Patented Dec. 13, 1949

2,491,006

# UNITED STATES PATENT OFFICE

2,491,006

## METHOD OF CONDITIONING FOUNDRY SAND

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No Drawing. Application August 15, 1947, Serial No. 768,941

7 Claims. (Cl. 22—217)

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My invention relates to a method of producing such compositions of matter as have particular application to foundry sands and foundry compositions.

One object of my invention is to provide a method of preparing foundry sands to impart thereto the advantageous qualities of high green strength, ready flowability, ease of ramming, and substantial freedom from burning on and sticking to the castings, coupled with a high degree of porosity so that little blasting or grinding of the castings is required in treatment subsequent to pouring, which method is at once simple, rapid and certain in its faithfully reproducible results, being economical and involving labor demands of but limited skill in the performance of its few manipulative steps. Properly effected, my method provides treated foundry sands which are readily incorporated with small quantities of suitable conventional foundry binders to provide foundry compositions displaying high green strength, required low retained strength, and high permeability, and readily flowable for easy tamping about the patterns.

Another object is to provide a method of reclaiming used foundry sands and mold compositions, to condition them for further use and for achieving the same advantageous results as set forth in the preceding recitation of objects.

Other objects in part will be obvious and in part more fully pointed out during the course of the following description, all taken in the light of the accompanying claims.

My invention accordingly may be seen to reside in the several procedural and manipulative steps, and in the association and interrelation of each of the same with one or more of the others, the scope of the application of all of which will be more fully set forth hereinafter.

As conducive to a more thorough understanding of my invention, it may be noted at this point that foundry practice, constituting one of the most important bulwarks of our heavy industries, has long been confronted with the problem of producing satisfactory molds for foundry use, as in the pouring of castings. In such foundry practice high green strength is required, so that the mold will not collapse under its own weight, and, as well, will withstand and hold up against the weight and impact of the molten metal as it is poured into the flask. Additionally, sufficient porosity must be imparted to the composition that the hot vapors and gases which are almost instantaneously produced and driven off

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when the molten metal is poured, will readily escape through the mold, without affecting the physical characteristics or conformation of the latter. Any localized blocking of such venting will result in surface defects or blow holes in the casting.

Moreover, the material from which the mold is to be formed must be capable of ready flow, so that it may be tamped tightly about the pattern and have imparted sharply thereto the outline of the latter. It is necessary that the foundry compositions display high green strength to permit imparting thereto this highly sharp definition which is so necessary for the formation of castings of faithfully reproduced detail. This is particularly true where the surface details of the pattern to be reproduced in the castings are of small section.

Finally, the detrimental phenomenon has frequently been observed that the sand would stick on or burn or fuse to the metal castings, accompanied by the formation of scale and surface oxides. This constitutes a matter of serious importance and presents grave difficulties to the art. Although the metallurgy is not fully understood, possibly it is the moisture present in the sands which gives rise to a predominantly oxidizing atmosphere when the metal is poured. This perhaps gives rise to energetic oxidation, with accompanying formation of scale. In any event, a low melting point iron silicate is formed when the molten metal is poured against the sand, causing the sand to adhere to the castings, and making the cleaning of the castings slow, difficult and costly. Moreover, the mechanical pressure created by the flashing of this moisture into steam probably conduces to poor flow and lay of the metal within the mold. Blow holes frequently are encountered as an incident to this undesirable phenomenon. It is highly desirable to have this steam held to a minimum and quickly vented to the exterior.

Over a long period of time, the workers in the art of foundry practice have striven to remove in substantial measure the many disadvantages and defects confronting them and to improve upon the green strength of the composition, while maintaining the dry strength and retained strength within required limits. Further objectives have been to increase the porosity and to improve the flow and tamping qualities, and to produce castings of sharp detail characterized by the absence of detrimental scaling and burning on of sand from the composition, and hav-

ing surfaces so nearly smooth that but little subsequent grinding is required.

Much research has been directed towards these objectives. Attempts have been made to mix dry sea coal and sea pitch with suitable foundry sands, so as to coat the particles of the latter and to aid in the production of a reducing atmosphere while the metal is poured. These efforts have been only partially successful, however, due in large measure to imperfect, spotty and inefficient dispersion of these cast-cleaning agents.

