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WOLLIN

SYSTEMATIC SPRAYING TECHNOLOGY

EFFICIENT DIE SPRAYING IN HPDC

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Efficient die spraying in HPDC

The potential for savings in an HPDC process is getting smaller and smaller. The areas where it is still possible to make significant improvements are thermoregulation and die spraying (which are closely related and interlocked). Nowadays, all foundries are able to implement effective spraying, but is this spraying efficient? Effectiveness shows the ability to achieve the set goal, while efficiency shows the ability to achieve the set goal with the least amount of resources. As far as die spraying is concerned, new release agents (oils or concentrates) are now available on the market that change the spraying philosophy: Whereas in the past spraying was used to cool the die surface, today spraying is used only to create the release film between the die and the casting. In this case, the differentiator is the technology used to apply these products: To achieve maximum results, the release agents must be micro-dosed. The precision and repeatability of micro-spraying is crucial and can only be achieved with appropriate technologies. WOLLIN's ECO spraying technology can reach the goal in different ways, adapting to the different needs of the foundry (long-term production or frequent die changes): the experience developed in recent years allows to successfully manage a wide range of projects. The objectives are multiple: reduction of cycle time; reduction of release agent, water and air consumption; longer life and higher availability of the die; better quality of castings and reduction of scrap.
It should not be concealed that a conversion of the casting processes requires a lead time of one to two years and ties up capacities in process technology. Those who take this on will be rewarded with more stable processes, a reduction in the scrap rate and better casting surfaces.

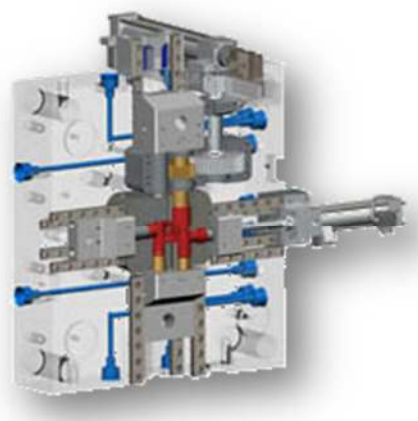
Efficiency in Die Casting

The die casting process has been established for many years and itself offers little potential for further savings. It is essentially the periphery that continues to offer opportunities for optimization. In addition to more efficient furnaces, explicit mention should be made here of die tempering, as well as the spraying process. The development of multi-circuit temperature control units in which each individual cooling channel can be controlled, the use of jet cooling systems, the use of 3D printing in die production, and new, more temperature-resistant release agents are resulting in new approaches to the spraying process.
This is significantly improved when it only has to ensure good release properties and good demouldability.

Requirements

The use of effective water- and oil-based multi-channel die temperature control systems enables a casting process that is much more thermally stable than in the past. This means that the temperature difference of the die between the filling phase and the solidification phase is significantly lower. Thanks to die temperature control channels close to the die and the use of jet cooling systems for squeezers and hotspots, cooling of the die by the spraying process is no longer necessary today.
The significantly lower cooling of the die saves energy, since the die has lost much less heat energy after the part has been removed and sprayed, so it does not have to be supplied again.

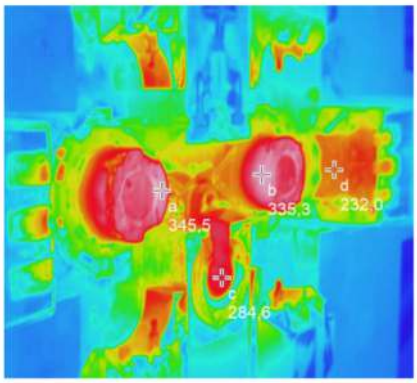
Fig.1 – Die tempering

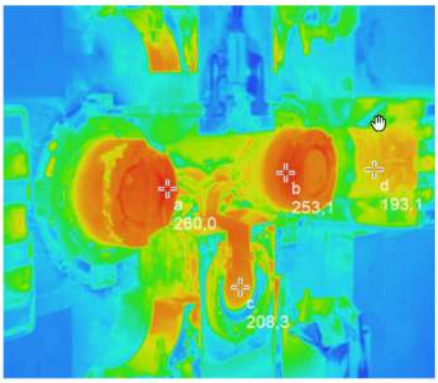


Separating agent

The new water- or oil-based release agents developed in recent years allow a significantly wider temperature spread of up to 400 °C. Depending on the application, wax-containing, wax-free or even wax-reduced release agents are offered. What they all have in common are very good release properties. Wax-reduced release agents additionally offer improved demoulding lubrication, as well as a significant improvement in surface quality, low machine contamination, clean surfaces and reduced scrap rates.

