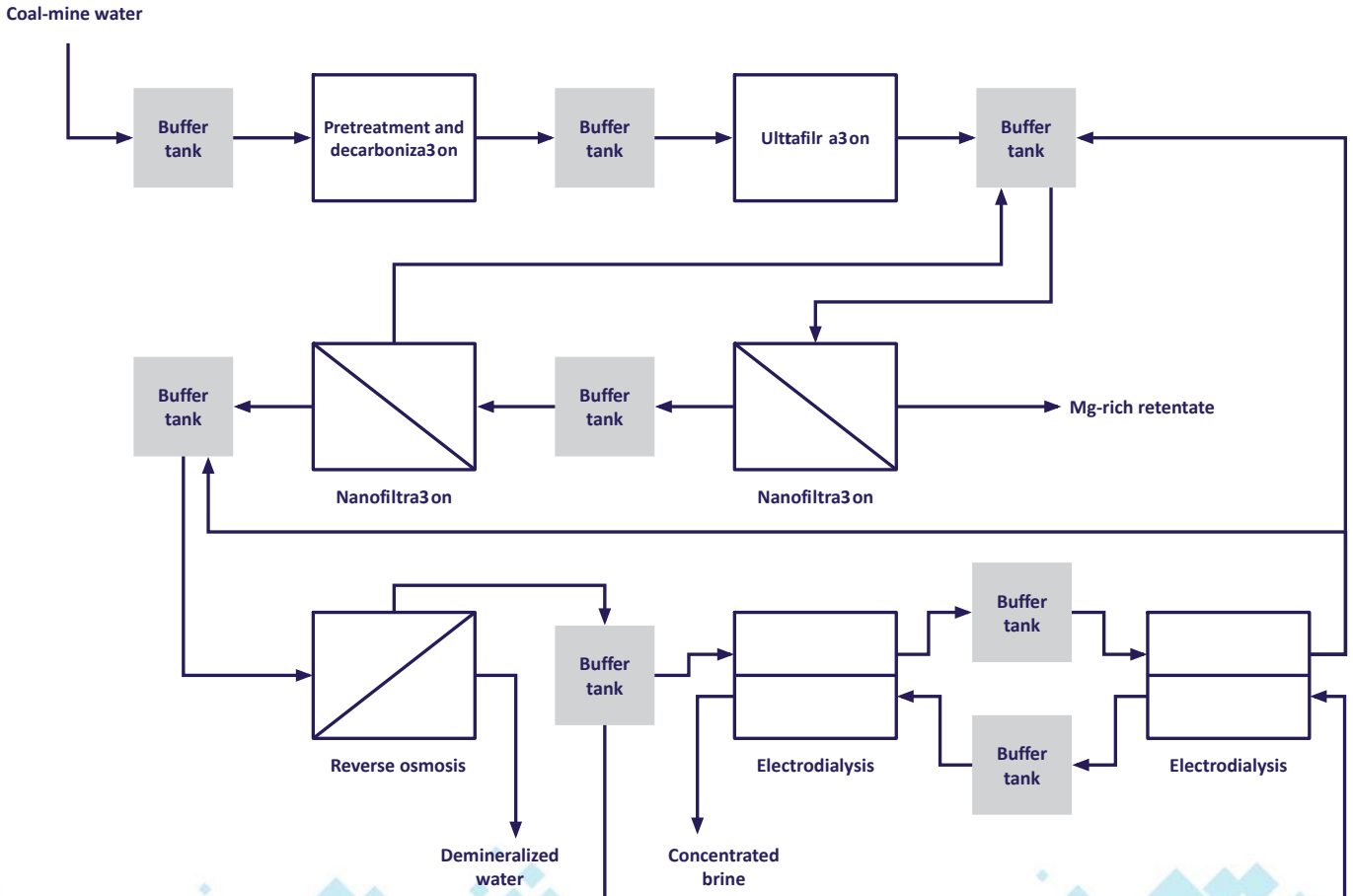
ZERO BRINE

WP3

Minimizing energy consumption and increase resource recovery yields through advanced treatment methods in the coal mine and textile industries

The ZERO BRINE project (www.zerobrine.eu) has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730390.