Attention has also been directed to coating the sands through the use of improved non-thermal setting, carbonaceous coating materials suspended in a coating solvent. The highly technical nature of this procedure, however, with its high cost of materials and poor recovery of solvent, as well as uneconomical time requirements, have been an obstacle to its acceptance in the art, despite the production of clean castings of sharp definition.

An important object of my invention, therefore, is to provide a method of producing foundry sands and foundry compositions which, in rapid, ready and efficient manner, with minimum cost of materials, machinery, and labor, will provide a thin protective coating of uniform thickness on each and every particle of sand; a further objective being to provide a method similar to that just described for producing foundry compositions having the aforementioned desirable properties, coupled with high green strength, desired low retained strength, ready permeability and high degree of porosity, displaying ready flow and tamping qualities and freedom from burning on or sticking to the finished castings, and giving rise to castings of high accuracy in surface detail and sound in all respects; a final object being to provide a method of reclaiming used foundry compositions of the type described and conditioning them for satisfactory reuse.

My invention may be envisioned as comprising mixing a suitable foundry sand in a mixer at an elevated temperature with a suitable heavy petroleum residue, non-thermal setting in nature, preferably a high carbon, low hydrogen hydrocarbon. I find it to be imperative first to heat the sand as in a mixer, or previous to adding to the mixer, until substantially all moisture is driven off and the sand is brought to a temperature of approximately 400° F. to 500° F. I then add the hydrocarbon residue and find that as the sand is agitated in the mixer, the heat of the sand melts the hydrocarbon so that the latter flows freely about the sand and uniformly coats the particles thereof. The thickness of this coating can be closely controlled by the proper selection of the quantity of petroleum residue which is added to the mix in proportion by weight to the quantity of sand which is present. The coating is hardened and fixed to the grain by cooling the sand. In similar manner, the exact nature and characteristics of this treated sand can likewise be closely controlled by the precise selection of the particular petroleum residue which is employed. Suffice it to say I observe that the sands thus produced display much more uniform coating, without the detrimental spotiness and irregularity of the coating which is brought about according to the prior practice of mixing dry powdered sea coal, sea pitch or hydrocarbon with foundry sand. The extremely poor coatings on the surface of the sand, as is evident under microscopic study, are substantially avoided by the practice according to my new method.



Compared with the use of a coating material comprised of a hydrocarbon suspended in a solvent, I observe that the results achieved by my new method are equally satisfactory, and, as well, possess the added advantages of greatly increased simplicity and rapidity and very greatly reduced costs. For example, it has been found that about 30% of hydrocarbon is the maximum which may be dissolved in aromatic solvent without creating excessive viscosity. If 5% of this solution at a cost of $.07 per pound is used in coating sand, we obtain a coating amounting to 1½% of the weight of the sand at a cost of $7.00 per ton of sand. By my invention, the direct addition of 1½% hydrocarbon at a cost of $.04½ per pound gives exactly the same coating at a cost of $1.35 per ton of sand.

The sands produced in accordance with my invention in themselves display appreciable green strength and modest dry strength. It is customary to add to them conventional clays or other binders plus sufficient water to make the binders workable. The sands are adequately porous, and display exceptional flow and tamping qualities, packing tightly about the pattern and giving rise to a casting of sharp definition. The sands do not fuse on or burn to the castings, and the castings are produced sound, free from surface defects or scale, and, as well, from undesirable blow holes. Apparently, a reducing atmosphere is produced at the time that the metal is poured, so that the formation of undesired iron oxides is suppressed. Silicate formation is likewise avoided. The surface purity of the castings is increased. The sands, upon burning or baking, do not bake into clods or other debris which are substantially unrecoverable. Rather, when the mold is broken away from the casting, the sand collapses into particles which are perfectly fit for reuse. The sand is conditioned for reuse by adding a small amount of hydrocarbon in dry form to heated sand.

