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COMPOSITION FOR MANUFACTURE OF SAND CORES

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The present invention relates to an improved composition for the manufacture of sand cores, and the like, for the casting of metal. It relates, particularly, to a so-called "core oil" or binder of the type which is used to form sand cores for the casting of hollow metal products. As the sands used for core manufacture have no natural binding property, it is necessary to introduce into the sand a binder. This binder is mechanically mixed with the sand that is to make up the core prior to core formation.

As is well known in the art, in the manufacture of hollow castings, such as steam radiators, automotive engine blocks, and the like, considerable skill is necessary in preparing sand cores of appropriate structural properties. The binder must mix well with the sand, coating the sand particles so the core is of uniform density. The binder must not create a sticky condition which would gum up the core molding boxes and it must not cause the core to swell or crack in baking or in storage. The binder must not absorb moisture from the atmosphere after it has been set in the mold waiting for the metal to be poured. Further, the binder must impart sufficient bond strength to the core before it is baked to permit manual handling. The binder must also permit easy removal of the sand core from its mold prior to baking.

During baking, the binder must oxidize and polymerize to yield a sand core having sufficient tensile strength to withstand the weight of metal when the casting is poured and also sufficient strength to resist ordinary handling in the foundry, both before and after baking. Also, the binder must decompose when the metal is poured. With a proper binder, when the casting is cooled, the core sand can be easily broken up and shaken free from the casting. These last two characteristics are in essential opposition to each other and require careful balancing of the ingredients in any core oil or sand binder.

In the prior art, it has been common to use various compositions comprising linseed oil, fish oil, and other fatty, vegetable and animal oils, along with modifiers of various types in the formation of sand cores for metal castings. These oils have been chosen since, during baking, they combine with oxygen in the air and are converted into a strong binder cementing the grains of sand to each other yielding a firm hard sand core. Commonly, such cores are baked with an optimum amount of the core oil binder, the preferred compositions having the property of polymerizing to a moderate extent to serve as a binder.

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Baking is conventionally carried out in a ventilated oven at moderately high temperatures, e. g., between 350° and 600° F. At such temperatures, volatile constituents of the core oil or binder are removed but the residue polymerizes or thickens without undue charring to bind the sand into a fairly strong and firm structure.

To facilitate this oxidation and polymerization, it is common in the prior art to add the soaps of lead, manganese and/or cobalt to the binder to accelerate polymerization. This action is well known and is similar to the employment of these additives in the manufacture of linseed oil paints.

Later, when the actual casting takes place, the molten metal temperature is quite high, ranging from 1200° F. for aluminum to approximately 3000° F. for iron. The temperature of the metal and the nature of the binder are preferably such that the binder breaks down immediately after the metal is formed and the sand can be freely shaken out of the cast metal product.

It has also been known in the prior art that certain hydrocarbon polymers, such as those obtained by clay filtering of cracked gasoline, have desirable properties for use in core oils, paints and varnishings. For example, the patent to Chittick, No. 1,891,079, suggests the use of such a polymer in a core oil with addition of a drying oil for such purposes. It has also been suggested that such hydrocarbon polymers may be combined with a fish oil which polymerizes moderately at the baking temperature and breaks down at casting temperature to permit ready removal of the sand core.

Linseed oil, soyabean oil, fish oil and related animal and vegetable oils having drying characteristics have been used in various proportions with and without the hydrocarbon polymers mentioned above.

An example of this prior art type of core oil is as follows:

	Per cent by weight
Raw linseed oil.....	20
Sardine oil.....	20
Clay filtered polymer from cracked gasoline..	45
Kerosene	15

The present invention is based upon the discovery that the properties of core oils or binders may be improved and, at the same time, their cost may be reduced in many cases by using a relatively inexpensive mineral oil of appropriate viscosity to modify the baking characteristics of the compositions of the prior art. According to the present invention, the tensile strength of the

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core oils after baking, and prior to casting, may be substantially increased by the used of about 5 to 30% by weight, based on the total composition, of a relatively viscous mineral oil, preferably one of a fairly heavy lubricating grade. Such oils should have a viscosity between 100 and 500 S. S. U. at 210° F. A viscosity range of about 100 to 300 S. S. U. is ordinarily quite satisfactory and oils having a viscosity in the neighborhood of 200 S. S. U. at 210° F. are particularly preferred.

