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FOUNDRY MOLD COATING

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This invention relates to foundry structures, such as cores and molds, and more particularly to a new and improved bonding agent therefor, and to the method of preparing foundry structures utilizing said bonding agent.

The practice in making foundry structures for the casting or molding of high melting point metals has been to prepare a foundry structure mix of some suitable comminuted refractory material, such as sand; embodying a binding agent therein which may be any one or a combination of, clay, molasses, dextrin, sulfite paper liquor, rosin, cereal, etc.; adding sufficient liquid, such as water, to make the mix workable; and forming the structure in an appropriate pattern. The foundry structure thus prepared may be used as such, i. e., green, or, where greater strength is desired, the structure may be dried by baking, torch drying, or simply air drying.

Foundry structures prepared in accordance with the general practice as indicated hereinabove also have been surface treated with binders in solution, or as a dispersion with a suitable liquid medium which may contain an admixed refractory facing material.

The incorporated binders have served the purpose of imparting greater strength to the structures to withstand handling and pressures exerted during the casting of metals therein and thereabout, and at the same time they have been of such character as to permit fairly easy removal of the core material after cooling the casting. However, bonding agents have been used and in such amounts as to give structures with such high strength as to result in cracked castings; this has constituted a substantial loss, especially in the casting of lighter metals. The binder should leave the structure porous enough to allow escape of the gases formed as well as a certain amount of expansion, during the casting process. The failure of some binders to function thus often has resulted in blowing of the core or mold gases out of the structure face adjacent the poured metal with resultant formation of blow-holes in the metal.

The practice of using green cores and molds to prevent "blowing," besides the disadvantage of lacking strength, has the drawback of the liability of the body material of the core or mold being washed into the flowing molten metal during the casting operation.

In order to overcome these and other disadvantages cores and molds have been surface coated with bonding agents, with and without highly refractory materials, such as graphite,

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plumbago, silica flour, etc., followed by suitable drying in a core oven, torch drying, air drying, etc.

Bonding agents used as surface binders should be sufficiently gas permeable to permit of easy escape of entrapped air; should impart sufficient mechanical strength to the structure; should permit of easy removal of the structure from the casting surface; and should function to protect the molten metal from action with any constituent of the structure. Lack of knowledge as to what causes certain phenomena in the utilization of foundry structures in casting operations indicates there are probably other important functions binders should serve, such as the minimizing or elimination of pinhole formation.

The formation of pinholes in cast metals has constituted a serious problem to the foundry industry, in the case of both ferrous and nonferrous foundry work. A number of facts associated with pinhole formation have been established, but no entirely satisfactory explanation has been found. This formation of pinholes is especially serious in the case of the light and chemically reactive metals, such as aluminum, where hydrogen may be formed quite readily by reaction of the metal with hydrogen-containing substances.

Pinholes may have a great effect directly upon the mechanical strength of the metal casting. Furthermore, the presence of pinholes in castings of such chemically reactive metals makes them subject to the corrosive action of the atmosphere and other gases, as well as liquids, with which they may come in contact, thereby contributing to mechanical failures. With the rapid expansion of the production and uses of these metals with the attendant requirements of high quality standards in such industries as aviation, and others, the demands placed upon foundry structure binders, especially in regard to minimizing loss due to pinhole formation, have not been met completely.

Now, in accordance with this invention, unexpected and highly advantageous results have been obtained in metal casting by using foundry structures comprising as a bonding agent therefor halogenated derivatives of certain hydrocarbons. It has been found that halogen derivatives of paraffin waxes possess marked advantages over other binders for foundry structures, especially when they are applied to the surface of the foundry structure to produce thereon a surface coating and binding agent. These halogenated derivatives of paraffin waxes have been used in

preparing foundry structures, and the structures thus treated in accordance with the invention have been found to be superior to those prepared by prior art methods, and especially inasmuch as metal castings prepared therewith are substantially free of pinholes.

Having now indicated in a general manner the nature and purpose of this invention, the following examples of preferred embodiments thereof, describing the invention in more detail, are given for the purpose of illustration.

EXAMPLE I

Cores were prepared from the core mix indicated in Table 1 below, and baked for one hour at 325° F.

Table 1

New Jersey No. 60 silica sand	grams	3000
Gelatinized starch binder derived from cereal	grams	30
Resin binder	do	30
Water	do	145
Mixing conditions: 3 minutes dry—3 minutes water—3 minutes resin binder.		
Moisture determined	percent	4.1

Baked cores prepared as described above were sprayed with a solution which was 15% chlorinated paraffin wax (containing 70.6% chlorine) in a petroleum hydrocarbon solvent mixture boiling over the range 93–135° C. and were air dried for different time periods. The resulting scratch hardness and plow hardness for these sprayed cores are tabulated in Table 2 below:

Table 2

Time of Air-Drying, Hr.	1	2	3	5	(Unsprayed Core)
Scratch Hardness No.	80	85	85	88	58
Plow Hardness No.	85	90	90	90	48

Surfaces and edges were firm and smooth.

Other cores prepared and sprayed in the same manner, except for being torch dried, exhibited a scratch hardness number of 82 and a plow hardness number of 88, as compared with 58 and 48, respectively, for unsprayed and untorched but oven-baked cores.

EXAMPLE II

The following solutions were prepared for use as sprays on foundry structures.

