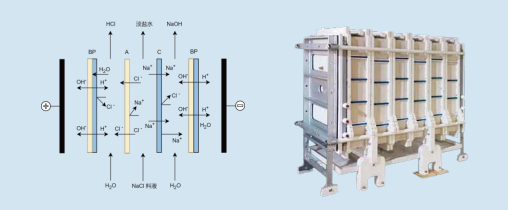
电渗析装置/双极膜电渗析装置

ELECTRODIALYSIS DEVICE/BIPOLAR MEMBRANE ELECTRODIALYSIS DEVICE

双极膜电渗析装置
Bipolar membrane electrodialysis device

双极膜电渗析装置是在传统电渗析基础上创新的高效集成系统。其核心由阴、阳膜与关键的双极膜交替排列构成。该装置实现了“盐转化”与“酸碱再生”的革命性功能。它无需外加酸、碱，即可将盐溶液(如氯化钠、硫酸锂)直接转化为对应的酸(如盐酸)和碱(如氢氧化钠)，同时完成物料的分离与浓缩。

The bipolar membrane electrodialysis device consists of alternating anion and cation membranes and key bipolar membranes, which can directly convert salt solution into corresponding acids and bases without the need for external acids or bases, while completing material separation and concentration.



应用场景
Application scenarios

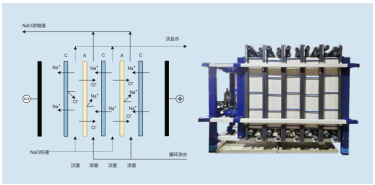
- 制备高纯酸、碱：装置采用耐酸碱阴阳离子模、双极膜，可用无机盐制备相应的无机酸/碱。适用于氯化钠、硫酸钠、硝酸钾等强酸强碱无机盐。
- 制备高纯氢氧化锂：在直流电场中将水直接电离为H^+和OH^-，OH^-通过膜与含锂盐溶液（如硫酸锂）中的Li^+结合，即可直接生成高纯度氢氧化锂溶液，同时联产相应的酸，实现资源的高效循环利用。

Preparation of high-purity acids and alkalis:The system features acid- and alkali-resistant anion, cation, and bipolar membranes, enabling the conversion of inorganic salts (e.g., ,NaCl, Na_2SO_4, KNO_3) into corresponding acids/bases.trong base inorganic salts such as lithium sulfate, sodium chloride, sodium sulfate, and potassium nitrate.

Preparation of high-purity lithium hydroxide: Under a direct-current electric field, water is split into H^+ and OH^-. The OH^- migrates through the membrane and combines with Li^+ from a lithium salt solution (e.g., Li_2SO_4) to directly produce high-purity LiOH solution, while simultaneously co-generating the corresponding acid—achieving efficient resource recycling.

电渗析装置
Bipolar membrane electrodialysis device

该系统由阳、阴离子交换膜交替堆叠而成，中间用隔板隔开，并配有电极板、端板和其他组件。工作原理为膜堆交替使用阴、阳离子膜，形成脱盐和浓缩系统。在直流电场影响下，当盐水被引入隔间时，阳离子只通过阳离子交换膜向阴极迁移，而阴离子只通过阴离子交换膜向阳极迁移，从而使得盐水在稀释区实现脱盐，在浓缩区完成浓缩。



The system is composed of alternating stacking of cation and anion exchange membranes, separated by partitions, and equipped with electrode plates, end plates, and other components. The working principle is that the membrane stack alternately uses anionic and cationic membranes to form a desalination and concentration system. Under the influence of a direct current electric field, when saltwater is introduced into the compartment, cations only migrate to the cathode through the cation exchange membrane, while anions only migrate to the anode through the anion exchange membrane, thereby achieving desalination of saltwater in the dilution zone and concentration in the concentration zone.

