frontiers | Frontiers in Chemical Engineering

TYPE Editorial
PUBLISHED 14 February 2023
DOI 10.3389/fceng.2023.1161913

OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Sustainable Process Engineering, a section of the journal Frontiers in Chemical Engineering

RECEIVED 08 February 2023
ACCEPTED 09 February 2023
PUBLISHED 14 February 2023

CITATION
Taboada-Serrano P, Yiacoumi S and Tsouris C (2023), Editorial: Separations for Energy and Environmental Applications. *Front. Chem. Eng.* 5:1161913. doi: 10.3389/fceng.2023.1161913

Editorial: Separations for Energy and Environmental Applications

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KEYWORDS

separation and recovery, energy, chemical process, metal recovery, energy sustainability

Editorial on the Research Topic
Separations for Energy and Environmental Applications

Climate change and global environmental impacts are challenging humanity as a whole, and particularly the scientific community, to rethink our approaches towards energy harvesting, storage, and utilization, and to formulate processes geared to restoring compromised environments. A large task in these efforts involves developing technologies that have low or no carbon footprint, enable the use of renewable energy sources, and minimize or eliminate contamination of water resources and generation of untreatable waste.

At the heart of many manufacturing technologies lie separation processes ranging from the purification of raw materials and consumables to the treatment or reutilization of waste. Therefore, revolutionizing these technologies involves developing novel separation processes that align perfectly with environmentally conscious goals.

The goal of this Research Topic titled "*Separations for Energy and Environmental Applications*" is to provide an avenue to disseminate critical review on the state-of-the art and original research articles on emerging separation processes that will support the formulation of new, environmentally conscious chemical technologies that enable the migration to renewable energy sources.

The first article (Murphy and Haji) presents *a review of technologies for direct lithium extraction from low concentration, lithium-ion aqueous solutions*. Lithium has become a significant player in the energy landscape, as it is the main component of lithium-ion batteries and of nuclear fusion technologies. Since lithium-ion batteries enable the utilization of intermittent, renewable energy sources as wind and solar, and the substation of fossil fuels in transportation, the demand for lithium increases exponentially as we migrate towards sustainable energy technologies. However, lithium land reserves are finite. According to the review article, lithium land reserves will be depleted within the next 60 years given the rate of exploitation required to satisfy the growing demand. It is imperative to develop technologies capable of separating and enriching lithium-ion from dilute solutions, from seawater to geothermal fluids and mine runoffs, and the review article in the Research Topic provides a much necessary foundation on the state-of-the-art for researchers to tackle this challenge.

The second article (Lee and Chung) in this Research Topic presents original research on the separation of lithium from low concentration, lithium-ion aqueous solutions, specifically geothermal fluid. The article focusses on the effect of silicate ions, ubiquitous in thermal fluids, on the yield of lithium during separation. This Research Topic is of particular interest, as it aims to enable the recovery of a valuable resource from aqueous waste generated during renewable, geothermal energy production.

The third article (McFarlane et al.) in the Research Topic presents original research on separation processes that would enable the utilization of molten chloride salts as heat transfer media during heat/energy recovery from solar energy and nuclear power systems. The article directly addresses the need of novel separation processes to enable efficient thermal energy storage, and eventually the utilization of thermal energy to generate electricity.

The fourth article (Gabitto and Tsouris) presents a thorough review on the basic science and modeling approaches used to design materials as separation media, and separation processes for the electrochemical isolation or retrieval of elements and metals from aqueous solutions. The physics and design principles described in the fourth article are relevant to the separation processes discussed in the previous articles of the Research Topic. Furthermore, the review on the state-of-the-art in the mathematical treatment of the basic science of separation and transport of metal ions and other species is relevant to environmental systems, such as water purification and reuse and geochemical processes.

We believe that this collection of articles will be very informative to scientists and engineers devoted to growing renewable energy technologies to their full potential.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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