United States Patent [15] **3,666,706**
Hespers [45] **May 30, 1972**

[54] SUBSTITUTE FOR COAL DUST IN CASTING MOLDS AS LUSTROUS CARBON-FORMING ADDITIVE

[72] Inventor: **Winfried Hespers,** Bielefeld, Germany
[73] Assignee: **Ravensberger Eisenhutte Reinshagen & Vogt,** Bielefeld, Germany
[22] Filed: **Nov. 6, 1969**
[21] Appl. No.: **870,553**

[30] **Foreign Application Priority Data**

Nov. 7, 1968 Germany ....P 18 07 453.8
Oct. 17, 1969 Germany ....P 19 52 357.0

[52] **U.S. Cl.** ....**260/29.6 XA,** 260/29.6 R, 260/DIG. 40
[51] **Int. Cl.** **C08f 45/24**
[58] **Field of Search** ....260/29.6 XA, 29.6 R, 41 R, 260/DIG. 40, 29.6 RU; 106/38.6; 164/43

[56] **References Cited**

UNITED STATES PATENTS

2,857,355	10/1958	Iler	260/29.6 XA
2,988,525	6/1961	Clem	106/38.6 R
3,005,244	10/1961	Erdle et al.	22/129 R
3,467,165	9/1969	Angeloff	164/43 R

Primary Examiner—Harold D. Anderson
Attorney—Ely, Golrick & Flynn

[57] **ABSTRACT**

A non-foamed, unsubstituted hydrocarbon polymer in finely divided form, of particle size less than 0.3 mm in amounts of 0.5 to 3 percent provides the lustrous or glance carbon forming constituent in place of coal dusts in a foundry molding sand composition with 6 to 8 percent bentonite as binder.

10 Claims, No Drawings

SUBSTITUTE FOR COAL DUST IN CASTING MOLDS AS LUSTROUS CARBON-FORMING ADDITIVE

Hitherto additions of mineral coal dust have been made to natural or synthetic quartz type foundry sands in the preparation of casting molds, in order to improve the surface quality of the castings obtained.

This admixture of coal dust is made in the expectation that, in similar manner to what occurs with blacking of molds, through its gasification upon pouring and the enveloping or coating of the quartz grains with lustrous carbon deposited from the gas phase and having a very low wettability by molten cast iron, a burning of the sand into the casting will be avoided and accordingly there will be produced a smooth and clean cast surface. It was also discovered that the use of mineral coal dust in molding sand contributes to compensation of sand expansion and to the avoidance of sand-originated defects.

Such use of coal dust in foundry molding sand, up to the present time, has been judged quite diversely by the technical people concerned. Thus the specifications worked out by the foundry industry prescribe that a mineral coal dust intended for use in molding sand shall not contain peat, brown coal, wood flour or the like; while on the other hand it was already proposed that stone coal dust be replaced by brown coal dust.

In the preparation of foundry cores, it is a known practice to add finely pulverized pitch as a binder for the core sand. In order to extend the finely divided pitch and to minimize its otherwise unfavorable characteristic of perhaps caking or agglomerating during storage, it has been proposed to mix in the very finely powered pitch, substances such as clay, cement, chalk, gypsum, blast furnace dust or brown coal dust, as thinning or anti-caking agents.

Under the temperature of the cast metal, diverse coal dusts form lustrous carbon, to an extent, however, of only about 10 percent conversion, so that considerable amounts of the dust are necessary to form sufficient lustrous carbon. To increase the yield of lustrous carbon special synthetic coal dusts have been developed, which, however, again produced only from 15 percent to at most 20 percent lustrous carbon.

In order to obtain sufficient lustrous carbon in the casting mold body, the aforedescribed carbon-containing additives must be added to the foundry sand in a comparatively great amount, thus amounts of from 5 to 10 percent. Since these are also hygroscopic and thus withdraw water from the foundry sand and from the binder, to compensate therefor the molding composition must have on the whole a comparatively high water content. However, the high water content is again deleterious in the molding composition.

A further disadvantage of the carbon-containing additions based upon mineral coals or pitch is that their sulfur content diminishes the binding capacity of the clays, especially bentonite, used as binders, so that a higher amount of binding agent likewise is necessary. This again is disadvantageous, since thereby the gas permeability of the mold composition is diminished. A further disadvantage of the sulfur content of the coal dusts is that subsequent enameling of the casting is made more difficult.

Such previously used carbon-containing additives, because of the high percentage required in molding sand compositions, could be used only in the production of castings from gray iron or iron alloys with a high carbon content; for in consequence of the carburizing or cementation of the casting, such additives are badly suited to mold compositions intended for preparation of steel casting molds.

