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Energy assessment of brine processing

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The recovery of valuable materials from industrial brines represents a key strategy in advancing the circular economy. However, these processes are traditionally associated with high energy intensity due to the substantial heat requirements for evaporation and crystallization. This study presents a model-based comparative assessment of various energy integrations aimed at improving energy efficiency and reducing the overall environmental footprint of brine treatment. The research utilizes Aspen Plus software to simulate and evaluate several configurations. A multi-effect evaporator serves as the baseline design, which is compared against newer integrated systems featuring electric heat pumps, thermocompressors, and hybrid arrangements based on membrane distillation. The study focuses on evaluating how different heat integration technologies influence both the thermal performance and the economic viability of the recovery process. The results showed that integrating these new technologies brings major improvements. Using heat pumps and thermocompressors significantly reduced the need for external heating steam by successfully recycling energy within the system. The best economic results were achieved by the systems using membrane distillation, which proved to be the most cost-effective option overall. Furthermore, the study found that the specific type of salt being processed greatly affects the efficiency.. Overall, upgrading traditional evaporation systems with these integrated technologies is a highly effective and simple way to save energy and lower the costs of industrial brine treatment.

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