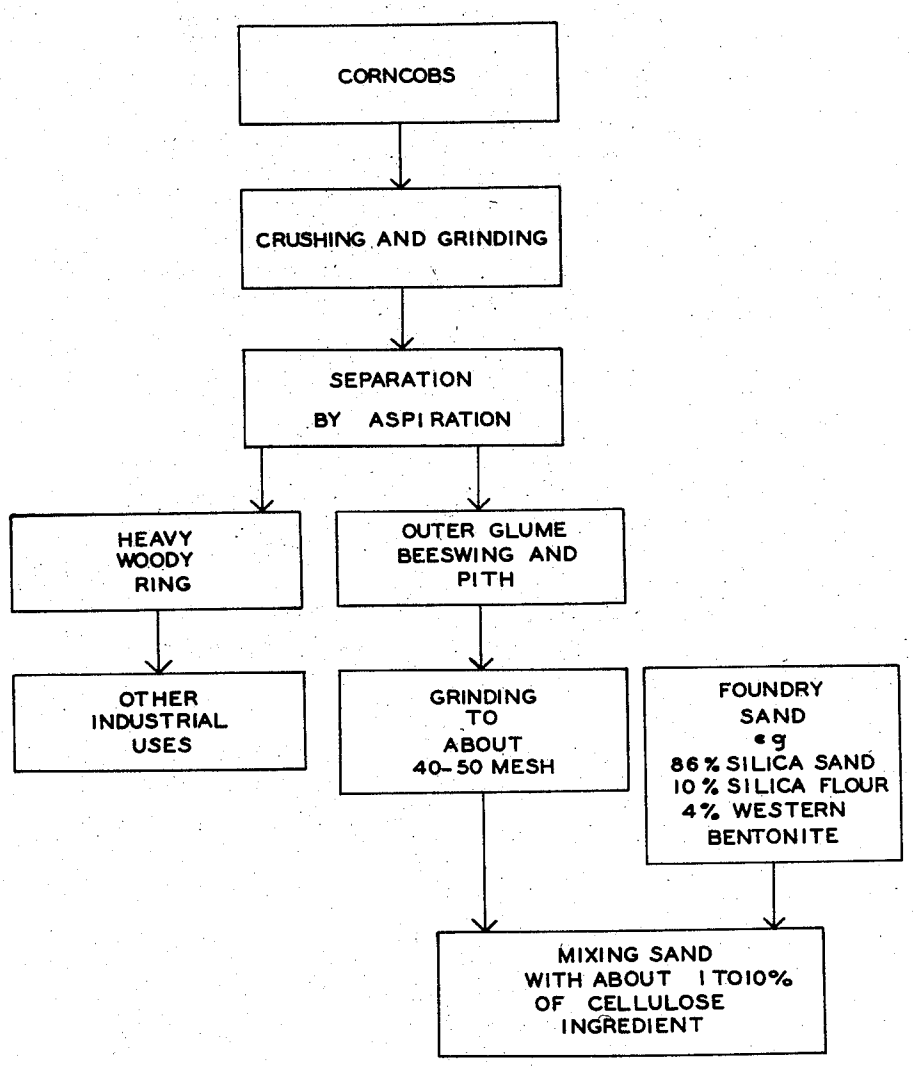
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BINDER FOR FOUNDRY SAND MOLDS AND PROCESS OF FORMING

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# BINDER FOR FOUNDRY SAND MOLDS AND PROCESS OF FORMING

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The invention disclosed and claimed in this application relates to sand mixtures with organic cellulose carbonaceous additives for use in preparing foundry sand molds and cores. We have discovered a new composition of matter for forming such sand molds and cores which is superior in many respects to compositions previously used. This newly discovered composition of matter when used as a sand mold or as a sand core for casting purposes substantially reduces the incidence of a number of defects in casted metal. Also we have discovered a new method of forming such a composition.

In the use of sand cores (prior to the time that it became customary to add a cellulose additive thereto) there was extensive fusing of the refractory which caused scabbing, rat tailing and other defects in the metal castings. In such cases, the molten metal caused oxidation to take place whereby the sand fused to the casting surface. Moreover, heat was generated by the molten metal causing the moisture to be converted to steam and the steam pressure generated caused irregularities in the metal castings. The high temperatures created caused the sand to move about creating defects in the castings. It has now, however, become well known in the prior art that the addition of cellulose organic carbonaceous additives to the sand mold aids in eliminating the incidence of such defects in casting.

