IO-MFA-based linear programming for the quality-oriented End-of-Life vehicle scrap recycling (for special session on MFA & IO modelling)

Topic: Material flow/stock analysis in input-output modelling II
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Steel is the most commonly used metal material. Accordingly, studies on material flow analysis (MFA) of steel abound. These studies are concerned with the quantity-based flow and cycle of iron and steel, and the importance and necessity of steel recycling are pointed out based on concerns about the depletion of high-grade iron ore and the requirement for CO2 reduction. Some studies have correctly pointed out the need for paying due diligence to quality-related issues for achieving a sound material cycle for steel. During the recycling phase of steel, various other elements are likely to intrude and contaminate because of the combinational use of various materials. Besides, steel originally contain other elements as alloying elements to get special properties. Consequently, steel recycling is complicated process from the view point of quality control.
For the achievement of quality-oriented steel recycling, exogenous contamination should be avoided by the removal of contaminant before re-melting. Although alloying elements should also be removed, they cannot be separated mechanically because they are alloyed with iron matrix. Therefore contents of alloying elements in recycled steel must be controlled within requirement and/or regulation during re-melting process to save not only the quality of steel but also precious alloying elements.
In this background, this study clarifies optimal scrap recycling conditions focusing on the End of Life vehicle derived steel scrap which contains a lot of alloying elements by means of IO-MFA-based linear programming (LP). By applying LP to IO-MFA, repercussion effects of the optimization can be estimated in addition to the optimal recycling condition. Using this method, the most efficient recycling of ELV derived scrap for alloying elements saving and environment are figured out.