SisClever process: simultaneous recovery of metals from ore or waste to high purity and high concentration via solvent extraction

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Sustainability requires the systematic recycling of materials, such as discarded lithium batteries or electronic waste. Both types of waste contain valuable components, such as rare earths, which it is desirable to recover. Li batteries contain various valuable components in varying concentrations, depending on the manufacturer and the specific design. As a result, for the treatment of these wastes, complex and multi-step processes have been proposed in the literature, which are costly. At the same time, valuable components that are present in low concentrations in the waste stream are difficult to be economically recycled.

To solve these and similar complex separation tasks, the SisClever process is presented, a new process based on reactive solvent extraction, applied to separation of valuable metals as an example. The idea is to establish an individual accumulation region for each component to be separated in the counter-current process. This is achieved by establishing a dedicated *p*H-profile along the process. At each accumulation region, the respective component is removed with a side stream. By appropriate design, in principle, arbitrary purity and arbitrary concentration can be reached, limited only, for example, by solubility. Several metals can therefore be recovered simultaneously as pure fractions in a single process. Even components with a low feed concentration can be recovered with high concentration.

A simulation tool has been developed to predict the components' behavior throughout the process. This tool enables the *p*H-profile to be optimized according to various aspects chosen by the user, such as product purity or acid and base consumption. The process idea was also experimentally validated by pseudo-continuous experiments carried out for the separation of two metals. Steady-state was reached experimentally, and the metals were recovered with high purity and enrichment.