Unlocking synergies: Comprehensive analysis and challenges in the integration of reverse osmosis with reverse electrodialysis.

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INTRODUCTION

Salinity Gradient

Bocas de ceniza – Caribbean Sea and Magdalena River

Barranquilla, Atlántico, Colombia

- Salinity gradient energy has a huge potential as alternative and sustainable energy source.
- Pressure-retarded osmosis (PRO) and reverse electrodialysis (RED) are the most frequently studied processes to extract the potential energy available from the mixing of freshwater and saltwater.

02

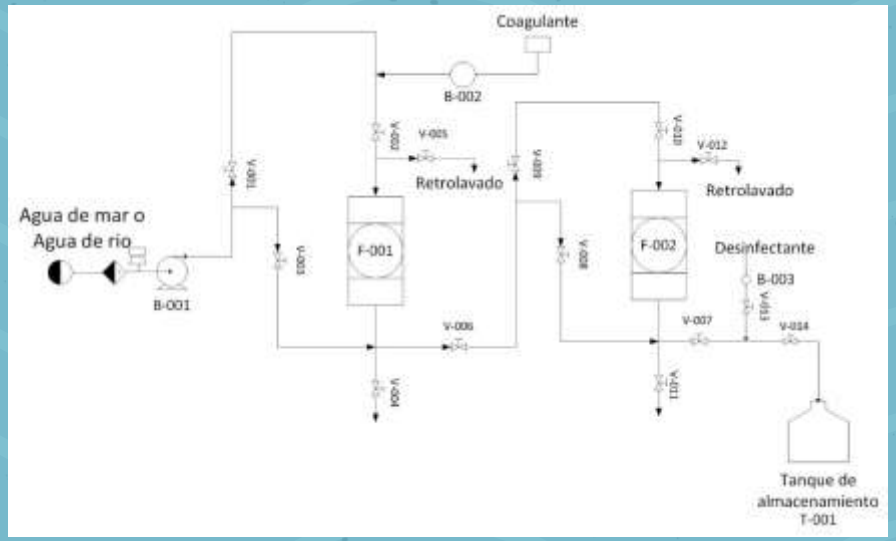
PRETREATMENT

CONVENTIONAL PRETREATMENT

Initial conditions:

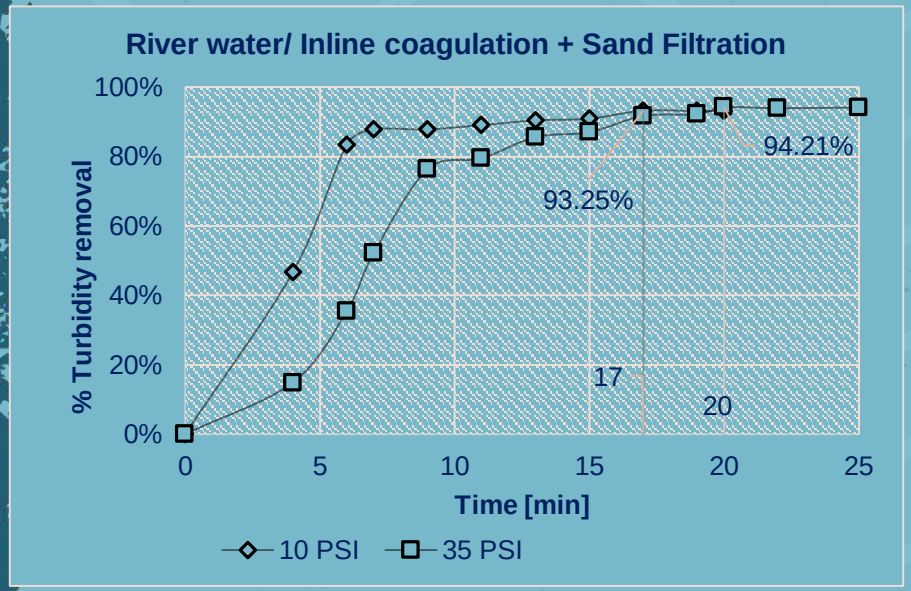
- River water: 260-605 NTU, SDI >20, 9-11 mg/L de TOC.
- Seawater: 12.5-103 NTU, SDI>20, 20-30 mg/L de TOC.

