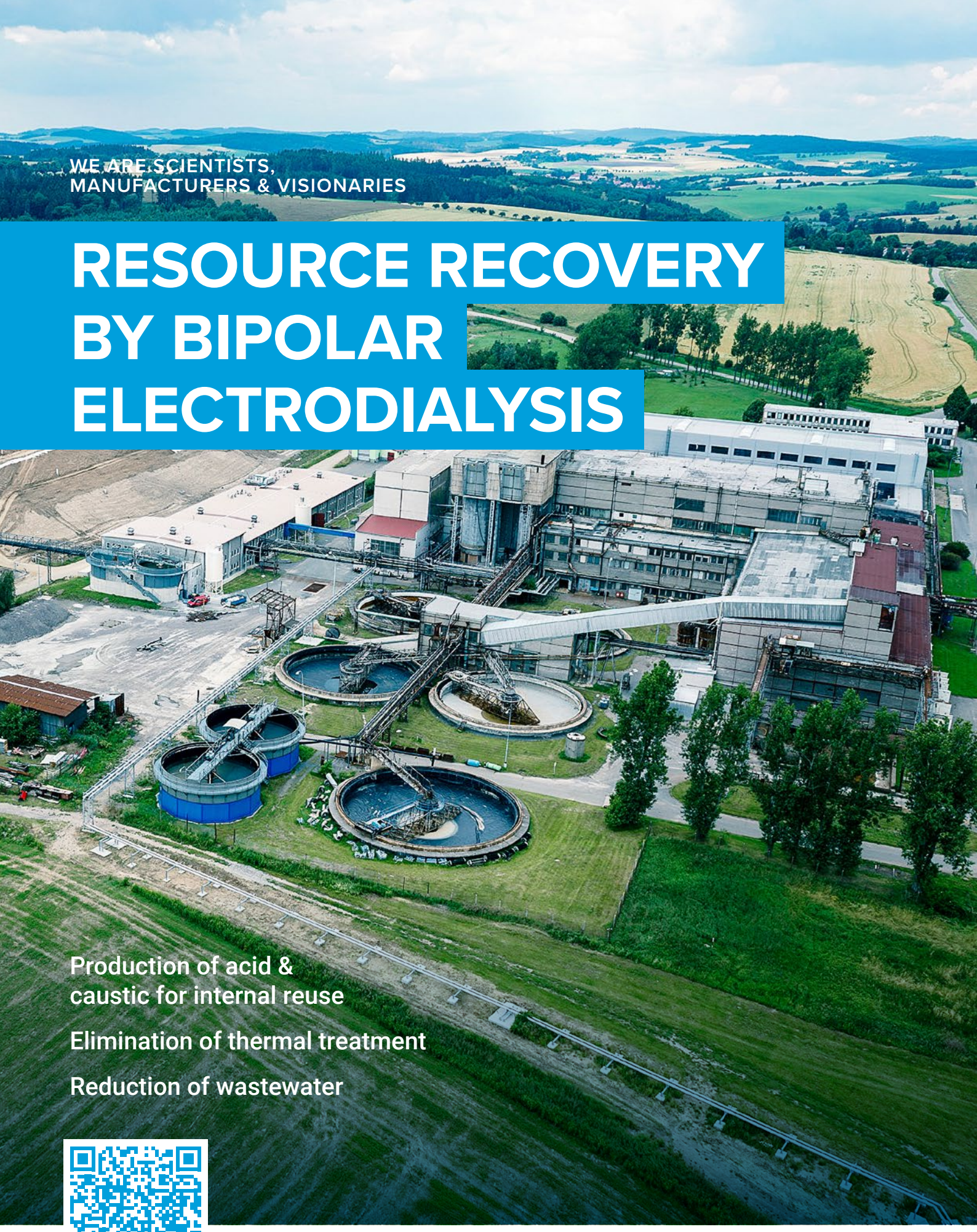

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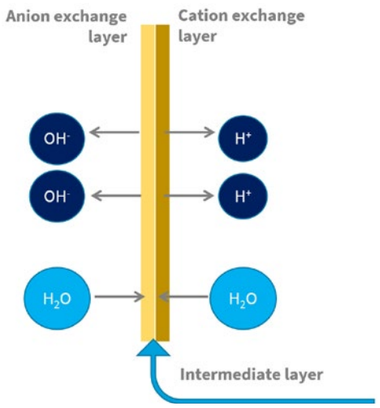
ADVANCED ION SPLITTING & SEPARATION FOR EFFICIENT RESOURCE RECOVERY

BIPOLAR ELECTRODIALYSIS (EDBM) IS A VARIATION OF THE CONVENTIONAL ELECTRODIALYSIS (ED) PROCESS WHICH ENABLES RECOVERY OF ACIDS AND BASES.

