

Automatic SEDEX* filter setting on vertically parted moulds

Introduction

In the ultra competitive foundry industry, continuous productivity improvements are a necessity for foundries to prosper. This is especially true of foundries in the higher labour cost countries if they are to compete with those of the world's emerging economies. One way to reduce costs is to automate repetitive tasks, such as insertion of feeder sleeves, cores and filters. Often this has the added benefit of reducing process variability.

Horizontal filter application

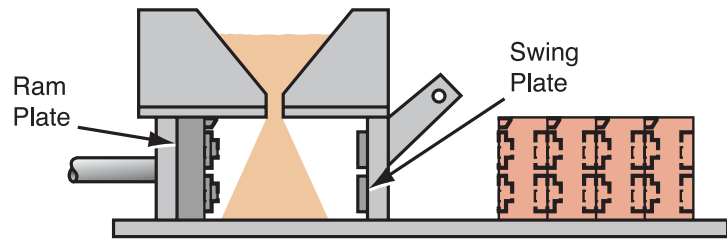
Today the vast majority of SEDEX filters are applied on horizontally parted, greensand, moulding lines. Filter insertion in a horizontally parted mould is a relatively straightforward process. The operator has easy and safe access to the open drag half of the mould and the filter can be put into position manually in a safe and timely manner. In some of the more advanced foundries, semi automatic core setters can set cores, sleeves and filters into the mould in one operation.

Vertical filter application

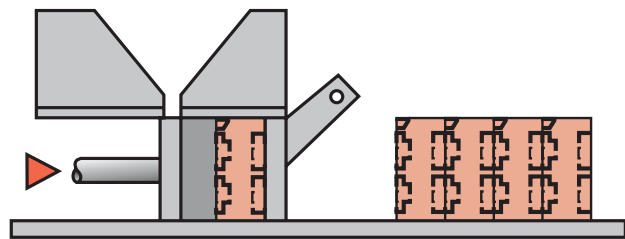
For the application of filters in vertically parted moulds such as a Disamatic, filter placement is far more demanding. The physical space between the mould forming stage and the mould closing stage is much more condensed. The cycle time between mould forming and mould closing is also very short - often only 7 or 8 seconds. The insertion of a filter in the open mould takes place at the mould closing stage. Therefore safety regulations do not permit the manual insertion of filters or cores into the mould face.

Disamatic moulding operation

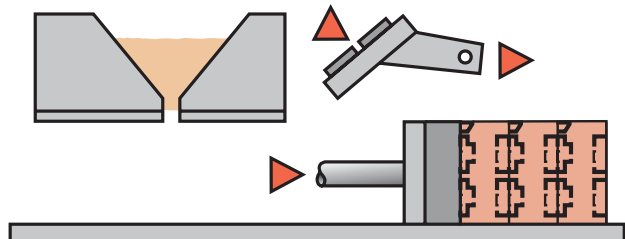
For better understanding of the issues associated with filter insertion into a Disamatic mould, the schematic (figure 1) illustrates the principles of the Disamatic moulding operation.



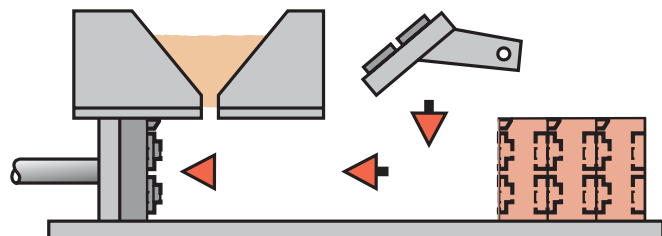
STEP 1: Sand is blown into the moulding cavity between the ram and the squeeze plates



STEP 2: When sufficient sand has been poured in, the ram pushes forward and compresses the sand against the swing plate



STEP 3: Impressions are consequently formed in the sand. The swing plate then moves backward and upwards to allow the ram to push the mould out of the chamber and adjacent to the string of moulds that have previously been rammed



STEP 4: The ram and the swing patterns return to their original positions so that the process can begin again. As sand is poured to make the next mould in line, metal will be being poured into a sprue further down the string

Figure 1 The principles of a Disamatic moulding machine

Filter placement

There are three possibilities when it comes to inserting filters into Disamatic moulds (figure 2):

- Core mask insertion
- Insertion in the pouring bush
- Mould face insertion

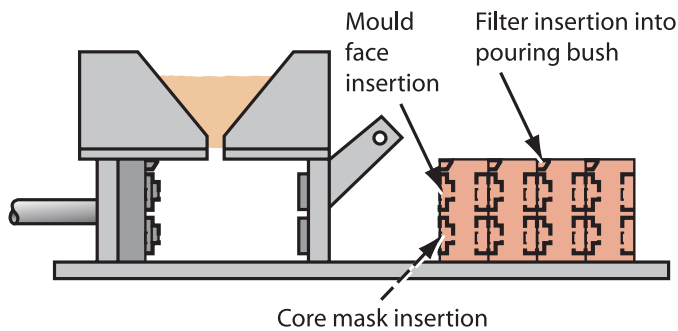


Figure 2 Filter insertion

For cored castings Disamatic lines use core masks or core setters. In this situation, filters can be manually inserted by the operator along with the cores without any negative effect on the production rate. In cases where coreless castings are being produced and core masks are available, filters can be placed by core masks into the mould. The only negative impact here is the extra manpower necessary to insert the filter in the core mask.