To increase the gas permeability of molds and cores made with the usual molding mixtures, it has been proposed to add synthetic plastic foam particles, particularly of polystyrene foam. Increased gas permeability results, since these foam particles have a high specific volume, that is, a large volume with small weight, and serve as spacers between the individual quartz grains. Use of such foam particles has, however, the disadvantage that the comparatively great spacing between the quartz grains results in penetration of the liquid metal into the core or mold cavity surfaces, which can only be impeded through black washing the surface of the core or the mold cavity. Hence in combination with these expedients it was proposed to fire burn the cores or molds so that the pores arising are filled thereafter by the black wash.

Such addition of foam particles to a molding composition does not serve to form the required lustrous carbon layer. Because the synthetic foam particles are present in the form of flocks, they cannot form a coherent lustrous carbon layer, but rather in consequence of their unequal distribution at best only individual specks of lustrous carbon can be formed.

The prior hydrocarbon-containing additives, whether coal dusts or foamed synthetic plastic particles, are not suited for use in the very advantageous high pressure molding process, but hitherto have led to difficulties in practice because large admixed amounts of coal dusts, in combination with the likewise required high additions of bentonite, lead to mold spring back as does also the use of foam particles. Further the coal dust content in combination with large amounts of bentonite and the high water content then required, diminish the fluidity of the molding sand composition for high pressure mold forming and the presence of the foam particles does likewise.

The general object of the invention is to provide a substitute for coal dusts as an additive to foundry sand for the formation of lustrous carbon in casting molds and cores, which substitute will not exhibit all of the aforementioned disadvantages of coal dust or other additives, and which in contrast to the hitherto proposed materials is outstanding through other advantageous characteristics and in particular need be added to the molding sand composition in only comparatively small amounts.

For the attainment of this object, as an additive to molding sand compositions comprised of natural or synthetic molding sands with conventional binders, in substitution for the coal dusts for the formation of lustrous carbon in casting molds, the present invention proposes as the additive a thermoplastic synthetic plastic in unfoamed form comprised of a non-substituted polymerized hydrocarbon in a particle size of less than 0.5 mm, preferably less than 0.3 mm, and in the molding sand mixture amount to about 0.5 to 3 percent, advantageously a content of 0.5 to 2 percent, by weight.

More particularly, there is used a non-substituted comparatively highly pure hydrocarbon, that is, one not including other elements as, for example, bromine, chlorine, sulfur, fluorine or like substances, which exert a harmful influence on the binder for the molding sand, or on the surface of the metal casting to be obtained in the mold.

Especially advantageously are used the polymers of styrene $(C_6H_5CH=CH_2)$ or of ethylene $(CH_2=CH_2)$ or propylene $(CH_3—CH=CH_2)$ or a mixed polymerizate of these compounds.

The additive of the invention does not serve as a binder in molding compositions, but merely for formation of lustrous carbon coatings to envelope the quartz grains in the mold.

The additive of the invention serves also as a substitute for the coal dust in the so-called black washes which are painted on or sprayed on the casting mold surfaces.

Since the additive here proposed will have a particle size of less than 0.5 mm, it can accordingly be introduced fine slurry as a mold slime material. Accordingly, it represents product obtained in the preparation of non-substituted hydrocarbon polymers by the suspension or emulsion processes, or by the bead polymerization process, without requiring that the polymer be dried or be dried in a high degree as was necessary in its prior processing to a final product. Hence it is not necessary that the water be completely removed from the emulsion polymerizate, or that the latter be rolled out at high temperatures or be compressed or densified through forming in an extrusion press. Rather the extremely finely divided dispersion obtained in the emulsion polymerization can be used as the additive for molding compositions.

Likewise in the suspension or the bead polymerization of non-substituted synthetic plastics, the starting material in an excess of water with addition of dispersing agents is broken up by powerful stirring into an infinitude of tiny spheres, and in this condition undergoes polymerization. Again the product plastic needs not to be completely dried as hitherto was the case when carrying out the process for other purposes; but rather the resulting fine spheres can be used wet since, obviously, the molding sand composition must have some water content. If the plastic to be used for practice of the invention is to be the product of bead polymerization, then it can be produced with a bentonite content higher than hitherto usual in that process for impeding agglomeration of the individual beads and accordingly can be produced as very fine spheres. This is possible, because the bentonite, covering the polymerized beads as a colloidal layer, need not be removed later, since it is also useful in the casting mold as a binder, so that a smaller than otherwise usual additional amount of binding agent, particularly bentonite, has to be added to the molding sand composition.

Since the additive of the invention can be added to the molding composition as a slime material or fine slurry, the addition can be made by a pump with quite exact metering. Also the bead suspension in water can be added to the molding sand.

