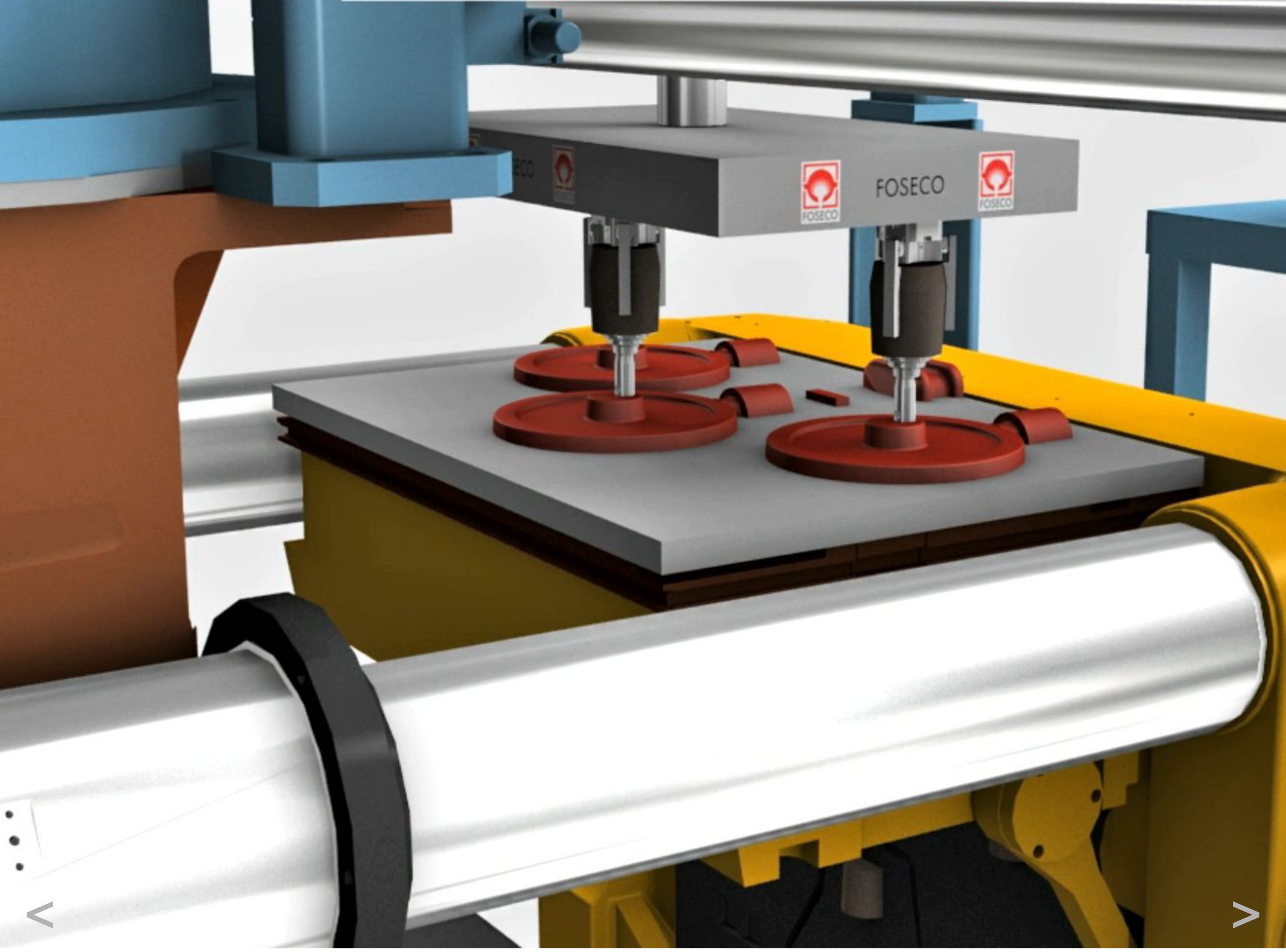

APPLICATION OF FEEDEX K ON DISAMATIC MOULDING LINES

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DISA's introduction of vertically parted moulding machines to the foundry market in 1962 revolutionised the industry with their high productivity and low process costs. Over time, efforts were made to increase the yield of DISA castings, including the use of feeder sleeves and direct pour systems. While feeder sleeves placed on the joint line of the mould improved casting yield and productivity, challenges arose with their application. The degree of utilization on vertically parted moulding lines was lower than on horizontal lines, but market pressures have led to heavier and more complex ductile iron parts being produced on vertical lines. Spot feeding techniques have emerged as a solution, and modifications have been made to spot feeders to address these challenges. In this paper, we will explore the impact of these advancements on the foundry industry.

