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WYDZIAŁ INŻYNIERII MATERIAŁOWEJ

Rozprawa doktorska
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„Wpływ parametrów obróbki cieplnej na wybrane właściwości mechaniczne ciśnieniowych odlewów strukturalnych ze stopów aluminium”

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ABSTRACT

The doctoral dissertation titled "Influence of heat treatment parameters on selected mechanical properties of structural aluminum die castings" consists of three interconnected parts.

In the literature review, it was observed that the recent growth in pressure die casting, both in Poland and globally, is driven by its high process efficiency, favorable functional properties, and the required dimensional and shape accuracy. Unfortunately, these advantages are counterbalanced by the high cost of pressure die casting machines and the regeneration of injection molds. Many polish pressure die casting foundries operate under corporate conditions, which limit the autonomy of the foundry and make it difficult to implement various changes for the benefit of process profitability. In such cases, the only way to reduce the share of defective products is to introduce changes that improve process profitability without altering the product's nature. One such solution is the selection of heat treatment parameters without changing its nature, which will reduce process execution time and reduce operating costs while meeting the technical specifications of the customer. This conclusion served as the basis for developing a research concept aimed at improving process profitability by selecting heat treatment parameters as the production stage where any changes can be made.

The preliminary research, forming the second part of the dissertation, began with the characterization of Magna Casting Poland foundry located in Kędzierzyn-Koźle, focusing mainly on the production of structural castings for automotive chassis components. An analysis of the company's portfolio revealed that some of the most frequently produced castings include rear bumper beam brackets cast from AlSi7Mg alloy for Porsche and rear suspension brackets made from AlSi10MnMg alloy for Jaguar Land Rover vehicles. Until now, these components have been subjected to heat treatment process (the first to the T5 state and the second to the T7 state), but their parameters did not guarantee, a satisfactory level of defective products, particularly concerning minimal elongation (8% for the Porsche detail and 10% for the Jaguar Land Rover detail), gas bubble content, and dimensional accuracy.

Given the above, the presented research concept involved selecting heat treatment parameters (while maintaining their type) that would increase the elongation of the tested alloys without deteriorating other quality criteria required by the customer.

The third part of the essential research includes industrial test series (according to the planned experiment design for both alloys). The results indicate that for aging, it is possible to increase the temperature by 5°C while simultaneously reducing the time by 20 minutes (for the AlSi7Mg alloy casting). However, the solution for solutionizing and aging requires a decrease in the solutionizing temperature by 10°C and aging by 5°C while maintaining the same process time. Importantly, all the studies were conducted at Magna Casting Poland facilities, and the research results were verified in industrial conditions.