STABILIZER FOR GREEN SAND MOLD

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ABSTRACT

A stabilizer for green sand mold includes a binding agent and an additive. Therein, the binding agent is a derivative of phenol, bonding with a variety of functional groups substituting hydrogen atoms, and present in an amount of 75 wt % to 85 wt % of the stabilizer. The additive contains a variety of trace elements. The binding agent and the additive are added in a weight ratio of 4:1, thereby improving the physical properties of the green sand mold and thus acquiring a reference for sand blending, molding and defects analyzing of castings.
silica sand + 1% water

first mixing (1 minute)

stabilizer A, B and C
weight ratio (0.3, 0.6, 0.9, 1.2%)
bentonite(12%), coal dust (1%), water(2%)

second mixing (4 minutes)

properties analysis

- green compressive strength test
- surface stability index test
- compactibility test
- air permeability test
- moisture content test

FIG. 2
FIG. 3

green compressive strength kgf/cm²

added amount weight ratio %

A
B
C
none
FIG. 4
FIG. 5
FIG. 6

A
B
C
none

0.3 0.6 0.9 1.2

add.

0.3 0.6 0.9 1.2

add. mm.

28 29 30 31 32 33 34

comp.

%
FIG. 7
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<th>50</th>
<th>70</th>
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<td>2.75</td>
<td>1.07</td>
<td>0.29</td>
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</tr>
</tbody>
</table>

FIG. 8
STABILIZER FOR GREEN SAND MOLD

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention
[0002] The present invention relates to stabilizers, and particularly to a stabilizer for green sand mold.
[0003] 2. Description of the Related Art
[0004] Green sand molding process is the most ancient molding process handed down in history. With the progress in generations, this molding process was not only preserved, but also more widely applied in various industrial fields with technological advancements. The material and method of green sand molding process are also improved within such years. Further, green sand molding process is also the most commonly used molding method in the world, mainly due to its easiness for shaping, high productivity, low cost, recyclability, and reusability of sand.
[0005] Green sand mold comprises silica sand, clay, and water. However, quality of green sand mold usually affects the quality of casting products. If the mixed green sand mold is expected to possess certain properties, such as improved strength or easiness for demolding, additives like dextrin or pitch can be added to change the physical properties of the green sand mold. Therefore, with the advanced technology today, it is necessary to strictly control the properties of green sand mold for acquiring high-quality and elegant casting products.
[0006] Regarding the physical properties of green sand mold, each property is converted into statistics and recorded through experiments of adding additives into green sand mold. A variety of additives are applied to improve a plurality of experimental parameters of green sand mold, such as green compressive strength, air permeability, compactibility, surface stability index, and moisture content, wherein each experimental parameter causes different influences as described hereinafter:
[0007] Green compressive strength decides the capability of resisting inflation, wherein the capability of resisting inflation further affects the integrity of green sand mold during transportation and the easiness of sand stripping off the casting products. Thereby, proper metal material for making casting products can be chosen.
[0008] Air permeability decides the capability of releasing gas, which is produced when the green sand mold contact molten metal, through gaps between sand particles, which further affects the formation of air holes of casting products.
[0009] Regarding compactibility, when the value is comparatively low, the green sand mold has low moisture content, causing low moldability and difficulty for demolding. On the other hand, when the value is comparatively high, the green sand mold possesses low quality of sand flow, causing the difficulty for tamping and the deficit of density. As a result, swelling is likely to occur, or defects like air holes or pin holes are easily produced during casting.
[0010] Surface stability index decides the quality and the surface roughness of casting products.
[0011] In terms of moisture content, adjustment of moisture is needed for controlling and acquiring an ideal compactibility. However, variation of composition of the green sand often causes variation of the correlation between compactibility and moisture. If the moisture content of the molding sand is much higher than a desired level, defects like pin holes may occur. Thus, an ideal range of moisture content must be set up in order to determine the composition of the sand.

SUMMARY OF THE INVENTION

[0012] For green sand molding process, experimental parameters aforementioned are used as a reference for sand mixing, molding and defects analyzing.