INTRODUCTION

DISA introduced vertically parted moulding machines to the foundry market during 1962. The high productivity and the resulting low process costs of this concept paved the way to success for this type of machine moulding lines. The initial approach to feed DISA castings was the use of sand risers. To increase the yield of DISA castings, efforts have been made in the past by introducing insert sleeves and direct pour systems. Applying feeder sleeves on the joint line of the mould is a common practice, which uses a core setter to position the unit(s) into a preformed core print. Besides an improved casting yield, in many cases feeder sleeves increase productivity as additional casting cavities can be located onto the pattern plate (Figure 1).

Figure. 1. Application of direct pour unit and insert sleeves to a ductile iron casting

The practice of locating feeder sleeves on the joint can occasionally lead to problems however, for example if the sleeve moves out of position before mould closure.

In contrast to horizontal moulding lines, the degree of feeder sleeve application on vertically parted moulding lines is much lower. One reason is the fact that a high proportion of castings produced on DISA moulding lines are grey iron parts. Standard feeder applications placed in the joint line as side or top risers were able to satisfy the feed demands of these castings.

Market price pressure and the lower production costs associated with DISA lines have increased the number of heavier and more complex ductile iron parts moving to vertical moulding lines. Practices such as metal padding that create a feed path to isolated sections, were used initially to enable the manufacturing of such parts. However, this approach was of limited benefit, as it resulted in reduced yield and increased fettling costs (Figure 2).

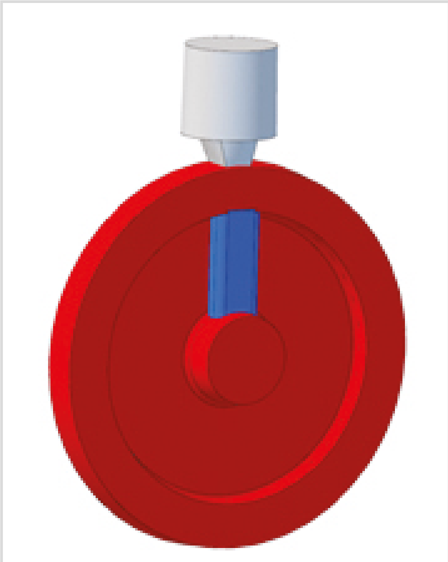

Figure 2. Metal padding to create a feed path through to a central boss on a typical disc casting

Initial efforts to use spot feeding for applications on vertical moulding lines started as early as 2006. At this time, simply using a modified spot feeder with a standard silica sand breaker core. In this case, three guiding ribs were introduced into the internal cavity of the sleeve, providing a support on the locator pin (Figure 3).

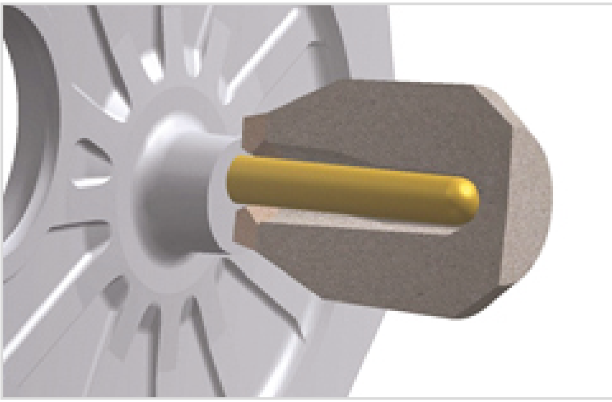

Figure 3. Casting with isolated boss fed by a spot feeder with sand breaker core

This method was the first approach to introduce spot feeding onto a vertical parted moulding line. Even though this application technique avoided metal padding, it had some disadvantages:

- Insufficient sand compaction in the area around the breaker core.
- Interruption of moulding cycles through manual application of sleeve on the pressure plate pattern, reducing productivity.

With regard to feed effectiveness however, first results achieved by the application of spot feeders were promising. Nevertheless, it was clear that from a commercial perspective further improvement of the method was necessary to enable an automatic sleeve application. A project was therefore initiated to further develop this type of spot feeding application for DISA moulding lines.

