

Electrochemical Ion Exchange (EIX)

Our Electrochemical ion exchange (EIX) system is designed for the treatment of process streams to recover and recycle valuable resources, including water, thus increasing production yield. EIX also minimises the costs of consumable treatment chemicals and significantly reduces secondary waste treatment and disposal in order to meet ever tightening environmental discharge standards. The EIX cells are compact and modular, thus enabling a flexible design to be modified to any required throughput.



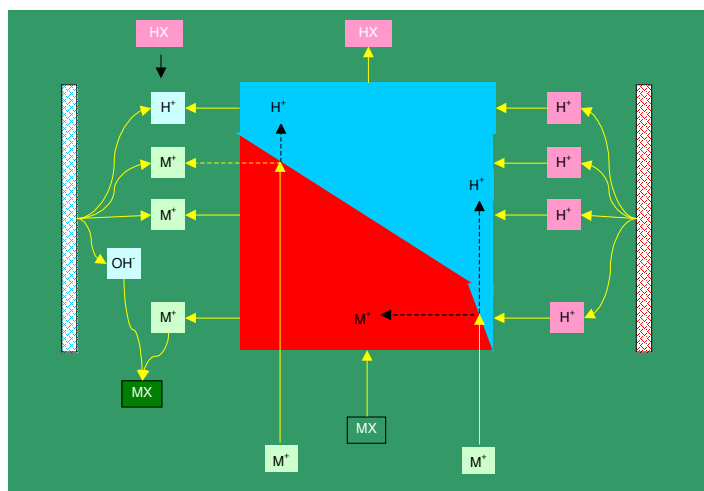
The Challenge

In conventional ion-exchange, target ionic material can be recovered from process streams by absorption. They then normally require additional reagents to elute the resin periodically for re-use when the capacity has been fully loaded. Not only do the reagents need storage but as the result of back-washing and rinsing of the resins, considerable volumes of concentrated waste for subsequent treatment and disposal are generated.

The EIX Process

However, in Electrochemical Ion-exchange technology this chemical elution from the 3D resin structure can be replaced by an externally applied electrical field. When combined with specific adsorbers and appropriate pH conditions, selective separations can be achieved at the same time as virtually complete recovery from the stream being treated into a small volume of concentrate at significantly lower energy costs compared with evaporation. EIX can be operated without interrupting the main process, thus increasing plant availability. The concentration factor of the secondary waste is enhanced compared with the conventional system by avoiding reagent addition and the need for rinsing the resin after elution

With the ion-exchange (IX) material in the form of a 3D structure (loose beads or a thick porous membrane) – the process is called Electrochemical Ion-Exchange (EIX), while with the material in a non-porous membrane form the process is called Electrodialysis (ED) or as a combination – Electrodeionisation (EDI).



In the example (left), cation specific material absorbs metal ions from the feed. The metal ions (M^+) are displaced by the acidity (H^+) generated at the anode which migrates through the anolyte and the membrane wall. The displaced metal ions are then recovered in a reduced volume of catholyte. Volume reduction factors in excess of 100 are readily achievable following selection of suitable adsorber materials and solutions. The technology works for anion recovery using anionic adsorber material.

The anion and cation systems can be used either separately or in combination depending on the application. These include rinse-water management in the metal processing, finishing and electronic industries and product recovery/recycle in fine chemical, mining and other effluent treatment.

The Benefits that this technology brings are:-

- Selective recovery and recycle of valuable resources, including the water
- Increased production yield
- Minimised costs of consumable treatment chemicals
 - Electrical pH control and adjustment
 - Significant reduction in secondary waste treatment and disposal costs
 - Selective contaminant removal
- Flexible and compact plant
 - modular scale-up
 - combined anion and/or cation removal
 - low maintenance plant - automatic control
 - energy efficient (ambient temperature/pressure)
 - simplicity of plant expansion.

Stream	Cation	Anion
Metal finishing	Cu, Ni, Cd, Zn, Pb	Cl ⁻ , CN ⁻ , NO ₃ ⁻ , SO ₄ ²⁻ , PO ₄ ³⁻
Nuclear	Cs, Sr, U Pu Am	NO ₃ ⁻ , BO ₃ ³⁻ , [Cl ⁻ , SO ₄ ⁼]
Refining	Base metals	Platinum group metals
Potable water	Base metals, NH ₄ ⁺	As, NO ₃ ⁻ , humate, F
Acid mine drainage	Cu, Zn	SO ₄ ⁼
Soil washing	Heavy metals	Phenol, CN ⁻
Electronics	Cu, NH ₄ ⁺	F ⁻ , NO ₃ ⁻ , SO ₄ ²⁻ , CH ₃ Cu ⁻ , PO ₄ ³⁻

Markets

Potential applications span:-

1. metal refining and metal finishing rinse-water management,
2. corrosive rinse water management
3. fine chemicals
4. product recovery/recycle,
5. solution mining
6. nuclear effluent treatment

Patent available

GB 2403166A Filed 2003	Electrode protecting flushed barrier. This describes a method of protecting one of the electrodes of an EDI unit by having an ED membrane/IX sandwich – such that any problem contamination that might seep into the electrode compartment can be inhibited. This channel is also flushed to reduce any potential contamination. In particular, it can be used to protect anodes from corrosion from HF, oxide electro-deposition or electro-oxidation of organic or amino acid products being recovered. It also includes the use of gas-diffusion electrodes (GDE) as either anode or cathode. A similar system can be used to protect cathodes from HF corrosion, metal or insoluble hydroxide deposition.
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