ABS Plastic Injection Moulds via 3D Printing, Cold Spray and other Coating Technologies

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ABSTRACT

The objectives of this dissertation were to investigate whether the use of gas dynamic cold spray and electrodeposition could be used to improve the performance of 3D-printed Acrylonitrile butadiene styrene (ABS) moulds for use in the plastic injection moulding process and whether the use of the aforementioned coating technologies would be economically justifiable. Various properties, such as surface roughness, coating adhesion, wear resistance, thermal conductivity, and thermal absorption were assessed. The results indicated that 3D printed ABS injection moulds produced via fused deposition modelling could be reinforced by means of metallic coatings produced via gas dynamic cold spray and electrodeposition. The use of the aforementioned coatings led to an overall increase in mould durability, specifically, superior mould cavity surface durability and mould dimensional stability. The use of cold sprayed coatings, specifically tin and zinc, as well as electroplated copper, nickel-blend and zinc could be used to effectively reduce the average moulding cycle times of injection moulded parts produced using 3D printed ABS moulds. The use of electroplated zinc, nickel, and copper, as well as conductive nickel paint, could be used to improve the surface finish of 3D printed ABS moulds. The thermal conductivity of the mould cavity walls could be increased significantly by means of electroplated zinc, copper and nickel, as well as cold sprayed zinc and tin coatings. The use of 3D printed polymer injection moulds coated with the various coatings offered lowered costs per part, tooling costs and lead time compared to conventional aluminium machined moulds.