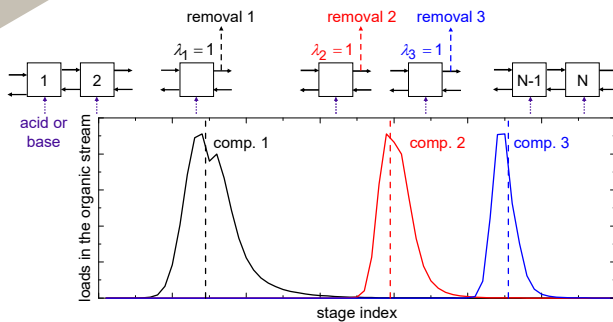


# Separation of multicomponent mixture to high level of recovery



The SisClever process enables the simultaneous separation of multiple components to a high level of recovery in a single process, resulting in high concentration and high purity. This is achieved by controlling the distribution of the components between the phases that pass through the process in counter-flow in such a way that for each component an individual accumulation region is established 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, for example, by solubility.

One application of the SisClever process is the separation of individual metals from an acidic solution. This material is commonly used as feedstock in the recycling of lithium-ion batteries, neodymium magnets, and electronic scrap. The metals are separated individually with reactive extraction by *pH* control. The SisClever process can also be applied to any other reactive extraction, for example from fermentation broth, if several components are to be separated individually.

In principle, the SisClever process can be applied not only for reactive extraction but for any separation where the distribution of the desired components can be influenced sufficiently, also by adding components that shift the equilibrium.

## KEY ACHIEVEMENTS

- counter-current separation process for multi-component mixtures reaching high purity and high concentration for each component.
- simulation tool based on equilibrium models for optimizing the process of reactive extraction of metals, for example from spent Li-ion batteries, electronic scrap, Nd magnet scrap, or similar.
- validated by simulation and experiment for metal separation

## KEY COMPETITIVE ADVANTAGES

- Compared to conventional, stepwise processes, concentration and purity achieved with the SisClever process are markedly higher with comparable effort. No additional purification steps are necessary.
- The SisClever process is capable of accommodating components with markedly disparate feed concentrations, thereby facilitating the valorization of minor yet valuable components.
- The SisClever process is a single process that can be flexibly adjusted to varying demands. The required equipment and consumables are equal to or less than those required for conventional processes for separating multi-component mixtures.
- The high concentrations are achieved without modifying the principal countercurrent flow rates of the phases, which results in the use of smaller equipment that is more straightforward to design and manage than that employed in conventional processes for similar separation tasks.

## UPCOMING CHALLENGES

- 15-stage mixer-settler battery is under installation to optimize the SisClever process for technically relevant systems.
- Applying the SisClever process to technical systems may present typical challenges associated with extraction, for example crud formation. Expertise is available to resolve crud issues.

## INTELLECTUAL PROPERTY

International patent application (not yet published)

## PARTNERSHIP SOUGHT

- Licensing: We are seeking companies that separate multi-component mixtures for which the SisClever process can be beneficially applied.
- Collaboration: We are seeking companies interested in exploring whether the SisClever process can be beneficially applied to their separation tasks.

## CONTACT

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