应用优势
Application advantages

- **离子交换容量高：**均相离子交换膜具有分布均匀的离子交换基团，且其含量较高，所以能够有效地与溶液中的离子进行交换反应，可用于高效的离子分离和富集。
- High efficiency: Homogeneous membranes have uniformly distributed ion exchange groups that can undergo ion exchange reactions and can be used for efficient ion separation and enrichment.
- **浓缩浓度高：**适合一价盐的高倍浓缩，浓缩浓度可达180g/L（以氯化钠计），比常规膜浓缩工艺高一倍，还可有效减少浓水水量。
- High concentration: suitable for high fold concentration of monovalent salts, with a concentration of up to 180g/L, twice as high as conventional membrane concentration processes, and can effectively reduce the amount of concentrated water.
- **纯度高：**不带电物质如COD、硼酸根、硅酸根、氨基酸等不会迁移，使制备的工业盐纯度更高。
- High purity: Non charged substances such as COD and silicate ions do not migrate, resulting in higher purity of industrial salts prepared;
- **能耗低：**结构均匀，离子在膜内的传输阻力小，膜电阻较低，较常规工艺（蒸发、反渗透等）节能50%以上，降低了处理负荷和电能消耗，提高了能源利用效率。
- Low energy consumption: uniform structure, low membrane resistance, energy saving of more than 50% compared to conventional processes, reducing load and electricity consumption, and improving energy utilization efficiency.
- **化学稳定性好：**在较宽的pH范围和多种化学环境下保持稳定，不易发生化学降解或结构破坏，可耐受强酸、强碱，适用于处理各种复杂的化学体系。
- Good chemical stability: Stable in a wide pH range and various chemical environments, resistant to strong acids, strong bases, suitable for handling complex chemical systems.
- **安全可靠：**运行压力0.05MPa，低温、低压运行安全可靠，抗冲击能力强。
- Safe and reliable: Operating pressure of 0.05MPa, safe and reliable operation at low temperature and low pressure, with strong impact resistance.

电渗析装置应用场景
Application scenarios of electrodialysis device

电渗析装置主要应用于无机盐溶液的浓缩或淡化（如盐湖提锂、废水脱盐）、工业酸碱的浓缩回收、高盐废水分盐及零排放处理，以及物料中无机盐与有机物的分离纯化，是实现资源回收和环保达标的关键技术之一。
可用于氯化锂、硫酸锂、氯化钠、氯化钙、氯化钾、硫酸钾、硫酸钠、硝酸铵、硫酸铵、氯化铵等 。

Electrodialysis devices are mainly used for concentration or desalination of inorganic salt solutions, concentration and recovery of industrial acid and alkali, salt separation and zero discharge treatment of high salt wastewater, as well as separation and purification of inorganic salts and organic matter in materials. They are one of the key technologies for achieving resource recovery and environmental standards.
Can be used for concentration or desalination of lithium chloride, ammonium sulfate, etc.

含锂料液的浓缩与有机物、硼的去除
Concentration and Removal of Organics and Boron from Lithium-containing Feed Solutions

如在盐湖提锂中，经反渗透、纳滤除杂浓缩后Li5~7g/L，需要继续浓缩满足后续沉锂或制备氢氧化锂的需求，电渗析浓缩Li浓度达14~15g/L，浓缩过程同步除硼，除硼率达92%以上。

For instance, in lithium extraction from salt lakes, after pretreatment and concentration using reverse osmosis and nanofiltration, the lithium concentration reaches 5–7g/L. To meet downstream requirements for lithium precipitation or lithium hydroxide production, further concentration via electrodialysis increases the lithium concentration to 14–15 g/L. During this process, boron is simultaneously removed, achieving a removal rate of over 92%.

优势
Advantage

01 浓缩浓度高，较RO工艺浓度翻一番，有效减少浓水水量。
High concentration, doubling the concentration compared to RO process, effectively reducing the amount of concentrated water;

02 相比于反渗透需五级除硼，且需要加大量碱的情况，电渗析除硼工艺简单，除硼率可达92%以上，锂回收率可达99.5%，锂浓度可浓缩至21g/L以上，可直接沉锂，无需添加大量药剂。
Compared to reverse osmosis, which requires five levels of boron removal and the addition of a large amount of alkali, electrodialysis has a simpler boron removal process, with a boron removal rate of over 92%, a lithium recovery rate of 99.5%, and a lithium concentration of over 21g/L. It can directly precipitate lithium without the need for adding a large amount of chemicals.

