Process-oriented Characterization of Platinum Group Metals from Spent Automotive Catalysts and Evaluating Future Urban Mines (Université de Liège)

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Process Oriented Characterization of Platinum Group Metals (PGMs) from Spent Automotive Catalysts and Evaluating Future Urban Mines

Degree: *Master ingénieur civil des mines et géologue – EMerald*

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Abstract: Platinum group metals (PGMs) are among the 27 raw materials labeled as critical by the EU in 2017 due to their economic importance and supply risk. South Africa and Russia collectively produce approximately 80% of the global PGM mine production. The single biggest application of Pt, Pd, and Rh is in automotive catalytic converters (ACCs) to abate the emissions from engine exhaust. Each ACC contains a few grams of these precious metals. The concentration of PGMs in ACC urban mines (>2000 ppm) is much higher than that of conventional mines (<10 ppm). Thus, recycling of end of life automotive catalytic converters (ACCs) present an important source of platinum group metals (PGMs). The circular economy of ACC not only helps Europe further develop domestic production but has several economic and ecological benefits. PGMs are currently recycled from ACCs by pyrometallurgical means and the development of low-cost alternatives in hydrometallurgy has long been the focus of research. The efficiency of the economical leaching techniques has generally been low, owing to the paucity of understanding of a very complex and heterogenous ACC material and insufficient process-oriented characterization.

An in-depth literature study suggested that automotive catalysis is a broad field and ACC input material is influenced by several factors including technological and legislative development, size and type of engine, manufacturer, etc. It was also found that due to the nano nature of PGMs in ACCs, the potential of SEM characterization has been under-utilized. SEM Characterization using SEM structural and compositional differences between ceramic three-way catalysts (CTWC), metallic three-way catalysts (MTWC), diesel oxidation catalysts (DOC), and diesel particle filter (DPF). It was also found that harsh operating conditions further impact the ACC material as analyzed under SEM. PGM particles were not only visualized but key processes that happen over time such as catalyst poisoning, PGM, and washcoat component thermal sintering, were obvious which influence chemical composition and particle size/porosity reduction. All this information was found to be of great relevance for subsequent leaching processes. Leach feed and residue samples also showed that some information on the process controls could be acquired using SEM.

It was also found that the statistics from the automotive market and basic understanding of ACCs could help in defining different sections of ACC-urban mines based on grade and PGM type.