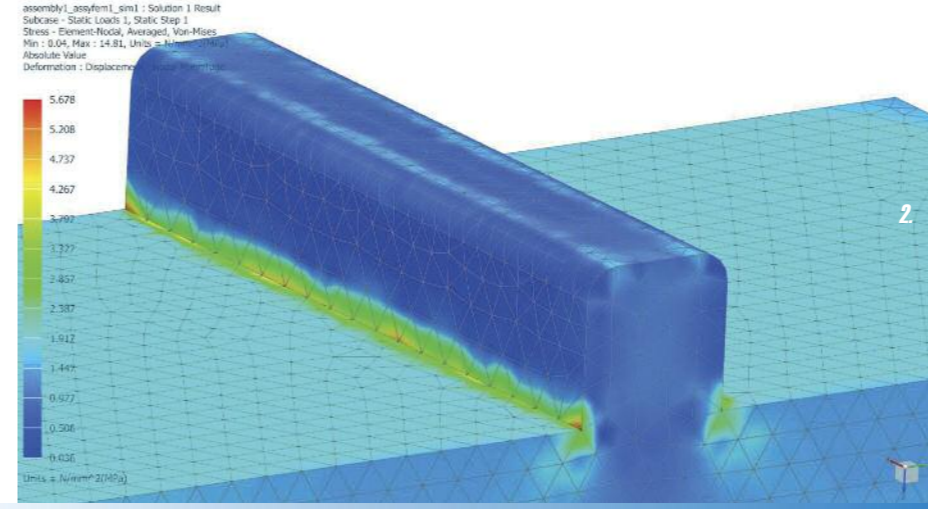
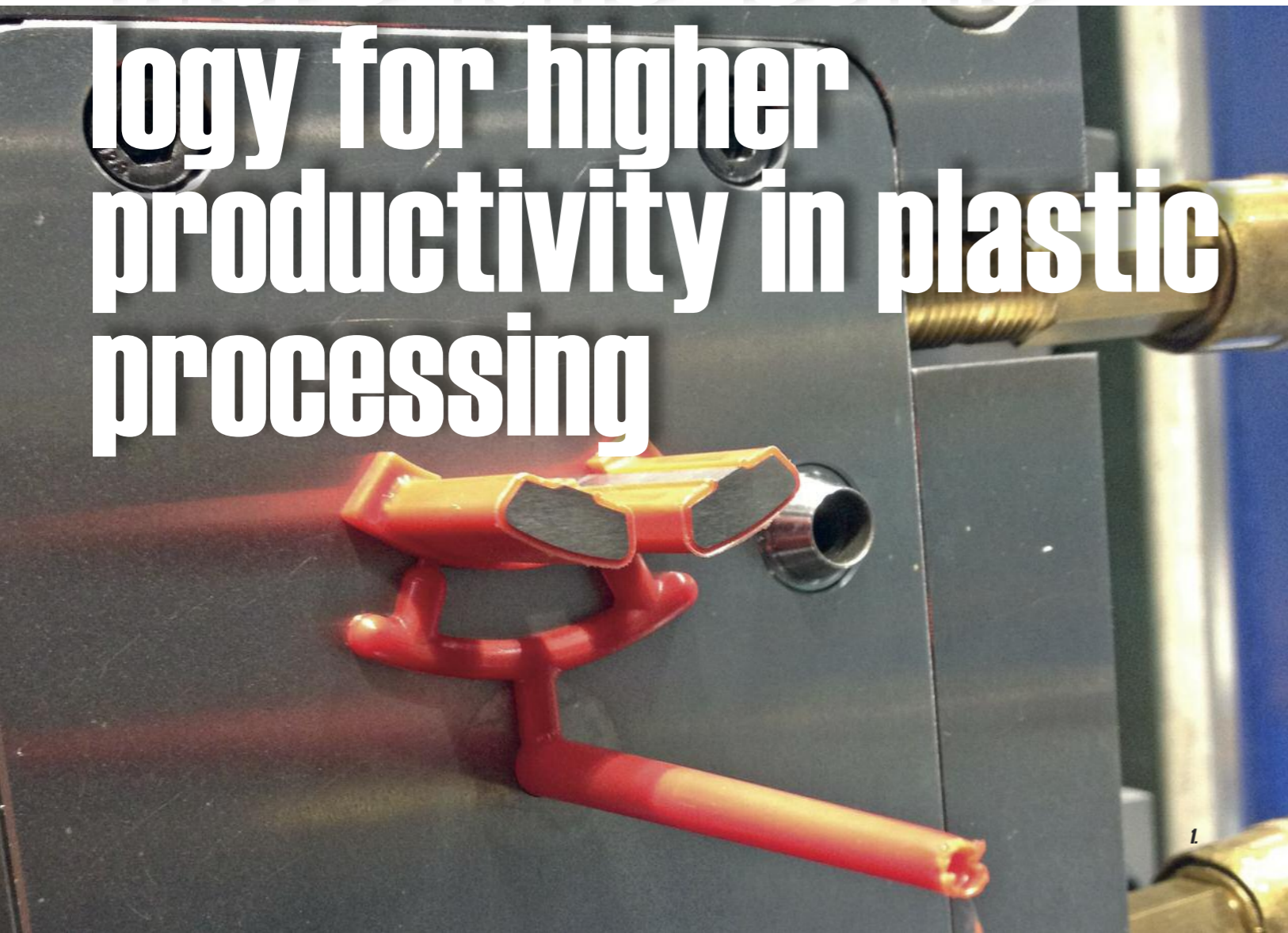