Polish case



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Work done so far

Bench-scale tests of unit operations used in the plant

Design and construction of the plant

Plant start-up

Preliminary tests with CrIEM

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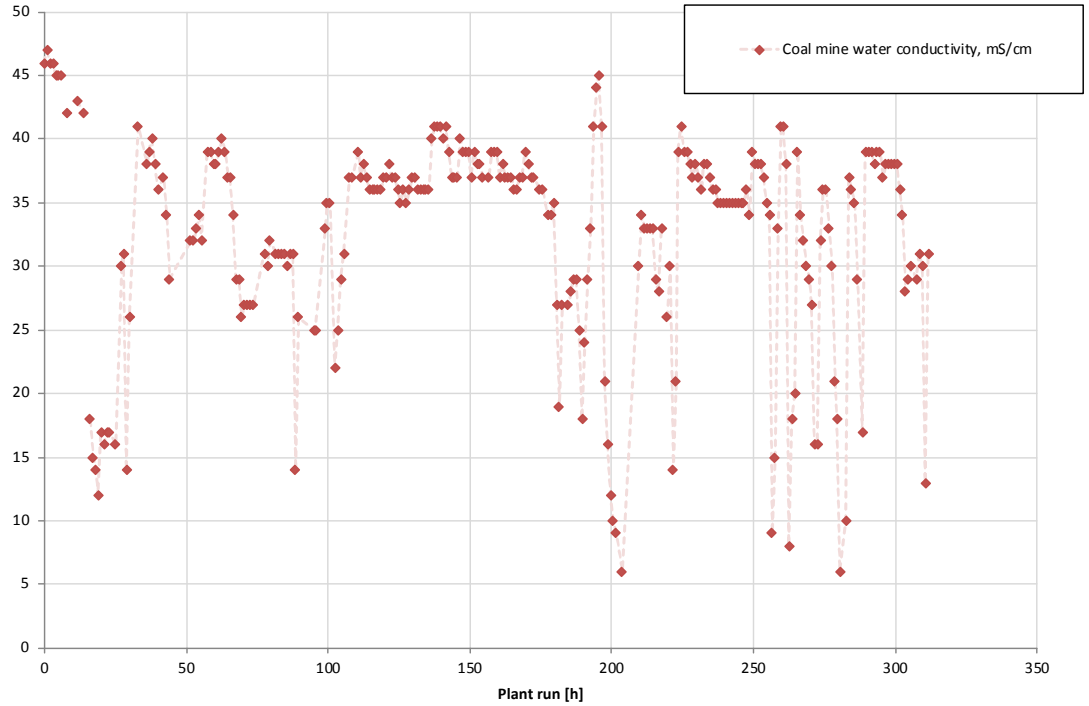
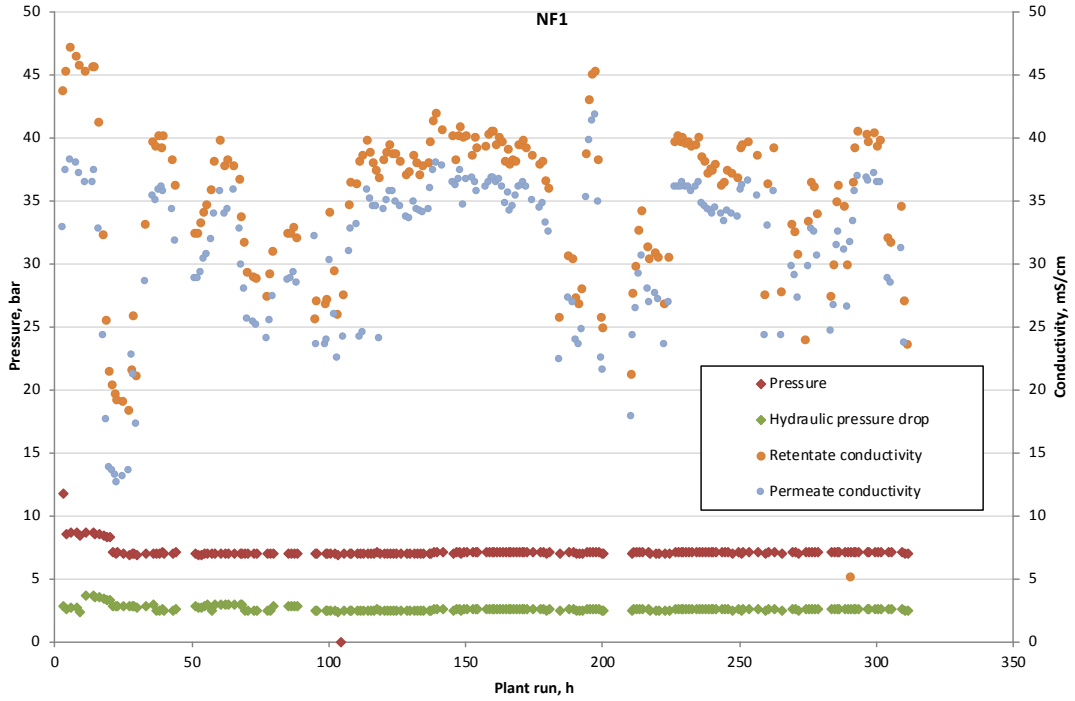
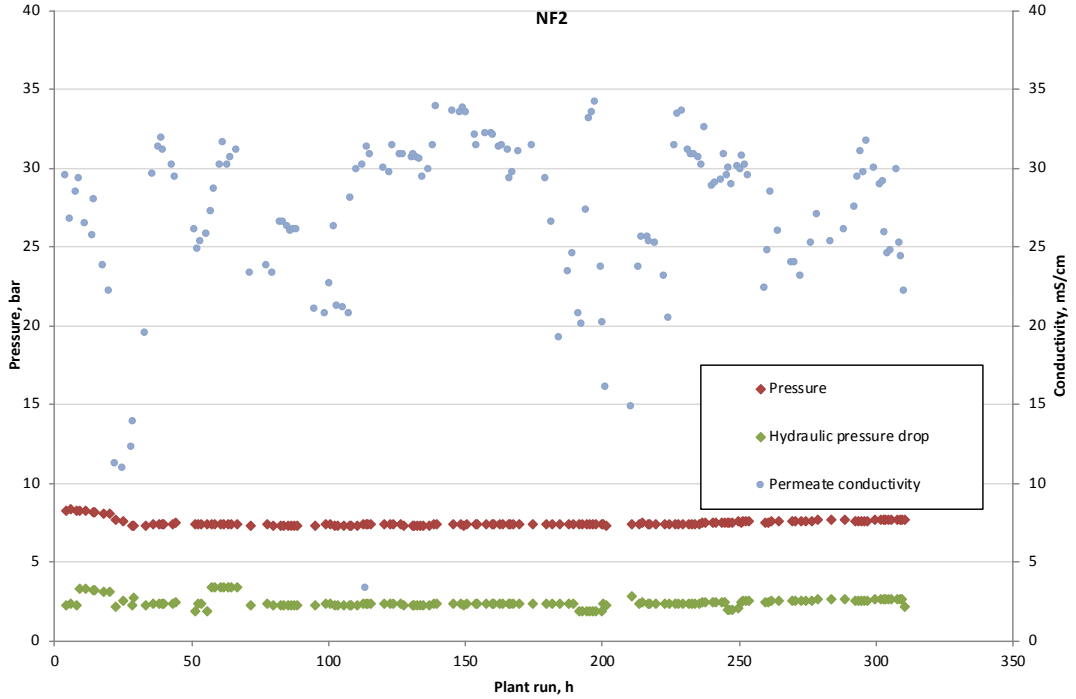
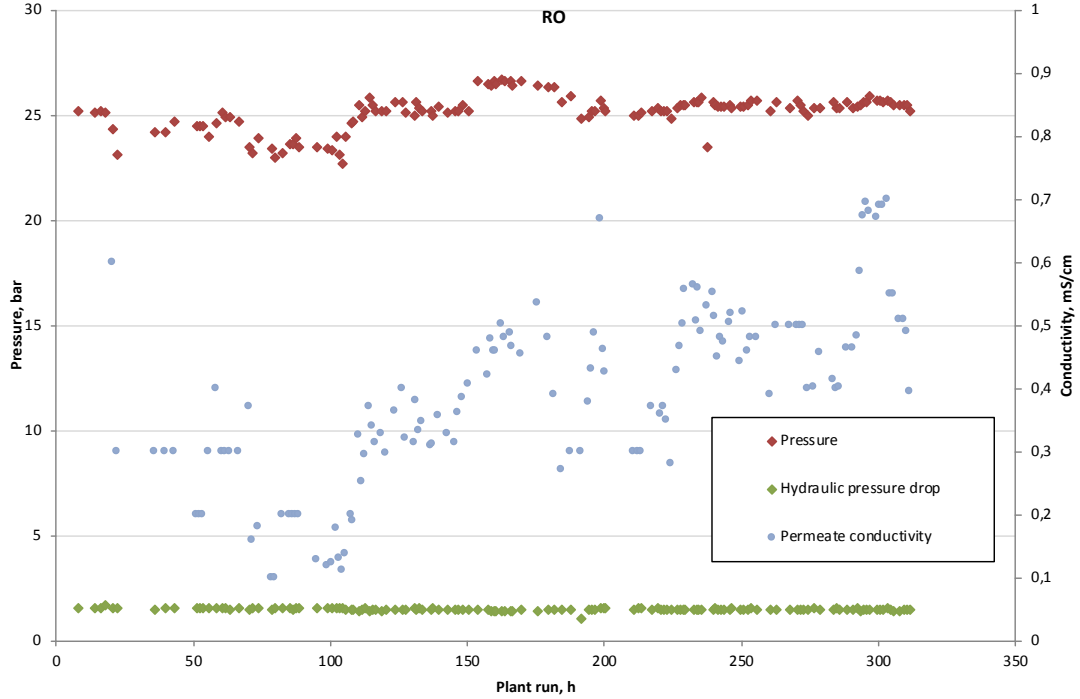
Preliminary results





