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Characterisation of Surface Reproduction in the Injection Moulding Process. Variation of Tool Steel, Surface Shaping, Coating, Polymer and Processing Parameters.

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Surface-structured injection-moulded parts are used extensively in everyday life. Fluctuations in the surface quality and differences in the gloss often lead to high rates of scrap in production. To obtain a high surface quality, various influencing factors and their interrelationships must be considered: on the one hand the steel grade and heat treatment of the mould, the shaping of its surface and the coating technology; and on the other hand the polymeric material and the injection moulding process. All of these are factors which influence the surface structure quality of the part.
Various different grinding and polishing methods, electro-discharge machining (EDM) and chemical etching are often used to shape the mould surface, in order to fulfil appearance requirements or to hide visible surface defects such as sink marks, weld lines or gloss differences. Typical structure depths are between 1 µm and 120 µm.
A special injection mould with a system of changeable mould inserts was built. EDM, chemical etching and laser texturing were used to manufacture geometrically and non-geometrically defined surface-microstructures on these mould inserts.
To quantify the quality of reproduction, a geometrically defined surface microstructure with a depth of 50 µm was reproduced on an injection-moulded part by injection moulding semi-crystalline polypropylene and amorphous polycarbonate. By measuring the topography of the mould and the moulded part with a non-contact 3D topography measuring instrument, a reproduction ratio can be defined. In an attempt to rank the influencing factors and their interrelationships according to their effect on surface structure reproduction, systematic tests were carried out based on a full factorial experimental design with variations in injection velocity, holding pressure, mould and bulk temperature. The results are presented here.