MAPPING THE CONTENT AND FATES OF SCARCE METALS IN DISCARDED CARS

Magnus Andersson, Chalmers University of Technology
magnus.andersson@chalmers.se
Maria Ljunggren Söderman, Chalmers University of Technology / IVL Swedish Environmental Research Institute
Björn A. Sandén, Chalmers University of Technology

Key Words: Scarce metals, Functional recycling, End-of-life-vehicles, Material flow analysis

A great variety of current products make use of components or materials (e.g. electronics, steel and aluminium alloys) that utilise increasing amounts of ‘critical’ or scarce metals (SM). For example, design trends for cars point at increasing SM utilisation in order for regulatory, business and consumer requirements on environmental performance, safety, costs, comfort and infotainment to be met. Modern cars now hold SM in substantial amounts, i.e. the circa one billion cars in use worldwide today, constitute a significant near-term secondary SM resource. However, current end-of-life vehicle (ELV) recycling is mainly aimed at isolating hazardous contents, dismantling spare parts and recycling bulk metals. There is thus a clear risk that ELV SM are not functionally recycled and thus lost for further use. Assessments of the opportunities for increased functional recycling require estimates of SM content of discarded cars and individual waste flows in ELV recycling. However, information on both is limited. Data related to cars is sparse, and challenged by the large range and age span of discarded car brands and models. Measurements of SM in waste flows are few and cover a limited range of SM. Consequently, available data does not allow us to quantify with precision the SM contents of discarded cars reaching the ELV recycling system, or map individual metal flows within it. Instead, our approach relies on mapping 25 ELV SM to main types of applications within three newly produced car models using automotive industry data (International Material Data System, IMDS), and letting these models represent the ELV fleet so that the annual input magnitudes of SM to ELV management can be estimated. Subsequently, we employ material flow analysis of ELV waste streams as basis for identifying potential pathways of these main applications, and the extent to which contained metals may reach processes capable of functional recycling. The approach allows us to qualitatively distinguish subsets of systems flows holding groups of SM, and discuss the potential for functional recycling. Using Swedish ELV management as a case, we conclude that only platinum may be functionally recycled in its main application. Cobalt, gold, manganese, molybdenum, palladium, rhodium and silver may be functionally recycled depending on application and pathways taken. For remaining 17 metals, functional recycling is lacking. Consequently, there is considerable risk of losing SM with current ELV procedures. Given differences in the application of metals and identified pathways, strategies for improving recycling and resource security are considered. Moreover, our case illustrates the considerable challenge, posed by the complexity and range of car configurations and the sparsity of information on SM, to closer assess recycling strategies and advance secondary SM resource utilisation.