The addition of the cellulose organic carbonaceous additive to the sand of the sand mold and cores is of advantage in the following manner. When the hot molten metal comes in contact with the carbonaceous cellulose organic material, the heat causes a burning of the cellulose organic material thereby leaving void areas which not only permit the passage of steam into such void areas but also the expansion of the sand thereinto. It appears that this expansion of the sand into the void areas eliminates the movement of the sand on the surface of the casting. Because this movement of the sand on the surface is one of the major causes of scabbing, rat tailing, and defects due to defective peel, etc. the elimination of such movement eliminates also to a large extent the defects mentioned. Heretofore the carbonaceous cellulose organic additives generally used have been wood powder, (sometimes called wood flour) and powder of the hard woody ring of the corncob. While the use of these additives has lowered the incidence of rat tailing, scabbing, and has provided better peel characteristics, the composition of matter which we have discovered comprising a mixture of a foundry sand mixture and a powder formed from the beeswing, pith and outer glume portions of the corncob has certain advantages over all of the prior art mixtures.

One of the objects of our invention is to provide a more effective composition of matter for use as a sand mixture with organic cellulose carbonaceous additives, which substantially lowers the incidence of defects of the casted metal.

A further object of our invention is the provision of a



method of producing a more valuable composition of matter for forming sand molds.

Further objects and features of our invention should be apparent from the following specification and claims.

The figure is a flow sheet illustrating a process of our invention.

As stated above, wood powder and powder made from the woody ring of the corncob have been used to supply the carbonaceous cellulose organic material for mixing with foundry sand in the formation of sand molds and cores. However, to the best of our knowledge, the other parts of the corncob have not been used and neither has any mixture been used containing these other parts of the corncob.

Structurally, a corncob is composed of four constituent parts: these are (1) the outer glume, (2) the beeswing, (3) the woody ring, and (4) the pith. The outer glume, beeswing and pith portions of the cob in their natural state are much lighter in weight and much more absorbent than is the woody ring portion of the cob. Even when crushed to a size of approximately ⅜" and when ground to sizes of .02" and upwards such portions are still lighter and more absorbent than comparatively sized particles of said woody ring portion. A typical quantitative analysis of the proportions of cob fractions (air dry basis, approximately 12% moisture) shows that by weight the woody ring forms 60.3% of the whole cob, the outer glume and beeswing form 37.8% and the pith forms 1.9%.

In preparing the powder of the woody ring portion of corncobs, in accordance with the usual prior art practice, whole corncobs are first crushed, as for example in a reduction device (such as a conventional hammer mill), so that the crushed cobs are reduced to particle sizes enabling the woody ring fraction thereof to be readily separated from the beeswing, outer glume and pith. For example, the constituents of the cob may be reduced to particles of about ⅜" and smaller. Thereafter these are subjected to a classifier through which forced air (either blown in or drawn out) is blown whereby the lighter weight outer glume, beeswing and pith portions are removed from the heavy woody ring constituent. The heavy woody ring constituent is then ground separately to about 10 or 20 mesh and is used for various uses including the use in tumbling operations for polishing, and absorbing liquid, etc., from small metallic parts, etc. For this operation the material used must necessarily be of hard consistency such as that of the woody ring but for this use the beeswing, outer glume and pith are not useful. These softer parts have heretofore been often discarded. However, in grinding the woody ring fraction to the desired degree of fineness (i.e. 10–20 mesh) for the tumbling operation, necessarily smaller particles of such woody ring portion are broken off. These smaller particles of the hard woody ring have heretofore sometimes been used in providing a carbonaceous cellulose organic additive to foundry sand.

However, so far as we know, the softer, lighter weight elements have not been used for such carbonaceous cellulose organic additives nor has the whole corncob itself been used. We have found that these softer, lighter, constituents of the corncob have substantial advantages over the hard woody ring of the corncob for use as an additive to the foundry sand and that even when mixed with the particles of the hard woody ring of the corncob the mixture is preferable to particles of the hard woody ring alone. We prefer to use only the softer, lighter elements of the corncob (i.e. the outer glume, the beeswing and the pith portions) in the performance of the method of our invention. In separating the softer lighter elements of the corncob in accordance with the present invention the same procedure as that used above for separating the

