Ram-up sleeve application to DISAMATIC moulding lines



Introduction

During the mid 1980's, a new thick-walled exothermic feeder concept emerged, which was trend-setting for further sleeve developments. This design later became known as the Spot Feeder. The invention was patented by Rexroth Foundry in Germany during 1985 [1]. The early sketches are still similar to today's spot feeder geometries. (Figure 1)

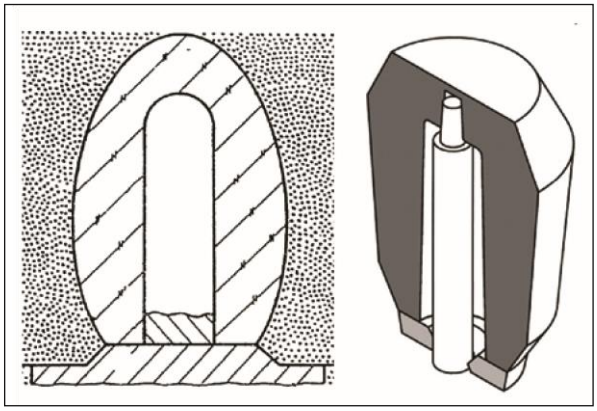


Figure 1. Comparison of an early design from the 1985 patent and current spot feeder design

This new design delivered several novel benefits for the foundryman, which enabled significant advances in application technology:

- a higher compressive strength that made it feasible to apply the feeder sleeves directly on the pattern plates of high-pressure green sand moulding lines
- smaller sleeve cavity volume with higher modulus, which led to improved casting yield and smaller footprint areas on the casting (Table 1)



	Sand Riser	Exothermic Insulating Sleeve	Highly exothermic Spot Feeder
Feeder Weight (kg)	8.2	2.1	0.82
Weight (%)	100	25.6	10

Table 1. Comparison of specific and relative weight of different sleeve designs with identical moduli

Over the next two decades, the development of spot feeding was driven by the technical demands of the foundry industry. The need to further reduce feeder footprint and contact area was driven by increasing demands from casting designers and pricing pressure from end users. Feeding technology had to deliver lowest fettling and cleaning costs, in combination with optimized yield. Parallel to this, higher compressive strength feeder sleeves were required to survive the increased moulding pressures on the new generation of high-pressure green sand moulding lines.

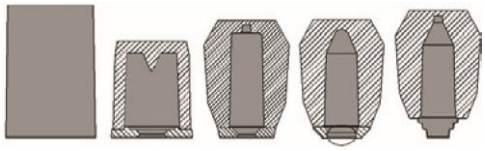
This led to the development of a new generation of highly engineered spot feeders [2], launched during 2004. (Figure 2)



Figure 2. Overview of the product range

The patented design of the collapsible metal breaker core combines the key benefits of resistance to the highest moulding pressures and minimized footprint / contact areas on the casting.

The footprint area of a spot feeder with collapsible metal breaker core requires less than 6% of the footprint area of an equivalent sand riser. (Table 2)



Sleeve design	Sand riser	Exothermic insulating insert sleeve P 6/9K	Highly exothermic spot feeder with silica sand breaker core	Highly exothermic spot feeder with exothermic locator core	Highly exothermic spot feeder with collapsible metal breaker core
Footprint area (cm^2)	64.6	55.4	24.6	5.5	3.5
Contact area (cm^2)	64.6	4.9	2.3	5.0	2.8

Table 2. Comparison of footprint and contact areas of different sleeve designs with identical modulus

The design of the collapsible metal breaker core was engineered to achieve a defined collapse (in height) during the extreme moulding pressure exerted by many modern green sand moulding lines. The deformation of the core during the moulding process has two key advantages:

- the moulding pressure is partly absorbed by the collapse of the metal breaker core and compaction of the moulding sand beneath it, enabling this concept to withstand higher moulding pressures than other conventional solutions
- the feeder neck height is reduced to ensure the feeder neck remains open until after the casting solidifies (Figure 3)

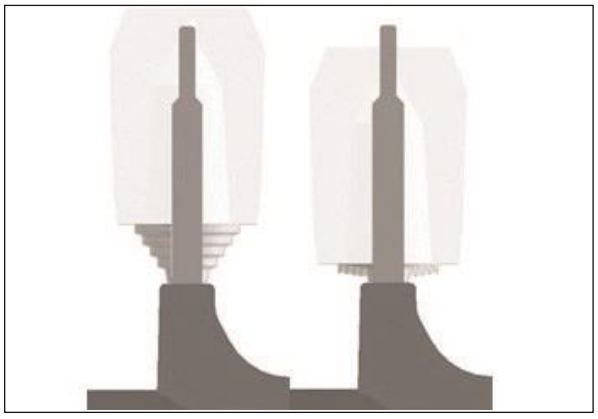


Figure 3. Sleeve and metal core before and after compaction

New approach to feeding Disamatic iron castings

Vertical moulding machines were introduced by DISA during 1962. Since the very beginning, the general approach to feeding DISA castings was the use of (spherical) sand risers. Endeavors have been made in the past to increase the casting yield by the introduction of insert sleeves and direct pour systems. A common practice is to apply the feeder sleeves on the joint line of the mould, using the core setter (if available). In addition to improving casting yield, in many cases productivity could be improved by including additional cavities on the pattern plate. (Figure 4)



Figure 4. Application of direct pour and insert sleeves to a ductile iron casting

Applying these types of sleeves on the joint line can, on occasion, lead to problems, when for instance the sleeve moves out of position before mould closure.