HOW EDBM WORKS

Electrodialysis with bipolar membranes (EDBM) is an electrically driven method of removing dissolved ionic compounds. The stack consists of alternating cation exchange membranes (CEM) and anion exchange membranes (AEM) with bipolar membranes (BM) placed at regular intervals.

Considering the different possibilities for cell arrangements with a bipolar membrane in an electrodialysis module, we distinguish three types.



THEORETICAL BACKGROUND OF EDBM

Bipolar membrane is a cation-exchange membrane combined together with an anion-exchange membrane, through an intermediate layer (the "junction" layer). This membrane arrangement placed in a high density electric field enhances dissociation (splitting) of water into H+ and OH- ions.

1. The production of acid, bases, and diluted solution is carried out using a three-chamber module configuration, which includes a cation-exchange membrane (CEM), anion--exchange membrane (AEM), and bipolar membrane (BPM).
2. For alkali production is using a two-chamber cell configuration with CEM and BPM.
3. For acid production is using a two-chamber cell configuration with AEM and BPM.

MEGA BIPOLAR ELECTRODIALYSIS

We offer our customers fully automatic, modular-designed EDBM systems, that may work at temperatures of 10–40 °C . Bipolar Electrodialysis finds applications in various industries such as chemical, biotechnology, food, and CO_2 capture technologies. Thanks to using EDBM in wastewater treatment you can desalinate or split salts to increase water recovery.

RALEX BIPOLAR MEMBRANES BY MEGA

MEGA is one of the world's leading producers of bipolar ion-exchange membranes. MEGA bipolar membranes easily fulfill the main criteria of ideal membranes such as good chemical and mechanical stability, long life-time and high limits of feed for hardness.

MEGA MEMBRANES ARE UNRIVALLED ON TODAY'S MARKET

MAIN APPLICATIONS OF EDBM

- Non-thermal ZLD
- Regeneration of absorbents for CO_2 capture technology
- Production of inorganic acids and bases from Na_2SiO_3, Na_2SO_4, Na_2CO_3, NaCl, $NaNO_3$, Na_3PO_4 etc.
- Regeneration of acids from galvanic bath
- Regeneration of Ionex columns
- Aluminium casting
- Treatment of Na_2SO_4 from textile industry
- Regeneration of ammonium nitrate waste from processing of nuclear fuel
- Purification of flue gases
- pH adjustment in the food and beverage industry

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MEGA EDBM FEASIBILITY STUDY

GEAM, DOLNÍ ROŽÍNKA, CZECH REPUBLIC

The GEAM plant in Dolní Rožínka, part of the state-owned enterprise DIAMO, was a functioning uranium mine where uranium concentrate (ammonium diuranate) was obtained by chemical alkaline leaching. The production of ammonium diuranate is closely related to the issue of overbalanced water in existing tailing ponds.

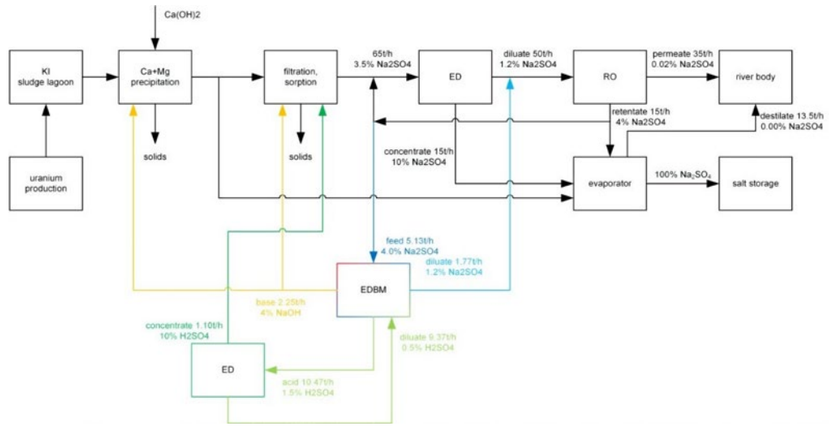
To maintain the balance in tailing ponds, a combination of massive pretreatment, electrodialysis (ED), reverse osmosis (RO) and an evaporator with total capacity of 230,000 m^3 per year are used. Meanwhile desalinated water matching the discharge limits is discharged into the water course, and concentrated streams from ED and RO are further treated by evaporation to produce crystalline sodium sulfate for commercial purposes.

