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In-situ Measurement of Green Sand during Molding Process

Dr.-Ing. habil. Hartmut Polzin[1], Dr.-Ing. Matthias Strehle[1], Prof. Dr.-Ing. Gotthard Wolf[1]
Dr. Hiroyasu Makino[2], Shuji Takasu[2] and Hiroyuki Miyazaki[2]
[1] TU Bergakademie Freiberg Germany, Foundry Institute
[2] Sintokogio Ltd, Aichi, Japan

A green sand molding process depends on a high number of variable influence factors. For stable mold strength at pattern plate, a useful sensor and control system is needed. Following, different sensors will be shown, which allow to measure and control sand filling and squeeze process in-situ. This technical paper shows valuable knowledge to understand green sand molding process and to achieve high quality mold with low energy.

Keywords: *sensor, green sand molding, aeration sand filling, squeeze*

1. Introduction

A high quality of casting product is depending on quality of sand mold. Generally, the green sand molding process consists of sand filling process and squeeze process. In order to produce and control high quality mold stably, it is necessary to know this processes in-situ.

Parameters of sand preparation, sand filling and squeeze are possible to measure and control. Industrial production always needs to produce with stable conditions by the same machine parameters. Measurements in foundry show that all parameters fluctuate in a range. The influence of each parameter is known by statistic investigation. With this measured parameter, the knowledge of influence and also a control system, it is possible to get high mold quality. This is the main reason for in-situ control of mold quality at pattern plate with sensors. As last step in mold production, squeeze is used. Here, the mold quality is influenced by the filling time, air pressure and also squeeze pressure. To have the right setting for this parameter, the knowledge about mold strength at pattern plate is needed. Until now, there was no measurement device that can be fixed on pattern plate, for the registration of sand filling and squeeze.

2. Sensor devices

2.1 First sensor

The first sensor, which was developed by Prof. Bast for air-flow (Seiatsu, Impact) and squeeze process, shows mold strength or mold hardness in-situ.

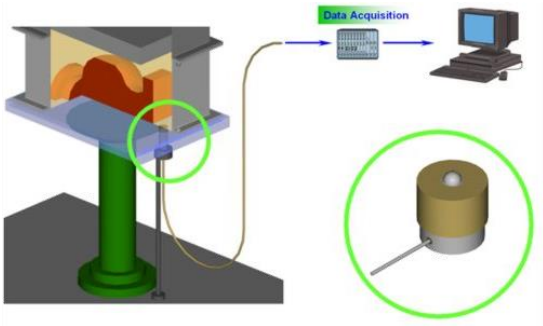

Fig. 1: First Sensor device

This sensor is useful to save energy and shorten cycle time for high quality casting. The construction of this sensor allows stable measurements for air-flow of Seiatsu/ Impact/, gravity sand filling and squeeze process. But for molding processes which use a very low air-pressure for sand filling, such as aeration sand filling, it is not possible to use the first sensor because of sensitivity [1].

2.2 Sensor for observation of sand filling

The second sensor, shown in Fig. 2, was developed to detect sand filling, aeration sand filling, high pressure blow sand filling and gravity sand filling. Actually, it was impossible to observe in-situ sand filling behavior inside tight flask at actual foundry shop. It is necessary to understand how sand flows inside flask and to use this sensor signal for squeeze control.

Fig 2: sensor for sand detection

Experiments were conducted at university and in foundry for practical trials. This experiments show, how sand flow inside the flask and fill the flask [2]. For this experiment, sensors were fixed at different position on the pattern plate and in sleeve with different high (0, 70, 90, 110mm). Now, it was possible to understand how sand flow inside the flask, sand filling time and also the influence of pattern shape (represented by different sleeve high).

2.3 Final sensor for all sand molding processes

The third sensor is shown in the Figure 3 and developed for all sand molding processes in-situ.

Fig 3: sensor for in-situ measurement of mold

The third new sensor combines all advantages, such as using for molding processes and a short reaction time for precision mold machine control. The new Sensor shows a high accuracy in experiments. It was possible to see the low air pressure, such as from aeration sand filling, in detail. Different settings from air pressure at molding machine will be measured by the sensor reliable. Also different squeeze pressure will be detected easily. Figure 4 shows an example of measured sensor voltage curve during aeration sand filling and squeeze. Three sensors were fixed at the bottom of sleeves on the pattern plate. When green sand contact the sensors during aeration sand filling, sensor voltages increased a little. Then, sensor voltages went up rapidly during squeeze.

With this new sensor, a valuable knowledge of mold quality at the area of pattern plate is available. Furthermore, this value of strength can use on one side for documentation the machine settings and mold quality for customer. But on the other side, this measured value is perfect for mold machine control. This possibility is given, because of the knowledge, when the maximum or needed strength is achieved at pattern. Without this sensor, it was not possible to know the right squeeze pressure for switch of hydraulic, by fluctuating properties of mixed sand and weight. In addition to the high and stable quality, it is also a tool for saving energy and protect molding machine, because of early stop of aeration and squeeze.

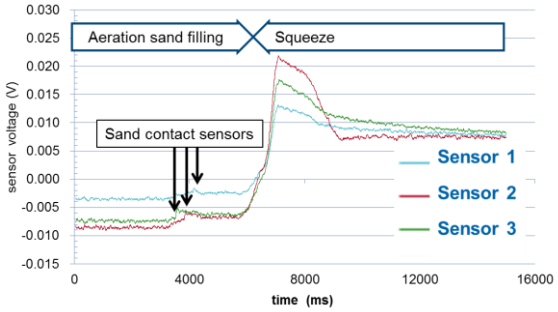

Fig 4: Measured sensor voltage curve during aeration sand filling and squeeze

3. Conclusion

Different sensors are developed for sand filling and squeeze process. The final sensors are tested in foundry and can be used such as follows:

- In-situ measurement of sand filling and squeeze for all technologies
- Using for machine control in a control cycle.
- Saving energy and time by knowledge of mold properties at pattern plate.
- Increase quality of mold, by compensation of fluctuating sand properties and sand weight.
- Using sensor as a tool for online documentation of molding properties for customer.

Acknowledgements

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References

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