When Disamatic moulding lines are designed to produce only coreless castings, core masks or core setters are not generally available. The remaining option then is to place the filter either in the pouring bush after the mould has closed - or direct into the mould face. For the pouring bush placement - which is rarely the optimum position for a filter - an extra person must be situated above the moulding machine, close to the pouring station, exclusively to place the filters. Apart from the unattractive workplace and the extra labour cost, the person has the added difficulty of manipulating the filter into position.

Therefore the more preferred method is direct mould face placement. As mentioned previously this cannot be done manually because of safety concerns. It therefore requires automation in such a way that the production rate is not affected and the filter is placed 'crush fit' in the greensand mould impression.

Background

Interest from the foundry industry in addressing the issue of "automatic filter placement" for vertically parted moulding lines, was initially expressed 5-10 years ago. The main drivers behind this interest were clearly cost reductions and productivity improvements that could potentially be achieved. As a major filter supplier, Foseco Europe was contacted by specific foundries 'to support and assist' the development of such an automatic insertion technique. In 2001 an external engineering company became involved. In 2002 it was decided by Foseco to adopt

this project under the title 'Filter Setting Robot'. The stated objective was 'to support the robotic filter setting in vertical parted moulding lines (Disamatic) in order to utilise SEDEX filters in this market segment'.

A somewhat bulky design was completed in 2002 for a Dutch foundry, however, due to the relatively high cost of the equipment and the related long pay-back time, the project was put on hold. During GIFA 2003 foundries showed stronger interest to improve productivity and to reduce cost and thus contacted Foseco again in order to assist them with projects to automate filter setting.

Robotec involvement

Early in 2004, the Georg Fischer foundry in Singen, Germany, contacted Robotec and set them the objective of designing and manufacturing a SEDEX filter 'unpacking and setting' unit. In order to assist Robotec in this project, direct contacts were made to establish a partnership between Foseco filter product management, the SEDEX filter manufacturing cell, and Robotec Engineering.

The first obstacle was to convince the customer and Robotec that such a device 'could handle SEDEX foam filters without causing the filter any damage' and that 'standard SEDEX packing with minimum changes' was acceptable. After Robotec visited the Foseco Germany SEDEX production line, the idea to use filters in cassettes or from a feeder bowl for this process was quickly abandoned. After gaining an understanding of the application of SEDEX in the foundry and the SEDEX manufacturing and packing process, Robotec devised a method that required no special packing considerations. The unit developed by Robotec uses two individual robots and meets the Georg Fischer specification in terms of robustness within the foundry environment and addresses the limited space available on the moulding line.

Filter setting robot

The unit works as follows - the operator places the full box of filters on the transition belt and removes the cardboard carton manually (figure 3). The first robot uses sensors to identify the exact location of the filters on the paper layer even though they will have moved slightly during transportation.



Figure 3 Removal of outer packaging

The first robot then uses suction nozzles to pick up and place the first filter into a magazine (figure 4). This suction has the added benefit of removing any loosened particles from the filters.



Figure 4 Robotic pick-up of SEDEX filters

This process is repeated until all the filters from the layer are removed. This same robot will then remove the tissue paper separating the filters to expose a new layer of filters (figure 5).



Figure 5 Robot automatically removes protective paper

With the filters now located in a magazine, the second robot can accurately 'grab' and position the filter in the holding cavity of the core mask (as in the case of Georg Fischer) (figure 6).



Figure 6 Robotic positioning of SEDEX filters in the core mask

Robotec claims, that the same robot operation can be arranged in such a way that the filter can be located direct in the mould - the so called mould face insertion - without using a core mask.

Productivity improvement

Assuming the cycle time of a moulding line is 7 seconds, the full content of a SEDEX filter box (50X50mm) will generally take more than an hour to be used up. The only manual operation necessary with the Robotec technique is for an operator to remove the filter box from the stack and to place a second stack in the waiting position. The stack of filters can then be manipulated by the robot and the operator is free to perform other tasks at the moulding line or in the foundry. This was the main driver behind the Georg Fischer decision to install a 'filter setting robot' on their Disamatic line. With the introduction of this robot the number of direct operators on this Disamatic line was reduced from three to two per shift. Based on this, the return on investment is calculated to be 2.5 years.

The first Robotec 'Filter Setting' unit was commissioned to Georg Fischer in Singen, Germany and has operated to the full satisfaction of the foundry since September 2004