Preliminary results





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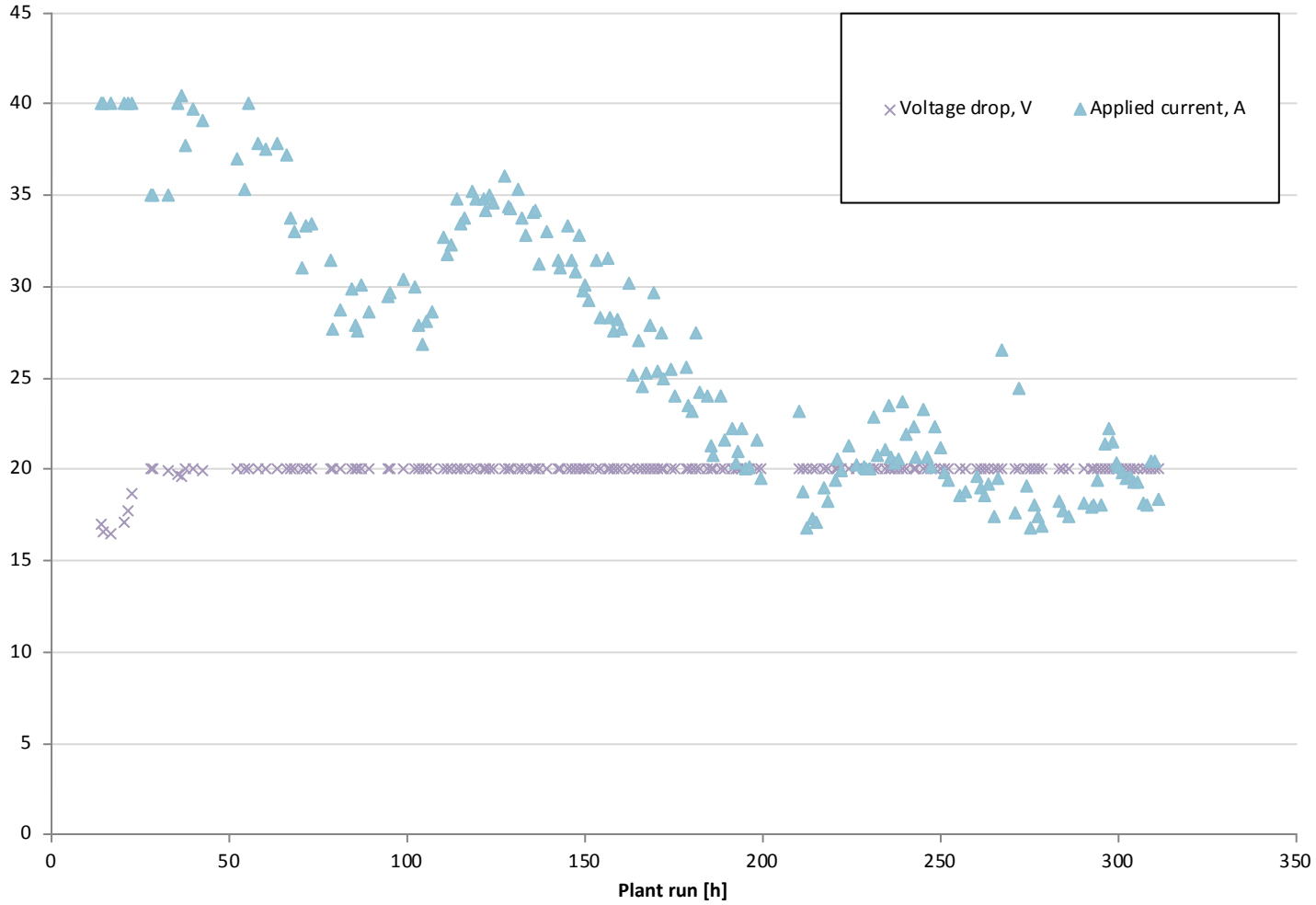
Preliminary results



