Quantifying the environmental performance of plastics in a circular economy: A case study on post-industrial plastic waste

Steven De Meester[a,b], Kim Ragaert[c], Sofie Huysman[b], Jonas De Schaepmeester[b], Jo Dewulf[b]

[a] Ghent University, Department of Industrial Biological Sciences

Graaf Karel de Goedelaan 5, 8500 Kortrijk

[b] Ghent University, Department of Sustainable Organic Chemistry and Technology

Coupure Links 653, 9000 Gent

[c] Ghent University, Department of Materials Science and Engineering

Technologiepark Zwijnaarde 915, 9052 Zwijnaarde

Steven.DeMeester@UGent.be

To monitor the environmental sustainability of plastic recycling, proper indicators are required. Life Cycle Assessment (LCA) is a common methodology that can be used for this purpose and that can guide decision makers towards choosing the best performing waste valorization scenario. However, typical LCA's do not account for the technical reality of the materials studied; in some cases for example only downcycling is possible whereas in others only incineration is feasible due to lack of separation and processing technologies.

In this presentation, we will elaborate on a newly developed life cycle based indicator that is capable of measuring the circular economy performance of plastic waste treatments starting from the quality of the waste material. Based on the compatibility between polymer blends, a (preliminary) quality factor is determined that gives insight in the valorization scenario's that are possible for this specific material. If the plastic is of high quality, the recycled material can substitute virgin material entirely (closed-loop recycling, option I). If recycled plastic is of lower quality, extra virgin material has to be added (semi closed-loop recycling, option II), or a different material is substituted (open-loop recycling, option III). If the quality is too low, the waste can be incinerated (incineration, option IV). Based on these options the circular economy performance indicator (CPI) can be calculated which is defined as the ratio of the actual environmental benefit of the chosen option over the maximally obtainable environmental benefit for the studied waste.

To illustrate the use of the indicator, the results of a case study about post-industrial plastic waste recycling will be shown. This case study generally concludes that the best environmental performance is achieved when plastic waste streams are treated according to their quality.