THE IMPACT OF TECHNOLOGICAL PARAMETERS OF DIE CASTING TO CASTING POROSITY

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DOI: 10.17973/MMSJ.2016_10_201623

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The article deals with the research of the influence of selected technological parameters of die casting on the internal structure of die-casts based on Al-Si alloys. Among the chosen technological parameters of die casting is pressing piston speed and holding pressure. Examined castings internal structure is defined by the percentage of porosity. The article described the course design and preparation of metallographic samples to be investigated by optical microscopy. The measured values are given in tabular and graphical form. At the end of the evaluation is shown the impact of individual parameters on the internal structure and quality of the castings.

KEYWORDS

die-casting, castings, parameters, porosity, Al-Si alloy, microstructure

1 INTRODUCTION

Evaluation and research on internal structure of materials is among the important aspects in the production and quality of the final products. When casting production occurs due to technology and other factors to various internal defects that directly affect the mechanical properties and the resulting quality of the cast. Some common errors include bubbles, cracks, fissures or pores. To detect these mistakes will enjoy a wide variety of different methods. In this article we will discuss the evaluation of the porosity of die casts based Al-Si alloys using optical microscopy. Ranked porosity will be examined on the basis of changes in selected technological parameters of die casting. Selected technological parameters of the velocity of the piston pressing and holding pressure.

2 MATERIAL AND METHODS

First they had to be created metallographic samples see Fig.1 to evaluate porosity. The core is the torn test bar of the tensile test and also cut selected sites castings. For cutting specimens was used circular saw MICRON with the possibility of water cooling. Cutting parameters were selected with respect to the material being cut, the pressing force applied to the cutting blade was set at almost its lowest level scale load, while the speeds were set higher, ie. 3000 rpm. These measures were chosen to obtain the highest quality of cut. Subsequent working operations are carried out in the laboratory. There was done embedding samples to dentacryl resin. To evaluate porosity and microscopic observation was necessary to properly prepare the samples, ie samples initially sanded under water on the discs and then polished to a sample of the required quality. This part of the preparation was carried out in the laboratory on a semi-automatic polisher Brand Struers LaboPol-5 see Fig. 2.

Figure 1. Metalographic samples

2.1 *Parameters of grinding and polishing*

In the process of grinding the following parameters were used to ensure the required quality of surface samples.

Grinding parameters:
- Sandpaper grit 1200
- Wheel speed 300 rpm

Compressive force applied to the sample chosen depending on unevenness surface grinding time depends on the surface quality, one cycle was three minutes, most of the samples was after two cycles (2 x 3 min) sufficiently grind, isolated samples was necessary to grind more.

The polished sample was necessary to further polish on the same device, but instead of the grinding wheel was used for polishing with a diamond paste DiaDuo the lubricant particle size of 3 microns and 1 micron. Firstly, there were all samples polished with the paste grain size 3 micrometers, then further samples were all polished with the paste of 1 micron grain size. All pastes have their special polishing discs which had to be varied depending on the polishing paste. Intensity grouting paste, we first set up manually, and then in the actual polishing the machine itself specifying how many glaze dropwise added to the polishing of the samples for a polishing wheel.

Figure 2. Polishing device Struers LaboPol-5

Polishing parameters:

- Wheel speed 150 rpm
- Polishing time of one cycle of 3 min, samples polished 2 x 3 min to 3 microns paste and usually 1 to 3 min 1 micron paste (in a few cases 2 x 3 min)
- Value of the contact force adjusted depending on the quality of the cut

