Challenges in LCA modelling of multiple loops for aluminium cans

Life Cycle Assessment (LCA) has traditionally played a key role in identifying the most efficient environmental design strategies and the best option for the end-of-life of products from an environmental point of view, within “one life cycle” approach. However, such an approach fails to capture one of the main features of circular product systems, i.e. the need to model multiple life cycles. There are some key methodological challenges that LCA has to face in order to exploit its potential in a circular economy framework, e.g. how to model the recycling of materials in multiple loops. We considered the case of closed-loop recycling for aluminium cans, where body and lid are different alloys, and discussed the abovementioned challenge. The Life Cycle Inventory (LCI) modelling of aluminium processes is traditionally based on a pure aluminium flow, therefore neglecting the presence of alloying elements. We included the effect of alloying elements on the LCA modelling of aluminium can recycling. First, we performed a mass balance of the main alloying elements (Mn, Fe, Si, Cu) in aluminium can recycling at increasing levels of recycling rate. The analysis distinguished between different aluminium packaging scrap sources (i.e. used beverage can and mixed aluminium packaging) to understand the limiting factors for multiple loop aluminium can recycling. Secondly, we performed a comparative LCA of aluminium can production and recycling in multiple loops considering the two aluminium packaging scrap sources. The results from the mass balance of the alloying elements showed that the limiting alloying element for continuous can-to-can recycling is Mn. Therefore we quantified the amount of Mn and primary Al that needs to be reintegrated in each scenario according to the recycling rate and used this information to perform an LCA of 30 recycling loops based on the actual alloy composition. From the comparative LCA the closed product loop option (i.e. using used beverage can scraps) turned out to have lower environmental impact than the open loop option (i.e. using mixed aluminium packaging scraps), at least with regard to climate change.