

Battery capacitor deionization technology



Overview

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- Material and surface properties impact on the efficiency of capacitive deionization.
- Charge and thermodynamic energy evaluation of capacitive separations.
- Routes for higher efficiency separation processes through intercalation.
- Membrane and surface functionalization to achieve selective salt removal.

Capacitive deionization (CDI), an emerging desalination technology, has received considerable attention in recent years due to porous carbon development, new cell designs, and unique operational modes providing high. As fresh water sources become further constrained, new and innovative methods are needed for water treatment operations. Suspended solids, organics, microorganisms, and dissolved solids are among the compounds requiring separation. For seawater desalination, distillation processes such as multi-stage flash distillation and multiple-effect distillation have traditionally been used. In recent decades, membrane-based processes such as reverse osmosis (RO) have been able to provide similar water quality to distillation at a fraction of the energy cost. This benefit combined with capital cost reductions over time has led to increased use of RO for total dissolved solids (TDS) removal. The energy efficiency values discussed here are generally used to analyze the ability of a process to deionize the bulk of a feed water stream, namely the ability of NaCl to be removed from the influent. Capacitive deionization has made tremendous gains in recent years for these separations through the advent of new carbon materials, cell designs. Papers of particular interest, published within the period of review, have been highlighted as:

- of outstanding interest.

Article Content

Low Energy Desalination Using Battery Electrode Deionization

New electrochemical technologies that use capacitive or battery electrodes are being developed to minimize energy requirements for desalinating brackish waters. When a pair of electrodes is charged in capacitive deionization (CDI) systems, cations bind to the cathode and anions bind to the anode, but high applied voltages (>1.2 V) result in parasitic reactions and ...

Photovoltaic-Driven Battery Deionization System for Efficient and ...

In this study, we construct the first photovoltaic-driven battery deionization system, termed PV-BDI, capable of continuously and simultaneously removing multiple ions ...

Advances in efficient desalination technology of capacitive ...

In recent years, capacitive deionization technology (CDI) has been widely used in many fields due to its environmental protection, low energy consumption, simple operation, and safety (Cho et al. 2019). For the desalination of low-concentration brine (50 mg/L), electrodialysis, reverse osmosis and ion exchange are usually used. However, the ...

Enhanced Desalination Performance of Battery ...

Battery electrode deionization is an emerging technology for water desalination that cuts down on energy costs when desalinating different water streams. It uses electrochemical reactions under the action of an electric ...

Exploring a sustainable binder for capacitive deionization technology ...

Capacitive deionization (CDI) technology is a new water desalination technology, of which the principle is to use the heterogeneous charge absorption to remove cations and anions of salts . It has the advantages of environmental friendliness, high desalination efficiency, cost effectiveness and long cycle life .

Flow Electrode Capacitive Deionization (FCDI): Recent ...

With the increasing severity of global water scarcity, a myriad of scientific activities is directed toward advancing brackish water desalination and wastewater remediation technologies. Flow-electrode capacitive deionization (FCDI), a newly developed electrochemically driven ion removal approach combining ion-exchange membranes and flowable particle ...

Capacitive Deionization: A Promising Water Treatment and

First studies on CDI started in the 1960s and early 1970s. The first work on CDI-type system presenting the concept of electrochemical water deionization using a sorption media was firstly reported by John W. Blair and George W. Murphy in January 1960 with a publication entitled “Electrochemical Demineralization of Water with Porous Electrodes of Large Surface ...

Capacitive deionization

An illustration of capacitive deionization device. Capacitive deionization (CDI) is a technology to deionize water by applying an electrical potential difference over two electrodes, which are often made of porous carbon. In other words, CDI is an electro-sorption method using a combination of a sorption media and an electrical field to separate ions and charged particles.

Commercialization Efforts of Capacitive Deionization Technology ...

Although capacitive deionization (CDI) technology has been studied intensively for more than 20 years, its commercialization remains in the initial stage, which is partly caused by the ...

Capacitive deionization: An emerging electrosorption technology ...

