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CORE BINDER

Thomas E. Barlow, McHenry, Ill., assignor to International Minerals & Chemical Corporation, a corporation of New York

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5 Claims. (Cl. 106—38.5)

The present invention relates to foundry cores. More particularly, it relates to an improved foundry core of high hot strength, containing a binder having superior properties.

In foundry practice, it is frequently necessary to incorporate "cores" in the molds to produce void spaces in the metal castings. Such cores are ordinarily prepared by compacting sand in the desired shape. In order for the core to have sufficient mechanical strength to withstand the impact of the hot metal, it is customary to incorporate one or more substances in the core mixture and thereafter to bake the core at elevated temperature before assembling it into the mold. A wide range of substances have been employed for this purpose, including cereal products, water glass, drying oils, resins, sulfite liquor, proteinaceous materials, molasses, clays, wood flour, gelatinized starches, dextrinized starches, and the like. The present invention involves a novel combination of substances for use as a core binder, whereby cores of superior strength at casting temperaures are obtained.

One object of the present invention is to prepare foundry cores having improved properties.

Another object is to prepare foundry cores having superior hot properties.

Another object is to provide an improved binding material for foundry cores.

Other objects of the invention will be apparent from the following description.

In the present invention, an improved foundry core is prepared by admixing sand with water, a gelatinized starch or starch fraction comprising gelatinized amylopectin, and a phosphate salt of an alkali metal or an alkaline-earth metal. The resulting mixture is formed into the desired shape and is thereafter baked under conventional conditions. The core obtained thereby has excellent baked tensile strength and outstanding hot properties.

In preparing a foundry core according to one embodiment of the present invention, sand is mulled with between about 3 and about 6% by weight of water, optimally around 4 to 5%. Gelatinized amylopectin is then added in a proportion between about 0.5 and about 2.5% by weight of the sand, dry basis, and is mulled in. Finally, the phosphate salt is added in a proportion between about 5 and about 25% by weight of the amylopectin, dry basis, and the entire mixture is mulled until homogeneous. The mulling steps ordinarily require periods of about 1, 1, and 6 minutes, respectively, for completion. Other materials of the types commonly employed as core binders may also be incorporated in the core mixture if desired.

The cores produced in accordance with the present invention are baked under conventional conditions. The required temperature and time will vary considerably, as the prior art recognizes, according to the size of the core, the surface-to-volume ratio, the water content, and the type and composition of the core binder. Laboratory test cores reach maximum tensile strength at around 350 to 450° F. in about 10 to about 30 minutes. Under otherwise comparable conditions, larger cores require increasingly longer baking times, particularly cores which

have lower surface-to-volume ratios. Higher temperatures may in many cases be employed, but are generally not preferred, owing to a tendency of the cores to become overbaked and case-hardened.

Other procedures may be employed satisfactorily in the preparation of the core mixture. For example, the sand, the gelatinized amylopectin, the phosphate salt, and any other dry ingredients can first be mulled together, followed by the water and any other wet ingerdients. In another method, the phosphate salt can be dissolved in the water, then mulled with the sand, followed by the gelatinized amylopectin. The method and sequence of admixing the various components can be varied at will while still producing improved results in the resulting cores. The mulling times employed are not critical, so long as a homogeneous mixture of the materials is achieved. For this purpose, it is ordinarily sufficient to mull the initial admixtures, if any, for only about 1 minute, and to mull the completed mixture for about 5 to 10 minutes, preferably around 6 minutes.

Starch generally comprises two primary fractions—viz., amylopectin and amylose, the proportions varying markedly from one starch to another. The present invention can suitably employ either amylopectin, or whole starch, or a starch fraction comprising amylopectin, so long as the said materials have been subjected to gelatinization. In this respect it should be noted that amylopectin, as ordinarily marketed, is in gelatinized form owing to the method by which it is separated from the original starch. It should further be noted that the so-called foundry cereals are invariably gelatinized starch of one type or another, always comprising amylopectin, and are satisfactory for use in the present invention.

Suitable salts for use in the present invention are the water-soluble orthophosphate, pyrophosphate, metaphosphate, and polyphosphate salts of the alkali metals and of the alkaline-earth metals, or mixtures thereof, which have a composition yielding a saturated aqueous solution of a pH between about 4 and about 7 at 25° C. Such salts or salt mixtures can conveniently be prepared by reacting a phosphoric acid with a basic alkali metal or alkaline-earth metal compound in aqueous solution while adjusting the proportions to reach the desired pH level. A preferred type of salt is a mixture of monosodium orthophosphate and disodium orthoprosphate having a pH of about 6. Another preferred salt is sodium metaphosphate. Other suitable salts include mixtures of monopotassium and dipotassium orthophosphates, mixtures of monocalcium and dicalcium orthophosphates, and the like, within the broad definition set forth above.

The following specific examples will more clearly illustrate the invention. All of the tests described therein were carried out according to standard methods defined in the "Foundry Sand Handbook," 6th edition (1952) published by the American Foundrymen's Society, Chicago. Except as noted below, all of the tests employed materials, proportions, and procedures as follows:—The sand employed was No. 1 steel sand having an AFS grain fineness of 62 ("AGF 62"). Measurements were based upon the dry weight of sand employed. Mulling was carried out in a laboratory-size Simpson muller. After mulling was completed, the core mixture was discharged from the muller and stored in a sealed can until used to make cores. The cores were baked at 425° F. for 15 minutes, then cooled to room temperature. The strength of the baked cores was measured in terms of their tensile strength at room temperature ("baked strength") and in terms of the time required for them to collapse at 800° F. under a load of 100 p.s.i. ("breakdown time"). In each case the cores were prepared and tested in triplicate, and the reported results are the average of the three tests.