	Example A	Example B	Example C
	Parts	*Parts*	*Parts*
Pine Wood Resin Substantially Petroleum Hydrocarbon-Insoluble [1]	15	8	
Ethyl Cellulose (100 centipoises)		2	
Chlorinated Paraffin Wax (70.6% chlorine)			15
Solvesso No. 1 (aromatic-containing hydrocarbon solvent)	68	68	85
2B Alcohol	17	17	

[1] Prepared in accordance with the procedure described in U. S. Letters Patent 2,193,026 to Lucien C. Hall.

The above-prepared sprays of Examples A, B, and C were sprayed on a critical portion of the surface of separate foundry structures which had been bonded with a polymerized petroleum oil and cereal and baked for five hours at 450° F.

All the sprayed portions air dried in about five minutes to form hard films on the sprayed surface. An aluminum alloy casting was cast in

each of the sprayed molds and after cooling the castings were shaken out and sand blasted.

The following Table 3 lists the results obtained with regard to pinholing in the portion of the casting that was formed adjacent the portion of the foundry structure treated as described hereinabove.

Table 3

Spray	Appearance of Metal After Sand Blasting
Example A	Poor—numerous pinholes.
Example B	Do.
Example C	Excellent—substantially free of pinholes.

It has been shown in Example I above that the use of a spray comprising about 15% of paraffin wax chlorinated to the extent of about 70% chlorine, in a suitable solvent therefor, when applied to the surface of foundry structures, gives a surface of greatly improved hardness. Furthermore, and much more important, is the fact, as demonstrated in Example II, that metal castings cast in and about foundry structures surface-treated with chlorinated paraffin wax in accordance with this invention are substantially free of pinholes, as contrasted with the presence of numerous pinholes in the corresponding portion of castings prepared in and about foundry structure surfaces treated with other surface bonding and coating agents.

The preferred core and mold spray, comprising a solution or suspension of chlorinated paraffin wax in a volatile solvent, will contain about 15% chlorinated paraffin wax and about 85% of a volatile solvent, such as aromatic hydrocarbons, esters, ketones, chlorinated solvent, petroleum hydrocarbon products high in aromatics such as Solvesso No. 1, and similar materials. The chlorinated paraffin wax is also soluble in turpentine, pine oil, and dipentene. While alcohols and mineral spirits are limited in solvent power for halogenated derivatives of paraffin wax, they may be used as diluents and dispersion media. This invention is not to be limited to a 15% solution of the halogenated compound as other concentrations are equally applicable. The concentration which may be used will depend on the amount which can be applied to give a uniform coat and the desired freedom from pinhole formation.

Although the preferred chlorine content of the chlorinated paraffin wax is from about 40% to about 80% chlorine, beneficial results are obtained when the chlorine content is from about 30% to about 85%.

It is well recognized that unsoundness in aluminum and its alloys is due almost entirely to the liberation of hydrogen, which is soluble in the molten metal to the extent of 0.23 cc., 0.87 cc., and 1.87 cc. per 100 grams of metal at 700° C., 800° C., and 900° C., respectively, and is virtually insoluble in the solid metal. When the molten metal is saturated with hydrogen, a certain amount is liberated in bubble form during the early stages of solidification, and escapes, but the gas responsible for unsoundless is that given off when solidification is nearly complete. This gives rise to the formation of irregular cracks and voids in the interstices of the dendrites and these are known as pinholes. It is suggested that the minimizing of pinhole formation in aluminum castings when aluminum and its alloys are cast in and about foundry structures prepared in accordance with this invention is due to the interaction of the hydrogen that is forced out of solu-

tion in the metal, with decomposition products of the chlorinated paraffin wax.

Among the advantages of the present invention is substantial elimination of pinhole formation in castings of metals, such as aluminum and its alloys, and the preparation of foundry structures with improved surface hardness. A further advantage in the use of chlorinated paraffin wax for preparing a foundry structure in accordance with this invention is the economy of time and labor involved in applying the chlorinated paraffin wax to the structure, since neither the concentration of chlorinated paraffin wax in the treating medium, nor the amount of chlorinated paraffin wax used in the surface treatment of the foundry structure is critical to obtain the desired result.

Scratch hardness and plow hardness as given in the examples were determined using an instrument manufactured by the Harry W. Dietert Company of Detroit, Michigan, called the core hardness tester. The hardness of the core is determined by pressing the core hardness tester against the surface to be tested. The hardness of the surface is indicated on a dial, the degree of hardness being measured by the depth of the scratch produced by a Carboloy cone point, in the case of scratch hardness, and by a Carboloy plow in the case of plow hardness, the depth being inversely proportional to the hardness of the core. The plow or cone is spring-loaded so that the indicator reads 100 when the plow is flush with the surface of the plate and reads 0 when the plow protrudes 0.10 inch beyond the plate. The dial readings are purely relative.

What we claim and desire to protect by Letters Patent is:

1. A foundry core or mold, the comminuted refractory mold material of which is bonded with a binder, and the surfaces of which comminuted refractory mold material are smoothly coated with a surface binder consisting of a chlorinated derivative of paraffin wax containing from about 30% to about 85% combined chlorine.

2. The method of making a foundry core or mold comprising preparing a foundry core or mold mixture containing a comminuted refractory mold material as a major component thereof and a binder as a minor component thereof, forming a foundry core or mold therefrom and coating the surface of the core or mold with a surface binder consisting of a chlorine derivative of paraffin wax containing from about 30% to about 80% chlorine, the amount of the chlorine derivative of paraffin wax being sufficient to give a uniform coat.

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