Plant modifications

Decarbonization unit moved from pretreatment to after the ultrafiltration

Additional buffer tanks

Additional filters for pretreatment

Next steps

Finish the plant modifications

Optimize the working conditions

Generate brines for CrIEM and EFC tests

Collect data for economic analysis and LCA

Batch System

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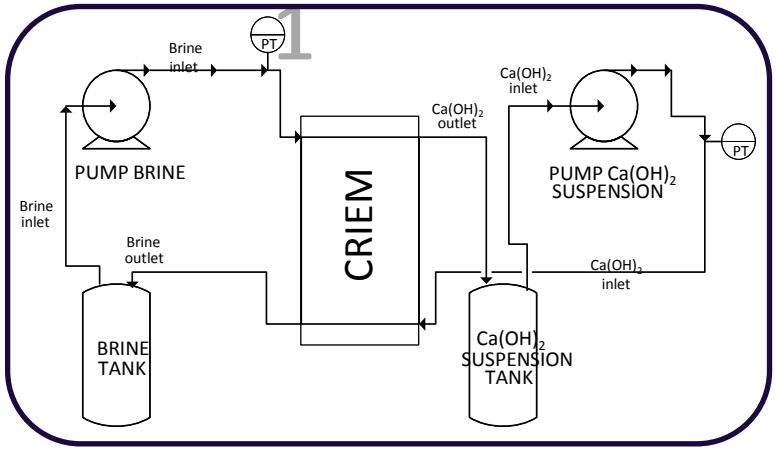
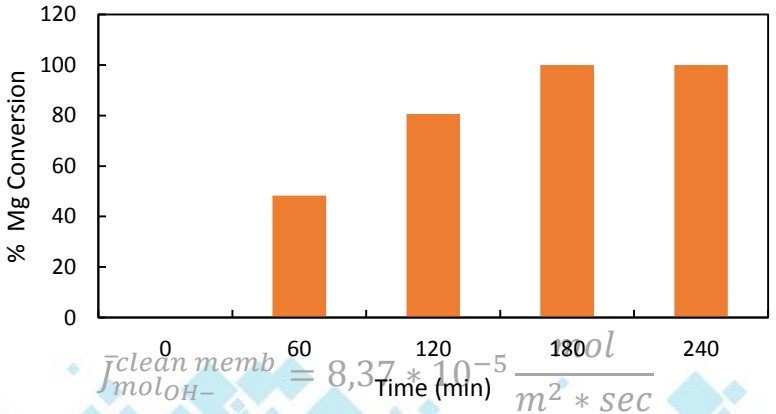


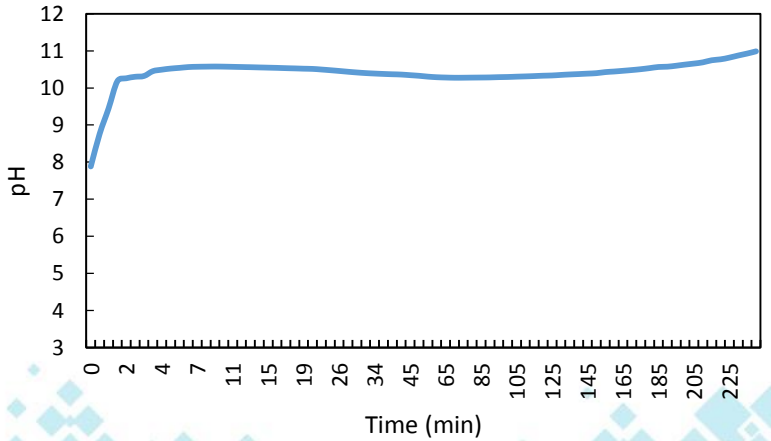
test	$[Mg^{2+}]\ (\frac{mol}{L})$	$[Ca^{2+}]\ (\frac{mol}{L})$	$[Na^{+}]\ (\frac{mol}{L})$	$\dot{Q}\ (\frac{ml}{min})$	Initial Volume [l]	Physical State of the Alkaline Solution
1	0,132	0,634	0.461	23.0	0,1	Solution
2	0,132	0,634	0.461	23.0	2	Solution
3	0,011	0,015	0.448	25.41	2	Solution
4	0,011	0,008	0.447	90.75	2	Suspension
5	0,011	0,008	0.447	181.5	2	Suspension
6	0,123	0,556	0.431	181,5	2	Suspension