Three types of high viscosity mineral oils have been found suitable. However, it is not intended to limit the present patent to these but they are given as examples of the products most suitable. The physical characteristics of these three preferred products appear below:

	Oil A	Oil B	Oil C
Specific Gravity at 60° F.-----	.9194	.9471	.9895
Flash Point, ° F.-----	530	540	470
Pour Point, ° F.-----	+10	+15	+50
S. S. U. at 100° F.-----	5,345	9,537	45,000
S. S. U. at 210° F.-----	200	251	253
Aniline Point, ° F.-----	200	180	120

Oil A is typical of a propane deasphalted, treated, dewaxed residuum from naphthenic crude commonly referred to as Coastal bright stock.

Oil B is the solvent, e. g., phenol extract obtained from processing a paraffinic type lubricating oil stock in the production of aviation motor oil.

Oil C is obtained by the solvent (phenol) extraction of a medium viscosity lubricating stock of naphthenic type in the production of an extracted motor oil. It will be understood that any of the above oils may have other oil components blended therewith, but preferably the oil used is primarily of one of these types.

According to the present invention, a drying oil, such as raw linseed oil, soyabean oil, or both, is combined with an unsaturated fatty oil, preferably a fish oil such as sardine oil, either with or without the presence of wood rosin or esterified tall oil.

To the drying oil and fish oil products described above, which comprise 30 to 50% or more of the total weight of the composition, are added from about 15 to 35% of the hydrocarbon polymer obtained by clay filtering of steam cracked gasolines, preferably 25 to 35%, and from 5 to 30% of the mineral oil mentioned above.

One such polymer is derived from the steam cracking of gasoline at high temperature and low pressure, e. g., at a temperature of the range of 1100° F. to 1300° F. This product is a very viscous, semi-solid, highly unsaturated plastic material. The product is well known in the petroleum industry and has been unofficially designated CTLA polymer.

While the polymer may be derived in various ways from gasoline refining processes, one preferred method is to filter the gasoline through clay and then to extract the polymer deposited on the clay with a light solvent, such as butane, propane, or the like, after which the solvent, of course, is evaporated and the residue of fairly high molecular weight and of consistency from heavy viscous to solid is used as the polymer constituent of the binder.

Any of the previously mentioned types of mineral oils may be used as the modifiers for enhancing the strength of the core after baking. They improve the essentially brittle nature

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of the polymers which remain after baking. At the same time, the presence of the oil does not yield a core which breaks up with difficulty following the pouring of the metal. The product is such that the oil is sufficiently non-volatile to remain as a plasticizer during the baking operation, but it decomposes with the rest of the binder under the influence of the higher temperature of the poured metal. The presence of the high viscosity mineral oil permits in some cases at least, reduction in the more expensive fish oil and linseed oil components permitting even greater use of the petroleum polymers which are less expensive but per se are distinctly brittle in nature after baking. Oil C in the example previously given is preferable for use when high concentrations of petroleum polymers are used. During manufacture, this oil seems to blend better with the other constituents, possibly due to its lower aniline point, and during baking it yields cores of superior tensile strength and resistance to breaking.

The invention will be more particularly understood by reference to the following specific examples:

Example I

21.60% by weight raw linseed oil
21.70% soyabean oil
25.00% wood rosin
21.70% sardine oil
10.00% oil A (above)

This core oil yielded satisfactory cores when oil A was present but without the addition of it, gave brittle cores.

Example II

17.50% by weight raw linseed oil
17.50% sardine oil
43.75% clay filtered polymer from cracked gasoline
16.25% oil C (above)

Here again, the presence of the oil is necessary to secure cores that are not entirely brittle and which, at the same time, break up freely after metal pouring.

Example III

39.00% by weight of raw linseed oil
17.50% sardine oil
30.00% clay filtered polymer from cracked gasoline
12.57% oil A (above)
0.42% lead linoresinate (30%)
0.31% manganese linoresinate (8%)
0.20% cobalt resinates (3% cobalt oxide)

In this case, the presence of the petroleum oil plasticizer in no way interferes with the behavior of the metallic driers, and yields cores of adequate strength which are not friable. In this example, the linseed oil content was increased and the hydrocarbon polymer reduced, as compared with the prior art product previously referred to. The baked core was distinctly superior in strength after baking, and still broke up easily after casting. Considerably less linseed oil may be used with entirely satisfactory results, as in Example II, or it may be eliminated altogether as in Example IV.

