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CORE BINDING COMPOSITION

Dorothea S. Phillips, Meredith, N. H., assignor to American Cyanamid Company, New York, N. Y., a corporation of Maine

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1

This invention relates to a foundry sand core composition comprising a predominant amount of sand and a binder, which comprises a mixture of a dicyandiamide-formaldehyde resin and a cereal binder, in a sufficient amount of water to permit gelatinization of the cereal binder. This invention further relates to a foundry sand core composition comprising a predominant amount of sand in a mixture of a dicyandiamide-formaldehyde resin, a cereal binder and bentonite, with a sufficient amount of water to gelatinize the cereal binder. Still further, this invention relates to a foundry sand core composition which is particularly adaptable for use in the casting and molding of metallic materials, where a reducing atmosphere is desirable. Still further, this invention relates to foundry core binders for high-strength cores, particularly useful for the molding of manganese steel castings, for which it is desirable to use a core binder which produces a reducing atmosphere around the core during the pouring operation, thereby eliminating the fusing of the sand to the finished casting, and preventing the oxidation of the manganese to manganese dioxide, which in turn fuses to the sand at molding temperatures, such as at 2800° F.

One of the objects of the present invention is to produce a foundry sand core binder comprising, in addition to the predominant amount of sand, a binder comprising a mixture of a dicyandiamide-formaldehyde resin, a cereal binder and sufficient water to gelatinize the cereal binder. A further object of the present invention is a produce a foundry core binder which is particularly applicable in the molding of manganese steel castings because of the characteristic of this particular core binder in producing a reducing atmosphere around the core during the pouring of the molten metal. A further object of the present invention is to prevent the oxidation of the manganese in a manganese steel alloy casting to manganese dioxide by the use of the core binder of the present invention. A further object of the present invention is to produce a sand core binding composition which comprises a predominant amount of sand, a dicyandiamide-formaldehyde resin, a cereal binder, alkaline bentonite and sufficient water to gelatinize the cereal binder. A still further object of the present invention is to produce a foundry sand core binder having sufficient green compressive strength to withstand handling prior to the baking operation and sufficient baked compressive strength and baked tensile strength so as to withstand handling prior to the actual molding operation. These and other objects of the present invention will be discussed more fully hereinbelow.

In the manufacture of sand molding cores, particularly in the manufacture of cores for metallic castings, it has been customary in the prior art to use a synthetic resinous composition as one of the components in the binder used in foundry sand core compositions. Amongst the various resins which have been suggested for this purpose are the urea resins and the melamine resins. These latter resins have performed quite satsisfactorily, but their use has been limited because of the tendency of the green mix containing these resins to adhere to the mixing and molding equipment. Certain other synthetic resinous materials have been suggested in the prior art for use as binding agents in foundry sand core compositions, such as the phenolic resins. In many respects, the phenolic resins have not proved to be successful, because the retained strength of the core, after the molten metal has been poured around it, is too high, thereby causing strains to be introduced into the castings, and causing considerable difficulties, in addition, in the removal of the core from the cast article. The applicant has discovered that by the use of the dicyandiamide-formaldehyde resins, all of the shortcomings of the materials of the prior art are overcome without sacrificing any of those physical properties which are particularly desirable in foundry sand core binders, such as green compressive strength, baked tensile strength and baked compressive strength.

2

In the practice of the process of the present invention, one may select any mol ratio of dicyandiamide:formaldehyde, such as mol ratios of 1:1 to 1:4 dicyandiamide to formaldehyde, respectively. It is preferred, however, to use a dicyandiamide:formaldehyde resin having a mol ratio of 1:2–1:4 dicyandiamide:formaldehyde, respectively.

In order to illustrate the process for the preparation of these dicyandiamide-formaldehyde resins, the following example is set forth, in which all parts are parts by weight. It should be remembered that any specific details enumerated hereinbelow are set forth solely for the purpose of illustration, and should not be interpreted as limitations on the case, except as indicated in the appended claims.

Dicyandiamide-formaldehyde resin

Fifty-three (53) parts of a 37% aqueous solution of formaldehyde and 27.7 parts of dicyandiamide are introduced into a suitable reaction chamber, equipped with thermometer, stirrer and facilities for heating and cooling. The mixture is then gradually heated to 85° C. and is held at that temperature for about 2½ hours. When the end point is reached (determined by diluting a sample of the resin to a 45% solids resin solution before hydrophobe), it is cooled and spray-dried.

