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FOUNDRY COMPOSITION

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My invention relates to compositions of matter and especially to compositions for foundry use.

Among the objects of my invention are the provision of a foundry composition which may be readily and accurately prepared with maximum economy, which is strong yet permeable to the fumes and gases encountered in actual use, which is adapted especially for use in making large molds and cores for the production of large castings, which possesses high hot strength and therefore is resistant to the cutting and washing action of molten casting materials, which does not fuse at high working temperatures because of its high sintering point, which has a satisfactory green strength together with a high dry strength and which may be recovered from the mold for repeated employment in the production of sound high grade castings.

Other objects in part will be obvious and in part pointed out hereinafter.

The invention accordingly consists in the combination of elements, mixture of materials and composition of ingredients, and in the several steps and the relation of each of the same to one or more of the others as described herein, the scope of the application of which is indicated in the following claims.

As conducive to a clearer understanding of my invention, it may be noted at this point that it is conventional practice in present foundry operations to produce a mold composition by mixing a small amount of bonding material into clean silica sand. The mixture then is tempered with water to form a moist workable mass. Burnt sand often is used as a substitute for part of the clean sand employed. Clay most frequently serves as the bonding material in mold compositions for it lends strength and workability to sand. The amount of clay and the quality thereof should be selected carefully for these factors have a major effect, for example, upon mold green strength, dry strength, hot strength, sintering point and permeability.

Now it must be observed that the numerous properties which mold compositions should possess vary with the many working conditions encountered in foundry operations. For example, casting size and thickness, together with the working temperatures and type of casting material used are factors which must be considered in determining the type of mold composition needed. Mold working properties are adjusted to meet the conditions required in the performance of a particular type of work. This

adjustment is accomplished by proper selection and proportionment of the mold constituents. Clay bonding materials such as kaolinite, Wyoming bentonite, non-swelling, colloidal montmorillonite, and non-swelling, non-colloidal montmorillonite, as well as other clays, when mixed with sand, produce mold compositions of differing characteristics. Now some of these clays are suitable for use in the production of certain kinds of castings, yet do not prove at all satisfactory for making other types as more fully set out hereinafter. Moreover, from the standpoint of economy, deposits of certain clays are so remote from the point of foundry operations that excessive shipping costs prohibit their use. Accordingly, it is to be noted that many problems are involved in the proper selection and proportionment of mold composition constituents.

Once a mold composition of specific properties is prepared, the mixture is rammed about a pattern placed in a molding flask. The flask parts are separated and the pattern is removed. Thereafter, the flask parts are placed together again and the mold is ready to receive molten casting material. High green strength of mold must exist to ensure that the mold does not slump, fall or crack during these operations. Essential green strength varies depending upon such factors as pattern shape and size. The mold composition must be of sufficient strength to remain in position during and after removal of the pattern.

When a casting is poured, the mold must have such hot strength as to resist the cutting and washing effects of the molten casting material. High hot strength of mold, therefore, is important in the production of clean, sound and accurate castings. Further, the sintering point of a mold composition must be sufficiently high to prevent the ingredients contained therein from fusing in the presence of intense heat. On the other hand, the mold must be of such porosity to allow fumes and gases to escape readily from mold sections adjacent to the casting. High permeability of mold prevents the formation of gas flaws in the casting. Again, certain parts of the mold frequently extend into recessed portions of a casting with the result that as the cooling casting contracts it exerts pressure upon these mold parts. By the time a casting cools somewhat, the mold dries because of the intense heat to which it has been exposed. Mold dry strength should be sufficiently low to permit normal shrinking of the casting, otherwise the casting will crack and thereby become unfit for use.

Again, the mold should be strong enough in dry condition to support the weight of the casting.

Any mold composition used in the production of large castings undergoes a very severe test. The large bulk of mold composition making up the mold must possess green strength high enough to prevent shifting, cracking or slumping of the mold after removal of the pattern. A large volume of molten casting material comes in contact with the mold surface when the casting is poured. Accordingly, the mold must possess exceptionally high hot strength in order to withstand the scouring, cutting and washing effects of the casting material. Big castings take considerable time to cool and while cooling give off very intense heat. Therefore, materials making up the mold must have unusually good heat resistance so that the sand will not fuse on to the casting. Thick castings, as compared to thin castings, are less likely to crack from overstress while contracting upon mold parts of high dry strength during the process of cooling. In fact, when the mold is loaded with a heavy casting it is important that mold constituents be well bonded in dry condition to prevent collapse of the mold.