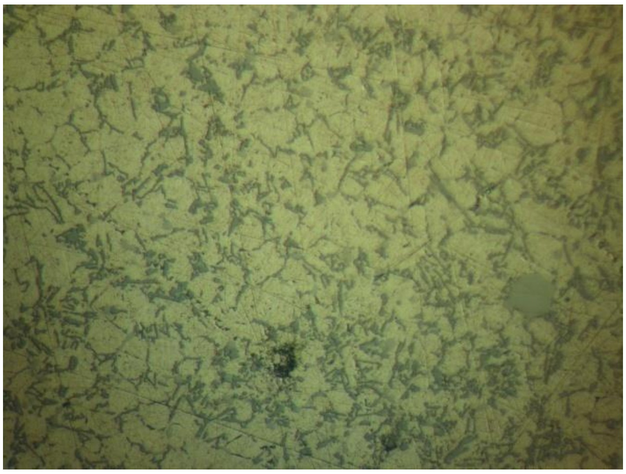

Figure 3. Micrographic image of the tested sample no.1

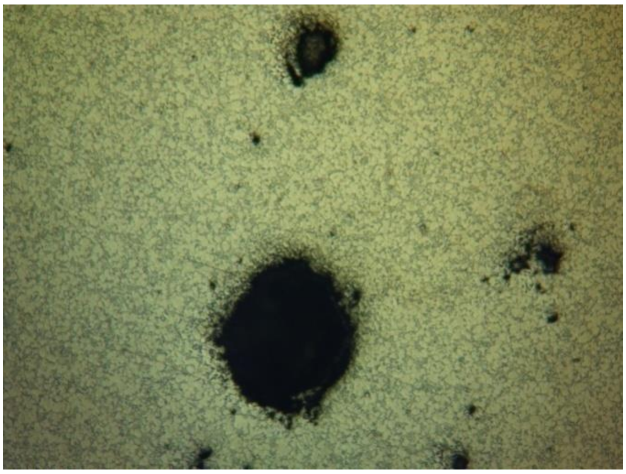

Figure 4. Micrographic image of the tested sample no.2

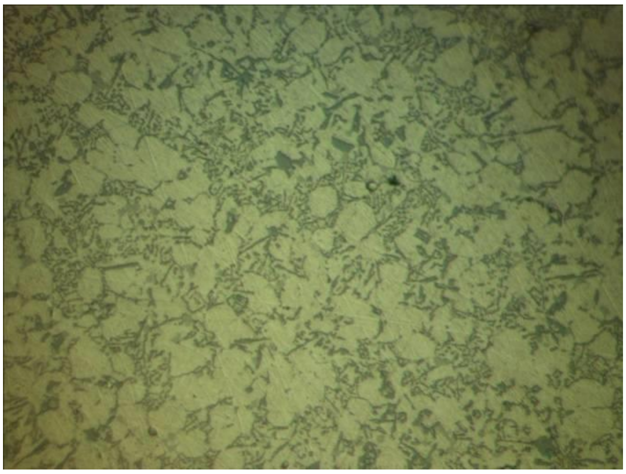

Figure 5. Micrographic image of the tested sample no.3

The quality of the polished sample, is checked with the microscope trinocular 2303 head Intraco Micro see Fig. 6. After examining all samples were clear that the samples are already in order and or that the samples must be polished again.

2.2 Evaluation of the porosity

Porosity was evaluated by optical microscopy, thereafter converting the image into a computer interface, where they were processed by image analysis computer software Stream Motion by Olympus. For these embodiments, photographs were taken of analysis shown in Fig. 3, 4, 5. For each sample, there were selected tree independent places where were performed measurement and evaluation of porosity. These selected sites had to be perfectly polished because the grooves and other depressions the program can also evaluate as the pores and the measurement results could then be distorted. It would be probably a much higher percentage of porosity than the actual event.

Figure 6. Microscope 2303 Intraco Micro

Porosity in Steam Motion Program is evaluated using graphics filters. These filters are pictured in the evaluation find the color on which they are set. Each of the filters has a defined sensitivity, which prevents interference with the detection zone of another filter. Before the measurement, the filter should be set to the proper sensitivity, so that they are evaluated only pores. After this setup program automatically analyzes the images of the objects that differ in color from their surroundings and meet all the specified boundary conditions. The results of all values from the samples are stored in the tables.

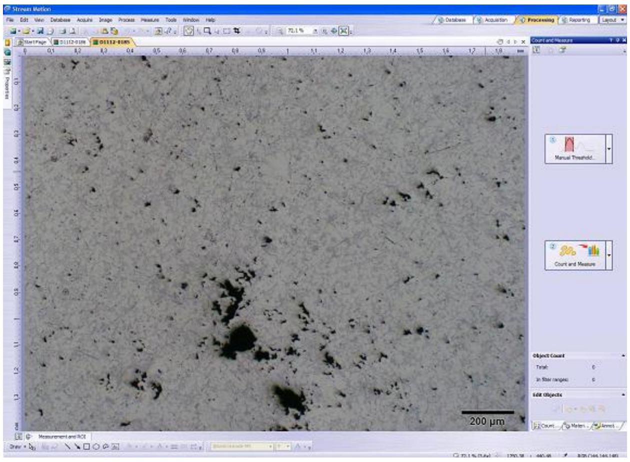

Figure 7. Evaluation of porosity in the program Steam Motion

2.3 *The measured values of porosity due to a change of compression piston speed and holding pressure*

This chapter provides the measured values of porosity due to a change of compression piston speed and holding pressure. In Tab. 1 we can see porosity values depending on the change rate of the pressing piston speed and on Fig. 8 is shown their graphical dependence.

Table 1: Porosity values depending on the change rate of the pressing piston speed.