盐湖提锂并回收铷、铯等伴生资源
Lithium extraction from salt lakes and recovery of associated resources such as rubidium, cesium.

锂矿提锂及伴生资源回收
Lithium Extraction from Lithium Ores and Recovery of Associated Resources.

粉煤灰资源化提锂
Lithium Extraction and Purification from Oil and Gas Field Brine

油气田卤水提锂
Lithium Extraction and Purification from Oil and Gas Field Brine

地热卤水提锂
Lithium Extraction and Purification from Oil and Gas Field Brine

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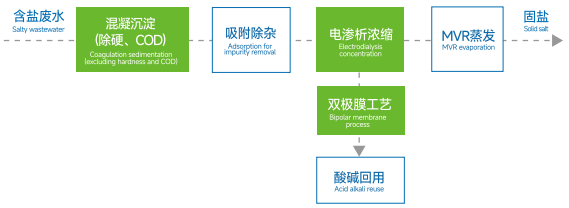
适配多个提锂场景中
锂液的浓缩及有机物、硼的去除
Designed for the concentration of lithium-containing solutions and the removal of organics and boron across multiple lithium extraction scenarios.

废水处理（浓缩、淡化、酸碱浓缩回收、无机盐与有机物分离纯化）
Wastewater Treatment (Concentration, Desalination, Acid/Base Recovery, Salt Separation and Purification)

含盐废水经过电渗析浓缩处理，盐浓度可达150g/L，电渗析浓水进MVR蒸发，减少直接蒸发的投资和能耗；或电渗析浓水进一步用双极膜制备酸碱实现盐制酸碱的资源循环利用；电渗析淡水可进行中水回用或组合RO膜进一步产纯水回用。

After concentration treatment by electrodialysis, the salt concentration of the saline wastewater can reach 150 g/L. The electrodialysis concentrate is then sent to MVR evaporation, reducing the investment and energy consumption compared to direct evaporation. Alternatively, the electrodialysis concentrate can be further processed with bipolar membranes to produce acids and bases, enabling resource recycling of salts. The electrodialysis diluate can be reused as reclaimed water or further treated with RO membranes to produce pure water for reuse.



电渗析/双极膜电渗析装置技术特点
Technical characteristics of electrodialysis/bipolar membrane electrodialysis device

分离精度高
产品纯度高
High separation precision，High product purity

利用电驱动+离子膜的选择透过性，实现离子与中性分子的精准分离。
Electrically driven separation utilizing ion-exchange membranes' selective permeability enables precise separation of ions from neutral molecules.

流程简化
实现“一变多“
Simplified process for "one-to-many" conversion

能将一个分离过程变为多个高价值产出。处理盐溶液时，可一步将盐转化为高纯度的酸和碱，实现了资源价值的最大化。
It transforms a single separation process into multiple high-value outputs. When processing salt solutions, it can convert salts into high-purity acids and bases in one step, maximizing resource value.

资源循环利用
变废为宝
Resource recycling and waste valorization

能将废液转化为可再利用的资源，构建闭环生产。
Leveraging ion-selective permeability enables precise separation of co-ions (monovalent/multivalent).

环境友好
节能降耗
Environmentally friendly，Energy saving

电驱动的清洁分离技术，过程中无需添加大量化学试剂，从源头上减少了废渣和废水的产生，且降低能耗。
An electrically driven clean separation technology that requires no bulk chemical addition, minimizing waste residue and wastewater generation at the source while reducing energy consumption.

电渗析/双极膜电渗析装置核心优势
Core Advantages of Electrodialysis/Bipolar Membrane Electrodialysis Systems

4 大核心优势

电渗析和双极膜电渗析装置装备MOS电源，采用双DSP高速数字信号处理技术，较常规配置电源具有高精度、低纹波、高动态响应速度，支持不间断电源更换，转效率达97%以上，高海拔不降容，功率因数达0.99，对膜的性能及寿命影响极小，保证装置运行效率和稳定性。

Equipped with MOS power supply, adopting dual DSP high-speed digital signal processing technology, supporting uninterrupted power supply replacement, with a conversion efficiency of over 97%, no capacity reduction at high altitude, and a power factor of 0.99. It has minimal impact on the performance and lifespan of the membrane, ensuring the operational efficiency and stability of the device.