Further studies have shown that in continuous FCDI batch experiments with low-concentration influent ($60 \text{ mg L}^{-1} \text{ U}$), the removal efficiency of U can still be maintained at more than 99 %, showing the wide application potential of capacitive deionization technology in U removal. This result shows that sulfonic acid-modified FeOOH nanorods not ...

From capacitive deionization to desalination batteries and desalination ...

In 1960, Blair and Murphy opened the carbon ages of electrochemical desalination by using porous carbon electrodes. This technology can be classified as first-generation (Figure 1). A first-generation cell is known as capacitive deionization (CDI) because of the mechanism of ion electrosorption. The cell contains one carbon electrode pair and a ...

Energy Efficiency of Capacitive Deionization

Capacitive deionization (CDI) as a class of electrochemical desalination has attracted fast-growing research interest in recent years. A significant part of this growing interest is arguably attributable to the premise ...

(PDF) Application of Capacitive Deionization in Water Treatment ...

With the rapid development of CDI technology, especially the continuous emergence of new CDI devices, representative advanced CDI systems such as membrane capacitor deionization (MCDI) technology, flow electrode capacitance deionization (FCDI) technology, and hybrid capacitor deionization technology (HCDI) have emerged .

Faradaic Electrodes Open a New Era for Capacitive ...

Capacitive deionization (CDI) is an emerging desalination technology for effective removal of ionic species from aqueous solutions. Compared to conventional CDI, which is based on carbon electrodes and struggles with high salinity streams ...

Recent Advances in Capacitive Deionization: Research Progress ...

With the increasing global water shortage issue, the development of water desalination and wastewater recycling technology is particularly urgent. Capacitive deionization (CDI), as an emerging approach for water desalination and ion separation, has received extensive attention due to its high ion selectivity, high water recovery, and low energy consumption. To ...

Capacitive Deionization: A Promising Water Treatment and

Capacitive deionization (CDI) technology has attracted wide attention since its advent and is considered as one of the most promising technologies in the field of desalination and ion recycling ...

Capacitive deionization in water treatment: A review of reactor ...

Capacitive deionization in water treatment: A review of reactor dynamics, electrode materials, functional membranes, and modeling techniques ... a feature primarily used in battery charging but promising for CDI systems. ... Progress and outlook for capacitive deionization technology. Curr. Opin. Chem. Eng., 25 (2019), ...

A review on lithium extraction by electrochemical electrode ...

Working mechanism of EEDI. Capacitive deionization (CDI) usually refers to the desalination technology using porous carbon materials with high specific surface area as positive and negative electrode materials [].The working diagram of EEDI based on the EDLC mechanism is shown in Fig. 2.As shown in Fig. 2, in the adsorption stage, a working voltage (usually ...

Photovoltaic-Driven Battery Deionization System for Efficient and ...

Seawater desalination via electrochemical battery deionization (BDI) has shown significant potential for freshwater production. However, its widespread application has been limited by the high energy costs involved. To facilitate the commercialization of BDI technology, it is crucial to develop innovative integrated BDI systems that utilize sustainable ...

Application of Capacitive Deionization in Water Treatment ...

electrode capacitance deionization (FCDI) technology, and hybrid capacitor deionization technology (HCDI) have emerged . The specific configurations are shown in Figure 2.

Batteries in desalination: A review of emerging electrochemical ...

Desalination batteries are promising due to their ability to simultaneously desalinate water and generate energy. A typical desalination battery consists of rechargeable ...

Battery-Type Desalination Behavior Confined Within Capsules for ...

Battery-type faradaic materials are considered a class of promising electrodes for capacitive deionization (CDI) due to their superior ability to store ions through redox reactions.

Electrocapacitive Deionization: Mechanisms, Electrodes, and Cell ...

Capacitive deionization (CDI) is an emerging water desalination technology for removing different ionic species from water, which is based on electric charge compensation by these charged ...

A two-pronged strategy to boost the capacitive deionization ...

Capacitive deionization is a burgeoning technique in the field of water treatment and desalination. Its growing popularity may be attributed to its operational simplicity, high durability, energy-saving and environmentally sustainable nature. The classical CDI system generally operates on carbon electrodes that possess a high degree of porosity, deploying the ...