[0013] The present invention provides a stabilizer for green sand mold for better green compressive strength, air permeability, compactibility, surface stability index, and moisture content, in order to improve the quality of green sand mold.

[0014] The stabilizer for green sand mold of the present invention comprises a binding agent and an additive. Therein, the binding agent is a derivative of phenol, bonding with a variety of functional groups substituting hydrogen atoms, and present in an amount of 75 wt % to 85 wt % of the stabilizer. The additive contains a variety of trace elements. The binding agent and the additive are added into the stabilizer in a weight ratio of 4:1.

[0015] Thus, the objective of the present invention is to add the stabilizer hereby produced into green sand mold, thereby greatly improving several physical properties thereof, including green compressive strength and surface stability index.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. 1 is a chemical structure of the binding agent in accordance with the present invention.
[0017] FIG. 2 is a flow chart of the experiment proceeded in the present invention.
[0018] FIG. 3 is a curve chart illustrating different green compressive strength of green sand mold due to various added amounts of the stabilizer of the present invention and other stabilizers on the market.
[0019] FIG. 4 is a curve chart illustrating different air permeability of green sand mold due to various added amounts of the stabilizer of the present invention and other stabilizers on the market.
[0020] FIG. 5 is a curve chart illustrating different surface stability index of green sand mold due to various added amounts of the stabilizer of the present invention and other stabilizers on the market.
[0021] FIG. 6 is a curve chart illustrating different compactibility of green sand mold due to various added amounts of the stabilizer of the present invention and other stabilizers on the market.
[0022] FIG. 7 is a curve chart illustrating different moisture content of green sand mold due to various added amounts of the stabilizer of the present invention and other stabilizers on the market.
[0023] FIG. 8 is a chart illustrating particle size distribution and grain fineness number (GFPN) of a silica sand product with a brand name of Chin-Ching No. 5.

DETAILED DESCRIPTION OF THE INVENTION

[0024] Other and further advantages and features of the present invention will be understood by reference to the description of the preferred embodiment in conjunction with the accompanying drawings where the components are illustrated based on a proportion for explanation but not subject to the actual component proportion.

[0025] A stabilizer for green sand mold of the present invention comprises:

[0026] a binding agent, with its chemical structure illustrated in FIG. 1, which is a derivative of phenol, present in an amount of 75 wt % to 85 wt % of the stabilizer, and bonded
with a variety of functional groups substituting hydrogen atoms, while the functional groups include ketone group, aldehyde group, alicyclic group, primary alcohol group, secondary alcohol group and alkynyl group, wherein the functional groups possess electron-donating groups and electron-withdrawing groups with high polarity, and capable of attracting and connecting with different function groups, thereby producing a binding effect in solution; and

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[0027] an additive containing a plurality of trace elements, including sulfur (S), magnesium (Mg), sodium (Na), and calcium (Ca).

[0028] Therein, the binding agent and the additive are present in a weight ratio of 81% and 19%, respectively, nearly in a ratio of 4:1, while a mixture of the binding agent and the additive is present as a solute of brown powder in this embodiment, possessing a volume density ranging from 25 g/cm³ to 30 g/cm³, a pH value ranging from 5 to 6, and a solubility of 92% in cold water.

[0029] FIG. 8 illustrates the particle size distribution and grain fineness number (GFN) of Chin-Ching silica sand No. 5, which is used in the experiment of the present invention. The experiment contains other additives, such as water, bentonite (SPV), coal dust, and stabilizers (A, B, and C), wherein the stabilizer A is the subject matter of the present invention, stabilizer B is a starch product in the market with a brand name of Zhuei-Zhong, and the stabilizer C is a binding agent in the market offered by John Winter & Co Ltd.

