the live steam distillation of the sulphuric acid treated light oil fraction of coke gas, the still residue containing from 30% to 85% by weight of ma-

terial not volatile at a temperature of about 212° to 214° F., 5 to 25 parts by weight of finely divided carbon, 1½ to 8 parts by weight of a glycol and 1½ to 4 parts of an acid selected from a group consisting of palmitic acid, oleic acid, linolenic acid and linoleic acid.

3. A new composition of matter for use as a mold wash or mold dressing in casting ferrous metal shapes composed of an oil and water emulsion composed essentially of 50 to 65 parts by weight of the still residue obtained from the live steam distillation of the sulphuric acid treated light oil fraction of coke oven gas, the still residue containing from 50% to 65% by weight of material not volatile at a temperature of about 212° to 214° F., 5 to 25 parts by weight of finely divided carbon, about 1½ to 8 parts by weight of a glycol and about 1½ to 4 parts of an acid selected from a group consisting of palmitic acid, oleic acid, linolenic acid and linoleic acid.

4. A new composition of matter for use as a mold wash or mold dressing in casting ferrous metal shapes composed of an oil and water emulsion composed essentially of 60 to 85 parts by weight of the still residue obtained from the live steam distillation of the sulphuric acid treated light oil fraction of coke oven gas, the still residue containing from 30% to 50% by weight of material not volatile at a temperature of about 212° to 214° F., 5 to 25 parts by weight of finely divided carbon, about 1½ to 8 parts by weight of a glycol, and about 1½ to 4 parts of an acid selected from a group consisting of palmitic acid, oleic acid, linolenic acid and linoleic acid.

5. A new composition of matter for use as a mold wash or mold dressing in casting ferrous metal shapes composed of an oil and water emulsion composed essentially of 50 to 65 parts by weight of the still residue obtained from the live steam distillation of the sulphuric acid-washed, primary light oil fraction of coke oven gas, the still residue containing from 50% to 65% by weight of material not volatile at a temperature of about 212° to 214° F., 10 to 20 parts by weight of finely divided carbon, about 1½ to 8 parts by weight of a glycol, and about 1½ to 4 parts of an acid selected from a group consisting of palmitic acid, oleic acid, linolenic acid and linoleic acid.

6. A new composition of matter for use as a mold wash or mold dressing in casting ferrous metal shapes composed of an oil and water emulsion composed essentially of 50 to 85 parts by weight of the still residue obtained from the live steam distillation of the sulphuric acid-washed, primary light oil fraction of coke oven gas, the still residue containing from 30% to 85% by weight of material not volatile at a temperature of about 212° to 214° F., 5 to 25 parts by weight of finely divided carbon, about 1½ to 8 parts by weight of ethylene glycol, and about 1½ to 4 parts of an acid selected from a group consisting of palmitic acid, oleic acid, linolenic acid and linoleic acid.

7. A new composition of matter for use as a mold wash or mold dressing in casting ferrous metal shapes composed of an oil and water emulsion composed essentially of 50 to 85 parts by weight of the pure still residue obtained from the live steam distillation of the sulphuric acid-washed, primary light oil fraction of coke oven gas, the still residue containing from 30% to 85% by weight of material not volatile at a temperature of about 212° to 214° F., 5 to 25 parts by weight of finely divided carbon, about 1½ to 8 parts by weight of a glycol and about 1½ to 4 parts of oleic acid.

8. A new composition of matter for use as a mold wash or mold dressing in casting ferrous metal shapes composed of an oil and water emulsion composed essentially of 50 to 65 parts by weight of the pure still residue obtained from the live steam distillation of the sulphuric acid-washed, primary light oil fraction of coke oven gas, the still residue containing from 50% to 65% by weight of material not volatile at a temperature of about 212° to 214° F., 10 to 20 parts by weight of finely divided carbon, about 1½ to 8 parts by weight of ethylene glycol, and about 1½ to 4 parts of oleic acid.

9. A new composition of matter for use as a mold wash or mold dressing in casting ferrous metal shapes composed of an oil and water emulsion composed essentially of about 60 parts by weight of the pure still residue from the live steam distillation of the sulphuric acid-washed, primary light oil fraction of coke gas, the still residue containing about 83% by weight of material not volatile at a temperature of about 212° to 214° F., about 6 parts by weight of finely divided graphite not larger than 100 mesh, about 2.35 parts by weight of ethylene glycol and about 2.35 parts by weight of oleic acid.

