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Determination of Processability and Performance of Mechanically Recycled Flexible Plastics

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Mechanical recycling of flexible plastics

In this PhD research a criteria to quantify the recycling quality for flexible plastics is developed. This quantification covers both the material processability and film performance aspects. The emphasis has been on the recycling of flexible polyethylenes (PE) and the influence of polypropylene (PP) as a cross-contamination polymer. A survey is also conducted on the efficiency of a recently developed recycling process with improved pretreatment and regranulation features.

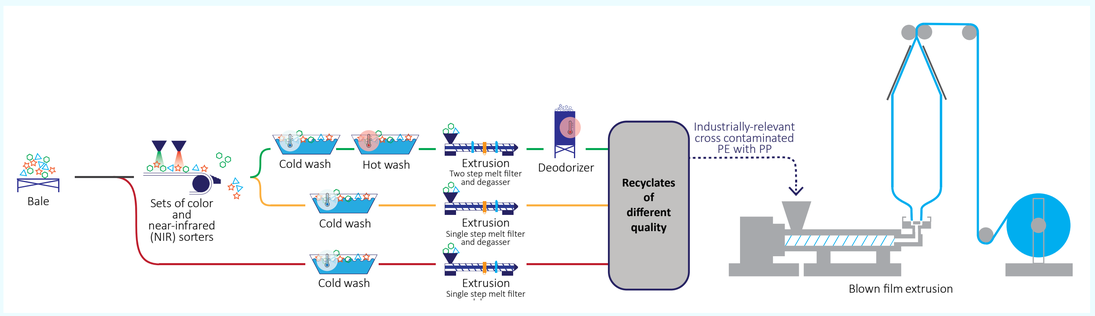

Figure 1: Scheme of the studied mechanical recycling procedure for the flexible plastics in this PhD research

Determination of regranulates' polymeric composition [3]

An artificial-intelligence (AI) assisted technique is developed which accurately determines the composition of blended PE/PP samples by acquiring thermograms via differential scanning calorimetry (DSC).

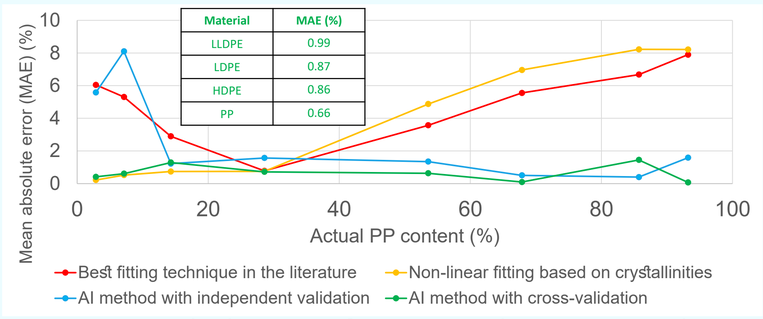

Figure 4: Mean absolute error of composition determination with different methods

Investigation into an improved mechanical recycling process for post-consumer flexible plastics

An improved mechanical recycling scheme (developed by CEFLEX and called Quality Recycling Process (QRP)) is investigated in this research and shown to be able to deliver recyclates of higher technical quality at a comparable process yield to the conventional recycling processes. On top of that the process is economically more self-sustaining.

- Material Flow Analysis and Recycling Performance [1]