As a still further advantageous point, I find that through the addition thereto of a small quantity of kerosene, the already high green strength of the sand is greatly improved without any appreciable diminution in the other qualities. I am unable to explain just why this phenomenon exists, but have definitely established the validity thereof through repeated tests. More will be said about the addition of kerosene at a later point herein.

Referring now to a specific example of the practice of my invention, I take a substantial batch of sand, say a substantial fraction of a ton up to several tons, and heat the same until substantially all moisture is driven off. The sand is then brought to a temperature of about 400° F. to 500° F. I add an inexpensive heavy petroleum residue such as asphalt, asphaltile, tar or carbonaceous resin. This ordinarily is in powder form. The amount employed is approximately one-half percent to five percent by weight of the total amount of sand present. The exact amount of petroleum residue employed depends upon the class of work to be done. If heavy castings are to be made, the quantity of non-thermal setting petroleum residue is greater while if small castings are to be made, the quantity of petroleum residue is less. In a preferred embodiment I employ petroleum residues in the amount of two percent by weight of sand.

Although entirely satisfactory results are

achieved by preheating the petroleum residues to a temperature below that of the sand prior to mixing therewith, I find that most advantageous results are achieved by simply employing dry petroleum residue at room temperature and mixing this with the heated sand. The heat of the sand is sufficient to melt the petroleum residue, and intimate admixture thereupon takes place so that the coating is thin and uniform.

The admixture of a suitable organic material such as kerosene is advantageous in the amount of one-half percent or less by weight of the sand, and, totally contrary to the case where kerosene is mixed with untreated sands, is found to give improved green strength, as heretofore pointed out. By contrast, it may be noted that the admixture of kerosene to a conventional mix will reduce the green strength to such point that the sand will be too weak for practical purposes. When the kerosene is added, however, to sands treated with petroleum residue, the green strength is improved, so that less foundry binder is required. Porosity is improved. Further, the kerosene makes the sand less subject to drying out, and resistant to any crumbling at the corners. Additionally, I find that the kerosene adds notably to the flowability of the sand, so that ramming and molding of the sand about the pattern can be accomplished with greater rapidity; and reduces the dry strength, so that tendency towards lumping is lessened.

With the treated sand obtained in the manner as heretofore pointed out, I find it desirable to add additionally to the desirable qualities thereof, to adapt it for the particular molding problem encountered, as by the addition of a small quantity of some suitable binder. A highly advantageous consequence of the practice of my invention is that the coated sands, I find, blend readily with the conventional binders to give rise to predictable good results attendant upon such practice. In a typical instance, I plan to add to the treated sand such binders as may be necessary for the molding strengths required. Refractory or non-refractory clays may be employed.

In making a foundry mold composition employing my treated sand I, for example, add two to four percent of southern bentonite, or two and one-half percent to five percent of western bentonite, or six to twelve percent fire clay depending upon the particular mold properties sought. The southern bentonite, colloidal and non-swelling in nature, gives rise to high green strength and low dry strength. The western bentonite, colloidal and swelling upon the admixture of water, is accompanied by lower green strength and higher dry strength. The fire clay has certain characteristic qualities which are well recognized in the art. Although these binders have been suggested as typical, cereal binder, silica flour, wood flour, or other agents may be added, if desired, in varying amounts. No casting-cleaning agent is required, however, such as sea coal and pitch, the coated sands serving adequately for this purpose.

I find that molding compositions thus produced will flow far more readily than conventional sands thus giving notably increased production and, at the same time, possessing high green strength with substantial porosity. Additionally, and most important, such compositions will not fuse or burn onto the castings during the subsequent pouring operation. Vastly improved results and great reductions in cleaning costs are achieved through the medium of procedural and manipulative steps which are simple in themselves and requiring minimum use of inexpensive materials, which ingredients are in large measure recouped for further use.



It has been suggested hereinbefore that recapture of a substantial part of the treated sands is achieved, for subsequent treatment and reuse. The recaptured compositions are screened and reheated in a mixer with the addition of from one-tenth to three-fourths of one percent of the petroleum residue by weight of sand thus treated or they may be treated with equal quantity of the petroleum residue in solution.

