

High Pressure Die Casting Process Optimization Using Artificial Intelligence

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Abstract: High Pressure Die Casting technology makes it possible to make precision castings of light metal alloys such as Aluminum. The PLC of the pressure machine monitors dozens of process parameters such as temperature, pressure, doping curve, vacuum level, etc. The number of parameters that affect casting quality is very large. Using the artificial intelligence system, it is possible to build a model that can predict the quality of a casting in real time, suggest to the operator what steps he should take to achieve high casting quality. By using the artificial intelligence system, it is possible to improve the quality of castings, reduce the number of defects, and increase production efficiency. The large number of production parameters makes it impossible for humans to analyze the process. Artificial intelligence algorithms including machine learning algorithms or neural networks perform these tasks very well. Improving the quality of castings is one of the most essential elements of optimizing the production process.

Keywords: Artificial Intelligence; machine learning; production process optimization; High Pressure Die Casting process optimization

1 Introduction

The HPDC process is a complex process that generates more than 100 parameters during one process cycle, which are stored in a PLC - Programmable Logic Controller. Such a large amount of data makes the process very complex and artificial intelligence can optimize it. The entire process is divided into several steps that make up the entire manufacturing process cycle.

2 Experimental procedure

By collecting data from the process combined with the quality of the casting as measured by e.g. leak test, a dataset was created. This data underwent a preparation process for use in machine learning. Outliers were eliminated, checked for blank data, were rescaled and normalized so that the artificial intelligence model created would be better. The data was then subjected to various machine learning algorithms. Separate models were created for each algorithm, which were compared with each other using appropriate metrics to measure model performance.

The entire machine learning process used the regression method, as there was a continuous value as the objective function.

3 Result and discussion

As a result of research using machine learning algorithms, a model was developed with which the optimum parameters for the HPDC process were determined. Such a model should be periodically trained so that its accuracy is even better. With the optimum process parameters set, they should be implemented.

4 Conclusion

The use of artificial intelligence to optimize the HPDC process yields very good results. There is an improvement in casting quality, there are fewer defects, higher profits for the foundry and an increase in the foundry's competitiveness.

The High Pressure Die Casting process consists of many process parameters, alloy and mold, which have a significant impact on the result of the process - casting. Optimization of this process, narrowing the range of parameters, selection of optimal parameters will significantly reduce the number of defects, improve the quality of products, competitiveness of the company and, above all, profits. The use of the machine learning process will not only allow us to explore the potential of the data, but above all thanks to it, based on production data, we can forecast the quality of the casting, measured in this case by leak test.

Various regression models were used to optimize the HPDC process. Appropriate metrics were selected to measure the performance of the model and based on them the best algorithm was selected. Before the data entered the algorithm, it had to be properly prepared. Carry out the appropriate transformations to obtain a normal distribution, scale the data, clean it, carry out the feature selection process to select the most important features (process parameters).

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