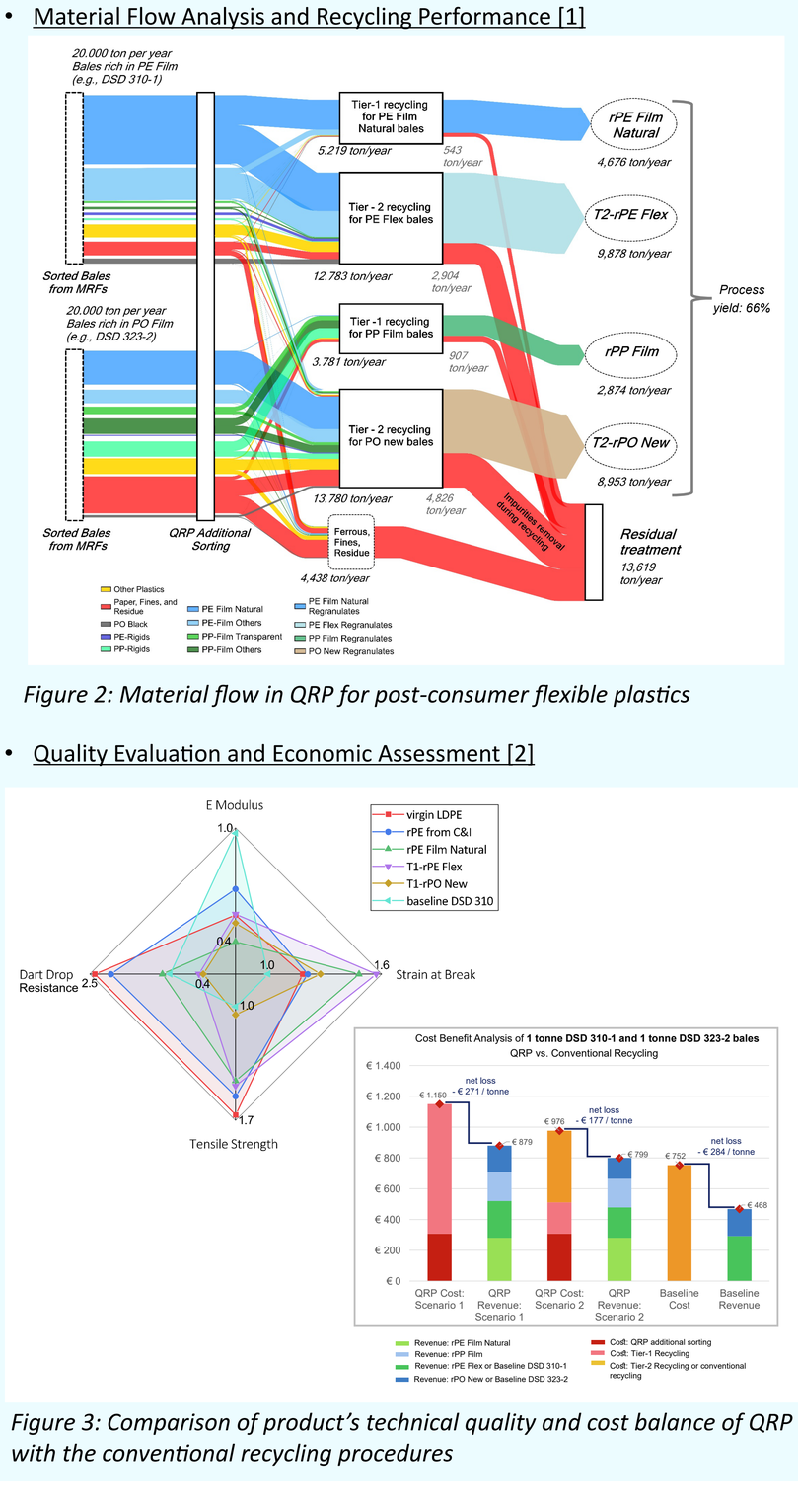

Figure 2: Material flow in QRP for post-consumer flexible plastics

- Quality Evaluation and Economic Assessment [2]

Figure 3: Comparison of product's technical quality and cost balance of QRP with the conventional recycling procedures

Macromolecular structure, rheology, processing condition, and morphology correlations in blown film extrusion (BFE) process [4]

In this research a methodology to determine the recycling quality upon BFE, from the both processability and product's performance perspectives, is developed. The influences of macromolecular architectures, rheology, processing condition, and morphology on each other and on Recycling Quality is explained.

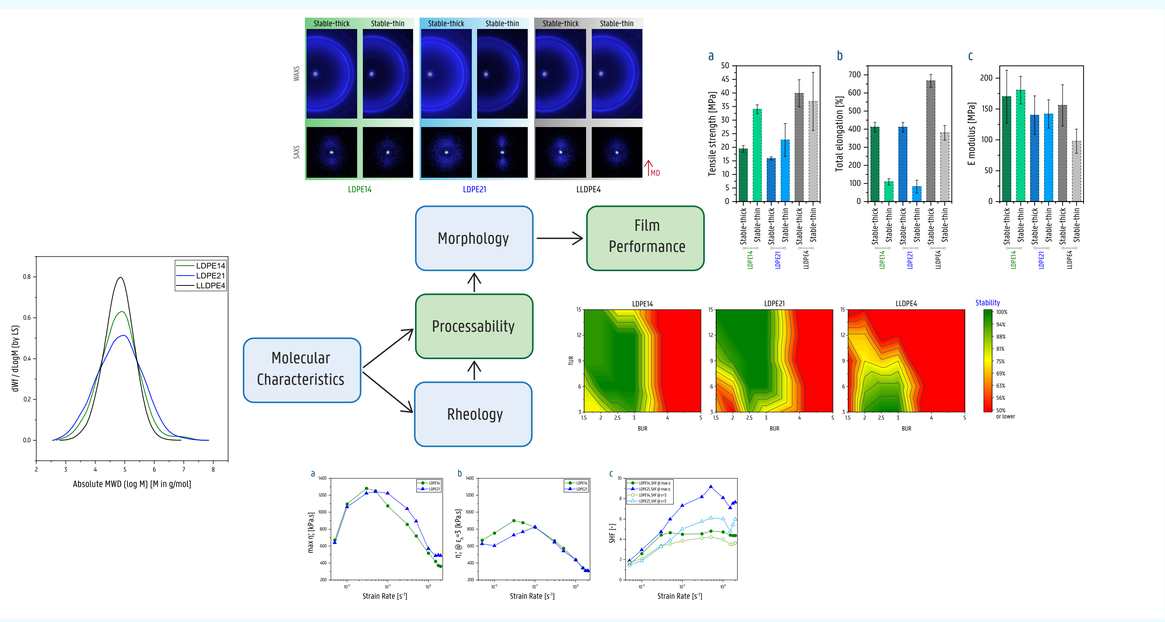

Figure 5: Hierarchy of correlations from molecular features of polymer to the final performance of the plastic films, the links are supported by Chromatography, Extensional Rheometry, Deformation Profile and Processability Mapping, X-ray Spectroscopy, and Mechanical Tests

The last piece of the puzzle

A survey into the recycling quality upon BFE of PE when contaminated with PP is being conducted. In this part of the research the correlations in Figure 5, will be made for industrially relevant compositions of PE flexible streams [5].

References

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[5] ***Bashirgonbadi, A.***, Delva, L., Van Geem, K.M., Ragaert, K., 2024. The Influences of Polypropylene (PP) Cross-Contaminations into Polyethylene (PE) Streams on the Recycling Quality of Flexible Plastics (in preparation)

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