Production of iron castings utilising a new generation of feeding systems

Introduction

Most iron castings require the use of feeders to deliver liquid metal to the casting as it solidifies. For many such castings produced on automated medium pressure greensand moulding machines, these were traditionally fed with greensand side risers or conventional slurry formed insulating or exothermic sleeves that were inserted into preformed cavities in the cope mould. Obviously this requires adequate cope access, and personnel available to apply the sleeves.

Alternatively a sleeve may be placed directly on the cope pattern and rammed up during the moulding operation. The benefits of this application method are:

- ❑ Reduced time requirement for sleeve application
- ❑ Ability to use a neck down breaker core and reduce the amount of work required to remove the feeders.

Standard insert sleeves may be damaged when rammed up on automated horizontal greensand moulding machines, due to the pressures involved. Increasing the sleeve strength is often achieved by increasing the density of the sleeve material, this can result in reduced insulating capability and permeability and hence reduce feed performance.

A carefully engineered project was initiated to develop a novel feeding system to fulfill this market need, namely to:

- ❑ Feed better than a standard exothermic/insulating insert sleeve
- ❑ Withstand medium-pressure moulding machines during ram-up
- ❑ Provide easy riser removal.

Design and integration

Using MAGMASOFT® casting simulation software, several sleeve designs were evaluated at multiple wall thicknesses, shapes and height-to-diameter ratios. Solidification modelling showed that a sleeve having a rounded top and thicker walls at the base provided the optimal combination of high thermal efficiency with strength and robustness necessary to withstand the ram-up process.

The FOSECO patented 'Kompressor' metal breaker core was likewise optimised using Abaqus stress-strain finite element analysis software to give a unit that collapses in a controlled manner on ram up, compacting the sand beneath the sleeve, and protecting the sleeve from damage (figure 1).

Figure 1 KALMINEX* K Sleeve/core prototype

Feed performance

Feeding tests were conducted to determine the relative thermal performance of the sleeve/core prototype against a standard exothermic/insulating insert sleeve with silica sand breaker core (figure 2).

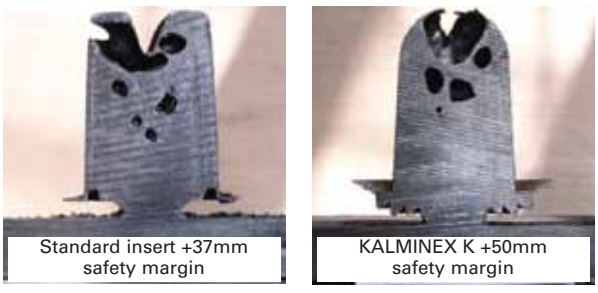

Figure 2 Ductile iron plate feeding results for standard exothermic/insulating insert sleeve against KALMINEX K

KALMINEX K gave a superior feed performance to the equivalent standard insert sleeve.

Production testing

Case Study 1 - Bearing housing casting
Hunter HMP 20D moulding machine
Class 30 grey iron. (Min 206 MPa)
Previous method:

- ❑ The total pour weight 35.9 kg (79.1 lbs)
- ❑ Casting weight of 20.0 kg (44.1 lbs)
- ❑ Yield of 56%.

The casting layouts are shown in Figure 3.

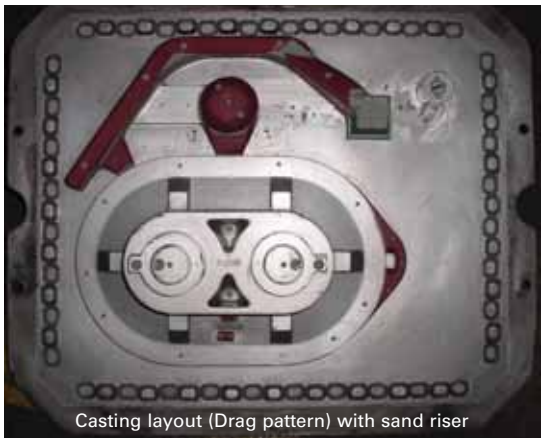

Figure 3 Casting layout and sleeve on pattern plate

Benefits from using KALMINEX K:

- ❑ Yield increased from 56% to 65.8%
- ❑ Easier riser removal - in many instances the risers were removed during shake-out.

Figure 4 shows the casting after shakeout with a sectioned feeder to demonstrate the superior flat feed performance.

Figure 4 Casting / Riser / Results

Case Study 2 - Winch casting:

- ❑ 65-45-12 Ductile iron (EN GJS 450-10)
- ❑ Three impressions per pattern
- ❑ Poured weight for the system is 28.6 Kg (63.0 lbs)
- ❑ Casting weight 5.73 Kg (12.63 lbs) Yield 60% (figures 5 and 6).

Figure 5 Cope pattern layout and cope casting cavity

Figure 6 Sectioned casting after shakeout showing feeder contact after knock off

These casting trials confirmed that KALMINEX K could be successfully applied in a production environment. The product withstood ram-up moulding pressures, successfully fed the casting, and was easily removed from the casting during shakeout.

Though not possible for this casting, the next level of investigations would usually focus on productivity improvements by increasing the number of impressions on the pattern plate.

Conclusion

KALMINEX K (patent applied for) has been developed to increase the productivity of foundries using automated, horizontal medium pressure moulding machines.

KALMINEX K has all the benefits of a lightweight exothermic / insulating sleeve, but with the added advantage that it can used in ram-up applications providing the customer with benefits including:

- ❑ Highly efficient top feeding
- ❑ Small footprint on the casting
- ❑ Faster application compared to insert technology
- ❑ Increased pattern plate utilisation
- ❑ Reduced fettling time and cost.