# ABSTRACT

The development and fabrication injection of moulding tools is complex and demands highly skilled personal. The research aim is to study the effect of surface roughness on mould filling and the ejection of parts for amorphous and semi-crystalline polymers. This study is to simulate and analyse polymers used and investigates the ejection force needed for different selected polymer resins for a series of cavity and core inserts with different surface roughnesses. Mould filling and comparison studies for polymers used also were carried out. Three common thermoplastics polymers were used for the cylindrical part: two amorphous thermoplastics: high impact polystyrene and an acrylonitrile butadiene styrene and a semi-crystalline polyamide. These three thermoplastics were selected due to these polymers are engineering materials being widely used in automotive parts, in the casing of household products and in gears. Apart from that there are different processing conditions for an amorphous and crystalline thermoplastic in terms of melting temperature, injection pressure, packing pressure and cooling times which are considered in this study. A two-cavity prototype tool for cylindrically shaped components was fabricated with variations in wall thickness by using a series of core inserts each with a different surface roughness. The part was constructed using CAD software and simulated in Autodesk Moldflow Insight 2010-R2 (AMI 2010-R2) in order to carry out the simulation works to obtain the required processing parameters for the injection moulding process. The application of simulation software packages for mould design and injection moulding process are vital in order to optimise the part quality and satisfy the market needs. For amorphous thermoplastics there is no melting point in terms of physical properties and having a high toughness due to butadiene chain present, in this case both for high impact polystyrene and an acrylonitrile butadiene styrene. Since polyamide has a viscosity lower than these two amorphous thermoplastics, the processing conditions and pressure will be different which can be identified through the melt flow rate of the resin. Polyamide also has a higher density which is 1.14 g/cm$^3$ compared with high impact polystyrene and an acrylonitrile butadiene styrene which were 1.04 g/cm$^3$ and 1.04 g/cm$^3$ respectively. The study concludes that polyamide resin requires a shorter cavity filling time and less pressure compared with an acrylonitrile butadiene styrene resin. Polyamide also requires high ejection forces due to surface texture generated as compared with high

impact polystyrene and an acrylonitrile butadiene styrene. The mathematical model results for the ejection force closely agree with the experimental data for the three materials used.