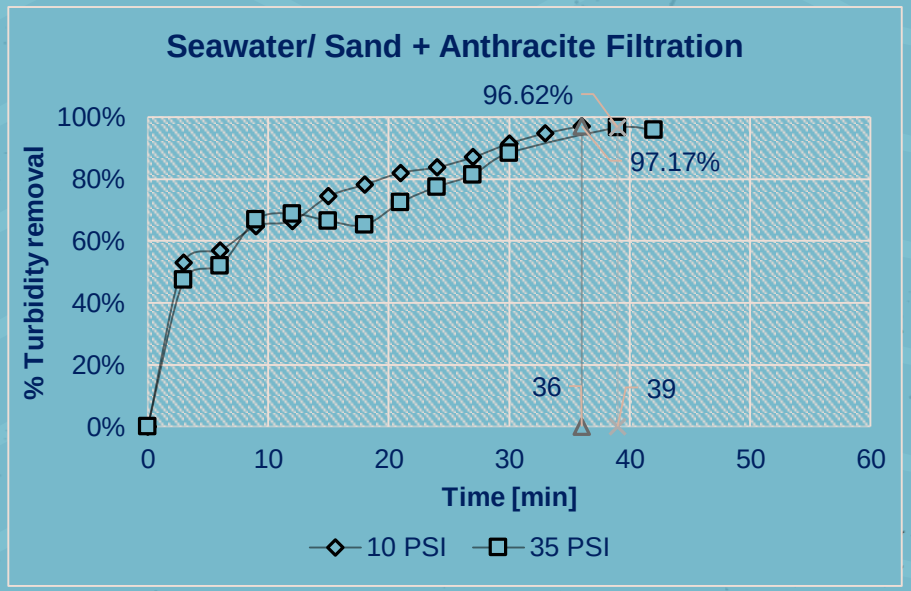
CONVENTIONAL PRETREATMENT



- Design of Experiment (DoE): Categorical Multilevel Factorial.
- Assessment of various filter's bed compositions.
- Coagulation with Polyaluminium chloride hydroxide sulfate.
- Pressure: 10-35 PSI

CONVENTIONAL PRETREATMENT





After selected conventional pretreatment (River water):1.33 NTU, 3.6 mg/L TOC y SDI 3.6 – 4.9.

After selected conventional pretreatment (Seawater): 0.89 NTU, 2-3 mg/L TOC y SDI 3.3 – 3.5.

03

DESALINATION

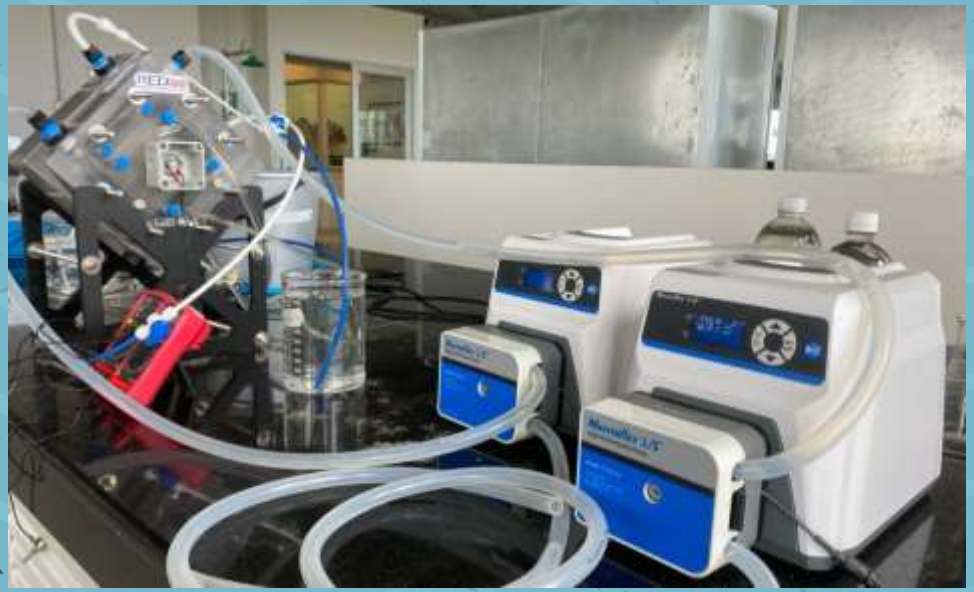
DESALINATION BY REVERSE OSMOSIS

DESALINATION BY REVERSE OSMOSIS

- Potential solution to obtain drink water.
- Energy requirement: 11-15 kWh/m^3
- Brine disposal.
- Area: 42cm^2 (Minimum scalable)