Conversion of the Reactants vs time



$$J_{mol_{OH-}}^{clean\ memb} = 8{,}37 * 10^{-5}\ \frac{mol}{m^2 * sec}$$

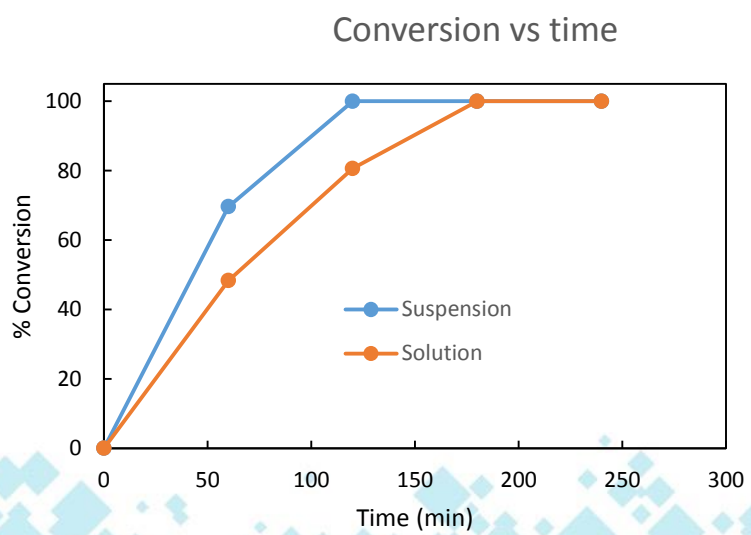
pH vs Time

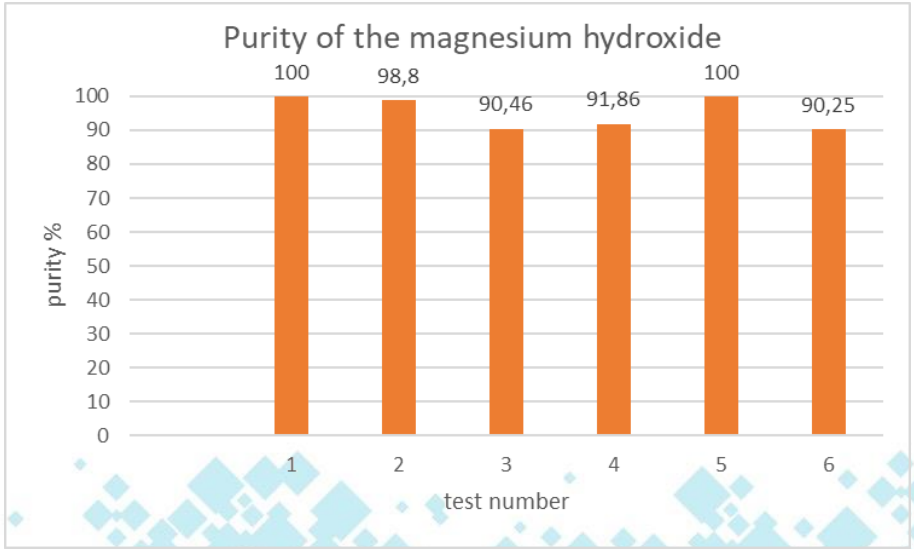


$$\bar{J}_{mol_{OH-}}^{clean\ memb} = 8{,}37 * 10^{-5}\ \frac{mol}{m^2 * sec}$$

Experimental Parameters in the batch campaign

Test	Mg Conversion %	Ca By-product %	Purity %	Ionic Flux $(\frac{mol}{m^2*sec})$	Reaction Time (min)	Final pH	Physical State of the Alkaline Sol
1	*100*	*0*	*100*	$7.17 * 10^{-5}$	*365*	*10.5*	*Solution*
2	*100*	*0.16*	*98.8*	$3.96 * 10^{-5}$	*660*	*10.5*	*Solution*
3	*100*	*8.77*	*86.43*	$7.54 * 10^{-5}$	*240*	*10.9*	*Solution*
4	*100*	*11.32*	*91.86*	$1.01 * 10^{-4}$	*240*	*11.4*	*Suspension*
5	*100*	*5.71*	*100*	$6.92 * 10^{-5}$	*300*	*11.4*	*Suspension*
6	*100*	*6.23*	*72.40*	$2.68 * 10^{-5}$	*5190*	*10.5*	*Suspension*





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Feed and Bleed system and result