It is particularly advantageous that the plastic additive be fine grained or in powder form, so that it can be added to the sand composition as a dry material by means of the metering devices generally present in foundries. The fine grained or powder form can be obtained through milling of a granulate or through spraying or atomizing of a plastic liquified at about 160° to 200°C. Particularly advantageous it is in fine grains, with a grain size of 0.2 mm and less, with an average grain size of 0.15 mm.

The additive has the further advantage that only comparatively small amounts are required in order to form a coherent lustrous carbon layer on the quartz grains of the mold sand. This results because with its even dispersal throughout the sand composition, about 90 percent of the additive is converted into lustrous carbon and the remainder to volatile components, predominately hydrogen. Furthermore, since the plastic additive is not hygroscopic and, moreover, exerts no harmful effect upon the binding capacity of a clay, particularly bentonite, because it is un-substituted and also contains no sulfur, the plastic additive here proposed diminishes the amount of binder required, especially bentonite, and thereby also leads to a smaller water requirement in the sand composition.

As the additive promotes fluidity of the molding sand composition, it is particularly advantageously suited to sand compositions intended for high pressure molding foundry practice. In these operations, upon pouring of the melt there results no expansion, or only an inconsiderable expansion of the mold space, so that not only are dimensionally exact castings obtained, but also the problems of feed and feeder heads are simplified and under some circumstances absolutely no after-feed needs to follow.

Because of the very high yield of lustrous carbon, only a small amount of the plastic additive is required, and the molding composition proposed in accordance with the invention also is better suited to the preparation of steel castings.

Also the comparatively small amount of additive required does not diminish the gas permeability of the molding sand composition.

Since a molding sand composition with an additive of this invention requires less binder, particularly bentonite, the reprocessing of the molding sand composition is also simpler, because dust removal is not required to so high degree as hitherto with known carbon-containing additives, especially mineral coal dusts.

A further advantage appears because the unconsumed additive present in the used molding composition is utilized in the course of re-use of the molding sand, so that upon a re-preparation of the old sand, only small make-up quantities of new synthetic plastic are needed.

Experience has shown that for the manufacture of 100 tons of good castings, with prior carbon-containing additives in the form of coal dust, 3.3 tons of synthetic coal dust and 5.4 tons of bentonite are necessary; while with use of the present invention, only 0.5 tons of polystyrene in fine grain form and 4.3 tons of bentonite are required.

Investigations carried out through the known determination of the ignition loss upon a heating of the mold sand to 1,000°C. have shown that with the known use of mineral coal dust in molding sand, there are obtained 1.5 percent lustrous carbon and 3 to 3.5 percent coke and other combustible residues; but if a plastic in accordance with the present invention is added to obtain in the mold sand 1.5 percent lustrous carbon, there then results only 0.5 percent of combustible residues. The invention here also represents considerable progress over known use of coal dusts which leave in the molding sand large amounts of residue and thereby diminish the gas permeability and the refractory character of the sand mold. These disadvantages are overcome through the invention.

In accordance with a further feature of the invention it is contemplated that the carbon containing additive, in the form of a fine grained synthetic plastic, be pre-mixed with a binding agent especially in the form of sodium bentonite, as an additive composition.

According to K. A. Hofmann, U. Hofmann and C. Röchling lustrous carbon is to be understood as a microcrystalline carbon deposited from the gaseous phase on hot surfaces having a temperature of 650° to 1,000°C, said carbon often having a shiny appearance. From a chemical point of view the lustrous carbon is more stable than coke and is only surpassed by graphite. Films of lustrous carbon, of reduced thickness (about 10^{-4}mm) fixedly adhere to the base. When the disposition temperature is increased the structure and appearance of the lustrous carbon becomes similar to that of retort graphite.

Compositions found quite suitable for attaining the above-described advantages for foundry molding and casting operations are represented by the following examples.

EXAMPLE 1

In accordance with the invention 10 kg of granulated polystyrene plastic material having an average grain size of 5 mm was ground in a crushing mill to an average grain size of 0.15 mm. Some of the grains had a size of 0.3 mm and others a size of less than 0.15 mm. This fine grained plastic material was fed into a mulling machine of conventional type known under the trade mark "Simpson," the said machine being a pan mixer including two heavy wheels rotating on a material receiving pan. 1,000 kg of quartz sand having an average grain size of 0.30 mm were received in the mulling machine. 60 kg of Wyoming Bentonite and 40 liters of water were fed into the machine. The mixing operation took place for 3 minutes. The resulting foundry sand composition was then fed into a disintegrator machine of the type known under the trade mark "-Samon" in order to crush the lumps of sand. The sand composition thus containing 90.1 percent sand, 0.9 percent plastic, 5.4 percent bentonite and 3.6 percent water, was fed into a jolt or jar ramming machine of the conventional type, working with usual pressure to obtain a casting mold for machine casting.