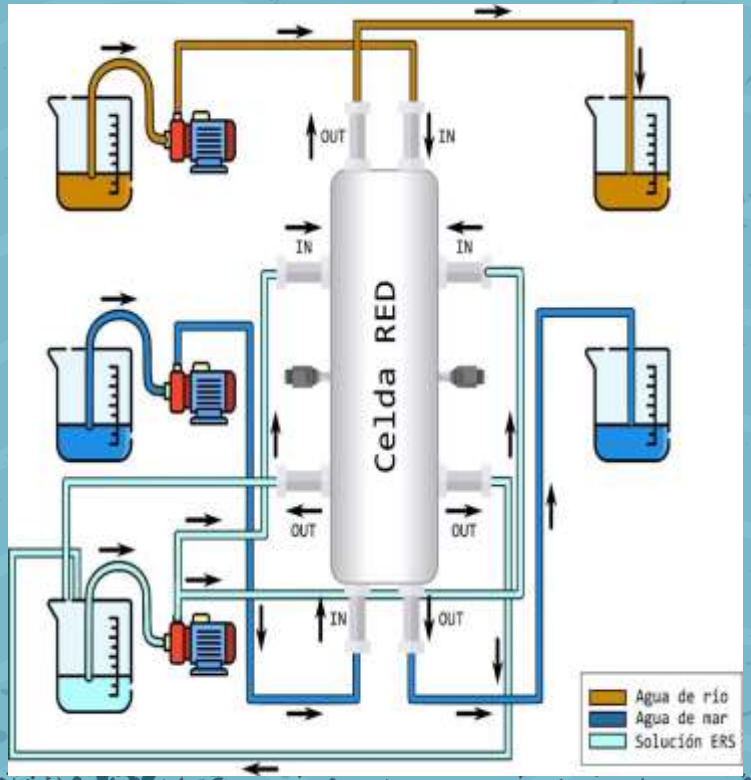
04
SALINITY GRADIENT ENERGY

SALINITY GRADIENT ENERGY BY REVERSE ELECTRODIALYSIS



- CCD as DoE to evaluate RED process in each system proposed.
- The mixing of de 1 m^3 of Seawater y 1 m^3 of river water releases energy equivalent to a waterfall with a height of 200 m.
- Difference in chemical potential which could be transformed directly into electrical energy.

SALINITY GRADIENT ENERGY BY REVERSE ELECTRODIALYSIS



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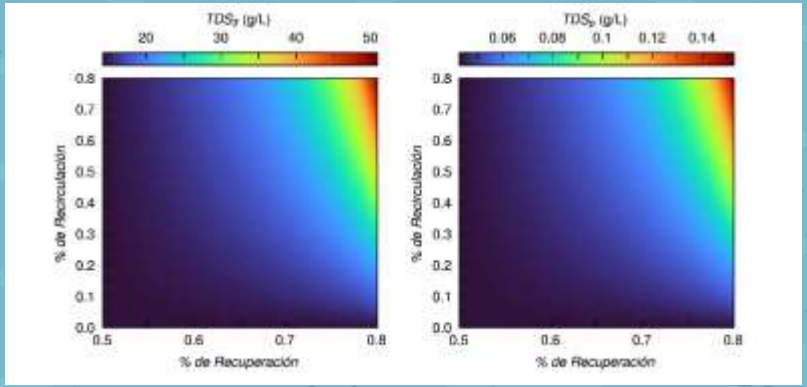

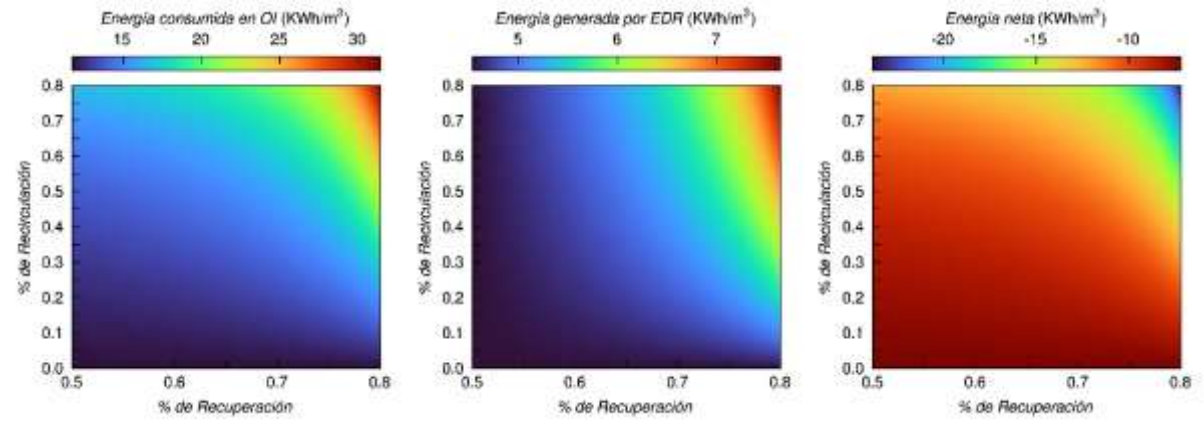

SALINITY GRADIENT ENERGY BY REVERSE ELECTRODIALYSIS

Pretreatment

Desalination

Salinity Gradient Energy (SGE)

Power density:
Real Brine/River water
0.34-4.35 W/m^2

05

CONCLUSIONS

Optimization of individual processes (RO and RED) might lead to the highest efficiency of the coupled system.

The location of a pilot plant should be where it can be easily found high and low-salinity waters.

Carrying out future work focused on the use of real water samples from our region leads to a better understanding of the phenomena and their actual potential applications.

Pretreatment is necessary for the samples of the Magdalena River and the Caribbean Sea.

Improving the water quality in the inlet of membrane systems is CRUCIAL to reduce costs and prevent early fouling.

THANKS!

Do you have any questions?

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