The main goals of the project were:

- Application of spot feeders without increasing the cycle time of a DISA moulding line
- Provide a feeder sleeve concept with critical features such as a small contact / footprint area on the casting which resulted in sufficient sand compaction during the moulding process.

These feeding requirements were provided by the use of a spot feeder in combination with a collapsible metal breaker core. In order to maintain the cycle time of the moulding line, the use of a core setter was essential. During the moulding operation, where the mould is indexed forward out of the moulding chamber, the swing plate is accessible in a horizontal position for several seconds. This time is sufficient to place of a feeder sleeve onto the pattern plate (Figure 4.)

By the introduction of a sleeve setter robot, the application of feeder sleeves to the swing plate can be automated. Obviously, the sleeves must remain in their position on the locator pins as the swing plate moves down from the horizontal to the vertical position in the moulding chamber.

One option is to incorporate a spring-loaded ball to the pin base, which holds the feeder sleeve in place and stops it from falling off the locator pin. Alternatively, the sleeve can be held in position by the use of a ring magnet in the base of the locator pin. The magnet holds (steel) metal core in position, ensuring the sleeve remains fixed during the downward movement of the swing plate. Both methods have been tested successfully in the field, however the solution with a magnet in the spring base has the added advantage of requiring no maintenance.

The moulding behavior of spot feeder sleeves with collapsible metal breaker cores were tested in practice on a DISA moulding line. A clean contact area of the metal core on the mould face and excellent sand compaction beneath the sleeve were confirmed (Figure 5).

A wide range of test set-ups have been evaluated to determine the feed performance of spot feeders in the central position of a boss section. These trials were conducted on a generic disc casting, where feeding from the top of the casting through a 10mm thin wall section is not possible (Figure 6)

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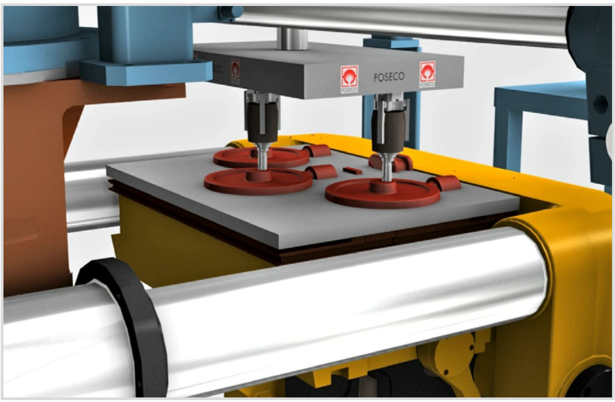

Figure 4. Application of feeder sleeves to the swing plate in a horizontal position

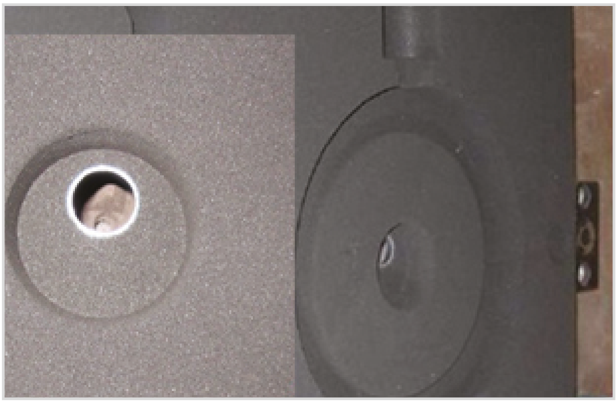

Figure 5. Moulding results on a generic plate casting with collapsible metal breaker core

