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MOLDED PRODUCT

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This invention relates to molded products, and particularly to a composition for molding which has as its principal ingredient sand or other similar granular or powdery substance.

5 The invention is adapted to the manufacture of various types of products which may be molded from sand to produce articles that are highly resistant to either heat or moisture. For example, fire bricks, ornamental pottery, ornamental building stones and the like may be made by the process of this invention.

10 One very extensive use of a molded sand product is the manufacture of cores for metal casting purposes, and as the present invention is particularly well adapted to this use, the following description of the invention will be more or less confined to this particular application. The manner in which the invention may be applied to other than this specific use will however be apparent.

15 In present foundry practice, hollow castings are made by pouring metal into a sand mold in which a sand core is supported to occupy the position corresponding to the hollow portion of the completed casting. The core is usually constructed of ordinary molding sand, with ingredients added to facilitate molding the sand to a definite shape and permit baking the core to render it sufficiently hard and firm to stand up under the pouring of molten metal, yet friable enough to be readily broken out of the completed casting.

20 The principal ingredient used for this purpose is vegetable oil, to which is added other materials to make what is known to the trade as "core oil." There are many varieties of core oils on the market for this purpose, all of which are supplemented in foundry practice by various special molding sands, powders, flours and the like, in an attempt to produce a satisfactory core. The vegetable oils used, as well as many of the other ingredients, are costly, and the results produced are neither uniform nor dependable.

25 It is the object of the present invention to provide a molded product such as may be used for a core and which is made entirely of inexpensive ingredients and that will produce a uniform, firm core; and to provide a core material that may be satisfactorily baked or cured with considerably less heat and in less time than is possible with materials known at the present time.

30 A further object of the invention is the provision of a molded product consisting principally of sand and a siliceous binder which will be highly resistant to destruction by either heat or moisture. Thus cores made in accordance with my inven-

tion are sufficiently resistant to moisture that they do not disintegrate in a moist atmosphere, and sufficiently resistant to heat so that they do not fall apart upon casting the molten metals. As is well known, cores made with sodium silicate alone are subject to both these faults, and, as a matter of fact, sodium silicate alone cannot be used as a binder for cores for these reasons. The difficulties encountered with hygroscopic cores are described in the Hanley patent, U. S. No. 1,673,356. My cores, however, are not so hard that they will cause cracked castings. On the contrary, extensive experiments in foundry work have shown that fewer failures are obtained with my binder than with any other binder known to me.

I have discovered that a satisfactory molded core may be made by mixing with common molding sand an alkali metal silicate, an alkali metal fluosilicate, and either an acid or an alum. It is preferred that the materials used for this purpose be such as are available at relatively low cost. Sodium silicate and sodium fluosilicate meet this requirement and are typical of the alkali metal silicates and fluosilicates that may be used. Aluminum sulphate is an example of an inexpensive alum-like substance that is suitable for the purpose of the present invention. In making cores, I first prepare a solution in the proportions of about

Water	-----gallons--	2
Aluminum sulphate	-----ounces--	1-10
Alkali fluosilicate	-----do-----	1-10
Alkali metal silicate	-----gallons--	1-10

The solution made within the limits of the above formula should be a clear liquid of approximately 30° to 32° Baumé. One part by volume of this solution is then mixed with from 5 to 60 parts of common molding sand, depending upon the use for which the product is being made. A core material made in this manner is readily molded into any desired shape, and upon being baked at, say, 200° F. for twenty minutes to two hours, is firm and dry and of superior quality to cores made with the more costly vegetable oils and other materials, which cores generally must be baked or cured for a period of from two to twelve hours at comparable temperatures. It is, as a matter of fact, unnecessary to bake the product made in accordance with my invention, as exposure to the atmosphere at normal temperatures will, in a few hours' time, produce the desired effect. Baking, of course, hastens the curing of the cores.

While the above formula is satisfactory for cores to be used with most metals, it is sometimes desirable in the casting of metals having extremely high melting points, such as certain types of steel, for example, that cores be given an additional hardness, and I have discovered that the product of my invention is rendered extremely hard by the addition of a small quantity of a compound of boron. For example, borax (sodium tetraborate) may be added in quantities of about one ounce to one gallon of the above solution to render the resulting product sufficiently hard to give unusually good results in casting metals having very high fusing temperatures.

The customary reinforcing of iron wire or the like may be used in cores made in accordance with my invention, but as my cores are firmer and less friable than ordinary cores, reinforcing may be eliminated in many instances where it would otherwise be necessary.