hard woody ring may be used. For example, as shown in the figure, according to our invention whole corncobs are crushed, as in a reduction device such as in a conventional hammer mill, so that the crushed cobs are reduced to sizes of particles enabling the woody ring fraction thereof to be readily separated from the beeswing, outer glume and pith. As shown and as explained above, these constituents are then subjected to a classifier through which forced air is blown whereby the lighter weight outer glume, beeswing, and pith are removed from the remaining heavier constituents. After such separation and/or screening, the hard woody ring portion is separated for other industrial uses and the outer glume, beeswing and pith constituents are preferably reground by passage through an attrition mill, hammer mill, or other suitable type of grinder. Following such reduction, however, the product is then screened through 40–50 mesh or finer. In the screening operation and in the processing there can be anywhere from 1% to 25% of the hard woody ring particles left in the mixture, because the fine particles of the hard woody ring are dispersed during the grinding and screening operations previously mentioned. When the outer glume, pith, and beeswing have been reduced to 40 or 50 mesh or finer, the product, which is substantially composed of these three portions of the corncob, represents a most advantageous ingredient to be used as carbonaceous cellulose organic additives in green sand mold mixtures.

In practical commercial practice our composition of matter will be normally prepared by crushing corncobs and separating from the crushed corncobs all or a substantial portion of the hard woody ring. In our operations, we prefer to separate substantially all of such woody ring portion. However, if a substantial portion only should be separated, the processor would still be using the invention which we have conceived and which we have disclosed herein. After separating all, substantially all, or a substantial portion of the hard woody ring, our invention contemplates the grinding of the mixture consisting mainly of the beeswing, outer glume, and pith to a powder of the required degree of fineness (40–50 mesh or finer) and the mixing of this powder intimately with a foundry sand mixture. Thus our new composition consists (in this phase) of an intimate mixture of a foundry sand mixture and ground powder of corncobs from which a substantial portion of the hard woody ring has been removed.

We prefer not to mix other cellulose materials with this powder of outer glume, beeswing and pith but ground wood powder and ground powder of the heavy woody ring of corncobs and other cellulose materials may be mixed therewith in minor proportions without substantial harm. Also, as suggested above, minor proportions of fine particles of the heavy woody ring may remain unseparated within the powder. Following are examples of tests performed by us to indicate the value of our process and of our new composition of matter.

*Example I*

We prepared a foundry sand mixture consisting of about 86% silica sand (AFS grain fineness No. 65), about 10% silica flour (140 mesh) and about 4% western bentonite.

Using this foundry sand we made three green sand molds each containing an 8" x 9" x ½" plate. The mold was poured at 2600° F. with gray iron containing 3.5% carbon and 1.9% silicon. The castings were examined for sand adherence (peel) and surface defects after they were shaken out of the mold. Two castings from the mold were examined for surface quality after grit blasting. We found that the sand adherence (peel) quality of the castings from these molds was very poor and that there were many rat tails (sand expansion defects) in both the cope (top) and drag (bottom) of the castings.



*Example II*

We prepared a foundry sand mixture of substantially the same composition as in Example I except that the silica sand was reduced by 1.5% and we added 1.5% of a commercial wood powder (of about 40–50 mesh and sometimes called "wood flour") as a cellulose additive.

The foundry sand mixture was used to make three green sand molds of the same character as described in Example I and these molds were poured with a similar gray iron to that used in Erample I. The castings were examined for sand adherence, peel and surface defects after they were shaken out of the mold, and two castings from each mold mixture were examined for surface quality after grit blasting. The castings from these molds were only fair in their quality of sand adherence (peel). They had some rat tails (sand expansion defects) in the cope (top) and a few rat tails in the drag (bottom). These castings were much better than the castings obtained in Example I both with regard to sand adherence and rat tails.

*Example III*

We prepared a foundry sand mixture similar to that described in Example II except that instead of adding 1.5% of wood powder, we added 1.5% of a ground powder (50-mesh) of the hard woody ring of corncobs. This sand mixture was used to make three similar green sand molds and these molds were poured with a similar gray iron. The castings were examined for sand adherence (peel) and surface defects, after they were shaken out of the mold, and two castings from each molded mixture were examined for surface quality after grit blasting. We found that the sand adherence quality of these castings was better than the sand adherence characteristics of the castings obtained in Example II; that the rat tails on the cope (top) were substantially the same as those in Example II; but that the rat tailing on the drag (bottom) was not as good as those in Example II.

