Flow visualization and simulation of the filling process during injection molding

To directly compare experimental moldings from an injection molding machine with simulations, a special mold has been produced with a glass window. The injection plane is perpendicular to the opening and closing planes, in order for the 55 mm thick glass window to be easily visible from the side. A high speed camera recording 500 frames per second was employed, and the mold had three thermocouples and two pressure sensors installed. The molded part is a 2 mm thick plate with a 0.5 mm thin section, which creates a characteristic V-shaped flow pattern. Two different materials were employed, namely ABS and a high viscosity PC. Simulations were performed using the actual machine data as input, including the injection screw acceleration. Furthermore, the nozzle and barrel geometries were included as a hot runner to capture the effect of compressibility of the material in front of the screw. These two had significant effects on the filling times and injection pressure calculated by the simulations. Other effects investigated included transient thermal management of the mold, pressure dependent viscosity and wall slip, but their effect were not remarkably large in this work. The obtained simulation results showed deviations within 10-30 ms (relative deviation in the order of 5-10%) for the ABS and slightly more for the high viscosity PC in the range of 100-500 ms (relative deviation in the order of 20-30%) on timings between different sections during filling.