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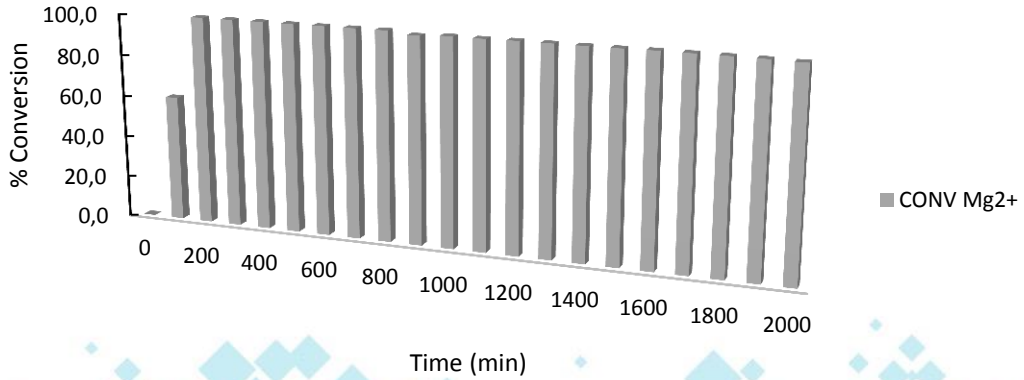
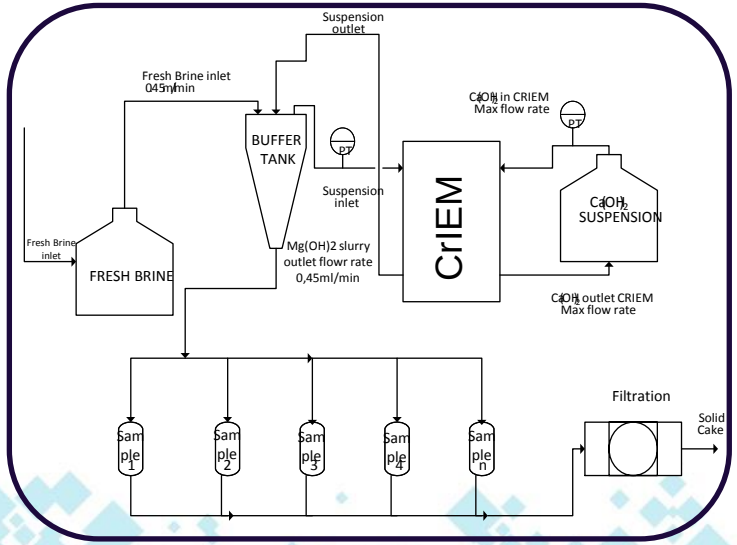
Experimental parameters

test	$[Mg^{2+}]$ $(\frac{mol}{L})$	$[Ca^{2+}]$ $(\frac{mol}{L})$	$[Na^{+}]$ $(\frac{mol}{L})$	$\dot{Q}$ $(\frac{ml}{min})$
1	0,119	0,551	0,423	0,49
2	0,126	0,591	1,125	0,47





Purity of magnesium hydroxide above 99%

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Next steps

CrIEM tests on a real NF retentates

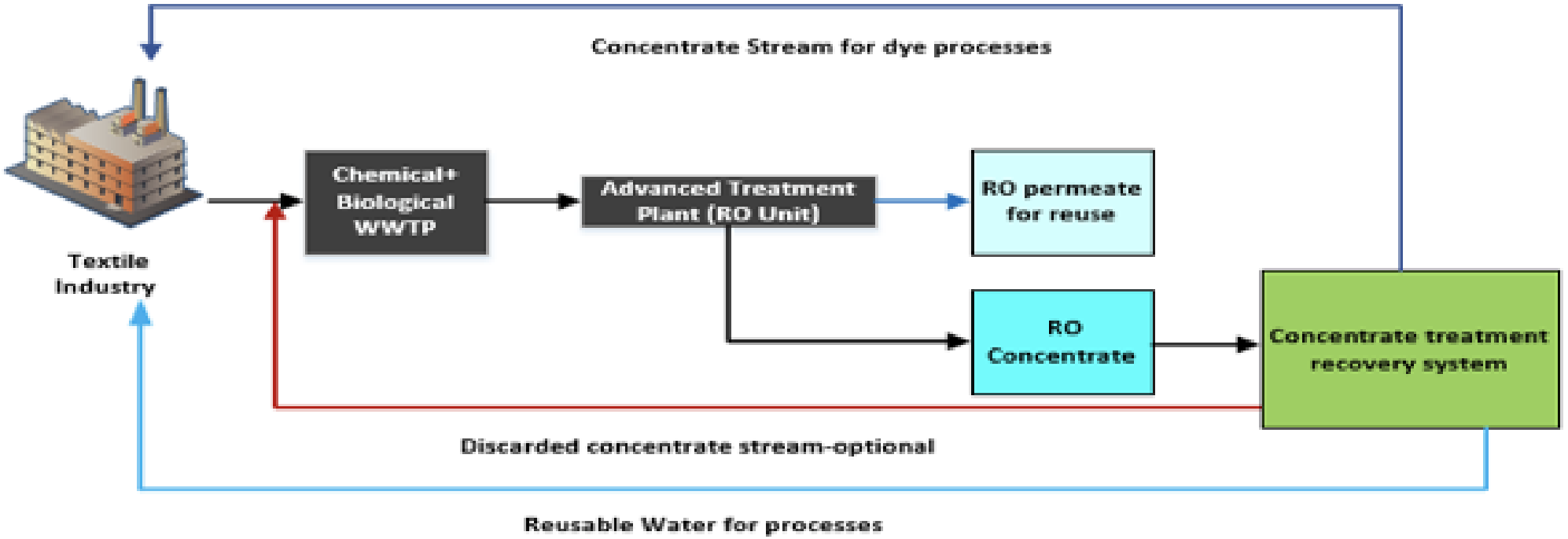
Testing the CrIEM in Poland (The CrIEM will be at SUT for the “Field visit to the ZERO BRINE demo-site in Poland” event organised by Revolve on the 8th of October)

EFC tests

Currently in progress with synthetic brines

Tests with real brines expected when ED is ready to run again (most likely this month)

Turkish case



Work conducted

Sampling and characterization

Among parameters, hardness, color fundamental concerns for textile dyeing processes.

