ЛИТЕЙНОЕ ПРОИЗВОДСТВО

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THE LATEST DEVELOPMENTS IN CONTROL SYSTEMS FOR CHEMICALLY BONDED SAND CONTINUOUS MIXERS

INTRODUCTION

The use of chemically bonded sand systems has afforded the foundryman the opportunity to produce high quality moulds at the appropriate production level and with the minimal amount of skilled labour.

This paper examines the latest control equipment for continuous mixers that has been designed to keep these systems performing at an optimum level, at the same time reducing binder additions to the minimum thereby decreasing the risk of gas generated defects and reducing overall costs.

The two fundamental control systems that will be examined are: **«Flow monitoring/control»** and **«Temperature sensitive acid blending»**.

Both these systems are becoming increasingly popular as foundries look to improve the consistency of the castings they are producing and, at the same time, curb costs and reduce potentially harmful emissions.

Flow monitoring and flow control

In order to utilise the benefits of modern no bake binders it is paramount that the addition levels be kept consistent and, where possible to a minimum. In practice, however, due to inconsistencies in material supply, pumping systems, etc. the foundry tends to run addition rates, in particular binder additions, at a level higher than the absolute minimum as "insurance" against such inconsistencies.

Apart from the cost factor which will be looked at in greater detail later, higher binder addition rates can contribute to the following metallurgical defects:

1. Gas porosity.
2. Increased chance of lustrous carbon defects in phenolic urethane type binder.
3. Less flowable sand leading to poorer compaction and increased chance of metal penetration.
4. Higher rate of potentially harmful emissions on casting.

The "insurance" level of addition rate that most foundries operate at is in the region of 0.1 to 0.2% binder content by weight of sand. The foundry knows that it is capable of producing good moulds or cores at the lower addition level but due to inconsistencies in delivery has to maintain this higher addition rate.

The flow monitoring and control systems currently being adopted by a number of foundries throughout the world addresses this problem by incorporating the latest technology that actually constantly measures the output of the binder and compares this to a pre-set operating parameter.

If the binder flow should go outside of these limits then the system will automatically increase or decrease the speed of the pump to compensate accordingly.

Cost considerations

As mentioned previously, by adopting this system there is cost benefits to be had from the reduction in scrapped moulds and cores and the potential reduction in rejecting castings through the incidence of gas related defects. The direct cost savings come from a reduction in the consumption of binder used which, when totalled over the year, can be a significant amount.

Example

Foundry A uses acid cured phenolic no-bake and runs at 1.1% binder addition rate. The foundry installs pump monitoring and consistently achieves 1.0% addition rate. The commercial savings equate as follows:

Tonnes of sand mixed in the year	=	5,000
Amount of resin consum	=	55 tonnes @ £1,000 per tonne equates to annual spend of £55,000
Amount of resin consumed after flow monitoring is 1.0%	=	50 tonnes @

		£1,000 per tonne equates to annual spend of £50,000
Potential cost savings on resin consumption	=	£5,000 per annum

Acid blending/temperature sensitive blending

The traditional way of increasing or decreasing the speed of cure with an acid catalysed system is by altering the addition rate or by changing the type of catalyst employed. Both these methods have limitations, namely when the catalyst addition level is increased there is a subsequent increase in gas evolution and also the release of potential harmful emissions such as Sulphur.

If more than one acid is used then it can become time consuming and laborious when trying to change over from one to another. Also, sudden fluctuations in sand temperature may make the immediate change over to a more suitable acid not practicable.

A new way of approaching this problem is by taking two catalysts – one strong and one weak and blending them together in various proportions in order to achieve the required set time. The catalyst addition rate instead of being variable would be fixed at between 30–40%.

The systems works by constantly monitoring the sand temperature. If the temperature increases or decreases then, through a plc control, the proportion of strong catalyst (in this example, XSA) and weak catalyst (Low sulphur PTSA) automatically alter to maintain the required set time.

Example

Foundry A requires a 20 minute strip time. The foundry's sand temperature will vary during the day from a minimum of 15°C to a maximum of 35°C. The optimum temperature in this case would he 25°C and at this temperature the catalyst selection would be such that the blend proportions were around 50:50.

If the sand temperature in the morning operation was 15°C, then the blend would be automatically changed to 70:30 (XSA:PTSA). During the day if the temperature was to suddenly increase to 35°C then the blend would reverse to 30:70 (XSA:PTSA) thus maintaining the strip time at a fixed addition rate.

Associated benefits arising from temperature controlled acid blending

1. Maintenance of sand strip time. No loss of production due to extended curing times.
2. Improvement in mould quality due to less chance of compaction of sand whilst outside of "working life".
3. No risk of over-catalysation.
4. Reduction in sulphur content of sand leading to reduced emissions and less chance of 'reversion' taking place with Spheroidal Graphite Iron.
5. No need to carry a number of different catalyst to suit varying conditions – only two different types of catalyst are needed.
6. As the catalyst addition is fixed at a low level (nominal 35%), overall acid consumption is reduced relating to an overall cost saving to the foundry.

CONCLUSION

Both the aforementioned systems have proved themselves in various foundry applications to give substantial benefits to the foundryman in seeking to improve the quality of the castings produced, reduce potentially harmful emissions and reduce overall costs.