Boron Anhydride on the Performance of Covering Sand

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Abstract: This article studies the laws of boron anhydride on the performance of covering sand. The results of the study show that after adding 3% boron anhydride and 7% Fe_3O_4 to the covering sand, after the sand core is solidified by the case of the sand, its room temperature resistance can reach more than 3MPa, and it has good storage stability. In addition, after baking at 550℃/2h and 800℃/2h, it can still maintain the strength of more than 1MPa.

Through analysis, the mechanism of boron anhydride to keep the strength of covering sand after baking at high temperature was discussed, which provided a way to expand the use covering sand.

Keywords: boron anhydride，covering sand core，storage stability，strength.

1 Introduction

Shell molding is a sand molding method in which resin coated sand is contacted with a metal mold preheated to about 230 degrees Celsius to form a hard shell[1-2]. The coated sand used in the production of ordinary cast iron is generally composed of silica sand, thermoplastic phenolic resin, urotropine and calcium stearate, and usually does not contain relevant additives, so it does not have high strength, high temperature resistance, low expansion, low gas and other characteristics.Steel casting has high requirements for dimensional accuracy, surface quality and stability of coated sand, so it is necessary to add some additives to the coated sand used in steel casting to make it have high strength, high temperature resistance and low expansion.

2 Experimental procedure

The core is formed by hot box method for tensile strength sample and core forming effect evaluation.

The strength before roasting, the strength after roasting at 550℃, the strength after roasting at 800℃ and the core forming effect of the sample were used as evaluation indexes. The factors to be considered include the presence or absence of impregnating coating, the amount of boron anhydride added and the amount of Fe_3O_4 added. The performance and application evaluation were carried out by comprehensive performance data and sand core.

The equipment used in this test is SAR-II intelligent temperature controlled coated sand making machine, box furnace, 8615 core making machine, and the raw materials used in this test are covering sand, boron anhydride, Fe_3O_4, 300H paint. The evenly mixed sand is made into a tensile sample. The core structure for tensile sample and sand core forming effect evaluation is shown in Figure 1.

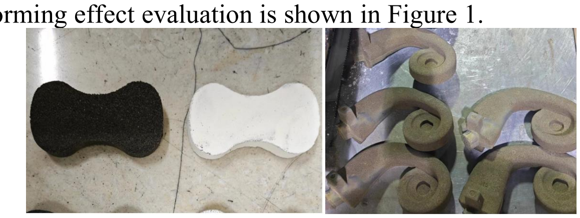

FIG.1 Core for tensile strength sample and core forming effect evaluation

3 Result and discussion

In order to obtain the core with good performance, the following main factors were determined through several tests and screening: the content of boron anhydride, the content of ferric oxide, whether the sand core was immersed in coating, the time of sand placement, etc.

According to the test data of each factor, the relationship curve between the level and intensity of each factor was drawn, as shown in FIG. 2 to FIG. 3.

It can be seen from Figure 2(a) that the strength of the core after sintering at high temperature can be increased with the increase of boron anhydride content. After sintering of the sand core at 800℃/2h, the resin gradually decomposes and burns, so the resin has basically no effect on the strength of the core.

At high temperature, boron anhydride can react with Al_2O_3 and other substances in the coated sand to solidify the sand core. However, it is found that when the content of resin is fixed and the content of boron anhydride is too high, the molding sand is sticky, the forming effect is poor, and it is difficult to remove the core from the mold. And the produced core is easy to damp, easy to break. The content of boron anhydride is set at 2%~3% after comprehensive consideration.

Then considering the characteristics of boron anhydride being easy to absorb moisture and water, the strength changes of sand exposed to air was studied, as shown in Figure 2(b). As can be seen from the figure, with the passage of time, the strength of the sand core at room temperature decreased slightly, and the strength after high temperature sintering did not change much, so it can be concluded that the sand can be used stably for a long time when it is sealed and stored, which has little impact on its overall performance.