It is apparent from the foregoing that the practice of my invention provides a thin uniform coating of heavy petroleum residue, non-thermal setting in nature, on each particle of sand. Without affecting the porosity of the sand so that the gases and vapor incident upon pouring the metal may be readily vented, this thin coat admirably serves the functions of preventing excessive penetration of the molten metal into the sand, and of providing, at the same time, a reducing atmosphere such as will prevent the formation of detrimental scale on the coating and will avoid burning on of the sand particles onto the castings. In short, casting rejects are reduced to a minimum and cleaning costs greatly reduced. The sands thus treated tamp readily about the pattern and flow easily into position, so that molds of sharp definition are easily achieved.

The treating method is simple, rapid and requires only a minimum of labor, itself of but moderate skill. The manipulative steps are few and simple. The sands thus treated are found, after use, to retain a substantial part of their initial petroleum coating. Since there is little tendency to form clods or lump debris, the sands are in large measure recoverable, and are readily reconditioned for subsequent reuse by a simple and inexpensive manipulative step wherein additional petroleum product is added to restore the sands to their original condition. The addition of kerosene is found to give greatly improved green strength so that satisfactory foundry compositions may be produced with the use of a smaller additive of binders. The porosity is thus improved. There is less tendency for the sand to dry out. The sands are tougher and crumbling at the corners is resisted. The sands may have added thereto conventional binders such as are requisite in the art, with predictable good results.

Finally, substantially all tendency of the sands to burn on or stick to the castings is effectively suppressed, so that clean, sound castings are produced, of perfect surface detail and requiring but a minimum of subsequent cleaning, or grinding, and this through the use of a process which is simple, rapid, economical and certain in results.

It is apparent from the foregoing that many embodiments of my invention will readily suggest themselves to those skilled in the art, once the broad aspects are disclosed, and that similarly, many modifications of the present embodiments will likewise be evolved, all falling within the scope and sphere thereof. Accordingly, I intend the foregoing description to be considered as merely illustrative and not by way of limitation.

I claim:

1. The method of conditioning sand for foundry purposes comprising heating the sand to a temperature of approximately 400° F. to

500° F., and while at said temperature intimately admixing with the sand a heavy non-thermal setting petroleum residue in powdered form, thereby melting the residue and providing a thin coating of the latter on the particles of sand.

2. The method of conditioning mold sand comprising heating the sand to a temperature of about 400° F. or more, and providing a thin coating of a heavy non-thermal setting petroleum residue on the sand particles by intimately admixing with the sand at said temperature, said residue in powdered form and in comparatively cold condition and ranging in quantity from about one-half percent to five percent of the total weight of the sand.

3. In preparing a mold sand for foundry purposes the art which comprises raising the sand to a temperature of about 400° F. to about 500° F., and thereupon and while at said temperature admixing therewith approximately two percent by weight of a heavy non-thermal setting petroleum residue in relatively cold condition, thereby providing a thin coating of the latter on the particles of sand.

4. The method of conditioning mold sand comprising heating the sand to a temperature of about 400° F. to 500° F., intimately admixing with the sand at said temperature a heavy non-thermal setting petroleum residue in relatively cold condition and ranging in quantity from about one-half percent to five percent of the total weight of the sand, and further adding kerosene to the composition in the amount of about one-half percent by weight of the sand.

5. In preparing a mold composition for foundry purposes, the art which comprises heating sand to a temperature of 400° F. to 500° F., admixing with the hot sand a comparatively cold non-thermal setting petroleum resin in the



amount of ½% to 5% by weight of sand, adding kerosene in an amount up to ½% by weight of sand, and thereafter adding a small amount of binder for increasing the green strength.

6. In preparing a mold composition for foundry purposes, the art which comprises heating sand to a temperature of 400° F. to 500° F., admixing with the hot sand a non-thermal setting petroleum resin in powdered form, and thereafter adding a small amount of binder for increasing the green strength.

7. The method of conditioning for reuse mold sand which has initially had applied thereto a thin coating of a heavy non-thermal setting petroleum residue, comprising heating the coated sand to a temperature of 400° F. to 500° F., and while at said temperature admixing with the sand approximately one-tenth of one percent to three-fourths of one percent by weight of heavy petroleum residue in powdered form.

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