[0030] FIG. 2 is a flow chart of the experiment of the present invention. Stabilizer A, B, and C are added in four different weight ratios of 0.3%, 0.6%, 0.9%, and 1.2%, respectively, for researching its effects upon each property of green sand mold. The experiment is proceeded with following steps: (a) adding the Chin-Ching silica sand No. 5 into a sand mixer, (b) adding water (1%) and mixing for the first time for 1 minute, (c) adding the bentonite (12%), coal dust (1%), stabilizer, and water (2%) and mixing for the second time for 4 minutes, and (d) acquiring the mixed sand.

[0031] After sieving the mixed sand through a 6-mesh screen, the sand is filled and crammed into a forming barrel. Then, the sand is made into a standard test specimen of green sand mold in a size of Ø50×L(50+1)mm by an extruding machine, used for testing each property, including green compressive strength, air permeability, compactibility, surface stability index, and moisture content. Based on the reason that the calculation method for all the parameters aforementioned are common knowledge in related fields, the calculating process is not stated herein.

[0032] FIG. 3 is a curve chart illustrating different green compressive strength of green sand mold due to various added amounts of the stabilizer of the present invention and other stabilizers on the market. According to the chart, when the added amount of stabilizer A of the present invention is higher (from 0.3 wt % to 1.2 wt %), the green compressive strength is also higher; on the other hand, when the added amount of stabilizer B or C is higher (from 0.3 wt % to 1.2 wt %), the green compressive strength is lower.

[0033] When the green sand mold is added with whichever kind of stabilizer, the green compressive strength of green sand mold is improved for a certain degree. However, in terms of the improvement due to different kinds of stabilizers, stabilizer A of the present invention causes the greatest improvement; besides, when the added amount of stabilizer A is higher (up from 0.3 wt % to 1.2 wt %), the improvement of green compressive strength is still higher (increasing for about 9.4%, from 0.53 kgf/cm² to 0.58 kgf/cm²). Regarding the improvements of stabilizer B or C, on the other hand, when the added amount of both stabilizer B or C is lower, the green compressive strength becomes lower in inverse (decreasing for about 14.3%, from 0.49 kgf/cm² to 0.42 kgf/cm² with stabilizer B; for about 10%, from 0.5 kgf/cm² to 0.45 kgf/cm² with stabilizer C). Further, when the added amount of stabilizer B reaches 1.2 wt %, the green compressive strength (0.42 kgf/cm²) is slightly lower than the original sample without adding stabilizer (0.43 kgf/cm²).

[0034] FIG. 4 is a curve chart illustrating different air permeability of green sand mold due to various added amounts of the stabilizer of the present invention and other stabilizers on the market. According to this chart, when added with higher amount of three stabilizers, respectively, the air permeability of all three specimens becomes lower.

[0035] When the green sand mold is added with whichever kind of stabilizer, the air permeability of green sand mold is decreased comparing with the air permeability of original sample without adding stabilizers. Therein, the air permeability with stabilizer A decreases for about 6%, from 147.4 to 138.6. The air permeability with stabilizer B decreases for about 10.5%, from 144.8 to 129.6. The air permeability with stabilizer C decreases for 10.7%, from 150.4 to 134.3. Based on such experimental results, except the result with the added amount of 0.3 wt %, the air permeability of green sand mold due to higher added amount of each stabilizer is recorded in an order: stabilizer A > stabilizer C > stabilizer B.

[0036] FIG. 5 is a curve chart illustrating different surface stability index (SSI) of green sand mold due to various added amounts of the stabilizer of the present invention and other stabilizers on the market. According to this chart, when the added amount of stabilizer A is higher, the surface stability index is slightly increased or at least maintained. On the other hand, when the added amount of stabilizer B or C is higher (from 0.3 wt % to 1.2 wt %), the surface stability index becomes lower.