The recently started EUREKA project Super-Moulds represents a perfect example where a full value chain of stakeholders in the Plasturgy sector are reunited and that highlights the competencies of the institute for Applied Plastics Research (iRAP) in terms of micro-nano technology

Micro-nano technology for higher productivity in plastic processing



The EUREKA Super-Moulds project is jointly financed by the Innovation Fund Denmark and the Swiss CTI. The project has started in January 2017 with a total duration of four years. This collaboration of seven Danish and three Swiss partners focuses on the optimization of the plastic injection process by optimizing the mould surface treatments. Demoulding of complex plastic parts is complicated by sticking and high friction between the polymer and the mould surface resulting in long cooling times to avoid deformation, process interruptions due to cleaning and reduced mould service life. The aim of this project is to tailor mould surface coatings and textures to achieve optimum anti-stick properties for a set of commercial plastic types.

This outstanding consortium is based on a complete value chain approach within plastic processing; beginning with the supplier of polymer material (Dupont de Nemours-CH), the stakeholders in surface texturing technology (Georg Fischer Machining Solutions-CH) and coating (Tribology Center, Danish Technological Institute-DK) to the supplier of moulding tools (Winther Mould Technology-DK). The Danish National Metrology institute (DFM) contributes with their expertise in surface roughness analysis and the academic partner (iRAP-CH) centralizes the injection tests. The end users (Novo Nordisk, SP Moulding and Giboplast) contribute to the definition of the appropriate plastic part geometries to study and validate the final results under production conditions. The Danish Plastics Federation and the Swiss Plastics Cluster will foster the market penetration by publishing the results.

The Institute for Applied Plastics Research (iRAP) plays a key role in this project since this partner centralizes the injection tests. Several test moulds have been realized and are ready for systematic injection tests (Fig.1) to identify the influence of polymer material, plastic part geometry, mould surface texture and coating on the demoulding properties. Tribological tests of the polymer-metal interface are performed to study the influence of surface micro-nano treatment on the friction behavior. EDX and contact angle analysis are done to study surface composition and energy. Nanoindentation is applied, a local probe method allowing for identifying the mechanical properties such as hardness that will be related to the wear resistance of the different surface treatments. The effect of EDM and Laser surface texturing (supplied by GFMS, Fig.3) will be evaluated by applying textures with different (sub)micron roughness levels on the mould surface. The effect of PVD coatings with additional ion implantation (supplied by DTI) will be analysed alone and in combination with surface texturing. The demoulding properties of the plastic part are quantified by measuring the force and the energy necessary for ejection. The plastic injection process is modelled with mold-flow and finite element analysis allowing for identifying the effect of the plastic part geometry on the shrinkage of the polymer and the associated contact pressures what directly influences the ejection process (Fig.2). Together with this Super-Moulds consortium iRAP wishes to reach an internationally renowned level in the domain of micro-nanotechnol-

1. Opened test mould for quantitative analysis of demoulding properties.
2. FE analysis of an injected plastic part showing stress accumulation at the edges.
3. Example of a laser surface texturing (Ra=0.4 µm, VDI12) performed by GFMS.



«Micro and Nanotechnology are powerful tools to improve plastic processing»

Dr Stefan Hengsberger, professor of physics and nanotechnology, member of the institute iRAP

ogy in Plasturgy. The developed solution targets a potential productivity increase of up to 50 % and a doubling of the mould service life without compromising the product quality. This project is therefore of key importance for the worldwide market of plastic industry, in particular for production sites in high salary countries.

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