CROSS REFERENCE EXAMINER

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METHODS OF AND COMPOSITIONS FOR MAKING MOLDS AND CORES

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This invention relates to a process for the manufacture of molds and cores in foundries and a composition for making such molds and cores and is a continuation in part of my copending application Serial No. 260,035, filed February 20, 1963, now abandoned, which was in turn a continuation in part of my earlier filed application Serial No. 822,749 filed June 25, 1959, now abandoned. There has long been a need in the foundry industry for a mold and for cores which could be formed and used without need for an intermediate baking step and which are non-deforming. Many core and mold binding compositions and oils have heretofore been used for the production of foundry cores and molds. Similarly many combinations of materials have been tried in the formulation of foundry cores and molds. No successful core or mold material which could be used without heating or baking has, however, evolved from these efforts. For example, Portland cement as a foundry mold and core binding agent has long been known. It has also been known to use certain additives such as molasses, sulphite fibers or pulp along with Portland cement and other conventional core forming materials in order to improve the rigidity of the molds and cores. However, the molds and cores formed with these materials have had an insufficient corner hardness or rigidity so that the corners or thin areas of the molds and cores tend to break off during casting. In an effort to correct this lack of corner hardness it has been proposed to use increased percentages of Portland cement in order to obtain better hardening properties. This, however, resulted in another and different defect. The addition of a higher percentage of cement produced cracks and hot tears in the casting which resulted in either the rejection of the casting or an excessively high cleaning cost.

The present invention overcomes these prior difficulties and provides cores and molds having satisfactory corner hardness together with the desired general rigidity of the mold and core. Furthermore, the invention provides molds and cores which set up sufficiently quickly without need for any baking or intermediate heating. Cores and molds made according to the present invention will set up and be ready for use in one-quarter the time required for similar cores and molds made according to prior art practices. I have discovered that the addition of sugars together with dextrose to the conventionally used molasses and Portland cement binder will produce these desired properties long sought by the art. This composition has the advantage that it does not have hygroscopic properties and can be stored as a mold or core for an unlimited period of time without deterioration. I have also found that this composition does not cause the surface of cores or molds to soften after the wash has been applied as is the case where molasses is used alone.

The most striking feature of the composition of my invention is the fact that it need not be baked in the oven. On the contrary, it has sufficient green strength so that it is possible to throw small cores and molds out of the boxes immediately upon completion of the forming operation and yet the mixture with sand has enough flowability that ramming is not required to produce sound cores and molds. Furthermore, because of its rapid setting characteristics it eliminates the need for the large number of core rods and wires heretofore used. I have discovered that a particular type of dextrose is most effective in the practice of my invention. I have discovered that the reaction product which is produced by the disintegration of starches through organic acids such as maleic acid anhydride, phthalic acid anhydride, oxalic acid, fumaric acid, diglycolic acid, sulfamine acid, etc. and the reaction product which is produced by disintegration of starches through oxygen carriers such as benzoyl peroxide, sodium perborate, sodium carbonate peroxide, ethyl peroxide and other organic and inorganic peroxides and salts containing peroxide, etc. or the reaction products produced by a combination of these processes, i.e., disintegration by a mixture of organic acids and oxygen carriers such as a mixture of maleic acid and sodium perborate or benzoyl peroxide and diglycolic acid are most satisfactory in my invention. For example the reaction products produced by disintegration potato starch, corn starch, cassava starch and the like by maleic acid anhydride, phthalic acid anhydride, or oxalic acid is a very satisfactory material. The disintegration of starches is preferably carried out by mulling a mixtue of the starch and disintegrating oxygen carrier or organic acid at temperatures between about 65° F. to 125° F. for time periods of between 1½ to 10 hours until reaction has ceased.

As examples of this disintegration, the following materials were treated as indicated:

A

100 parts by weight of potato starch were mulled with 5 parts by weight of sodium perborate and 1 part by weight of oxalic acid for 5 hours at 90° F. The resultant material had a viscosity in 10% solution of 50,000 centipoises and had a pale color. Solubility was between 88 to 90% of the entire product.

B

100 parts by weight of corn starch were mulled with 1.5 parts by weight of benzoic acid and 1.0 parts by weight of lactic acid for 6 hours at 100° F. The resultant material is similar to A above.

C

100 parts by weight of Manioka starch were mulled with 0.5 part of maleic acid anhydride and 0.5 part by weight of ammonium persulfate for 8 hours at 75° F. The resultant product had characteristics described in A above.

D

100 parts by weight of wheat starch were mulled with 1 part of sodium percarbonate and 3 parts by weight of boric acid for 7 hours at 90° F. The resultant reaction product had characteristics as described in A above.

The reaction product of disintegration of starch as here disclosed appears to be very similar to dextrose but unlike conventional dextrose, has a very high tensile strength admixed with foundry sand. It appears to be perhaps more closely similar to amylin.

The invention can perhaps be best understood by reference to the following examples.

Example I

A mold was prepared for a foundry casting as follows: 100 parts by weight of fine grain silica sand was mulled with the following mixture—5 parts of Portland cement, 3.5 parts by weight of a binder made up of 70% molasses, 4% glucose, 6% reaction product produced by disintegrating potato starch with dry mulling with 4% of a mixture of maleic acid anhydride and sodium perborate at a temperature of 80° for 7 hours, 10% cane sugar and 10% water. To this was added one and one-half parts by weight of water. The mixture was poured into a mold box and was immediately thereafter thrown out of the box. The mold had sufficient green strength to retain its shape and was cast into after three hours of setting up without any intermediate baking. The resulting casting was found to be completely satisfactory.