In order to further improve the stability of the sand core at high temperature, the influence of whether or not the sand core is impregnated with paint on its strength after sintering at high temperature was studied. As can be seen from the figure, the strength of the sand core impregnated with paint after sintering at high temperature is generally higher than that of the sand core without impregnating paint, so the whole sand core should be impregnated with paint later.

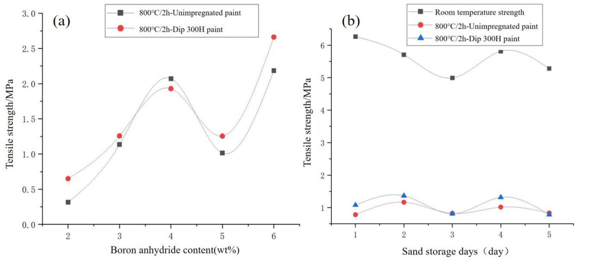

FiG.2 (a)Relationship between boron anhydride content and sample strength. (b)The variation of sand days and tensile strength.

In order to further improve the sintered strength of the sand core and reduce the influence of boron anhydride on moisture, Fe_3O_4 was considered to be added to the sand. As can be seen from Figure 3, with the increase of Fe_3O_4 content, the strength of the core after sintering can be maintained above 1MPa. Therefore, the content of Fe_3O_4 should be controlled at 7%.

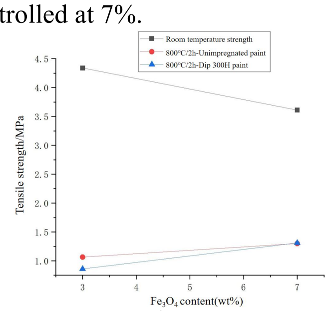

FIG.3 Relationship between ferric oxide content and tensile strength.

As shown in Figure 4, in the process of core making, it is found that the formability of the core of this process formula is not very good, and the core is sticky to the mold, which is not easy to clean; After adjusting the core parameters and changing the mold structure, the core making situation has been improved.

FIG.4 (a)The picture shows the bad situation of sand core making, and (b)the picture shows mass preparation of sand core after modifying core parameters and mold structure.

The formulated core can be used in the lost mold casting process; When casting complex products, the pouring system needs to carry out the process of burning the empty shell at 800℃/0.5h, and the sand core still maintains a high strength and does not break after this process, which provides a guarantee for the successful casting of products.

After the casting is completed, as shown in Figure 5(b), when cleaning the inner cavity of the casting, it is found that although the residual core is still massive, the strength is low and it can be easily removed. Therefore, it can be judged that the collapsibility and cleanability of the residual core are better.

The results of pouring test show that the inner cavity of the casting is easy to clean after pouring, and it has the advantage of mass production.

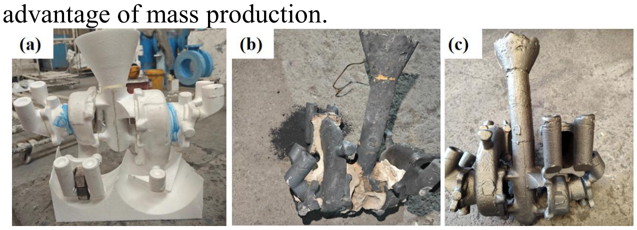

FIG. 5 (a) Lost mold casting system (b) sand drop condition of castings after casting and (c) castings after shot blasting

4 Conclusion

1. Sand mixed with boron anhydride and Fe_3O_4 can be used as a binder to solidify the sand core in the process of lost mold casting.The sand formula has excellent resistance to high temperature deformation. After dipping coating, it can meet the core requirements for investment casting.
2. The result shows that the residual sand core in the casting has good collapsibility and is easy to clean.
3. When the addition amount of boron anhydride is 3% and Fe_3O_4 is 7%, the sand core state is the best.

Acknowledgments

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References

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