Fig.2 – Die temperature before and after Spraying



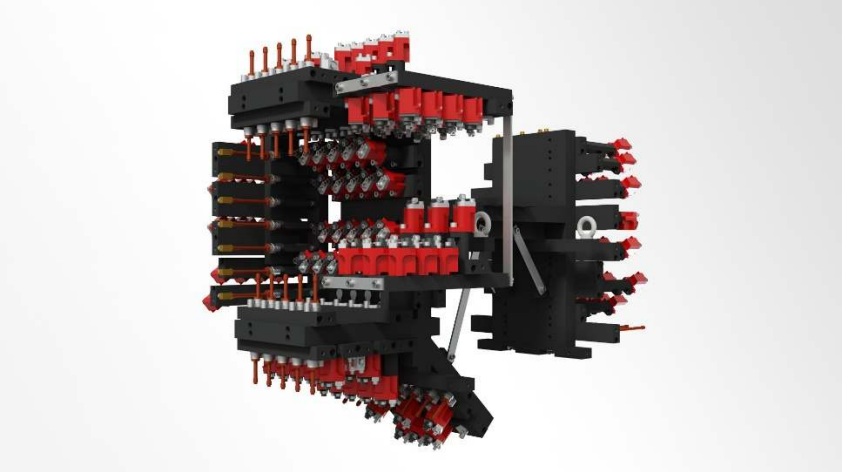


Spray Process

For an optimal result in micro spraying, a few things are helpful. Ideally, a spraying machine with a high payload is used, which can support a mask spraying tool adapted to the die. Separate pressure control for blowing and spraying air is also advantageous for a good result, as is a booster station for control air pressures of up to 8 bar; Wollin also offers retrofit solutions for this.

When the spraying tool is moved into the die, the two die halves are blown out at high pressure. The masking tool, which is adapted to the die and equipped with DDV nozzles, ensures uniform release agent application during spraying. Patented dosing nozzles are used for micro-spraying, which are offered with different dosing volumes so that a suitable release film is achieved for each part of the die.

Fig.3 – Mask spray tool



Experience shows that the release agent concentrates available on the market have excellent flow properties, so that even areas of the die that are difficult to reach receive sufficient release agent. The release agent is applied in a pulse by which the release agent in a chamber of the spray nozzle is sprayed into the die under high pressure in very fine atomized form. The air pressure must not be set too high so that the release agent is sprayed onto the die and does not evaporate without effect. Contrary to initial assumptions, ionization of the release agent and die is not only not necessary, but in many cases rather a hindrance. Due to the course of the field lines, most of the release agent is deposited in the foremost area of the die.
Due to the fine atomization of the release agent, there is practically no Leidenfrost effect with microspraying. Another advantage of applying only the amount of release agent required for the release effect is that only very small amounts of substances are measured in the air.
Afterblowing after spraying is unnecessary, since no excess water was sprayed. The formation of cracks due to thermal shock during conventional spraying is avoided, resulting in a significant extension of the die service life.

Quality
The lack of water during spraying enables a more even distribution of the release agent in the die, which contributes to a significant improvement in part quality. The surface and the microstructure become significantly more homogeneous, practically no blowholes are formed, and porosity is reduced to a minimum.

Environmental aspect
Significant savings can be achieved through the contemporary form of spraying using EcoSpray. Today, awareness of environmentally compatible and resource-saving production is greater than ever. The aluminum industry already has a major advantage here thanks to the very good recyclability of die castings. However, the classic casting process has a not inconsiderable impact on the environment, which is also reflected in the costs. These include the energy costs incurred by cooling and reheating the dies, and the enormous consumption of water and compressed air during spraying.
With microspraying, on the other hand, only very small quantities of the release agent are evaporated, no fresh water is required and, crucially, no waste water is produced. The consumption of energy-intensive compressed air is reduced enormously.
This makes the die casting process much better in terms of its climate footprint.

Tab. 1 - Savings

Wollin Eco Spray savings:	
Energy savings (tempering of die cast mould)	60-80%
Compressed air (vol.)	70-80%
Fresh water	100%
Waste water	100%
Prolonging of die life time	300%

Cost factor

The environmentally friendly process of micro-spraying also has the advantage that it achieves significant cost benefits with only slightly higher investment costs for the dies and their temperature control. The energy savings in die temperature control often achieve a return on investment in just a few months, the generation of compressed air is very expensive, a saving of 70-80% offers enormous financial savings.
The costs for fresh water treatment are eliminated, the release agent mixing in the foundry is no longer necessary. In addition to cost savings, the risk of bacterial contamination is significantly minimized. The expensive disposal of waste water is completely eliminated. New foundries are already being designed without the equipment for waste water disposal.
By eliminating the need for afterblowing during the spraying process, up to 10 seconds or more of cycle time can be saved. The extension of the die service life also provides significant savings for the maintenance or renewal of the dies.

Tab. 2 – Example Cost Savings

Oil pan for automotive industry	Water based medium	EcoSpray with concentrate
Weight of the casting (complete)	15.000 g	15.000 g
Cycle time	82 sec	77 sec
Medium	1,8 l/cycle	5 ml/cycle
Reject Parts	4 %	0,9 %

Cost Savings total / year		197.000,- €
Water/Waste water		14.000,- €
Die life time (+50%)		77.000,- €
Cycle time		25.500,- €
Reject parts		80.500,- €

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