SUCCESS STORY

CHASE
Chemical Systems Engineering

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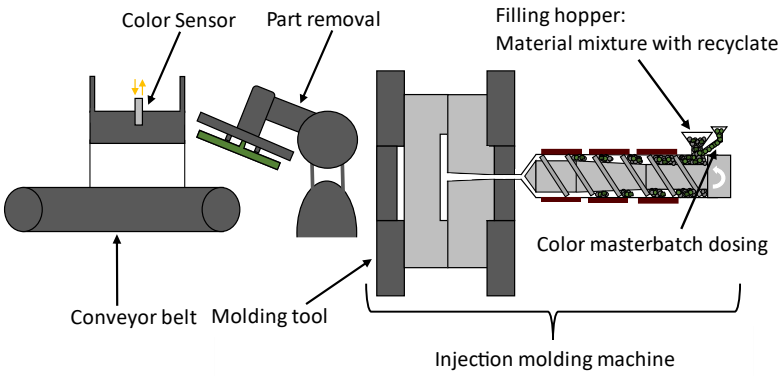

ADJUSTMENT OF COMPONENT COLOR IN THE INJECTION MOLDING OF RECYCLED PLASTICS

ASSISTANCE SYSTEM WITH INLINE COLOR MEASUREMENT AND MODEL-BASED MASTERBATCH CONTROL

Injection molding is one of the most important discontinuous manufacturing processes in the polymer-processing industry. Typically, granular or powdered plastic materials are converted into products used in a wide range of applications (e.g. automotive, packaging, construction or medical). The input material is conveyed by a rotating screw, melted through inner friction and external heating, and injected under high pressure into a mold, whose geometry determines the shape of the injection-molded component. The material is then cooled and solidified, allowing the finished part to be removed by opening the mold.

When processing recycled plastics, quality assurance plays a particularly important role. In addition to dimensional accuracy, mechanical, thermal, and optical properties such as the color of the injection-molded component are of critical importance. Due to the heterogeneous and contaminated nature of recycled materials, variations in component color can occur, which are generally undesirable in most applications due to predefined specifications and performance requirements. New technical solutions are required to counteract these color variations. One effective approach to achieving consistent component color is the targeted coloring of the material by adding color masterbatch.

In this project, a method for controlling the color of the injection-molded part was developed. The key components are shown in the figure on the cover page and include (i) a color sensor for the inline measurement of the component color after

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demolding, (ii) a dosing unit for controlled addition of the color masterbatch and (iii) an injection molding machine. The inline color sensor, which was selected in a previous experimental study, generates the XYZ tristimulus values (color values) of the injection-molded part. The most used color space in the industry is the CIELAB color space.

The control system is based on a mathematical model that calculates the optimum portion of masterbatch according to the color deviations of the component. This represents the minimum required amount of additive needed to achieve the specified reference color. The process works as follows: First, the color of the current component is measured at a predefined position, using the inline color sensor. This color is then compared with a previously defined reference color. The resulting color difference (ΔE-value) serves as the input to the model, which determines the required amount of color masterbatch and sends this information to the dosing unit.

Figure 1:. The functionality and robustness of the control system were tested in injection molding trials using multiple material streams.

The newly developed method enables automated control of the component color even for fluctuating input streams without operator intervention. Through flexible and optimal adjustment of the material composition, a consistent component color can be ensured while also reducing rejects and saving material. In collaboration with our project partners, the control system has already been successfully tested on various material streams, such as post-industrial and post-consumer waste, on an industrial scale.

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