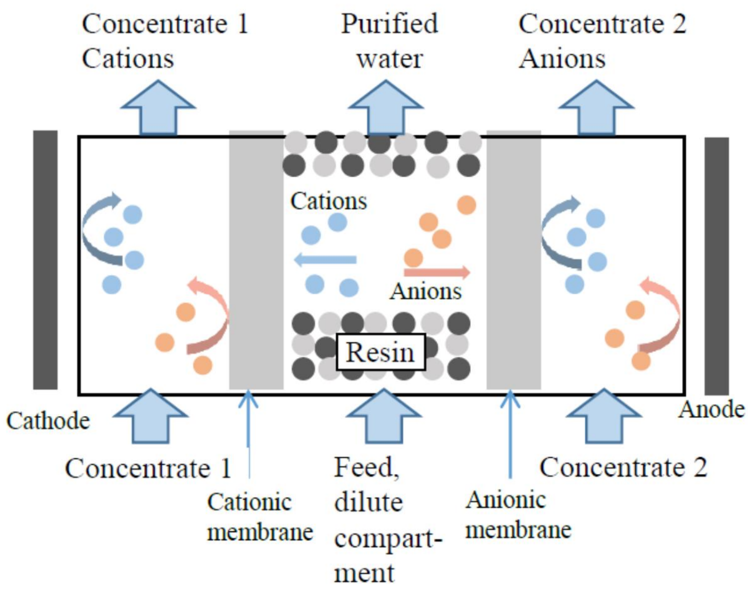
Development of Novel Electrodeionization System for Recovery and Recycling Of Precious Metals and Rare Earth Elements from Mining Effluents

Principal Investigator: Prof. Mika Sillanpää

In the current scenario, the role of rare earth elements and precious metals plays is instrumental. They have influenced the developments in electronic, automotive and energy sectors to a greater extent. The advantages of such elements are often accompanied with concerns regarding the methodologies involved in recovering those metals both from an economic and environmental point of view. Such concerns have motivated the constant search of sustainable and novel methodologies in mining sector. This would eventually lead to efficient methods in the process of recovery and recycling of valuable elements from mining operations. The primary aim of the project is to develop a methodology for the selective recovery of such elements at low concentrations. The proposed method involves the combination of ion exchange and electrodialysis (electrodeionization) process with the scope of integration with the current industrial processes.

The polluted mine water from the mining process has always been considered undesirable or waste despite being a source for valuable elements. Current mining methods eventually dispose of the sludge and highly concentrated brine after purification and decantation of the mine water. The potential to recover the valuable elements from the sludge or brine are greatly influence by the acidity and composition of the ionic species. Hence it is essential to develop novel techniques to reclaim the valuable elements at low concentrations. Such an efficient technique is the ion exchange process. Prior research in this domain involves methods to remove mercury, sulfate and uranium but there is a need for the chemical regeneration of the resin. This can be achieved through a combined method involving ion exchange and electrodialysis for continuous “in-situ” regeneration of the resin. Additionally the methodology is environmentally sound and energy efficient in terms of purification, separation and concentration. The schematic of the proposed method is shown in the figure below. Continuous regeneration occurs through electrochemical splitting of water with the continuous removal of target metal from the dilute through the concentrate compartments.

There are recent evidences for the recovery of Ni, Cr (III) and Cr (IV) but in the case of rare earth elements and precious metals, there is considerable need to evaluate the knowedge of such a process. Though the current application of the electrodeionization is in the water treatment domain, the development of novel and higly stable ion exchange resins would be a promising solution for the treatment of mining effluents. In-situ regeneration is a prime advantage as compared to metal recycling methods as it would contribute to the development of a sustainable process.



Contact:
Prof. Mika Sillanpää
Mika.Sillanpaa@lut.fi Tel.+358 400 205 215