Faradaic Electrodes Open a New Era for Capacitive Deionization

Capacitive deionization (CDI) is an emerging desalination technology for effective removal of ionic species from aqueous solutions. Compared to conventional CDI, which is based on carbon electrodes and struggles with high salinity streams due to a limited salt removal capacity by ion electrosorption and excessive co-ion expulsion, the emerging Faradaic electrodes provide ...

Application of capacitive deionization technology in ...

Capacitive deionization technology (CDI) offers numerous advantages, including high efficiency, energy savings, ease of operation, and renewability. It has been actively developed as a promising new technology. ...

Capacitive deionization: Capacitor and battery materials, ...

Capacitive deionization (CDI) has been considered as a novel technology to relieve freshwater shortages. However, due to the limited physical adsorption capacity, the salt removal capacity remains ...

A Novel Dual-Ion Capacitive Deionization System Design with ...

Capacitive deionization is an emerging desalination technology with mild operation conditions and high energy efficiency. However, its application is limited due to the low deionization capacity of traditional capacitive electrodes. ... The configuration of the CDI cell with dual-ion battery electrodes; (b) the deionization capacities of ...

Integrating battery and capacitive materials for efficient sodium ...

Capacitive deionization (CDI) has been considered as a novel technology to relieve freshwater shortages. However, due to the limited physical adsorption capacity, the salt removal capacity remains low. To enhance the desalination capacity, battery type, and capacitive materials are employed to fabricate a dual-ion electrochemical deionization (DEDI) device. ...

Curvature-induced ion docking effect in capacitive deionization

The shortage of affordable clean freshwater is currently one of the most critical concerns for human survival 1,2,3,4,5. As an emerging technique for seawater desalination, capacitive deionization ...

Integrating battery and capacitive materials for efficient sodium ...

To enhance the desalination capacity, battery type, and capacitive materials are employed to fabricate a dual-ion electrochemical deionization (DEDI) device. Herein, a ...

Lithiophilic sites in phosphorus and nitrogen-doped carbon ...

Capacitive deionization (CDI) technology has emerged as a widely adopted method for Li^+ ions extraction from salt lakes. Its high selectivity, low energy consumption, and environmental friendliness contribute to alleviating lithium resource shortages [18, 19] mostly used electrode materials consist of graphene, carbon nanoparticles, and Li^+ ion sieves .

Integrating battery and capacitive materials for efficient sodium ...

Capacitive deionization (CDI) has been considered as a novel technology to relieve freshwater shortages. However, due to the limited physical adsorption capacity, the salt removal capacity remains ...

Application of Capacitive Deionization in Water Treatment and

If the CDI battery is regarded as an energy storage element, the adsorption and desorption stages can be regarded as the charging and discharging stages of the energy storage element. ... Cetinkaya, A. Life cycle assessment of environmental effects and nitrate removal for membrane capacitive deionization technology. Environ. Monit. Assess. 2020 ...

Application of Capacitive Deionization in Water Treatment ...

systems such as membrane capacitor deionization (MCDI) technology, flow electrode capacitance deionization (FCDI) technology, and hybrid capacitor deionization technology (HCDI) have emerged . The specific configurations are shown in Figure 2. The conventional CDI system has a “common ion effect” . When a voltage is applied

Commercialization Efforts of Capacitive Deionization ...

Although capacitive deionization (CDI) technology has been studied intensively for more than 20 years, its commercialization remains in the initial stage, which is partly caused by the ... His research interests cover battery materials, capacitive devices, and operando gas sensing techniques for electrochemical cells. Figure 1. Schematic ...

A review on lithium extraction by electrochemical electrode ...

deionization technology Ming Liu¹ · Haolin Li¹ · Hongjiang Chi¹ · Shuaiwei Chen¹ · Hui Wang¹ · Chen Wang¹ · Xiumei Ma¹ · Zhengyou Zhu¹ · Faqiang Li^{1,2} ... nism of EDLC, but also the pseudo-capacitor materials and battery materials . With the introduction of these materi-als into the eld of CDI, the term “Capacitive deionization” ...

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