10. A new composition of matter for use as a mold wash or mold dressing in casting ferrous metal shapes composed of an oil and water emulsion composed essentially of about 54 parts by weight of the pure still residue from the live steam distillation of the sulphuric acid-washed, primary light oil fraction of coke gas, the still residue containing about 56% by weight of material not volatile at a temperature of about 212° to 214° F., about 17 parts by weight of finely divided graphite not larger than 100 mesh, about 2.5 parts by weight of ethylene glycol and about 3 parts by weight of oleic acid.

11. A new composition of matter for use as a mold wash or mold dressing in casting ferrous metal shapes composed of an oil and water emulsion composed essentially of about 78 parts by weight of the pure still residue from the live steam distillation of the sulphuric acid-washed, primary light oil fraction of coke gas, the still residue containing about 34% by weight of material not volatile at a temperature of about 212° to 214° F., about 7.5 parts by weight of finely divided graphite not larger than 100 mesh, about 2.75 parts by weight of ethylene glycol and about 2.75 parts by weight of oleic acid.

12. An ingot mold coated with a composition consisting essentially of an emulsion of oil and water composed essentially of 50 to 85 parts by weight of the pure still residue from the live steam distillation of the treated light oil fraction of coke oven gas, the still residue containing from 30% to 85% by weight of material not volatile at a temperature of about 212° to 214° F., 5 to 25 parts by weight of finely divided carbon, and 1½ to 8 parts by weight of a glycol.

13. An ingot mold coated with a composition consisting of an emulsion of oil and water composed essentially of 50 to 85 parts by weight of the pure still residue from the live steam distillation of the sulphuric acid-washed, primary light oil fraction of coke oven gas, the still residue containing from 30% to 85% by weight of material not volatile at a temperature of about 212° to 214° F., 5 to 25 parts by weight of finely divided carbon, 1½ to 8 parts by weight of a glycol and 1½ to 4 parts of an acid selected from a

group consisting of palmitic acid, oleic acid, linolenic acid and linoleic acid.

14. An ingot mold coated with a composition comprising an emulsion of oil and water composed essentially of 50 to 65 parts by weight of the pure still residue from live steam distillation of the sulphuric acid-washed, primary light oil fraction of coke oven gas, the still residue containing from 50% to 65% by weight of material not volatile at a temperature of about 212° to 214° F., 5 to 25 parts by weight of finely divided carbon, about 1½ to 8 parts by weight of a glycol and about 1½ to 4 parts of an acid selected from a group consisting of palmitic acid, oleic acid, linolenic acid and linoleic acid.

15. An ingot mold coated with a composition comprising an emulsion of oil and water composed essentially of 60 to 85 parts by weight of the pure still residue from the live steam distillation of the sulphuric acid-washed, primary light oil fraction of the coke oven gas the residue containing from 30% to 50% by weight of material not volatile at a temperature of about 212° to 214° F., 5 to 25 parts by weight of finely divided carbon, about 1½ to 8 parts by weight of a glycol, and about 1½ to 4 parts of an acid selected from a group consisting of palmitic acid, oleic acid, linolenic acid and linoleic acid.

16. An ingot mold coated with a composition comprising an emulsion of oil and water composed essentially of 50 to 65 parts by weight of the pure still residue from the live steam distillation of the sulphuric acid-washed, primary light oil fraction of coke oven gas, the still residue containing from 50% to 65% by weight of material not volatile at a temperature of about 212° to 214° F., 10 to 20 parts by weight of finely divided carbon, about 1½ to 4 parts by weight of a glycol, and about 1½ to 4 parts of an acid selected from a group consisting of palmitic acid, oleic acid, linolenic acid and linoleic acid.

17. An ingot mold coated with a composition comprising an emulsion of oil and water composed essentially of 50 to 65 parts by weight of the pure still residue from the live steam distillation of the sulphuric acid-washed, primary light oil fraction of coke oven gas the still residue containing from 50% to 65% by weight of material not volatile at a temperature of about 212° to 214° F., 10 to 20 parts by weight of finely divided carbon, about 1½ to 8 parts by weight of ethylene glycol, and about 1½ to 4 parts of oleic acid.

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