Example IV

25.00% by weight of sardine oil
25.00% soyabean oil
40.00% esterified tall oil
9.50% oil B (above)
0.50% pine oil

In this case, tall oil replaced the petroleum gasoline polymer and the oil plasticizer still serves its intended purposes of minimizing brittleness in baked cores. The small amount of pine oil contributes an agreeable element to the odor of the binder before and during baking.

The use in Example IV of high boiling mineral oil, preferably lubricating oil extract, as a plasticizer, prevented crumbling and did not materially reduce ultimate strength.

It should be emphasized that the core oil of the present invention provides a more durable sand core, because of the plasticizer used, but does not interfere with the breaking up and ready removal of the sand core after casting.

It will be understood that various modifiers known to the prior art may be used in small proportions without departing from the present invention. Such modifiers in small quantities, usually less than 1%, as cobalt, manganese and lead driers, have been quite useful, as suggested above, and the invention contemplates their inclusion when desirable. The proportions of the various ingredients may be varied within the limits previously set forth, preferred proportions being about 25 to 35% by weight of the hydrocarbon polymer, or as much as 50% in some cases where strength is not quite so critical, 10 to 15% of the viscous mineral base oil and 15 to 22% each of soyabean oil, raw linseed oil and fish oil, such as the sardine oil. The proportions of the last three ingredients may be varied very widely since they are roughly equivalent to each other in respect to polymer formation and drying characteristics. For many reasons, one or more of the three drying oils last mentioned can be eliminated entirely, being replaced by larger proportions of one or more of the other retained ingredients. It is generally preferred, however, that at least two drying oils, in total proportions of 30 to 50% by weight, based on the entire composition be used. The cracked gasoline polymer or equivalent resinous material may be replaced partly or entirely by wood rosin or any substantially hydrocarbon resin or polymer which will retain substantial tensile strength after baking (350° to 600° F.), but will quite fully disintegrate at metal casting temperatures of 1200° to 3000° F. or so.

What is claimed is:

1. A core oil composition comprising about 30 to 50% by weight, based on the total composition, of drying oil, 15 to 35% of an unsaturated clay-filtered polymer of cracked gasoline derivation and 5 to 20% by weight of a viscous mineral oil of at least 100 and not more than 500 S. S. U. viscosity of 210° F.

2. A core binder composition comprising at least 30% of drying oil, 15 to 35% by weight of the hydrocarbon polymer obtained by filtering cracked gasoline and 5 to 20% by weight, based on the total composition, of a viscous mineral oil

having a viscosity of about 100-500 S. S. U. at 210° F. as a plasticizer.

3. Composition according to claim 2 wherein the plasticizer is a lubricating oil extract.

4. Composition according to claim 2 wherein the plasticizer is a naphthenic lubricating oil extract of between 100 and 300 S. S. U. viscosity.

5. Composition according to claim 2 wherein the plasticizer is an oil of about 200 S. S. U. viscosity.

6. A binding material for sand casting cores, and the like, consisting essentially of 25 to 35% by weight of the hydrocarbon polymer obtained by clay filtering of steam-cracked gasoline, 10 to 15% of a mineral base oil of 100 to 300 S. S. U. viscosity at 210° F. and at least two of the following: 15 to 22% soyabean oil, 15 to 22% sardine oil and 15 to 22% raw linseed oil.

7. A binding material for sand cores, and the like, consisting essentially of the following ingredients by approximate weight:

19.00% raw linseed oil
18.75% soyabean oil
18.75% sardine oil
29.93% clay-filtered polymer from cracked gasoline
12.28% mineral oil of about 200 S. S. U. viscosity at 210° F.

8. A core oil consisting essentially of a total of 30 to 50% by weight of one to three drying oils selected from the group consisting of linseed oil, soyabean oil and fish oil, 15 to 35% of a hydrocarbon polymer obtained by filtering cracked gasoline, which polymer retains substantial tensile strength at baking temperatures up to 600° F., and 5 to 20% of a mineral base lubricating oil of at least 100 and not over 500 S. S. U. viscosity at 210° F.

9. Composition according to claim 8 wherein said mineral base oil is primarily a Coastal bright stock.

10. Composition according to claim 8 wherein said mineral base oil is primarily a solvent extracted paraffinic oil.

11. Composition according to claim 8 wherein said mineral base oil is primarily a solvent extracted naphthenic oil.

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