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Development of the New style Green Sand Molding Machine

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In the field of the green sand molding technology, various molding methods, such as jolt-squeeze, blow-squeeze and SEIATSU, etc. were developed in the 20th century. Thereafter, in the beginning of the 21st century, a new molding method with the new sand filling mechanism was developed[1,2]. That is the aeration sand filling mechanism with low pressure air. Through this technology, the sand filling to the mold was dramatically improved, the quality of mold has been stabilized and high performance molding has been carried out. At the same time, this molding method contributed to the environment issue by the large reduction of compressive air and decrease of the noise and vibration.

This innovative green sand molding technology is used as a core technology in our various molding machines including tight flask and flaskless ones. On the other hand, since foundrymen have a wide variety of requirements, the authors have developed two types of molding machines employing a different aeration sand filling technology to further satisfy their needs.

A sensing technology for visualization of operating conditions and preventive maintenance, etc. is applied in various forms to these molding machines from the view point of more stable quality cast and productivity improvement.

***Keywords**: Aeration, Sensing technology, Visualization, Reduction of defects, Quality stabilization*

1. Introduction

The authors have a wide selection of molding machines with aeration sand filling[1,2] as a core technology which achieves uniform sand filling and saving energy. Futhermore, The authors have developed two types of molding machines employing a different aeration sand filling technology to further satisfy their needs.

2. Development of the New style Green Sand Molding Machine

2.1 New type tight flask molding machine

The molding method of tight flask molding machine employing aeration sand filling technology have two advantages: uniform mold strength by segment squeeze where each segment foot moves vertically as shown in Fig.1, a sand compaction ratio is preset as a/A=b/B at the time of completion of squeeze, mold sand is filled by aeration into the mold and then the mold sand is squeezed mechanically; and plane squeeze where the back face of the mold is flat when squeeze is completed.

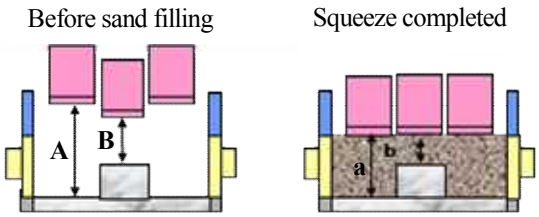

Fig. 1 Preset squeeze

Molding conditions such as aeration and squeeze, etc. can be registered for each pattern, which includes setting of pre-molding conditions. However, sometimes preset functions are not set properly and sometimes customers prefer simple segment squeeze due to troublesomeness of setting.

In this paper, the authors have developed a tight flask molding machine where segment cylinders are arranged on the whole surface of the squeeze board.

This made it possible to fill sand by aeration into every hole and corner of patterns without preset pre-molding and produce high quality molds by segment squeeze onto the overall sand. Furthermore, this made it possible to produce higher-quality molds in combination with preset pre-molding.

2.2 New type flaskless molding machine

The flaskless molding machine has various sand filling methods. The methods used for our flaskless molding machine are vertical aeration, side aeration and top & under blow sand filling.

In case that a molding machine is replaced, a failure of sand filling occurs sometimes due to a change in the sand filling method. Especially, the top & under blow type molding machine has a feature that sand filling is superior just under the blow nozzle. We applied this superiority to different sand filling types of molding machines. However, sand filling was sometimes unsatisfactory in specific points.

The new flaskless molding machine developed by us this time is the successor of top & under blow type of molding machine which uses a sand filling method of top & under aeration. As a result, mold quality and productivity are more improved.

Consumption of compressed air could be reduced by about 20% by filling sand at a lower pressure as compared with a conventional molding machine. We have also found that proportional valve can prevent sand from being compressed in the sand introduction pathway of aeration tank, etc.

Other features can be summarized as follows. Pattern drawability from the mold and use frequency of in-use match plates were improved by employing squeeze balance control and slightly adjusting squeeze force of the cope and drag.

2.3 Approach to visualization of operating conditions of green sand molding machine

To achieve visualization of the operating conditions of a molding machine, a system for monitoring them is installed as a standard in the newly developed molding machine. For that various sensors are set at the points to be monitored and the operating conditions can be understood through the data measured in real time and on line by the sensors.

Previously, aging deterioration due to operation was judged and cause investigation on the abnormal operation was performed based on monthly or annual inspection work at regular intervals. Accordingly, effective quantitative judgment based on numerical data provided big progress for preventive maintenance.

Moreover, there was great progress in the field of quantitative assessment of sand filling process which was indirectly assessed based on molds actually produced. Fig. 2 is a graph showing behavior of air pressure in the aeration sand filling process and pressure in the sand tank extracted from the measured data.

It is possible to estimate sand injection time and check if the function of sand filling is operating properly by understanding a fluctuation of injection time for the same pattern. Additionally, assessing differential pressure between the pressure in the chamber for supplying aeration air and the pressure in the sand tank leads to visualization of a status of clogging of the aeration filter, contributing to effective preventive maintenance against decreased function of sand filling.

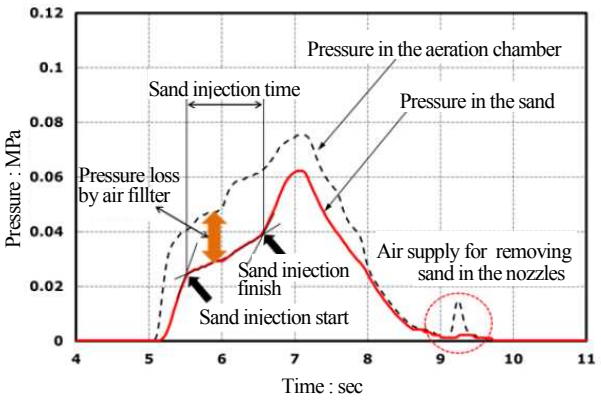

Fig. 2 Pressure behavior in sand filling process

These instances demonstrate that visualization of the operating conditions of the device using sensing technologies which have been used until now for the molding machine is very effective for stabilizing the operation of the molding machine and securing the quality of casts in combination with know-how about analysis of the measured data.

3. Conclusion

2 types of molding machines developed this time are added to a product group employing various types of aeration sand filling methods. It is expected that this will really contribute to response to a variety of foundrymen's needs, proposal about better production of casts and enhancement of the operating rate of equipment.

It seems that IoT (Internet of Things) technologies will increasingly advance in the manufacturing industry in the future and a mass of data will be accumulated and shared in connection with development of information and communications technologies. Bearing in mind enhancement of IoT technologies in the field of casting equipment, we will also utilize the data obtained through various sensing technologies and provide technologies and services based on the concept of ensuring the product quality and "preventing equipment from stopping unexpectedly".

Reference

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