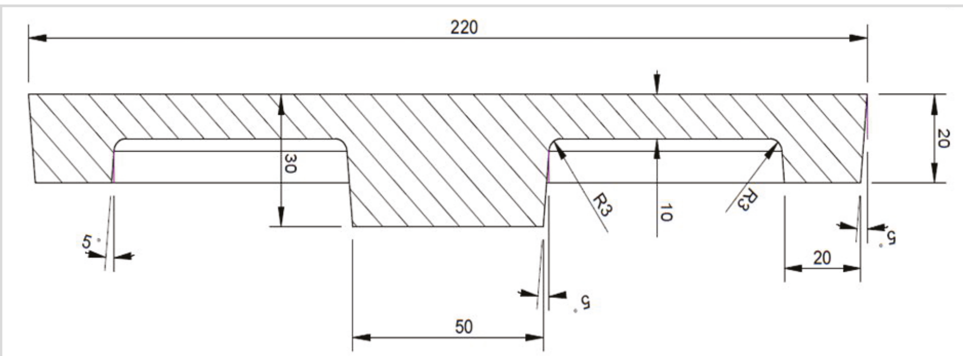

Figure 6. Layout of a generic disc casting

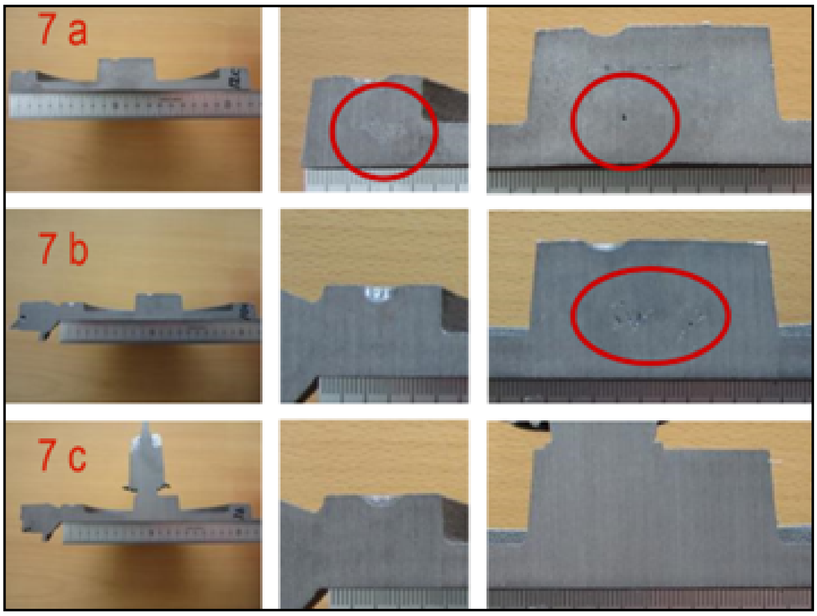

Figure 7a-c.
Test castings using different feeder configurations

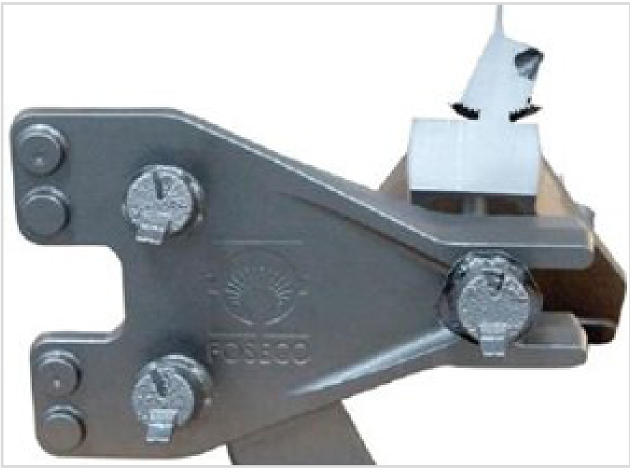

Figure 8. Generic truck bracket casting fed with (3) inclined spot feeders

Figure 9. Spot feeder after knock-off, resulting in minimum residual stub

The different feed configurations were tested with a GGG 500 alloy, poured at 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 an excellent result. The test casting (7c) with both top and central spot feeder was sound, the casting with only a top feeder (7b) showed clear porosities in the region of the centre boss.

Casting trial Figure 7a was conducted as a blank test to measure the feed requirement. It showed porosity in both the flange and boss areas.

The test demonstrated that even when used in a horizontal orientation a highly exothermic spot feeder in combination with a collapsible metal breaker core can work effectively. The promising feed results were also backed by excellent knock off / riser removal properties. As a result of the small contact area the majority of the feeders fell off during shake out operations. The notch incorporated at the bottom of the metal breaker core provides an even break off area, reducing or even eliminating additional fettling work.

Further tests conducted with a generic truck bracket casting also confirmed the viability of the spot feeding concept (Figure 8).

In this case, where feeding from the parting line without metal padding is not possible, inclined spot feeders in combination with a collapsible metal breaker core were applied. This design provides additional metallostatic pressure (due to the inclination of the sleeve) to ensure a consistent feed into the cast part.
Again, the advanced metal core design provided excellent knock off results (Figure 9).