采用液压式的膜堆，上下双压头压紧的方式保证膜堆受力均匀，从而使膜堆内部水流分布均匀，有效降低占地面积，同时有效减少膜堆漏水、漏电、烧膜风险，提高电流效率。

Adopting a hydraulic membrane stack, the upper and lower pressure heads are pressed together to ensure uniform force distribution inside the membrane stack, effectively reducing the footprint and minimizing the risks of water leakage, electric leakage, and membrane burning, thereby improving current efficiency.

隔板采用具有良好密封性的弹性复合PP材质，不变形，减少系统50%漏液量，降低生产维护工作量。

The partition is made of elastic composite PP material with good sealing performance, which does not deform, reduces the system's leakage by 50%, and reduces production and maintenance workload.

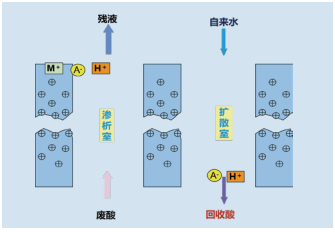
采用工控机和PLC控制整个系统，动态显示整个系统运行工况，重要运行参数如电流、电压、电导率、浓度等，直接形成趋势曲线，更形象的反应运行过程，有助更好的优化工艺操作。

The entire system is controlled by an industrial computer and PLC, dynamically displaying the operating conditions of the entire system. Important operating parameters such as current, voltage, conductivity, concentration, etc. are directly formed into trend curves, which more vividly reflect the operating process and help optimize process operations.

扩散渗析装置
Diffusion dialysis device

扩散渗析法回收酸采用渗析原理，以浓差为推动力，膜两侧分别通入废酸液和纯水时，因浓度差作用，含酸液中的游离酸及其盐类会向纯水侧渗透，阴离子膜带正电荷，能选择性吸引负离子通过，同时为维持电中性会夹带正离子。酸中H浓度高且水化半径小、电荷少，相比金属离子更易透过，从而实现酸的分离或回收。

Diffusion dialysis recovers acid using concentration gradients as the driving force. When waste acid and pure water flow on opposite sides of an anion exchange membrane, the membrane's positive charges selectively attract anions (including free acid radicals) while cotransporting cations to maintain electroneutrality. Due to their small hydrated radius and high mobility, H^+ ions permeate preferentially over metal ions, enabling acid separation and recovery.



应用优势
Application advantages

- **高效节能，降本增效：**专为金属表面处理工序设计，依托浓度差驱动无需外部能量输入，可高效回收酸废液中有效酸并直接回用于生产，既减少新酸采购成本，又降低废液中和处理费用，实现降本增效与节能环保的双重效益。
  Efficient and energy-saving, cost reduction and efficiency improvement: Specially designed for metal surface treatment processes, relying on concentration differences to drive without external energy input, it can efficiently recover effective acids from acid waste liquid and directly reuse them in production, reducing the cost of new acid procurement and the cost of waste liquid neutralization and treatment, achieving dual benefits of cost reduction and efficiency improvement as well as energy conservation and environmental protection.
- **稳定槽液，提升品质：**可连续地从处理槽中分离并去除累积的金属离子，有效稳定槽液成分与工艺参数，保障处理质量的一致性。
  Stabilize the tank solution and improve quality: It can continuously separate and remove accumulated metal ions from the treatment tank, effectively stabilizing the composition of the tank solution and process parameters, ensuring consistency in treatment quality.
- **撬装模块，省心便捷：**装置采用撬块化设计，结构紧凑简单，出厂前已完成预制，极大缩短了现场安装与调试周期，日后维护轻松便捷。
  Pry installation module, worry free and convenient: The device adopts a pry block design, with a compact and simple structure. It has been prefabricated before leaving the factory, greatly reducing the on-site installation and debugging cycle, and making maintenance easy and convenient in the future.

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