Open-loop versus closed-loop recycling in IOA: a sysnthesis

Topic:
Author: Shinichiro Nakamura
Co-Authors: Kazuyo Matsubae, Kenichi NAKAJIMA, Yasushi Kondo

Metals can in theory be recycled an infinite number of times to produce new materials without any deterioration in their inherent properties as basic materials. In other words, they can be recycled in a closed loop infinitely. In reality, however, metals do not usually occur separately, but in combinations in alloys and/or in combined forms based on bondings of a physical and chemical nature. When products such as cars or electronics are discarded, and submitted to end of life (EoL) processes, a mixing of different metal species is likely to occur due to incomplete separation and/or liberation. Consequently, , in reality, not closed loop cycles but open loop cycles are typical for many metals recovered from EoL products. Associated with open loop recycling are quality and dilution losses. This paper addresses the quantification of these losses by means of hybrid Input-Output analysis. we focus on the losses associated with the recycling of ferrous materials recovered from end of life vehicles (ELV) due to the mixing of copper, a contaminant for ferrous materials. Our approach to issues of scrap quality is based on explicit consideration of different grades of iron & steel (IS) scraps and their use patterns, which were made possible by detailed study on of economy- wide inter-industry flows of ferrous materials, including eight types of IS scrap in a form compatible with the Japanese IO table of around 420 production sectors. The issues related to open loop recycling and dilution by primary material are addressed in line with Nakamura and Yamasue (2010). The results indicate that avoidance of the quality and dilution losses could reduce the CO2 emission associated with the production and EoL phase of a passenger car by 30%. Applied to 4 million ELVs generated annually in Japan, the avoidance of the losses could amount to a saving in emissions of around 0.5% without causing a domestic shortage of the supply of ferrous scrap.