Parting problems in pressure die-casting?

The use of ever larger and more efficient pressure die-casting machines with higher closing tads increases the frequency f parting problems. These lead) rejects and impede automation. Detailed analysis shows hat the feared snagging or sticking in the pressure die-casting process has three causes which often occur simultaneously in practice: fusion seizing, shrinkage and erosion.

Problem 1: Intel-metallic compounds

Fusion seizing occurs when an intermetallic compound is formed between the cast metal (aluminium) and the mould steel (iron). The extent of this formation is determined by the factors of pressure, temperature and time. From the physical standpoint the pressure die-casting process is ideally suited for allowing intermetallic compounds to form, since aluminium and iron can easily be melted together and dissolve in one another. Each of them has a high affinity for the other. Unless the formation of such intermetallic compounds is prevented, snagging or sticking will occur during pressure die-casting.

This problem becomes more serious when larger pressure die-casting machines with higher cast weights are used: the factors "pressure" and "time" (dwell time) have a higher value in large than in smaller machines. Since the trend today is clearly towards large machines, the parting problem is becoming increasingly serious. There are three possible ways to largely prevent intermetallic compound formation:

- the addition of Fe and Mn as minor alloying constituents in the melt; this reduces the aggressiveness of the melt since it is then slightly more "saturated";
- the nitration of mechanically highly loaded parts of the mould;
- the use of pressure die-casting parting agents; these form a protective layer on the surface of the mould steel, preventing or at least reducing contact between the two metals.

Problem 2: Shrinkage

During the solidification of the melt in the mould, the cast metal shrinks. This phenomenon affects aluminium alloys and magnesium alloys in the same way.

Shrinkage is particularly problematic for cores, which are surrounded by metal on all sides, and especially cores with low conicality. Complex engineering articles with pronounced recesses are at greater risk than flat articles. The size of the casting is also relevant since in absolute terms large articles shrink more than small ones.

In modern foundry practice shrinkage is the most frequent cause of snagging or sticking. The formation of intermetallic compounds and adhesion of the aluminium melt to the steel mould can be overcome relatively effectively by a range of technical measures. The following measures are adopted by casters in order to produce acceptable components without excessive trouble despite shrinkage:

- sufficient and uniform cooling of the mould;
- ejection of the components at the highest possible temperature, i.e. as soon as solidification has ended, and
- the use of mould parting agents.

Problem 3: Erosion

Eroded surfaces of pressure die-casting dies can be recognised by the presence of small cracks and surface irregularities. The cast metal penetrates into the recesses and snagging results. During metal injection, more or less large amounts of aluminium or magnesium are pressed through the gating zone into the mould cavity.

In the gating zone the molten metal passes into the mould at high speed and pressure, as if through the eye of a needle. The larger the machine and the larger the quantity of cast metal, the greater are the speeds and pressures required to fill the mould in the shortest possible time, before the aluminium solidifies.

Severe erosion of the mould steel in the gating zone takes place due to the factors of mould filling time, flow rate, pressure, temperature change and aggressiveness of the aluminium melt. The larger the machine, the greater is the probability of erosion. The gating zone is generally a high-risk area for snagging. The following measures are adopted to counteract erosion:

- The use of special copper pistons with self-lubricating properties in combination with piston lubricants containing graphite. The more easily the piston slides, the more problem-free is the flow of melt into the mould cavity.
- The use of parting agents which form good, high-temperature-resistant layers which the inflowing aluminium or magnesium melt neither decomposes (burns) nor rubs off mechanically.

What happens nowadays?

When all the technical measures mentioned above have been exhausted and despite this snagging still occurs, then parting pastes are used which are as a rule acidic anti-braze greases or silver pastes. Such pastes can be used only occasionally or, in extreme cases, for each casting. However, this measure creates serious disadvantages for the pressure die-casting process as a whole:

- The surfaces of the die-castings become streaky and sometimes black, and casting porosity increases. The reject rate rises.
- The pastes are applied manually, and this stands in the way of automation.
- When the mould is flushed out, hot oil vapours are released.

For some years it has been attempted to apply oily parting agents automatically in multi-circuit spray systems. This solves the automation problem, but the problems relating to casting porosity and streaky surfaces persist.

A new solution

Tribo-Chemie has addressed the problem and has managed to develop a low-viscosity polymer solution with enormous parting efficacy. This is a water-thin, clear and odourless liquid without any mineral oil addition, marketed under the name Isolat UP 27. The product has a parting action comparable to that of acidic anti-braze greases. In new moulds it will build up a long-lasting parting layer (patina). Its use gives bright castings with no ill effect on casting porosity. Consumption is extremely low and fume release is tolerable and much less than that of pastes.

The new product was developed in collaboration with a noted pressure die-casting foundry in southern Bavaria. It now replaces a silver grease which had to be used for practically every casting because of the size of the casting machine. At first the agent was sprayed in with a lance, but owing to this manual handling the consumption was quite high, mainly through fear that snagging would lead to interruptions. Later, quantities were systematically reduced and are now around 2O°/o of the silver grease used previously. During the entire test phase of around six months not a single adhesion occurred.

Now, the product is applied to the high-risk parts of the mould by a separate spraying circuit. The process now runs completely without trouble, it is automated, and rejects have been reduced considerably.

Tests are also in progress on the impregnation of new moulds with Isolat UP 27, as is familiarly done with anti-brazing grease. The preheated die is thinly sprayed and a casting is made. This process is repeated several times. Whereas previously the articles so cast had to be rejected because of black spots, they can now be used since they are bright, with excellent surfaces. However, the black colour of the steel mould is missed - it is now light grey - but the caster will probably get accustomed to that in time.

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