

## **Determination of stabilizer degradation products as markers for the integrity of recycled polyolefins**

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Polymer materials offer numerous advantages, like cheap price, low weight or applicability for a wide range of products. Yet, they have a limitation in life time and therefore significant amounts of related waste are generated every day.

Used polymer materials are frequently deposited at landfills or incinerated for the purpose of energy recovery. According to statistic evaluations, only about 9% of the waste is recycled, either chemically or mechanically [1].

The quality of mechanically recycled polyolefins is strongly dependent on the homogeneity as well as the integrity of the polymer, which is influenced by the degradation during its lifetime and the recycling process itself [2].

For the quality assessment, numerous analytical methods are available, like viscosity measurements or the determination of the melt flow index (MFI) [3]. Yet, these approaches may be affected by contaminations of other polymers, leading to limitations of the prediction accuracy about the integrity.

Therefore new methods for the analysis need to be developed. The use of degradation products of common stabilizers as markers for the degradation of the analyzed polyolefins can be one approach. Therefore, virgin unstabilized polypropylene and polyethylene (both commercially available) were compounded with a primary antioxidant and extruded various times to mimic recycling cycles. For the characterization and quantification of the degradation products of the sample, an HPLC with UV-detection was employed, as well as an HPLC-QTOF-MS for the identification of unknowns. A time line was created for each degradation product (first occurrence until total decomposition). To assess the quality of the recycled polyolefin, one of the stabilizer degradation products was eventually chosen as a marker.

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[1] Geyer R, Jambeck J, Law K, *Sci. Adv.* 2017;3:7.

[2] Pieszczek L, Daszykowski M, *Chemom. Intell. Lab. Syst* 2019;187.

[3] Hamad K, Kaseem M, Deri F, *Polym. Deg. Stab.* 2013;98:2801.