*Example IV*

We prepared a foundry sand mixture of substantially the same composition as Examples II and III except instead of the commercial wood powder and the ground powder of the hard woody ring of the corncob we used in the mixture for this Example IV, 1.5% of a ground powder (40-mesh) of the pith, beeswing, and outer glume of corncobs. This sand mixture was also used to make three green sand molds of similar size and these molds were poured at similar temperature with similar gray iron. The castings were examined for sand adherence (peel) and for surface defects after they were shaken out of the mold. Two castings were examined for surface quality after grit blasting. These castings were better than the castings of Examples I and II as far as the characteristics of sand adherence (peel) were concerned and were equal to the castings of Example II in this respect. They were better than the castings of Example II with regard to rat tails (sand expansion defects) on the drag or bottom of the castings, and substantially better than the castings of Example I in this respect. They were substantially equal in quality with the castings of Examples II and III with regard to rat tailing (sand expansion defects) on the cope or top of the castings and were very much better than the castings of Example I in this respect.

In the above Examples we have shown the use of a particular foundry sand mixture (i.e. 86% silica sand, 10% silica flour and 4% western bentonite). Obviously the particular composition of the foundry sand mixture is not critical in our invention. We have combined our organic cellulose carbonaceous additive with other foundry sand mixtures and have found such combination of materials form a composition of matter of substantially the same favorable characteristics. By foundry sand mixtures as used hereafter in this specification and claims,

we mean therefore any mixture of silica sand with other sand, clay, other earth or other material used heretofore in the formation of foundry mold parts.

The newly discovered composition of matter also definitely lessens the incidence of rat tailing over a similar composition using only the hard woody ring of the corncob as an additive to a foundry sand mixture and produces castings equal in quality in all other respects to castings produced by such similar compositions using only the hard woody ring of the corncob with the foundry sand mixture.

While we prefer to use about 1½% of our organic cellulose carbonaceous additive to the foundry sand mixture, yet we have added different percentages with favorable results. Thus we have found that percentages of from 90% to 99% of a foundry sand mixture may be mixed with from 1% to 10% or more of the ground powder of the soft portions of the corncob as an organic cellulose carbonaceous additive to produce an advantageous new composition of matter.

We have found that the addition of the ground powder of the soft lighter portions of the corncob to a wood powder or flour or to a powder made from the hard woody portion of the corncobs to foundry sand mixtures gives better results than the use of sand mixtures using only wood powder and powder from the hard woody portion of the corncobs as additives to the foundry sand mixture. Thus, though it is not a preferred embodiment of our invention, we also consider it within the scope thereof to produce a composition for forming sand molds and cores comprising crushing corncobs, grinding to a powder of a fineness of about 40–50 mesh or finer, and mixing such powder with a foundry sand mixture in proportions of from 90–99% of a foundry sand mixture and of from 1% to 10% of the ground powder of the organic cellulose carbonaceous additive or even more, subject to the type of sand used.

It is to be understood that the above described embodiments of our invention are for the purpose of illustration only and various changes may be made therein without departing from the spirit and scope of the invention.



We claim:

1. A composition of matter for forming sand molds and cores comprising an unreacted intimate mixture of (1) a foundry sand mixture and (2) a mixture consisting essentially of ground powder of corncob beeswing, ground powder of corncob outer glume and ground powder of corncob pith.

2. A composition of matter for forming sand molds and cores comprising an intimate unreacted mixture of (1) a foundry sand mixture and (2) a ground powder of corncob from which a major portion of the woody ring portion has been removed.

3. A composition of matter for forming sand molds and cores comprising an intimate unreacted mixture of (1) from 90% to 99% of a foundry sand mixture and (2) from 1% to 10% of a ground powder of corncob from which substantially all of the woody ring portion has been removed.

4. A method of producing a composition of matter for forming sand molds which comprises mixing intimately a foundry sand mixture and ground powder consisting essentially of corncob beeswing, outer glume and pith.

5. A method of producing a composition of matter for forming sand molds which comprises crushing corncobs; separating and discarding substantially all of the hard woody ring portion thereof; grinding the outer glume, beeswing and pith portions thereof to a powder of a fineness of about 40–50 mesh; and mixing said powder with a foundry sand mixture in proportions of approximately from 90% to 99% of a foundry sand mixture and from 1 to 10% of said powder.

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