Quite a number of clays are readily available at a given point of foundry operations, yet they are unsatisfactory for use in the production of large castings because working requirements are too severe. Excessive shipping costs, followed by increased production costs, frequently are suffered when a proper bonding clay is procured. Economy, therefore, demands that the working properties of readily available clays be altered so that such clays are suitable for making heavy castings. For example, the Patent 2,180,897 to Dunbeck, describes and claims a foundry composition comprising sand and a reversible binder of non-swelling, colloidal montmorillonite of the Pontotoc, Mississippi grade. This clay has proven to be a very satisfactory binder for molds employed in producing castings of light or medium thickness or weight. Mold compositions containing non-swelling, colloidal montmorillonite are objectionable for use in making heavy castings for such compositions possess low hot and dry strengths. Now, this clay is readily available in many sections of the country and it is being used with good results in types of foundry practice where unusually high hot and dry strengths and a high sintering point are not so important to the production of clean, sound castings. Accordingly, there is a demand that the range of utility be extended to include good service in molds employed for the production of thick, heavy, castings.

One of the objects of my invention is the provision of a mold composition especially adapted for use in producing thick heavy castings; which comprises a cheap and readily available clay bonding material together with an ingredient serving to improve hot strength, dry strength and sintering point normally imparted to a mold by the clay; and which in use permits the production of consistently sound, clean and accurate castings.

Considering now the practice of my invention, I find that the hot strength, dry strength and sintering point of mold compositions are improved greatly by mixing a substantial amount of silica flour with the other ingredients of such compositions. Mold compositions containing certain clays heretofore were not suitable for employment in producing thick, heavy castings. These same compositions now lend themselves

quite readily to such use when a substantial amount of silica flour is present as a constituent. Moreover, I find that great economy results from the practice of my invention since foundry operations now can be carried out using cheap and readily available materials. It is possible, for example, to use one type of clay for practically all classes of foundry mold work when silica flour is added to modify the effects of the clay upon the mold when particular classes of work are to be performed.

Non-swelling, colloidal montmorillonite of the Pontotoc, Mississippi grade is one clay with which my invention is practiced with particularly good results. Heretofore, non-swelling, colloidal montmorillonite has had limited utility in foundry operations because of the low hot and dry strengths together with the low sintering point it imparts to a mold. Non-swelling, colloidal montmorillonite has been employed in molds for light castings with very good results as more particularly discussed in Patent 2,180,897 to Dunbeck. The clay does not swell to any marked degree in the presence of tempering water and this is one major advantage distinguishing it from other clays such as Wyoming bentonite, which is identified by its swelling characteristics. I find, when silica flour is added to a mold composition comprising non-swelling, colloidal montmorillonite, the dry strength, hot strength and sintering point of the composition are increased a very material amount. Improvement of these properties permits non-swelling, colloidal montmorillonite to be used for a bonding agent in a wider range of work including the production of thick, heavy castings.

In preparing a foundry mold in accordance with my invention, I mix together by weight in any convenient manner, 95% to 60% of clean silica sand or silica sand containing a quantity of burnt sand as desired, 2% to 25% of silica flour and 3% to 15% of clay, such as a clay largely comprising non-swelling, colloidal montmorillonite of the Pontotoc, Mississippi grade. These ingredients are mixed, for example, in the usual foundry mixers to obtain a fairly uniform consistency. Tempering water then is added to the mix in desired amount, usually some 2% to 6% by weight of the mix. The mixing is continued, giving a uniform mold composition of desired strength. The composition then is ready for use in preparing a foundry mold in accordance with methods well known in the art.

My mold composition is easily worked, for it is smooth and not gummy or sticky. It is rammed readily about a pattern. After the use of conventional jolt or other types of molding machines, the composition is packed tightly about the pattern, giving a smooth molding surface which accurately follows the details of the pattern. Molds made in accordance with my invention are strong and durable. The mold is well retained within the cope as the pattern is withdrawn and is free of edge breaks and cracks. The mold, therefore, permits the production of clean, sound, and accurate castings with a minimum of labor and expense.

In addition to the highly desirable properties noted above, my mold composition possesses a satisfactory green strength, a high dry strength, an unusually high sintering point and a hot strength which, even at temperatures around 2500° F. is high. All of these properties contribute to making my composition very valuable for employment in the production of thick, heavy cast-

ings such as large machine parts and the like. Mold compositions containing a clay binder of Wyoming bentonite, which are of repute for possessing the combination of high dry strength, high hot strength and high sintering point, cannot compare in performance with my composition at working temperatures in the neighborhood of 2500° F. Moreover, the non-swelling, colloidal montmorillonite which I prefer to use as a binder in my mold composition, is obtainable more cheaply in the eastern part of the country than is Wyoming bentonite. Further, my invention permits non-swelling clays to be used in lieu of Wyoming bentonite, in molds for the production of thick, heavy castings.