CHENG PAO FOUNDRY, TAIWAN

These encouraging test results stimulated foundries to adopt this technology. One of them is CHENG PAO in Taiwan, where a project for this application technology was launched beginning 2021.

CHENG PAO were starting to use their newly installed DISA 2110 MK3 at this time and the FEEDEX* K product was proposed to them. This foundry is eager to cast high quality and demanding castings to fully utilize the capability of the DISA 2110 MK3.

It was not an easy task in the beginning and many challenges were met along the way. First to mention is the change from an older moulding machine to the new one. Secondly, the search for castings to fill their new capacity also presented challenges, as most of the parts they targeted were already being successfully produced on horizontal moulding lines. Lastly, the demand for efficient machine utilization, whilst delivering higher casting quality and reliability has never been greater. CHENG PAO were open to challenging the normal approach and were interested to work with FOSECO to develop this new feeding approach.

The introduction of FEEDEX K eventually resulted in the request for three Methoding projects – all clutch parts. One for a clutch cover on the DISA 2110 and the other two parts on the DISAMATCH 24/28 – which used also used FEEDEX sleeves. The methods required each one of FEEDEX HD1 GK 4/7KW/ 34MH for spot feeding, insulating insert sleeve KALMIN* KSP 3/5KT as top feeder sleeve, and SEDEX* US 40x40x11mm for filtration (Figure 10).

The heavy section in the centre of the the cast part cannot be fed from the outside and requires spot feeding. Several MAGMA simulations were conducted to develop the optimum setup. (Figure 11)

The first trial was conducted in March with ten (10) moulds. The tests revealed that the sand strength was low, pattern drafts were insufficient, some feeder sleeves broke due to inadequate application and pouring temperature was too low. As series of corrective actions were implemented, followed by subsequent trials and by July the casting was in mass production (Fig 12 a+b).

This success opened the door for further applications of FEEDEX sleeves on two more clutch parts and five other projects. During this project a partnership developed between CHENG PAO and FOSECO, which enabled further castings to be successfully methoded and fed using this ram-up spot feeding technology.

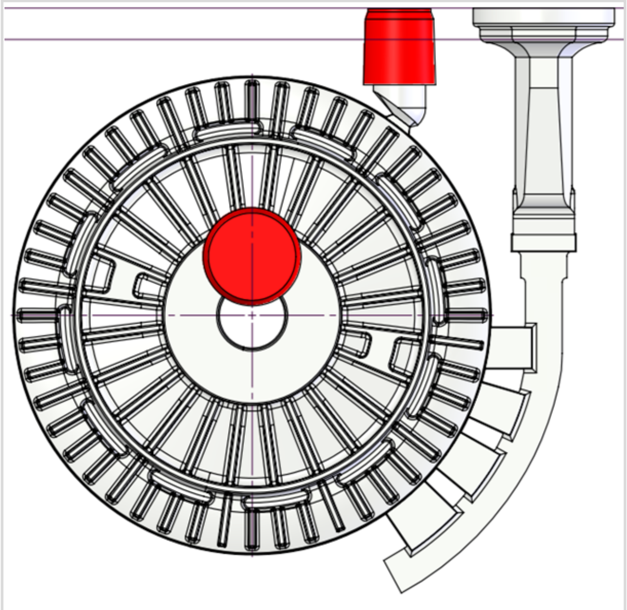

Figure 10. Pattern plate layout

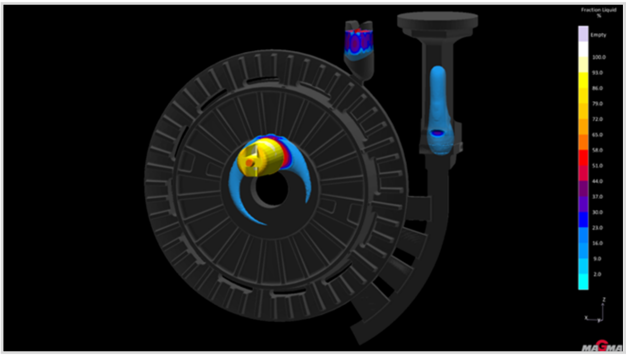

Figure 11. MAGMA result/ fraction liquid

Figure 12 a+b. Photos of section feeders and cast part after feeder knock-off

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