Organic content of concentrate and sulfate are also considered to be crucial.

Bench scale treatability and assessment

Testing unit processes, NF, IEX (cation anion), ozone ox., AC adsorption, RO, electro-coagulation, electro oxidation, evaporation

Development of process schemes

Selection of best applicable option

Detailed design of selected process scheme

Selected process scheme

Process steps	Applied process units	Remarks/expected impacts
Pre-treatment	ozone oxidation	removal of color, organic matter
	Nano filtration (NF), 2 steps	retaining impurities i.e. color hardness, sulfate, remained organics and allowing passage of salt for the concentration step
Concentration	Reverse osmosis (RO)	concentrating pre-treated brine, RO permeate to be reused
Further treatment-softening	ion exchange - cationic	achievement of suitable and secure salt solution for dyeing process

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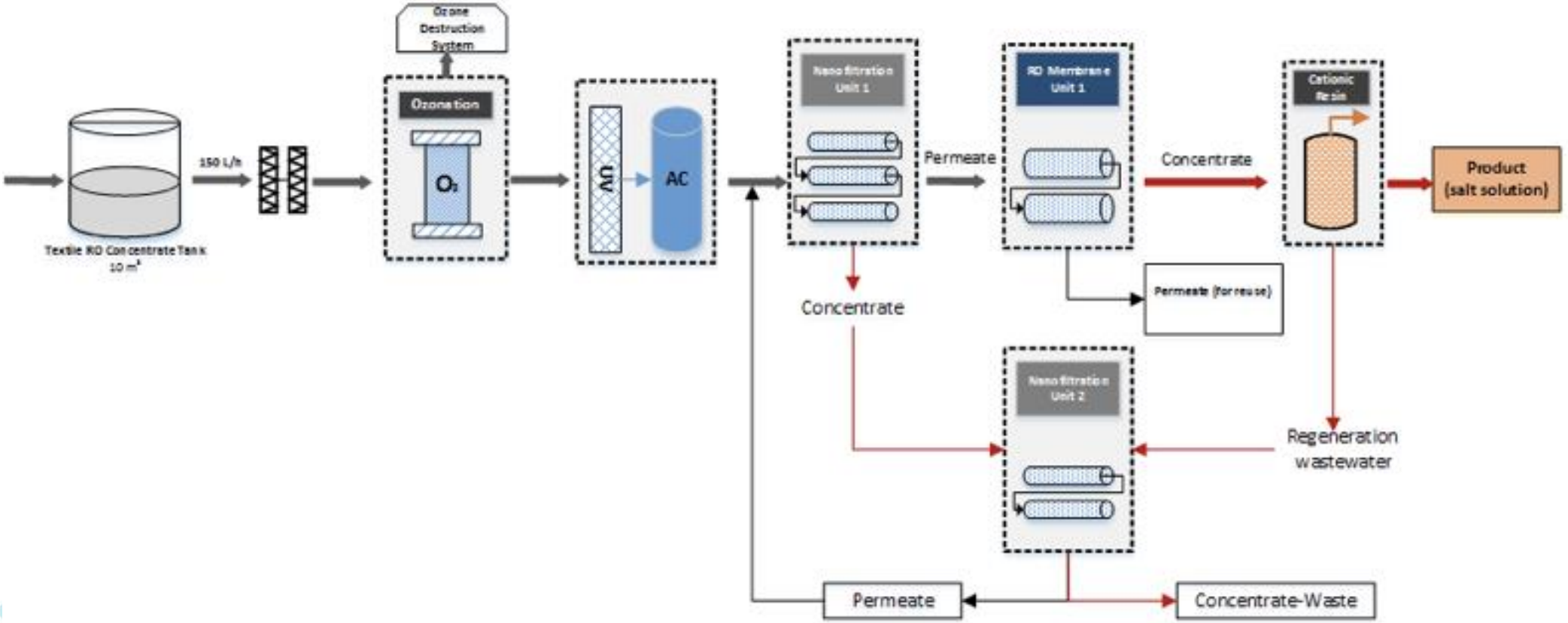
Brine treatment and recovery – to be constructed



Next steps

Procurement is about to be finalized,

Installation and testing period will be commenced

Construction, operation and optimization,

Evaluation of the environmental benefits, social benefits and the economic feasibility of the innovative ZERO BRINE textile demo case will be appraised.