Example II

Cores were made by mulling 100 parts of medium grain size silica sand with 6 parts of Portland cement, 0.3 parts of water and 4 parts by weight of a binder made up of 50% molasses, 30% reaction product produced by disintegrating by dry mulling potato starch with about 5% of a mixture of maleic acid anhydride and sodium perborate at a temperature of 90° F. for 4 hours, 5% glucose, 2% cane sugar and 13% water. The mixture was poured into core boxes, the cores were immediately thrown out of the boxes, and at the end of four hours were used for casting. The resulting castings were entirely satisfactory even though the cores had never had an intermediate baking.

Example III

Cores were made by mulling 100 parts of silica sand with 6 parts of Portland cement, 0.3 parts of water and 3.8 parts by weight of a binder made up of 60% molasses, 5% glucose, 2% cane sugar, 15% water and 18% of the reaction product of the disintegration of corn starch by dry mulling with a mixture of a half and half admixture of benzoyl peroxide and diglycolic acid under the condition described in B above. The resulting cores had high green strength and the resulting castings poured around the cores were satisfactory even in the absence of baking.

Example IV

Cores were made by mulling together 100 parts by weight of silica foundry sand with 5½ parts of Portland cement, 0.6 parts of water, 5 parts by weight of a binder made up of 15% of the reaction product of disintegrating cassava starch by dry mulling with 3% phthalic anhydride at 120° F. for 2 hours, 4% cane sugar, 11% water and 70% of molasses. The resulting cores had high green strength and cast satisfactory castings.

I prefer to use Type 3, Early Setting Portland cement in my invention. However, all types of Portland cement may be used with satisfaction. In the practice of my invention, I prefer to use from 4 to 8 parts of Portland cement and from 2 to 5 parts of the binder consisting of molasses, dextrose and a sugar mixture, this portion of the binder being made up preferably of 40 to 80% molasses, 5 to 40% dextrose, and 5 to 20% of other sugars, preferably, can sugar and glucose with the balance water. It is of course evident that molasses could make up all of the sugars other than the reaction product of starch disintegration with reduction in added water. A single preferred composition of binder is 60% cane sugar molasses, 18% glucose, 12% reaction product and 10% water.

I have found that small amounts of inorganic chlorides such as sodium chloride, calcium chloride, magnesium chloride and small amounts of mineral acids such as nitric acid, sulfuric acid and hydrochloric acid do not detrimentally affect the results obtained by using my invention. On the contrary, small amounts of mineral

acids such as about 0.5% to 5% on the binder of sulfuric acid, etc. will aid in improving collapsibility.

I have found that small amounts of water soluble proteins such as soybean protein, casein, bone protein, protein from animal refuse, gluten, etc. aid in promoting green strength and mechanical resistance as well as improved collapsibility. In this connection I have used 0.1% to 5% on the basis of the sand in mixtures such as those of Examples I and II. In such cases the water soluble protein is added to the sand and binder mix as it is being mulled or mixed preparatory to forming the cores or molds.

While I have set out hereinabove certain preferred embodiments and practices of my invention it will be understood that this invention may be otherwise practiced within the scope of the following claims.

I claim:

1. A cold setting binder for foundry molds and cores consisting essentially of 3 to 8 parts by weight of Portland cement, and 2 to 5 parts by weight of a binder mixture consisting essentially of 40 to 80% molasses, 5 to 35% of the reaction product of the disintegration of starch by reaction at a temperature between about 65° to 125° for a time period between about 1½ and 10 hours with a member selected from the group consisting of organic acids, materials carrying a peroxide group and mixtures thereof, up to 20% of sugars and sufficient water to make a formable mass.

2. A composition for making foundry cores and molds consisting essentially of 100 parts by weight of sand, 4 to 8 parts by weight of Portland cement, and 2 to 5 parts by weight of binder consisting essentially of 40 to 80% molasses, 5 to 40% of the reaction product of the disintegration of starch by reaction at a temperature between about 65° to 125° for a time period between about 1½ and 10 hours with a member selected from the group consisting of organic acids, materials carrying a peroxide group and mixtures thereof, and up to 15% sugars and sufficient water to make a formable mass.

3. A cold setting binder for foundry molds and cores consisting essentially of about 3 to 8 parts by weight of Portland cement and 2 to 5 parts by weight of a binder mixture consisting essentially of 40 to 80% molasses, 5 to 35% of the reaction product of the disintegration of starch by reaction at a temperature between about 65° to 125° for a time period between about 1½ and 10 hours with a member selected from the group consisting of organic acids, materials carrying a peroxide group and mixtures thereof and sufficient water to make a formable mass.

4. A composition for making foundry cores and molds consisting essentially of foundry sand admixed with a binder made up of about 3 to 8 parts by weight of Portland cement and 2 to 5 parts by weight of a mixture of 40 to 80% molasses, 5 to 35% of the reaction product of the disintegration of starch by reaction at a temperature between about 65° to 125° for a time period between about 1½ and 10 hours with a member selected from the group consisting of organic acids, materials carrying a peroxide group and mixtures thereof and sufficient water to make a formable mass.

5. A binder as claimed in claim **3** wherein the reaction product has been produced by the disintegration of starch through organic acids.

6. A binder as claimed in claim **3** wherein the reaction product has been produced by the disintegration of starch with compounds carrying a peroxide group.

7. A binder as claimed in claim **3** containing about 0.5% to 5% of a mineral acid based on the weight of the binder mass including the Portland cement and the molasses sugar mixture.

8. A binder as claimed in claim **3** containing about 0.5% to 5% of an inorganic chloride of the group consisting of sodium chloride, calcium chloride and magnesium chloride based on the total weight of binder including the Portland cement and sugar mixture.

9. A composition as claimed in claim 4 containing about 0.1% to 5% of a water soluble protein based on the weight of the sand.

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