EXAMPLE 2

12 kg of polyethylene thus representing about 1.1 percent plastic, 5.4 percent bentonite, 3.6 percent water and 89.9 percent sand, instead of 10 kg of polystyrene were used in a second mixture. 5 kg of polypropylene and 5 kg of polystyrene thus representing about 0.9 percent total plastic were used in a third mixture. In each case the grain size was as mentioned in example 1.

EXAMPLE 3

1,500 kg of quartz sand having an average grain size of 0.24 mm were fed into the mulling machine as describe above. Thereafter 30 liters of a water-polystyrene emulsion containing 30 percent by weight polystyrene were fed into the mulling machine. The size of the polystyrene particles was less than 0.02 mm. Thereafter 90 kg of sodium bentonite (Wyoming Bentonite) and 40 liters of water were fed into the machine to obtain a water content of 4 percent in the foundry sand.

EXAMPLE 4

69 kg of Wyoming Bentonite were mixed with 10 kg of polystyrene having an average grain size of 0.1 mm. This mixture was introduced into a mulling machine of the type known under the trade mark "Simpson" together with 1,000 kg of quartz sand having an average grain size of 0.18 mm. 50 kg of water and 10 kg of corn-starch of the type known under the trade mark "Maizena-Mogul" were introduced during mixing and mixing took place for 5 minutes. The composition thus represented about 87.8 percent sand, 6.06 percent bentonite, 0.88 percent polystyrene, 4.39 percent water, and 0.88 percent starch.

EXAMPLE 5

1,000 kg of natural foundry sand of the type known under the trade mark "Rosenthal" and including glauconite as binding clay were fed into the mulling machine. Thereafter 12 kg of polystyrene having an average grain size of 0.2 mm with greatest particle size of 0.5 mm were fed into the machine. Water was added during the mixing operation to obtain a water content of 6 percent with about 1.1 percent polystyrene in the foundry sand composition. The mixing time was 8 minutes.

EXAMPLE 6

80 liters of a water-polystyrene emulsion comprising 40 percent by weight of polystyrene of an average grain size less than 0.02 mm were mixed with 2.5 kg of Wyoming Bentonite and 20 of water to obtain a mold finishing material. This mold finishing material, by weight comprising about 2.4 percent bentonite and about 31 percent polystyrene in water as a carrier, was then painted on the surfaces of a foundry mold of conventional sand composition.

EXAMPLE 7

50 liters of a liquid comprising natural resin dissolved in alcohol were mixed with 30 kg of pulverized polystyrene having an average grain size less than 0.1 mm. The resulting composition was sprayed on the surfaces of the mold.

In all cases the particle size of the plastic material should not be greater than the particle size of the grains of the quartz sand.

Coal dust, lignite, peat dust, wood flour can be added to the sand composition according the invention to obtain different effects such as easy break up of the mold after the casting operation. Likewise other inorganic substances such as iron oxide can be added in order to avoid casting deficiencies as known per se. Thus all other additions as conventional in preparing foundry sands or core compositions can be added, even if they should produce lustrous carbon to a slight degree.

I claim:

1. A foundry sand composition consisting essentially of a molding sand, a bentonite binder and water, with all these components in usual contents for molding procedures, and at least 0.5 percent by weight of a lustrous-carbon-forming additive; said additive consisting essentially of a thermoplastic non-foamed polymerized non-substituted hydrocarbon type synthetic plastic material of a particle size smaller than 0.3 mm, said plastic material selected from the group consisting of polystyrene, polyethylene, polypropylene and mixtures thereof.

2. The composition as described in claim **1** wherein said synthetic plastic material is comprised of a polystyrene.

3. A composition as described in claim **1** wherein said synthetic plastic material is a bead product of bead polymerization.

4. A composition as described in claim **3** wherein the polymer beads are coated with colloidal bentonite.

5. The composition as described in claim **1** with said synthetic plastic material added in the form of a water emulsion.

6. The composition as described in claim **5** wherein the synthetic plastic material amounts to from about 0.5 percent to about 2 percent in the molding sand mixture.

7. The composition as described in claim **1** wherein the synthetic plastic material amounts to from about 0.5 percent to about 3 percent in the molding sand mixture.

8. The composition as described in claim **1** with said synthetic plastic material added in a fine grained or pulverulant form with size of 0.2 mm and less with an average grain size of 0.15 mm.

9. The composition as described in claim **1**, wherein said synthetic plastic material has an average particle size smaller than 0.3 mm.

10. A foundry sand mold finishing composition, consisting essentially of, by weight, about 2.4 percent bentonite, about 31 percent polystyrene of an average grain size less than 0.02 mm, and the balance water as a carrier; the polystyrene emulsified in water.

* * * * *