The amount of the dicyandiamide-formaldehyde resin which is used in the core binder composition constitutes a rather substantial part of the binder and, with respect to the components in the binder, it may be varied over a fairly wide range. However, with respect to the total core composition, wherein there is present a predominant amount of sand, the dicyandiamide-formaldehyde resin actually constitutes a rather minor amount of the total composition. It is sufficient if there be present in the foundry sand core composition between about 0.5–5% by weight of resin, based on the total weight of the core composition. The dicyandiamide-formaldehyde resin may be used in the core composition without the benefit of any bentonite, but it is, actually, preferred that there be some bentonite present in the core composition. It is further desired that the ratio of resin to bentonite be approximately 1:1 parts by weight in addition to the resin already present in the composition. Thus the total ratio of resin to bentonite in the core binder composition will always be at least 2:1. For this reason, then, it is desired that there be 1–10% by weight of dicyandiamide-formaldehyde resin present when there is bentonite present in an amount varying between 0.5–5% by weight of bentonite. When there is no bentonite present, the preferred proportions of resin are within the range of 2–3% by weight of resin, based on the total weight of the core composition. The presence of the bentonite (alkaline) results in an accelerated cure of the resinous material during the conversion of the green sand composition to baked sand core composition.

In the formulation of the core binder, it is desired to have a green compressive strength sufficient to withstand handling prior to baking and a baked tensile strength and a baked compressive strength sufficient to withstand handling after baking, so as to avoid premature disintegration. By the addition of a cold-water-soluble cereal binder to the core binder composition, one enhances the green strength and the post-baked strength. These cereal binders may be added in amounts varying over a fairly wide range, based on the total weight of the core composition, the binders are present in comparatively small amounts. For instance, one may use between about 0.05–2% by weight of cereal binder, based on the total weight of the core composition. In most instances, however, it will be desirable to use not less than 0.4% by weight of cereal binder, based on the total weight of the core composition. Amongst those cereal binders, which may be used, are tapioca flour, wheat flour, pearl starch, corn starch, partially dextrinized corn starches, dextrin, potato starch, rice, rye flour and the like. In order to illustrate the concept of the present invention, the following example is set forth solely for the purpose of illustration and all parts are parts by weight.

Example

Ninety (90) parts of an American Foundry Society sand, 6 parts of a dicyandiamide-formaldehyde resin prepared according to the example set forth hereinabove, 3 parts of bentonite (alkaline) and 1 part of Kordek (cereal flour) and 7 parts of water.

The formulation set forth hereinabove is thoroughly blended and then formed into cores, against which molten castings can be poured.

These foundry sand core compositions had the following strength characteristic:

	P. s. i.
Green compressive strength	2
Baked compressive strength	600
Baked tensile strength	155

The baking cycle in the preparation of the cores may be varied over the conventional range, such as about ¾ hour at temperatures between about 350–400° F. If one desires to use bake temperatures lower than 350° F., one must use longer baking time, such as 120 minutes at 300° F. and more than 180 minutes at 220° F. These formulations, when processed, show no indication of being sticky, since the sand residue could be cleaned easily from the mixing and molding equipment.

These sand core compositions may be used in all metallic castings, ferrous and non-ferrous alike, such as copper, aluminum, magnesium, iron and the like, and alloys such as bronze, brass, steel and the like. It has been pointed out hereinabove that these particular sand core compositions are particularly useful in the molding of manganese steel castings, because of the ability of these binders to produce a reducing atmosphere, which in turn prevents the oxidation of the manganese to manganese dioxide.

I claim:

1. A foundry sand core composition which consists essentially of a predominant amount of sand and a mixture of (1) 0.5–5% by weight of a dicyandiamide-formaldehyde resin, (2) 0.15–2% by weight of a cereal binder and (3) sufficient water to gelatinize the cereal binder, said composition being capable of processing without adhering to the mixing and molding equipment.

2. A foundry sand core composition which consists essentially of a predominant amount of sand and a mixture of (1) 1–10% by weight of a dicyandiamide-formaldehyde resin, (2) 0.05–2% by weight of a cereal binder, (3) 0.5–5% by weight of bentonite and (4) sufficient water to gelatinize the cereal binder, said composition being capable of processing without adhering to the mixing and molding equipment.

3. A foundry sand core composition which consists essentially of a predominant amount of sand and a mixture of (1) 2–3% by weight of a dicyandiamide-formaldehyde resin, (2) 0.05–2% by weight of a cereal binder and (3) sufficient water to gelatinize the cereal binder, said composition being capable of processing without adhering to the mixing and molding equipment.

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