Example 1

The following example illustrates the effectiveness of gelatinized amylopectin in combination with mixed sodium orthophosphates as a core binder. The phosphate salt mixture was a blend of disodium orthophosphate dihydrate and monosodium orthophosphate monohydrate in 2.54:1 ratio by weight. The composition and preparation of the core mixtures were as follows:

5% water
0.15% phosphate salts
0.85% gelatinized amylopectin
Remainder sand

The sand and water were mulled 1 minute; the phosphate salt mixture was added and mulled for 1 minute; and the gelatinized amylopectin was added and mulling was continued for 6 minutes. The completed mixture retained 5.1% water. Cores prepared therefrom had a baked strength of 200 p.s.i. and a breakdown time of 11.33 minutes.

For comparison, a core mixture was prepared in a similar manner, omitting the phosphate salts. The resulting cores had a high baked strength, 290 p.s.i., but the breakdown time was only 3.07 minutes.

For further comparison, two core mixtures were prepared with 0.25 and 0.5% of phosphate salts, omitting the gelatinized amylopectin. Cores prepared therefrom had baked strengths of only 10 and 15 p.s.i., respectively, and were not tested for breakdown time.

Example 2

Mixed sodium orthophosphates were dissolved in water and mulled with sand for 1 minute. Gelatinized amylopectin was then added, and mulling was continued for 6 minutes. The materials, proportions, and procedure were otherwise the same as described in Example 1. The cores prepared therefrom had a baked strength of 225 p.s.i. and a breakdown time of 9.90 minutes.

Example 3

The following example illustrates the use of gelatinized whole corn starch in combination with phosphate salts as a core binder. The starch was prepared by wetting it with water and passing it downward between rotating drums heated with steam under pressure. By this means, the starch was simultaneously gelatinized and dried in the form of a thin film. Before use, the starch was ground to a fine state of subdivision. Cores were prepared according to the procedure of Example 1, substituting the gelatinized corn starch for gelatinized amylopectin. The resulting cores had a baked strength of 190 p.s.i. and a breakdown time of 9.57 minutes.

For comparison, three additional groups of cores were prepared in an analogous manner using ungelatinized whole corn starch alone as the core binder, ungelatinized whole corn starch plus the sodium orthophosphate salt mixture referred to above, and gelatinized whole corn starch alone. Cores prepared therefrom were far inferior in breakdown time:

Binder	Baked Strength, p.s.i.	Breakdown Time, min.
Ungelatinized corn starch	110	2.82
Same, plus phosphates	100	3.29
Gelatinized corn starch	215	3.31

Example 4

A core mixture was prepared according to the procedure described in Example 1, using 0.25% of the sodium orthophosphate salt mixture and 0.1% of a standard foundry cereal (i.e., a gelatinized starch preparation). Cores prepared therefrom had a baked strength of 165 p.s.i. and breakdown times of 7.37 minutes at 800° F. and 5.82 minutes at 1000° F.

For comparison, a core mixture was prepared according to the procedure of Example 1, employing only a foundry cereal at the 1.0% level as the core binder. Cores prepared therefrom had a baked strength of only 140 p.s.i. and a breakdown time of only 1.45 minutes at 100° F.

Example 5

A core mixture was prepared as in Example 1, replacing the sodium orthophosphate mixture with 0.2% of sodium metaphosphate. Cores prepared therefrom had a baked strength of 165 p.s.i. and a breakdown time of 10.64 minutes at 800° F.

The foregoing description refers to numerous details of core mixture composition, preparation techniques, and the like, for the purpose of illustrating and clarifying the invention, but in no respect by way of limitation. It will be apparent that numerous modifications and equivalents of the invention will be suggested thereby to those skilled in the art.

The following claims particularly point out and distinctly claim the subject matter of the invention:

I claim:

1. In a method for producing a foundry core, which method comprises commingling sand, water, and binder, forming the resulting mixture into the desired shape, and baking the shaped mixture at a temperature between about 350 and about 450° F., the improvement which comprises employing as said binder, in combination, at least about 0.5% by weight of gelatinized amylopectin, based on the dry weight of sand contained in the core mixture, and a phosphate salt selected from the group consisting of the water-soluble alkali-metal and alkaline-earth-metal phosphates and mixtures thereof which produce a pH between about 4 and 7 in saturated aqueous solution at about 25° C., the proportion of said phosphate salt being between about 5 and about 25% by weight, based upon said gelatinized amylopectin.

2. The method of claim 1 wherein said gelatinized amylopectin is employed in a proportion between about 0.5 and about 2.5% by weight, based upon the dry weight of sand contained in the core mixture.

3. The method of claim 1 wherein said phosphate salt is an alkali-metal orthophosphate.

4. The method of claim 1 wherein said phosphate salt is a metaphosphate.

5. In the method for producing a foundry core, which method comprises commingling sand, water, and binder, forming the resulting mixture into the desired shape, and baking the shaped mixture at a temperature between about 350 and about 450° F., the improvement which comprises employing as said binder, in combination, gelatinized whole starch containing between about 0.5 and about 2.5% by weight of gelatinized amylopectin, based upon the dry weight of sand contained in the core mixture, and a sodium orthophosphate of a composition which produces a pH between about 4 and about 7 in saturated aqueous solution at about 25° C., the proportion of said sodium orthophosphate being between about 5 and about 25% by weight based upon said gelatinized amylopectin.

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CERTIFICATION OF CORRECTION

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Thomas E. Barlow

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 6, for "100° F." read -- 1000° F. --; column 4, line 35, for "about 4 and 7" read -- about 4 and about 7 --.

Signed and sealed this 29th day of August 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents