OPTIMISATION OF THE DEMOULDING PROPERTIES OF PLASTIC PARTS WITH MICRO/NANO SURFACE TREATMENTS: AN EUROSTARS PROJECT

Stefan Hengsberger, Adrien Spaggiari

Haute école d'ingénierie et d'architecture de Fribourg, HES-SO/FR

In the frame of the Eurostars project Superslip E!7412 six partners out of three European countries collaborated around the optimization of the release properties of plastic objects during the injection process. At the institute of applied Plastics research at the College of Engineering in Fribourg (Switzerland) systematic tests of the influence of surface coatings in combination with surface finishes like microblowing and nano Laser texturing have been performed. Several main plastic materials were employed that are in use by the partner companies in this project consortium: out of these materials results for Polypropylene (PP), POM and ABS are presented.

In this project a new test mould has been developed that allows for fixing cylindrical inserts with different surface treatments. The force that arises during the ejection phase was analyzed and the maximum force and the impulse (integral of the force versus time signal) were determined.

Figure 1: left: Cylindrical insert that has been surface treated and tested in an injection mould **right**: Test piece. Several polymers that are commonly in use in plasturgie have been tested.

The results have demonstrated that the optimal surface treatment depends on the applied polymer (***see Figure 2***). The injection tests have demonstrated a significant effect of the superslip coating (CrN & N_2 ions) on the ejection force for PP. In fact a reduction of the demoulding force of 20% was detected for this material. It is supposed that the additional N_2 dose makes the surface coating chemically more inert (see ***Figure 3***). A CrN coating with HiPiMS (High power impulse magnetron sputtering) has shown a 30% reduction for POM and a laser nano texturing with Ra=0.57 um has led to a 28% decrease of the ejection force for ABS. The test protocol that has been developed in the frame of this project has allowed for quantifying the absolute effect of each mould surface treatment step. These promising results have been thoroughly checked in terms of reproducibility. The project outcome has furthermore been validated under production conditions by two Danish industrial partners of the consortium, i.e. Proinyec and Novo Nordisk.

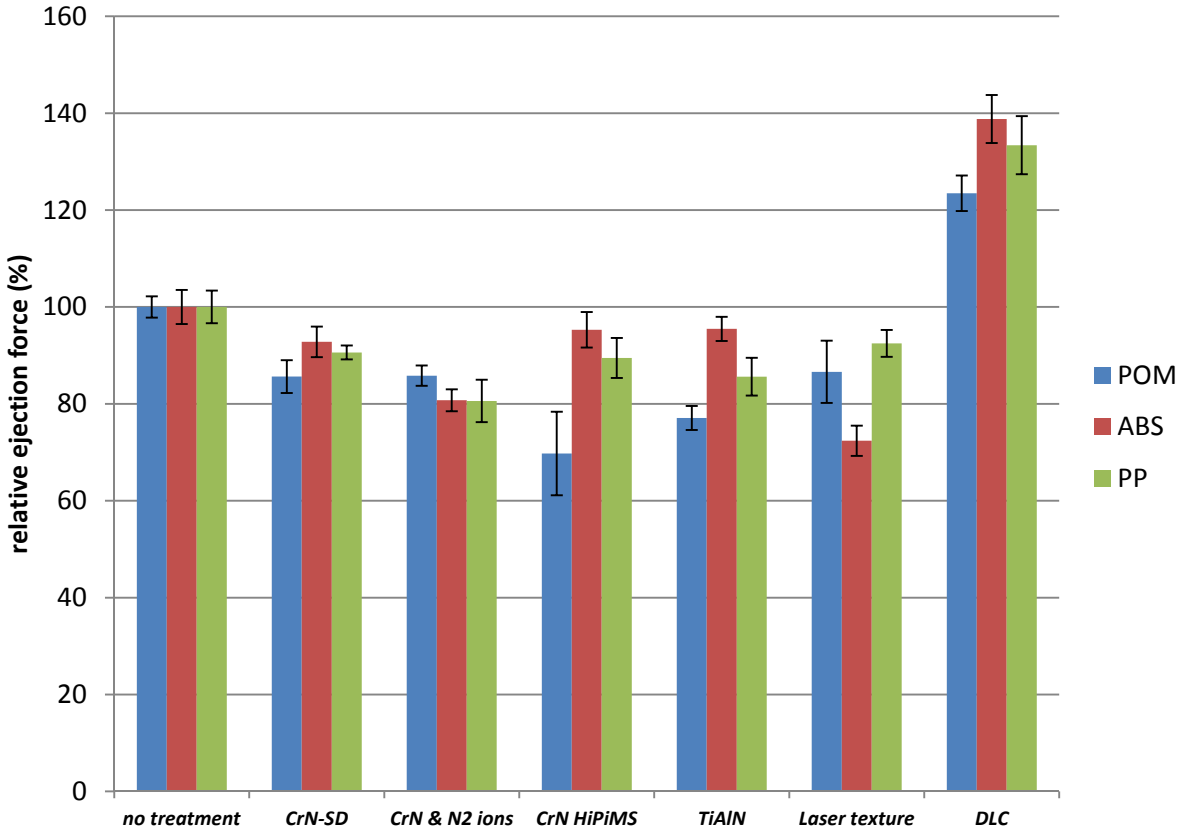

Figure 2 : Relative change of ejection force for different surface treated cores. The optimal surface treatment depends on the applied polymer. The Superslip coating based on CrN & N2 ions has shown a 20% reduction for PP while Laser texture has shown a reduction of 28% for ABS. The CrN coated with HiPiMS (high power impulse magnetron sputtering) has shown a 30% decrease for POM.

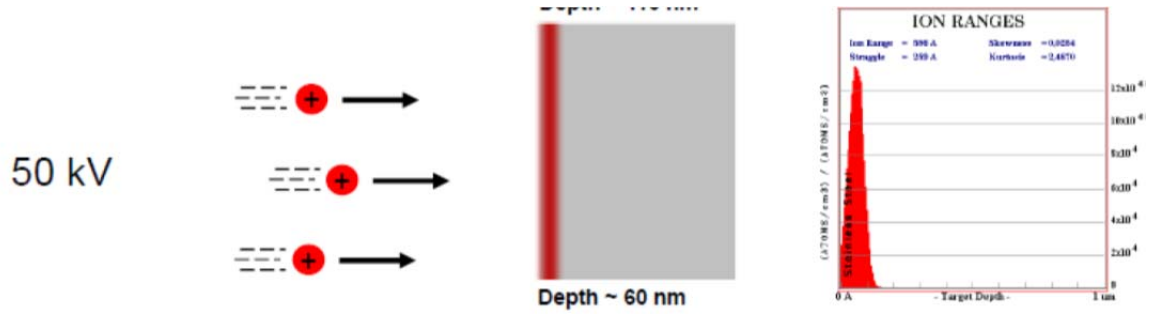

Figure 3: CrN coating with additional N2 ion sputtering. The depth of penetration of the ions can be tuned with the kinetic energy. The superficiel deposition of additional ions makes the CrN coating chemically more inert.