Peerawatt Nunwong 2012: Development of Zinc-Alloy Coating for Aluminium-Filled Epoxy Resin Mould. Doctor of Engineering (Mechanical Engineering), Major Field: Mechanical Engineering, Department of Mechanical Engineering. Thesis Advisor: Associate Professor Chatchapol Chungchoo, Ph.D. 262 pages.

This research covers four areas in the development of thermally sprayed Al filled epoxy composite (AL-EP) rapid mould, which are: (1) failure and wear investigation of steel mould surface during plastic injection moulding using SEM technique, (2) development of Zn-alloy sprayed coating onto AL-EP mould material, (3) tribological examination of the mould materials, (4) lifetime evaluation of the rapid mould for injection moulding application. The first topic involves the study of failure of an industrial injection mould. It was found that several failure modes can occur on the worn surface of the steel mould. The second topic covers the development of a surface protection method for the AL-EP mould material. The work includes the study of the mould substrate materials and an optimisation of coating parameters for the electric arc spraying technique using Zn-alloy as a coating material. The results indicate that polypropylene (PP) is a suitable material for the mould substrate due to the good coating built up thickness of 480 μm and the ease of mould substrate removal. On the study of the coating parameters, it was found that the gun surface speed is one of the parameters affecting the deposition efficiency (%DE) of the coating. From the study of various surface speeds, they were found that the suitable surface speed is 160 mm/s, which provides the coating with a % DE of 53.72. The third topic of this work is to study the slurry erosion behaviour of the materials, and the wear formation of material is presented as a function of the impact angle during the erosion test. The finding can be used as a guideline for the rapid mould design. The highest wear of AL-EP casting material was found to be 3.97×10^{-3} mm^3/g at normal impact angle, while that of the coating material is at 4.44×10^{-4} mm^3/g at the impact angle of 60^o. Thus, these impact angles on the appropriate materials should be avoided in mould design. The wear mode in AL-EP material is a brittle failure while a ductile failure mode is found in the coating material. The surface improvement of AL-EP mould material is summarised in the forth topic of this work. The non-coated and coated surfaces of a plastic injection mould was compared. In the non-coated cavity, it was found that the injection pressure and the thermal effects are the major causes resulting in a sudden increase in the surface roughness value of greater than 25%. Where as the roughness value of the coated mould cavity was decreased. Therefore, it can be concluded that the Zn-alloy coating can improve the wear resistance and enhance the lifetime of the AL-EP mould.

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