Compared to horizontal moulding lines, the pace of development for feeder sleeve applications to vertically parted moulding has been much slower. This is partly due to the fact that for many years, a very high proportion of the castings produced on DISA lines were grey iron parts. Conventional feeder applications, side or top risering, based around the mould joint line were sufficient to satisfy the feed requirements in most castings.

The generally lower process costs compared to horizontal moulding lines and price pressure by the market, made it increasingly necessary to develop methods to produce heavier and more complex ductile iron castings on vertical moulding lines. The initial approach to method such castings has been to use techniques such as metal padding, to enable a feed path to be established to isolated sections. This measure is limited in effectiveness, and has several disadvantages, resulting in increasing cleaning costs and reduced casting yield. (Figure 5)

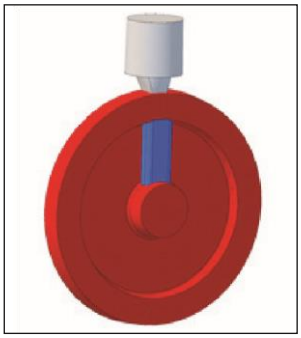


Figure 5. Metal padding to create a feed path through to a central boss on a typical die casting

First attempts to introduce spot feeding for DISA applications were undertaken in 2006 by using a modified spot feeder with a standard silica sand breaker core. Three guiding ribs were added to the internal cavity of the sleeve to provide a support on the locator pin. (Figure 6)

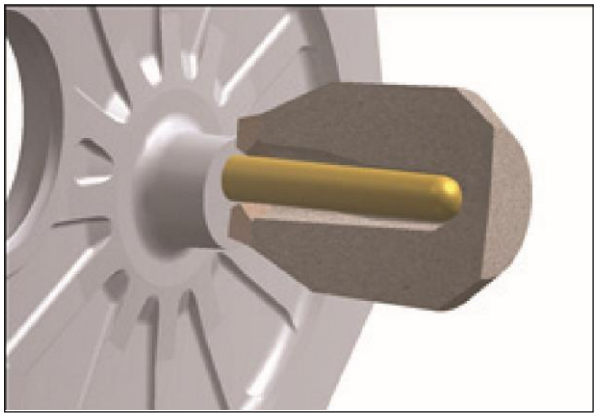


Figure 6. Casting with isolated boss fed by a spot feeder with sand breaker core

This feeding application was the first effort to conduct spot feeding on a DISA moulding line. Although this avoided the use of metal padding, the sleeve application was problematical:

- problems with sand compaction around the breaker core
- the moulding cycle had to be interrupted to apply the sleeve by hand

The early results with the application of spot feeders were encouraging in terms of feed performance. It was however clear that further development would be required to improve the technology to a point where such products could be applied automatically. The key objectives for the project were:

- to apply the feeder sleeves without increasing the cycle times of the DISA moulding lines
- to develop a feeder concept capable of providing a small contact / footprint on the casting and capable of ensuring good sand compaction during moulding

To meet the requirements of minimum contact area and excellent sand compaction, the collapsible metal core concept was selected. In order not to extend the cycle time, it was clear that the core setter could not be used. During the moulding process where the mould is moved forward out of the moulding chamber, the swing plate is available in the horizontal position for a short period of time – several seconds. In principle, this is sufficient time to enable placement of a feeder sleeve. (Figure 7)

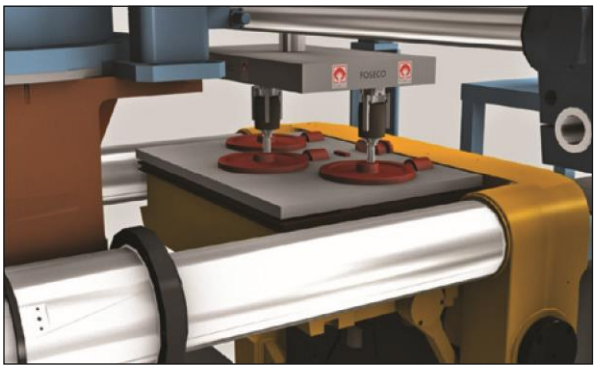


Figure 7. Application of feeder sleeves to the swing plate in a horizontal position

The application of feeder sleeves to the swing plate can be automated by the introduction of a sleeve setter robot, as in many cases there is sufficient access from the top of the moulding machine.

Clearly, as the swing plate moves back down from the horizontal position to the vertical location in the moulding chamber, the sleeves must remain in position on the locator pins.

