FINITE ELEMENT MODELLING OF CASTING PROCESS

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Introduction

Metal Flow is recognised for its central role in the casting process. It involves many factors such as design criteria of the mould cavities and physical properties of the materials. The proper design of a feeding system to achieve smooth and complete filling of the casting is crucial to casting integrity. The analysis of flow is truly complex especially for turbulent flow. Numerical modelling, which offers the possibility to model filling in complex shapes is investigated and tested in this research. The objectives were: (1) To develop, test and verify a finite element base engineering design and analysis software for the design and analysis of metal flow behaviour, thermal characteristics in the casting process; (2) To develop the most efficient mould/die which can produce casting with free defect; and (3) To develop techniques to enable fill modelling in a computationally efficient manner and to validate from experiments conducted in UPM.

Materials and Methods

The project involved in development of thermal and fill modelling and verifications. The main deliverables: Development of fill modelling in feeding system using finite element method, Validate filling system modelling methods (experimental/modelling), Development and testing of codes to effect efficient and robust solution. Pre/post processor for fill and thermal model preparation. The equipment used were:Two units of computers and printer, one unit of data acquisitions, casting simulation computer software, foundry unit – experimental work.

Results and Discussion

Generally the simulation results covered thermal and filling analysis as mentioned in the objectives of research. For thermal analysis, the temperature response and thermal history of casting has been achieved. Temperature contours of the mould or die, helped to visualise the high temperature zones, which will help the designer to predict the maximum stress position. Using LUSAS software package, a full finite element analysis has been done in order to achieve an optimum design and predict the die life. The modelling has been repeated several times for different elements to determine the best possible design. Since casting is a repeated manufacturing process, fatigue load was taken into consideration and analysis was also carried out for a high number of cycles. For filling analysis, it covers metal front movement of single and multi impressions. Simulation of molten metal flow along runner and gating system of casting is carried out. Network analysis was used for this simulation with the aid of a program written in FORTRAN language. This method was chosen to reduce the amount of computation needed. The results of this analysis assist with die/mould design with regard to the location of cooling channels (Shamsuddin Sulaiman and Gethin, 1996). This approach also allowed the convenient modelling of a series of casting cycles to establish the stable casting operating conditions. The experimental work of casting process is being carried out and currently is in the final stage. This includes mould preparations and data collections. Once the results are ready, then its will be compared with modelling and theoretical results. With the new technology approach, the development of computer aided design (CAD) system for casting process is also carried out (Shamsuddin Sulaiman et al. 1997). The system includes facilities for drawing the die geometry, simulation of the flow process and die analysis under the casting conditions.

Conclusions

Finite Element Method has been used to predict the metal flow characteristics in the feeding system of casting. Thermal Analysis of casting process has been carried out using Finite Element Method. Metal front movement was also predicted and analysed. Network analysis software is developed and gives new approach in casting simulation. CAD system of casting design and analysis is developed.

References

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