Tackling the 'disease' not the symptoms

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Die life can be improved significantly through the use of simulation techniques. In this article the author describes some of the problems which beset diecasting and the ways in which software packages help to assess and reduce stresses and strains which reduce die life. Examples are given of the contribution made by the use of MAGMASOFT® to achieve a better understanding of what occurs during the diecasting process.

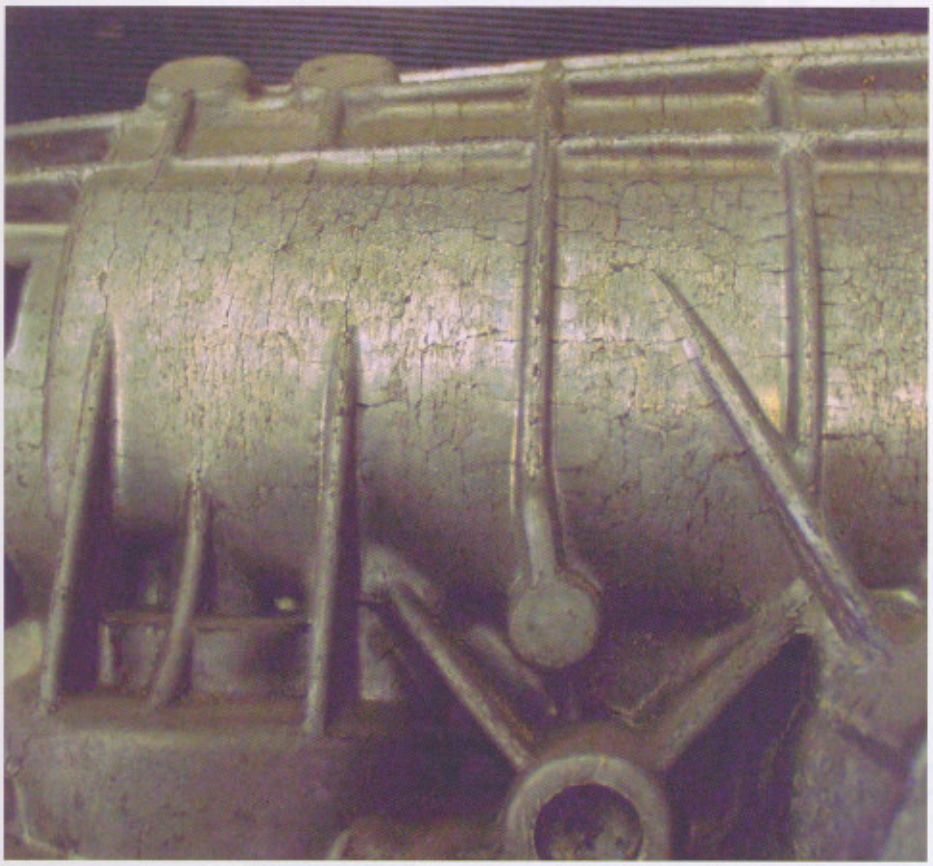

Fig 1 The surface of a casting showing severe heat checking

Experienced producers of diecastings soon realise that even if a sound casting is achieved with the first shot and the production run starts to make money on the first few thousand parts off, a lot can still go wrong further down the line. Even when dies are well cared for and maintained both on and off the machine, the early onset of heat checking and even catastrophic cracking of the die can lead to the need for replacement, long before anyone wants to pay for new dies. Fig 1 shows a casting with severe heat checking on the surface. Fig 2 illustrates the complete failure of the die caused by a through going crack. Both of these defects are caused by stress and strain, loads or forces placed on the die during its life, which in these cases has shortened their lives.

Simply by using a die in a high pressure die-casting machine puts it under stress. Similarly, techniques used for die tool manufacture and heat treatment affect the die before it gets to the machine. Die closing and opening, casting and ejection all impose mechanical loads on the die. The way in which the casting and runner are laid out and the water cooling and oil heat channels are placed, together with the cycle time and die spraying all affect the temperature of the die. The inevitable temperature difference between different parts of the die causes variations in expansion and contraction and this generates thermal stresses in the die. To understand and control these stresses it is necessary either to measure them (which is very difficult and rarely if ever done) or to calculate them.

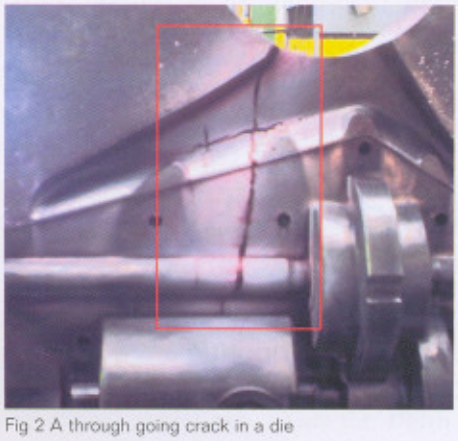

Fig 2 A through going crack in a die

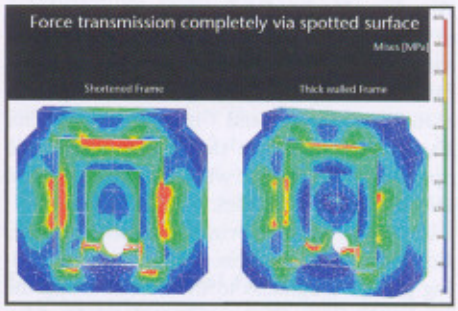

Fig 4 A stress calculation on the die insets and machine platens for a 'thin' and 'thick' frame on die closure

In recent years some work has been undertaken using simulation tools to determine the mechanical loads on a die. Fig 3 shows the results of a virtually unique study during which the closing forces on one die were simulated. By comparison, the application in the die casting industry of simulated filling and solidification is wide spread. In this context Magmasoft is used now by many hundreds of diecasters on a daily basis, mainly to optimise die filling and eliminate porosity. Thermal stress analysis was introduced to the range of Magmasoft capabilities in the mid 90s with the addition of the Magmastress package.

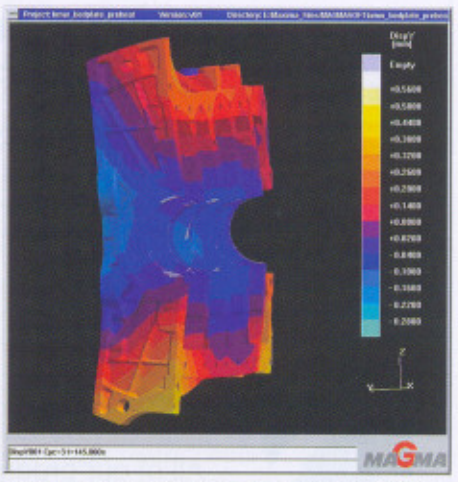

Fig 3 Distortion of an aluminium high pressure diecast bedplate. The distortion has been exaggerated for visualisation purposes. Courtesy of MCL Ltd

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