

SIMULATION OF THE CASTING PROCESS - A POWERFULL TOOL FOR ENCHANCED DESIGN OF THE CUTTING TEETH IN SURFACE MINING

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Recent development in the computer simulation technology caused a tremendous influence on a rapid prototyping in casting process. These computational tools facilitate engineering work and urge moulding verification in foundries. Among dedicated software packages the MAGMASoft is selected for availability reasons. Its effectiveness is proved with the simulation of moulding process of the cutting teeth for a bucket wheel excavator. Use of MAGMASoft enables a shortcut to a forceful and durable product, without internal cavities and micro-porosity. Such advancement of the moulding process is described in this paper.

Key words: casting, porosity, wear, simulation, MAGMASoft

INTRODUCTION

Bucket-wheel excavator (BWE) normally operates in difficult exploitation conditions. Key element of BWEs is a steel made cutting tooth. Dominant criteria for selecting appropriate material, for the cutting tooth manufacturing would be: 1) good ductility 2) top hardness (to resist dynamic load) 3) resistance to abrasive wear. Regarding these criteria, molding arises as the most appropriate and affordable fabrication method. Since casting is the only product forming operation, the outcome properties mostly depend on the solidification process. Understanding of the solidification process means the true knowledge of the following items: 1) molten metal properties (temperature, composition) 2) crystallization conditions 3) Fe-C phase diagram

Prediction of the solidification course is a difficult issue, therefore this paper presents the advantages of MAGMASoft computational package application.

Unlike a traditional approach in casting parameterization which is regularly combined of theoretical calculus and empirical trials, MAGMASoft enables visualization and optimization of solidification conditions simply by virtual analysis. Main target in solidification is:

- Well formed microstructure
- Minimal micro/macro porosity

Improvement of these properties significantly increase fatigue strength and resistance to abrasive wear.

CUTTING TOOTH DESIGN

Economy of coal mining is of crucial importance for an efficient exploitation, and for that a primary goal in

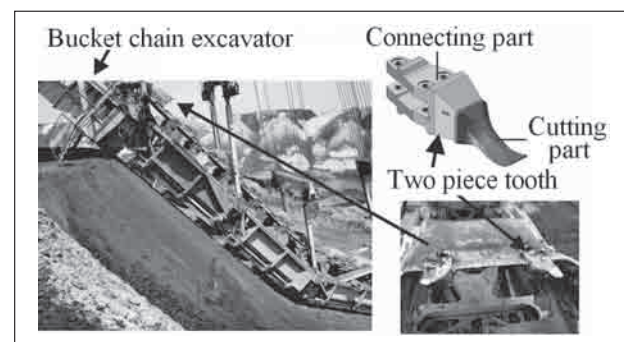


Figure 1 Cutting tooth on BWE

tooth design is development of a “split-part” concept [1]. This would be a simple assembly, composed of a dispensable cutting edge (CE) and steady holder (SH) (Figure. 1).

Thus the spare part becomes only cutting edge, which is replaced after being worn out. Steady holder remains in use for a long term operation as being unexposed to the wear. Part design, as well selection of appropriate material can significantly refine cutting edge performance. Fortunately material properties (abrasive wear resistance, ductility, hardness, dynamic strength etc) can be radically altered by appropriate casting technology in order to fit the operational conditions and improve cost/effect ratio.

CAD/CAM SIMULATION OF THE CASTING PROCESS

Casting process simulation (with MAGMASoft) requires a full 3D CAD model definition, i.e. definition of all the following segments: 1) collector 2) runner 3) drains 4) sprue 5) mold pattern and cores 6) gas drains 7) riser

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