The improved nature of a molding composition prepared in accordance with my invention is illustrated in the following tests which were made in conformity with the recommended procedure of the American Foundrymen's Association.

	Mixture A	Mixture B	Mixture C
Silica sand (A. F. A. Std. Test Sand).....percent..	96.5	86.5	76.5
Silica flour.....do.....	0.0	10.0	20.0
Non-swelling, colloidal montmorillonite (Pontotoc, Miss.).....percent..	3.5	3.5	3.5
Moisture.....do.....	2.0	3.1	4.9
Permeability.....do.....	247	155	76
Green compression strength.....p. s. i.	8.1	6.6	7.6
Dry compression strength.....do.....	27	105	135
Sintering point.....°F.....	2440	2550	2640
Hot strength (p. s. i.):			
500° F.....	25	80	160
1000° F.....	30	120	270
1500° F.....	28	190	450
2000° F.....	30	180	380
2500° F.....	2	28	165

It will be noted from inspection of the table that mixture A comprises 96.5% silica sand and 3.5% clay. Mixture A is suitable for use in the production of castings which possess low melting points or which are thin or light in character. Because of characteristically low hot and dry strengths, this mixture cannot be employed with any great satisfaction in the production of castings of high melting point or of the thick or heavy type.

By the inter-comparison of mixtures A, B, and C, it will be noted that the dry strength, hot strength and sintering point grow higher in direct proportion to the amount of silica flour used to replace a part of the basic 96.5% silica sand. There must be a limit, however, to the amount of silica flour used in lieu of sand because permeability of mold varies inversely as the quantity of silica flour employed. A large amount of silica flour must be used to lower mold permeability to an objectionable figure and the numerous existing advantages of the present invention are achieved before this point is reached.

The use of silica flour in a mold composition permits the addition of considerably more tempering water to the mold composition without changing sand consistency. Moreover, the additional tempering water improves hot strength of the composition. Clay and silica flour are distributed uniformly throughout the mixture to produce a well-bonded mass. The high sintering point which is characteristic of a mold composi-

tion produced in accordance with my invention, probably is obtained because of the refractory value of the uniformly dispersed silica flour and reduced rate of heat penetration into the sand. It is quite likely that the silica flour reacts with clay constituents to form refractory silicates. These silicates also possess cementing properties which possibly account for the greater hot strength of mold obtained. I do not wish, however, to be bound by this explanation.

It will be understood that the various ingredients going to make up the mold composition of my invention may be mixed together all at once or in any desired sequences. While as illustrative of the practice of my invention definite ranges of sand, clay, silica flour, and tempering water in my composition are given, it will be understood that these limits may be extended depending upon such factors as the character of the work to be done and the grade of materials available for use.

Furthermore, my described mold composition may be made with such sands as new silica sand, burnt silica sand, new molding sand, burnt molding sand, lake sand or bank sand. Also, small quantities of auxiliary binders, such as cereal binders, cement, goulac, pitch or rosin and casting cleaning elements, such as sea coal, wood flour, or oils may be added.

It is to be understood clearly that my composition may be made with clays other than non-swelling, colloidal montmorillonite. Moreover, a combination of several different types of clay binders may be employed in my composition and one of these clays may be non-swelling, colloidal montmorillonite.

Thus it will be seen that there has been provided in my invention a composition and art of employing the same in which the various objects hereinbefore noted, together with many thoroughly practical advantages are successfully achieved. It will be seen that my composition is well adapted to withstand the many varying conditions of actual operational use in many applications, particularly as a mold composition in the production of thick, heavy castings.

As many possible embodiments may be made of my invention and as many changes may be made in the embodiments hereinbefore set forth, it is to be understood that all matter described herein is to be interpreted illustratively and not in a limiting sense.

I claim:

1. In compositions of matter of the class described, a foundry composition comprising in combination, sand, a montmorillonite clay and a substantial amount of silica flour.

2. In compositions of matter of the class described, a foundry composition comprising in combination, sand, a substantial amount of silica flour and a clay binder largely comprising non-swelling colloidal montmorillonite.

3. In compositions of matter of the class described, a foundry composition comprising in combination, 95% to 60% sand, 2% to 25% silica flour and 3% to 15% clay largely comprising non-swelling colloidal montmorillonite.

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