[0037] When the green sand mold is added with whichever kind of stabilizer, the surface stability index is varied in accordance with the variation of green compressive strength. Only when the added amount of stabilizer A of the present invention is 1.2 wt %, the result maintained almost unchanged. However, comparing the various kinds of stabilizers, the improvement due to stabilizer A is the steadiest. Namely, when the added amount of stabilizer A is higher (from 0.3 wt % to 0.9 wt %), the surface stability index is also increased for about 2.1% from 64.7% to 66.8%. On the other hand, when the added amount of stabilizer B or C is higher, the surface stability index is lower (decreasing for about 13.3%, from 59.9% to 46.6% with stabilizer B; for about 11.1%, from 51.5% to 40.4% with stabilizer C). To sum up, when the added amount of stabilizer B is 0.9 wt % to 1.2 wt %, and when the added amount of stabilizer C is 0.6 wt % to 1.2 wt %, the surface stability index of green sand mold is lower than the surface stability index of original sample without adding stabilizer (SSI at 50%).

[0038] FIG. 6 is a curve chart illustrating different compactibility of green sand mold due to various added amounts of the stabilizer of the present invention and other stabilizers on the market. According to the chart, when the green sand mold is added with higher amount of three stabilizers, respectively, the compactibility of all three specimens becomes lower.
When the green sand mold is added with whatever kind and amount (0.3 wt % to 1.2 wt %) of stabilizer, the compactibility becomes lower. However, in terms of results due to different kinds of stabilizers, stabilizer B causes the greatest decreasing effect, that when the added amount of stabilizer B is higher (from 0.3 wt % to 1.2 wt %), the compactibility becomes lower (for about 3.5%, from 33.5% to 30%), following by the decreasing effect caused by stabilizer C (for about 2.5%, from 31% to 28.5%). The decreasing effect upon compactibility caused by stabilizer A (0.3 wt % to 1.2 wt %) of the present invention is the slightest (for about 2.2%, from 33% to 30.8%).

FIG. 7 is a curve chart illustrating different moisture content of green sand mold due to various added amounts of the stabilizer of the present invention and other stabilizers on the market. According to this chart, three lines have an identical slope, indicating that when added with whatever kind and amount of stabilizer, the moisture content of green sand mold varies with the increasing of moisture maintenance time in an identical trend (moisture content decreasing for 0.1% in average per hour). In other words, when the added amount of all three stabilizers is ranging from 0.3 wt % to 1.2 wt %, the variations of moisture content due to different stabilizers during 0 to 4 hours are identical.

Therefore, adding the stabilizer of the present invention greatly improves experimental parameters, including the green compressive strength, air permeability, compactibility, surface stability index, and moisture content, thereby improving quality of green sand mold, and able to be considered as a reference for sand blending, molding and defects analyzing of castings.

The present invention has been described with reference to the preferred embodiment and it is understood that the embodiment is not intended to limit the scope of the present invention. Moreover, as the contents disclosed herein should be readily understood and can be implemented by a person skilled in the art, all equivalent changes or modifications which do not depart from the concept of the present invention should be encompassed by the appended claims.

What is claimed is:

1. A stabilizer for green sand mold
   a binding agent, which is a derivative of phenol, bonding
   with a variety of functional groups substituting hydrogen atoms, and present in an amount of 75 wt % to 85 wt % of the stabilizer; and
   an additive, comprising a plurality of trace elements;
   wherein the binding agent and the additive are present in a weight ratio of 4:1.

2. The stabilizer of claim 1, wherein the trace elements comprises sulfur (S), magnesium (Mg), sodium (Na), and calcium (Ca).

3. The stabilizer of claim 1, wherein the functional groups comprises ketone group, aldehyde group, alicyclic group, primary alcohol group, secondary alcohol group, and alkenyl group.

4. The stabilizer of claim 1, wherein the binding agent is present in an amount of 81 wt % of the stabilizer.

5. The stabilizer of claim 1, wherein the additive is present in an amount of 19 wt % of the stabilizer.

6. The stabilizer of claim 1, wherein the binding agent and the additive are mixed and present as a solute of brown powder.

7. The stabilizer of claim 6, wherein the solute has a volume density ranging from 25 g/cm³ to 30 g/cm³.

8. The stabilizer of claim 6, wherein the solute has a pH value ranging from 5 to 6.

9. The stabilizer of claim 6, wherein the solute has a solubility of 92% in cold water