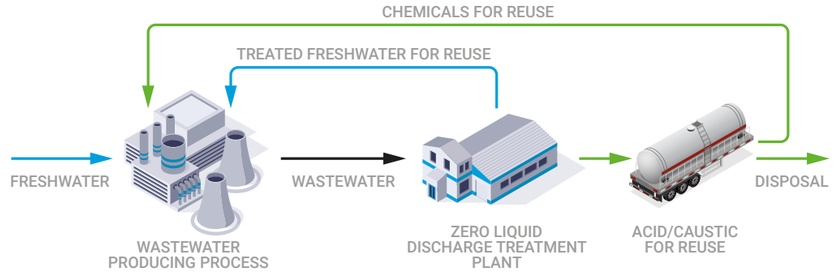
EDBM technology has been introduced by MEGA to existing water treatment to recycle and reuse sulfuric acid and sodium hydroxide, which are nowadays very costly to purchase.

INDUSTRIAL-SCALE ELECTRODIALYSER

Produced NaOH may be further used for pH adjustment and H_2SO_4 for ammonia adsorption and IEX regeneration in pretreatment lines. Common ED technology is added after EDBM for further concentration of sulfuric acid.

This elegant and environmentally friendly solution presented by MEGA will significantly save the customer's costs associated with the purchase of acids and alkalis used for pretreatment technologies and simplify the whole chemical handling process.





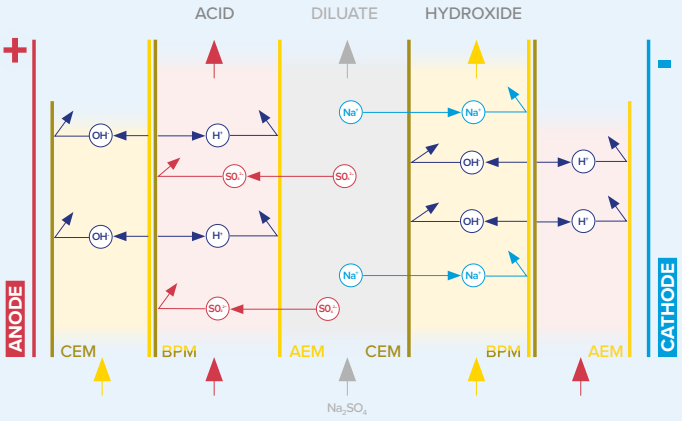
MEGA EDBM HIGHLIGHTS

- Production of acid & caustic for reuse
- Reduction of wastewater, recovery and reuse of chemicals
- Elimination of thermal treatment
- High limits of feed water hardness
- Low-maintenance modules
- Tailored systems (the membranes and systems can be specifically designed according the problem to be solved)

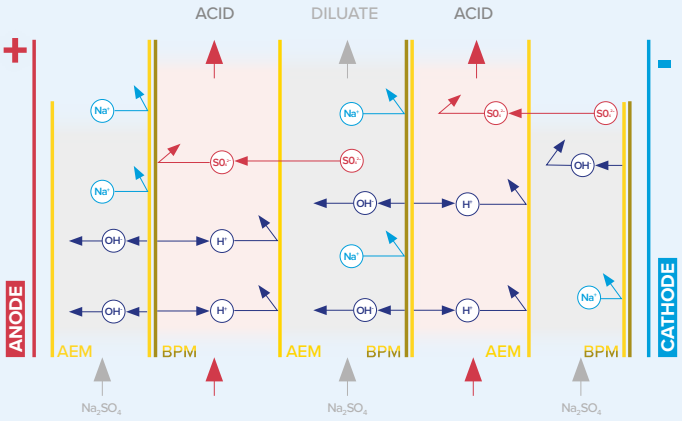
RALEX MEMBRANES ADVANTAGES

- Very good chemical and mechanical stability
- Long Life-time
- Suitable for use in industries
- Certified for the food industry

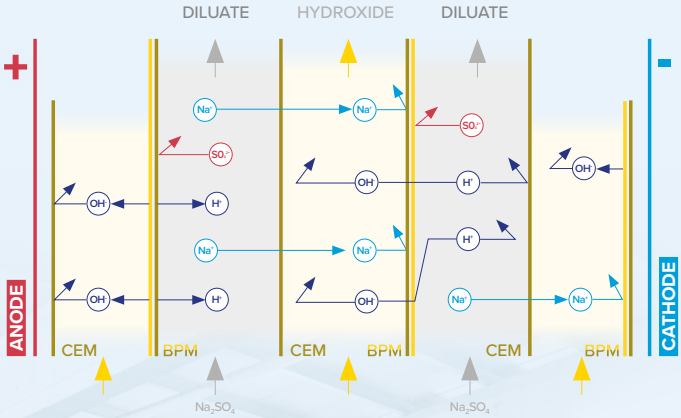
CELL ARRANGEMENT – THREE CHAMBERS



CELL ARRANGEMENT – TWO CHAMBERS (WITH AEM)



CELL ARRANGEMENT – TWO CHAMBERS (WITH CEM)



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