

Research of steel preheat temperature and molten casting alloy AlSi9Cu3(Fe) impact speed on wear of X38CrMoV5-1 steel in high pressure die casting conditions

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ABSTRACT

Influence of mould preheat temperature and molten aluminium alloy impact speed on total mould wear was researched using novel laboratory die casting testing equipment. Testing parameters were set to simulate HPDC of aluminium alloy AlSi9Cu3(Fe). The specimens were made from X38CrMoV5-1 hot work steel (H11). Experiment was designed using central composite design. Following the experiment design, 13 specimens were heat treated and the surface was modified by “Tenifer” nitrocarburizing. Specimen wear was measured by a tribology scale and shown graphically by 3D scan before and after the experiment; the 3D scans were overlapped to determine main wear areas. Response surface was acquired. Most influential tribological wear mechanisms were determined by ANSYS CFX 17.2 analysis. It was found that preheat temperature and molten aluminium alloy impact speed directly affects total wear of the mould surface. An increase of preheat temperature decreases total wear, while an increase of molten aluminium alloy impact speed increases total wear. Conditions for minimum and maximum wear were quantified; most significant wear was observed on sharp edges of nitrated mould material specimens. ANSYS CFX 17.2 hard particle erosion rate simulation suggested erosion occurrence mostly at impact angles perpendicular to the specimen surface. Other ANSYS CFX 17.2 simulation suggested occurrence of cavitation erosion. SEM analysis indicated an occurrence of intermetallic compounds between molten alloy and hot work steel.

BIOGRAPHY

Dr. Zvonimir Dadić has his expertise in materials used in mechanical engineering and a passion in tribology. His other research includes steel heat treatment, corrosion behavior of copper alloys, austempered ductile iron heat treatment etc. For his doctoral thesis, he did research in wear of molds used in high pressure die casting. His research was mostly concentrated on thermal fatigue and erosion of molds at high number of work cycles, using aluminium casting alloy. This was done in collaboration with the industry, company LTH Metal Cast in Benkovac, Croatia.

His scientific work was preceded by industry work in the field of mechanical engineering, specifically hydraulic and pneumatic systems. Subsequently, he started at the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture in Split, Croatia. At the faculty, beside his scientific work, he continued his cooperation with the industry and did a number of expertise in the area of mechanical engineering.

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