I have also discovered that mineral oils, which are ordinarily unsatisfactory in the manufacture of cores because of the fact that they do not cure or dry, are usable with the solution set forth in the above formula, and that a mixture of said solution with mineral oil will produce a satisfactory core. This discovery is important because of the fact that mineral oils are much less costly than vegetable oils which are used in core manufacture, and the present invention therefore provides a market for inexpensive grades of mineral oil. While at current market prices mineral oils are most costly by the gallon than the solution used in my invention, it is possible that the use of mineral oils with the solution may reduce the total amount of liquid employed in mixing with sand to produce a satisfactory core material, to the extent that mineral oils used with my solution may be used at no greater ultimate cost than if the solution were to be used alone.

I have referred to sand as one ingredient of my core, and it should be understood that the term "sand" as used in the foregoing specification and in the appended claims refers to any type of molding sand or other granular material that is capable of being molded when moist.

The product made according to the method described above, like all cores and similar molded products, occasionally has a slight tendency to adhere to the core box or wooden mold in which it is formed. This tendency, while considerably less in cores of the present invention than in conventional cores, must be overcome whenever it is found to exist at all, and I have discovered that the addition of a small quantity of glycerin or oil, say about one part of glycerin or oil to 500 parts of the above described solution, will satisfactorily prevent the adherence of the core material to the core box.

Burning of the core due to impinging of molten metal during the pouring operation, which is ordinarily prevented by a coating of specially prepared substances for this purpose, which are formed principally of graphite, asbestos, etc., may be prevented by the application to the surface of the completed core of a core paint made up of a mixture of my solution with diatomaceous earth. The diatomaceous earth may be mixed with the solution to obtain a consistency varying from a fluid, which may be sprayed or painted onto the surface of the core, to a pasty substance, which may be applied by smoothing on with a spatula or the like. In either extreme, the result is the

provision of an extremely hard, smooth external surface which is highly resistant to the deleterious effect of molten metal being poured against the core.

Many attempts have heretofore been made to use compounds of silicon as a binder for molded products, but have proven unsatisfactory because the binder breaks down under the influence of either heat or moisture. In the present invention, however, even though sodium silicate is the principal ingredient of the binder, neither moisture nor heat will destroy the molded product.

The invention is also adapted to the manufacture of the straight cylindrical cores, known as shop cores, by the extrusion process, and produces a core that will not warp or bend, upon absorbing moisture, after it has been cured.

As is well known, there are generally two types of water-soluble sodium silicates, namely, those in which the ratios of $\text{Na}_2\text{O}:\text{SiO}_2$ are 1:2 and 1:3, respectively (Thorpe: Dictionary of Applied Chemistry, Supplement, vol. 2, 1935, page 377). The latter is more difficultly soluble in water. However, as long as it can be dissolved in water, it may be used, and other differences, for instance, in the content of water of crystallization as between sodium metasilicate and sodium pyrosilicate, are immaterial as far as my purpose is concerned.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A baked molded product of sufficiently high tensile strength to be used as a core for metal casting purposes and having a high degree of resistance to heat and moisture comprising a mixture of sand and a binder which comprises an aqueous solution of an alkali metal silicate, an alkali metal fluosilicate and a compound of boron.

2. A molded product of sufficient high tensile strength to be used as a core for metal casting purposes and having a high degree of resistance to heat and moisture comprising a mixture of sand and a binder which comprises an aqueous solution of an alkali metal silicate, an alkali metal fluosilicate, aluminum sulfate and a compound of boron.

3. A baked molded product comprising sand and a binder which comprises a mixture of a mineral oil, an aqueous solution of a water-soluble alkali metal silicate, and an alkali metal fluosilicate.

4. A molded product of sufficient high tensile strength to be used as a core for metal casting purposes and having a high degree of resistance to heat and moisture comprising a mixture of sand and a binder which comprises an aqueous solution of an alkali metal silicate, an alkali metal fluosilicate, aluminum sulphate and a mineral oil.

5. In the manufacture of a baked product of sufficiently high tensile strength to be used as a core for metal casting purposes the steps comprising adding a binder consisting of an aqueous solution of an alkali metal silicate, an alkali metal fluosilicate and a compound of boron to sand and molding and baking the resulting mass.

6. In the manufacture of a baked product of sufficiently high tensile strength to be used as a core for metal casting purposes the steps comprising adding a binder consisting of a mineral oil, an aqueous solution of a water-soluble alkali metal silicate and an alkali metal fluosilicate to sand and molding and baking the resulting mass.