One method is to integrate a spring-loaded ball into the pin base, which secures the feeder sleeve and prevents it falling off the locator pin. The development and optimization of the locator pin design was based upon many practical foundry tests.

A second possibility to secure the sleeve is the use of a magnet in the base of a non-magnetizable stainless steel locator pin. The magnet locks the metal core in position, ensuring the sleeve remains fixed during the downward movement of the swing plate. This method was also tested extensively and has the added advantage of requiring little or no maintenance.

Initial moulding trials were conducted to test the moulding behavior of spot feeder sleeves with collapsible metal breaker cores on a vertical moulding line. The results showed excellent sand compaction beneath the sleeve and a clean contact area of the metal core on the mould face. (Figure 8)



Figure 8. Moulding results with collapsible metal breaker core

Extensive tests have been conducted to evaluate the feeding performance of spot feeders in an application as a central side feeder. (Figure 9a)



Figure 9a. Casting results using different sleeve configurations

These trials were conducted on a generic disc casting (220 mm diameter) containing a central boss, 30mm high and 50mm diameter, which was isolated by a thin wall section. Top feeding through the 10mm thin wall was not possible.
(Figure 9b)

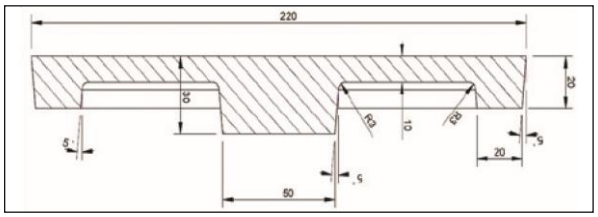


Figure 9b. Layout of a generic disc casting

Several different feed configurations were tested using ductile iron GGG 500 alloy, pouring temperature of 1405°C. [Chemical composition 3.7% C, 2.76% Si, 0.5% Mn, 0.015% P, 0.004% S, 0.044% Mg and 0.25% Cu.] Even using this hypereutectic ductile iron composition demonstrated a clear result. The test casting (Figure 10c) with both top and spot feeder was sound, the casting with only a top feeder (Figure 10b) showed clear porosities in the area of the center boss. Casting trial Figure 10a was conducted as a blank test to measure the feed requirement. It showed porosity in both the flange and boss areas.

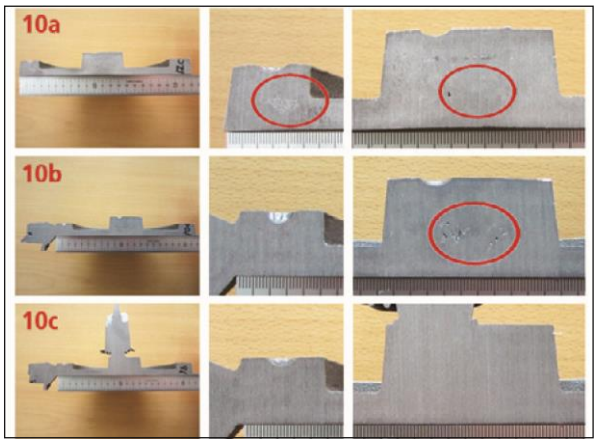


Figure 10a-c. Test castings using different feeder configurations

It could be clearly demonstrated that even when used in a horizontal orientation the highly exothermic spot feeder can work effectively. (Figure 11)

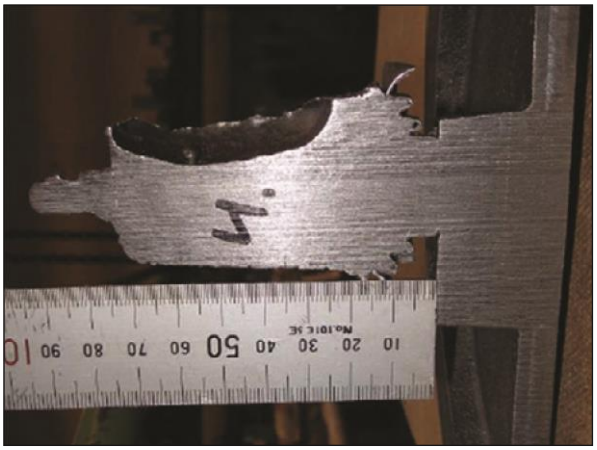


Figure 11. Cross sectioned casting with feeder

The encouraging feed results were also supported by the excellent knock off / riser removal properties. Due to the small contact area, most of the feeders fell off during shake out operations. The notch at the bottom of the metal breaker core guarantees a level break off which helps to reduce or even eliminate cleaning operations. (Figure 12)



Figure 12. Knock off result of FEEDEX* K sleeve

Conclusion

The extensive moulding and casting trials conducted to date have proven the feasibility of spot feeding applications on vertically parted moulding lines. The application of feeder sleeves directly to the swing plate provides greater flexibility and potential for the production of more complex, heavier section ductile iron parts on DISA moulding lines.

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References

1. Scherer, M., German Patent No. 3418137, October 02nd 1986
2. Powell, C., Sällström, J., Pehrsson, J. E., European Patent No. 1567294, May 5th 200

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