Electron induced electrostatic sorting of mixed separable polyolefin waste

Uwe Gohs[1], Annabelle Lindau[1], Kathrin Harre[1], Doina Constantinescu[2], Christian Schickel[3], Nils Schulze[3]

[1]University of Applied Sciences Dresden, Germany
[2]S.C. Monofil S.R.L., Romania
[3]hamos GmbH Recycling- und Separationstechnik, Germany
e-mail: uwe.gohs@htw-dresden.de

The production of products from mixed plastic waste leads to a reduced mechanical performance because of most polymers are incompatible in the melt mixing. Consequently, the recycling process requires an additional separation step to separate mixed plastic waste into its material fractions. The electrostatic separation of plastic waste is an effective technology using the well-known electrostatic charging of polymers. In the case of polyethylene (PE) and polypropylene (PP), the electrostatic separation is not applicable due to small differences in the tribo-electric row. PE and PP have similar chemical structural and density. Consequently, they cannot be charged up during the tribo-electrical impact and a specific pre-treatment is required.

Accelerated electrons transfer energy and uncompensated negative charges to irradiated polymers. These excess negative charges were used in sorting of mixed polyolefin waste [1], since their number and lifetime depend on the temperature and air humidity during processing as well as on the glass transition temperature and the degree of crystallinity of polymers. Thus, an additional electron treatment prior to electrostatic sorting leads to polymer specific chargeability of PP and PE. This novel pre-treatment was comprehensively tested [2] using virgin polymers such as PE and PP without and with additives (pigments, antistatic agents, and fillers at different concentrations). The experimental results demonstrated clear sorting by electrostatic separation after an electron pre-treatment. The sorting result was almost independent of additives and fillers (except talc). The general principle of electron-induced electrostatic sorting of polyolefins is shown in the figure.

In this work, low-energy electrons were tested for the first time for the electron pretreatment of separable mixed industrial polyolefin waste after shredding, sink-float separation and drying. Based on the experimental data, material limitations, separation factors and additional sorting costs were presented.

References:

[1] V. Albrecht, E. Reinsch, U. Gohs, R. Schünemann, K. Husemann, F. Simon. Aufbereitungstechnik 49, 26-34, (2008)

[2] V. Albrecht, F. Simon, U. Gohs, B. Kretzschmar, E. Reinsch, R. Schünemann, U.A. Peuker. Recovery: Recycling Technology Worldwide, 36-45 (2016)