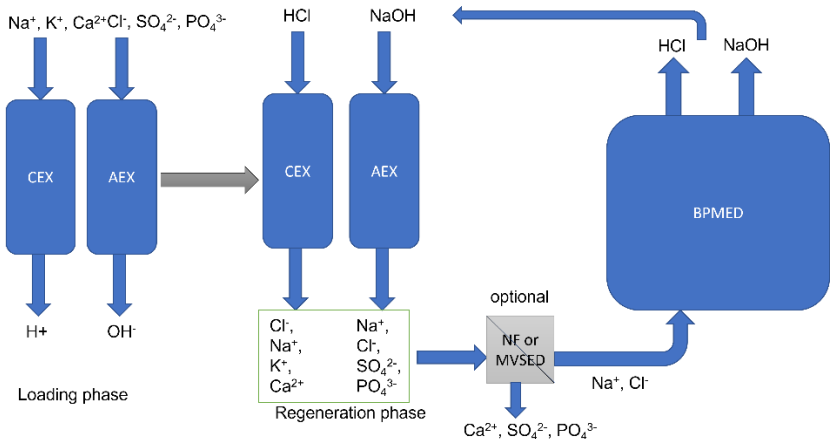


Abstract Title	<p>title</p> <p>Circular chemical use: producing acid and base with (bipolar) electro dialysis from IEX regenerate</p>
Topic	<p>O Improving water quality</p> <p>O Resilient water systems</p> <p>X Circular solutions: Reuse, Recover and Recycle</p> <p>O Transitions in water, agro/food and energy</p>
Challenges and Solutions	<p>Challenges and solutions</p> <p>Use of water and chemicals should be reduced by closing loops at chemical plants. Production of chemicals on site from waste streams, using EDBM, enables circular use of chemicals.</p>
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Abstract	<p>Ultrapure water is produced using ion exchange columns. These columns need to be regenerated using acid and base, and produce a salt effluent stream. When this effluent is treated by electro dialysis with bipolar membranes (EDBM), the salts are separated and transferred back in their associated acid and base component. These can then be used again to regenerate the IEX columns. This enables the circular use of chemicals and saves water as well. Moreover it will reduce logistics and storage of concentrated chemicals.</p> <p>In this research we have compared two types of membranes (from different manufacturers) for their performance. The electrical efficiency of Weifang membranes was 77% at 200 A/m<sup>2</sup> for base production, compared to 65% for Mega membranes using a NaCl brine. Also the effect of other ions present in the IEX regenerate on the electrical efficiency was investigated using a synthetic stream.</p> <p>Experimental results were used to evaluate product (acid and base) quality, recovery efficiency and energy efficiency of the EDBM process. In addition to studying pure NaCl brine</p>

	<p>streams, a stream from a chemical plant (with ions other than NaCl) was evaluated as well.</p> <p>The results of this research enables the circular use of chemicals, leading to a smaller water and chemical footprint in the industry.</p>
<p>Figures/diagrams/illustrations</p>	<p>Up to 2 (in abstract)</p>  <p>The diagram illustrates a circular process for water treatment and chemical recovery. It consists of the following stages and components:</p> <ul style="list-style-type: none"> <li><b>Loading phase:</b> Two ion exchange units, CEX and AEX, receive a feed containing <math>\text{Na}^+</math>, <math>\text{K}^+</math>, <math>\text{Ca}^{2+}</math>, <math>\text{Cl}^-</math>, <math>\text{SO}_4^{2-}</math>, and <math>\text{PO}_4^{3-}</math> ions. The CEX unit produces <math>\text{H}^+</math> ions, and the AEX unit produces <math>\text{OH}^-</math> ions.</li> <li><b>Regeneration phase:</b> The CEX and AEX units are regenerated using <math>\text{HCl}</math> and <math>\text{NaOH}</math>, respectively. This process recovers <math>\text{Cl}^-</math>, <math>\text{Na}^+</math>, <math>\text{K}^+</math>, and <math>\text{Ca}^{2+}</math> ions from the CEX unit and <math>\text{Cl}^-</math>, <math>\text{SO}_4^{2-}</math>, and <math>\text{PO}_4^{3-}</math> ions from the AEX unit.</li> <li><b>Optional NF or MVSED:</b> The recovered ions pass through an optional Nanofiltration (NF) or Mixed Bed Ion Exchange (MVSED) unit. This unit separates <math>\text{Ca}^{2+}</math>, <math>\text{SO}_4^{2-}</math>, and <math>\text{PO}_4^{3-}</math> ions from <math>\text{Na}^+</math> and <math>\text{Cl}^-</math> ions.</li> <li><b>BPMED:</b> The <math>\text{Na}^+</math> and <math>\text{Cl}^-</math> ions are fed into a Bipolar Membrane Electrodialysis (BPMED) unit. This unit produces <math>\text{HCl}</math> and <math>\text{NaOH}</math>, which are then recycled back into the regeneration phase.</li> </ul>