Sample no.	Pressing speed of the piston v_p [$m.s^{-1}$]	Pressure [MPa]	Porosity P [%]	Average porosity P_p [%]
1.1	3,5	28	2,15	2,49
1.2			2,74	
1.3			2,59	
2.1	4,5		2,89	3,29
2.2			3,78	
2.3			3,21	
3.1	5,5		4,58	4,22
3.2			4,12	
3.3			3,98	

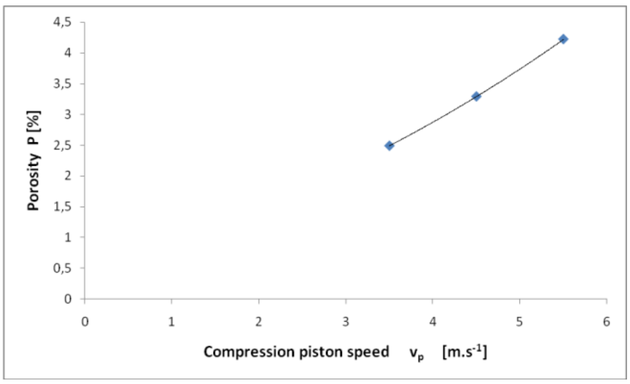

Figure 8. Graphical dependence of the average porosity on the piston speed change

In Tab. 2 are shown porosity values depending on the change rate of the pressure and Fig. 9 shows their graphical dependence.

Table 2: Porosity values depending on the change rate of the pressure.

Sample no.	Pressure [MPa]	Pressing piston speed v_p [$m.s^{-1}$]	Porosity P [%]	Average porosity P_p [%]
1.1	22	4,5	3,97	4,04
1.2			4,12	
1.3			4,05	
2.1	28		3,49	3,44
2.2			3,89	
2.3			2,95	
3.1	32		2,87	2,64
3.2			2,68	
3.3			2,36	

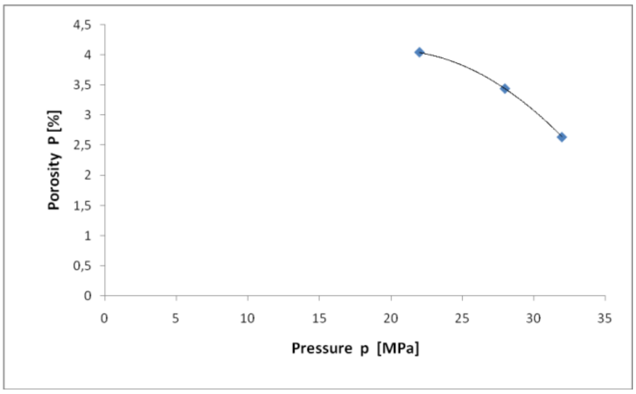

Figure 9. Graphical dependence of the average porosity on the pressure change

3 RESULTS AND DISCUSSION

The measured porosity values of samples tested show the impact of compression piston speed and holding pressure on the internal structure of the casting. In increasing the compression speed of the piston can be observed in Fig. 8 increasing values of porosity casting. Since the different speeds of the pressing piston takes place in various types of filling of the cavity, we can say that the latter is dependent on the filling of the cavity. In evaluating porosity casting depending on changes in holding pressure in the mold cavity was a decrease of porosity due to increasing holding pressure. This dependence is shown graphically in Fig. 9.

Fig. 10 shows a comparison of the values of porosity due to a change speed of the press piston and the holding pressure. When a comparison between the values of porosity in the casting change compression piston speed and holding pressure, the lowest porosity value recorded for the lowest speed of the pressing piston and at the highest value of holding pressure in the mold cavity. The highest porosity values were recorded at the highest speed of the pressing piston and the lowest value of holding pressure in the mold cavity.

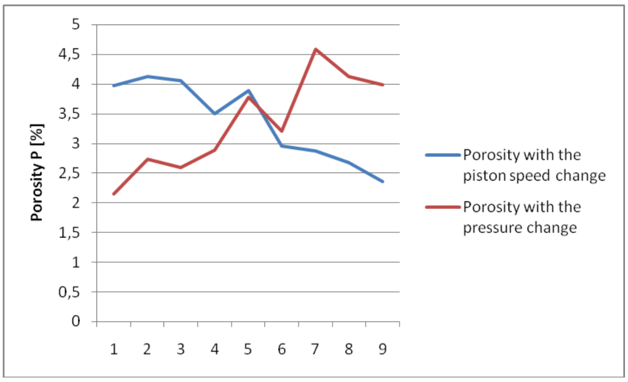

Figure 10. Porosity values with the change of piston speed and pressure

Higher value of porosity at high speed filling of the cavity shows less degree of filling of the mold cavity caused by dispersing the melt stream. Lower values of porosity occur at low speeds filling of the cavity in a laminar flow of the melt. In terms of the speed of filling of the cavity to achieve lower porosity it is advisable to choose lower speeds or pressing the plunger. filling of the cavity melt.

In view of holding pressure analysis it showed that the higher the values favorably influence the final properties of the casting. Nevertheless, higher holding pressure decrease and increase the life of the mold die casting machines downtime, positive impact on the refill casting, reduce the volume of air enclosed in the casting, thereby reducing porosity and increasing the resulting quality of the internal structure, together, the resulting strength. The porosity analysis of the results showed that at higher holding pressure, the percentage of low porosity. In contrast, lower value of holding pressure, the percentage of higher porosity. To achieve a lower percentage of porosity is advisable to opt for higher levels of holding pressure in the mold cavity.

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