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Nanofiltration technique to improve Li recovery from acid leachate of the spent Li-ion battery: Characterization of Li and other contaminated ions in recovering process.

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Lithium (Li) is an essential element for lithium-ion batteries (LIBs) that are necessary for effective mobile energy in appliances and electric vehicles; the demand for Li has been elevated worldwide [1]. Meanwhile, the sites for lithium resources are limited geographically, many countries cannot ignore a supply risk for elevating demands in the future. Thus, establishing a technology to recycle Li from the spent LIBs efficiently is an important matter for the sustainable use of Li resources. Nanofiltration is anticipated as an effective treatment for separating multivalent ions and small ions, such as Li^+ [2]. We thus applied it to improve Li recovery from spent LIBs acid leachate using an acid-resistant nano-filter. The present study evaluated the effect of the filtration technique on the Li recovery, and the behavior of ions in the separating process was investigated.

Acid leachate of spent LIBs, the initial solutions without any treatment (A0), and the solutions that passed the nano-filter (Atf) were used in this study. Li was obtained as Li_2CO_3 from them by following processes: (1) removing metals and SO_4^{2-} by alkalization (pH 11 – 12) with $Ca(OH)_2$, (2) removing added Ca^{2+} by carbonization with Na_2CO_3, and (3) deposited Li_2CO_3 by evaporation of solvent. The metal concentrations were determined by ICP-OES, and the precipitates in each process were characterized by X-ray diffraction pattern (XRD) analyses.

In the case of A0, more than half of the sample solution was lost during the precipitate removal process in alkalization, moreover, it was difficult to raise the pH value. The XRD analysis revealed that a high amount of Al in A0 led to generating ettringites by adding $Ca(OH)_2$, which reaction was a factor that disturbed the alkalization and caused the loss of solutions. In the case of Atf, SO_4^{2-} ion was effectively removed as gypsum during the alkalization, Li_2CO_3 was obtained successfully after the carbonation and evaporation.

[1] Alessia et al., J. Clean. Prod., 2021.

[2] Darren et al., J. Wat. Proc. Eng., 2017.