Production of Fe and Al based coagulants from the recovery of brines and metal scraps

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YWP YOUNG WATER PROFESSIONALS SPAIN

IWA the international water association — YOUNG WATER PROFESSIONALS SPAIN

INTRODUCTION

Currently, the use of reverse osmosis or ion exchange for obtaining drinking water or reclaimed water, as well as high quality water for industrial processes, are increasing. In both processes, a high salinity waste stream, called brines, is produced. The direct discharge into the environment of these **brines** is considered a major environmental problem.

In parallel, there is also an increase in the demand of raw materials such as metals as well as an unsustainable **scrap metallic waste** management.

Part of these metals taken from natural resources are used for the manufacturing of commercial coagulants. This process generates waste streams, and entails energy and raw material consumption, including toxic and corrosive reagents.

In LIFE Waste2Coag, an innovative solution for the **on-site production of sustainable coagulants** is being demonstrated.

Fe and Al based coagulants are produced using an electrolytic technology system (ELS) using wastes as raw materials, specifically industrial scrap metallic wastes and brines, generated in both desalination plants and industrial plants (Figure 1).

This will enable to offer an alternative for the management of brines in WWTP as well as to minimize their operating costs.

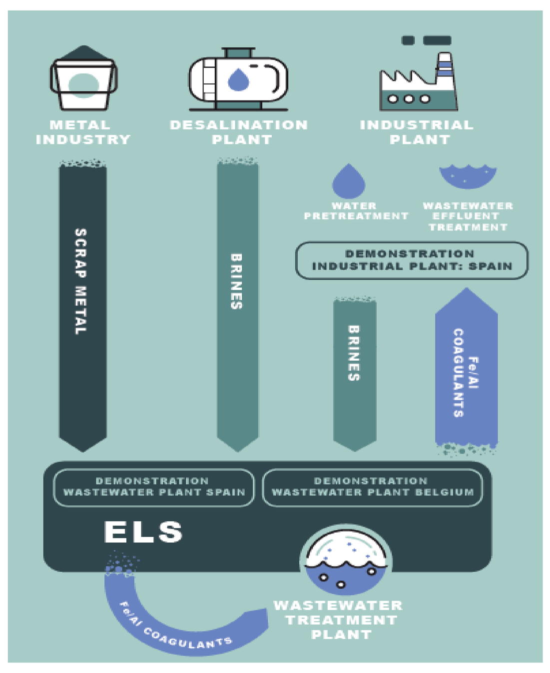


Figure 1- LIFE Waste2Coag approach.

BACKGROUND

Laboratory scale operation (1 L reactor)

Brines	• Physico-chemical caracterisation. • Selection of 2 brines with different salinity (11 mS/cm & 4 mS/cm).
Metal	• Identification of waste managers. • Characterisation of the composition of metallic steel and aluminium wastes. • Selection of the most sustainable Fe and Al wastes to operate as electrodes.
Coagulants produced	• Coagulants production at different current densities (A/m²). • Production at different electrolysis time. • Evaluation production efficiencies. • Quantification of energy consumption. • Product validation on wastewater through Jar-Test.

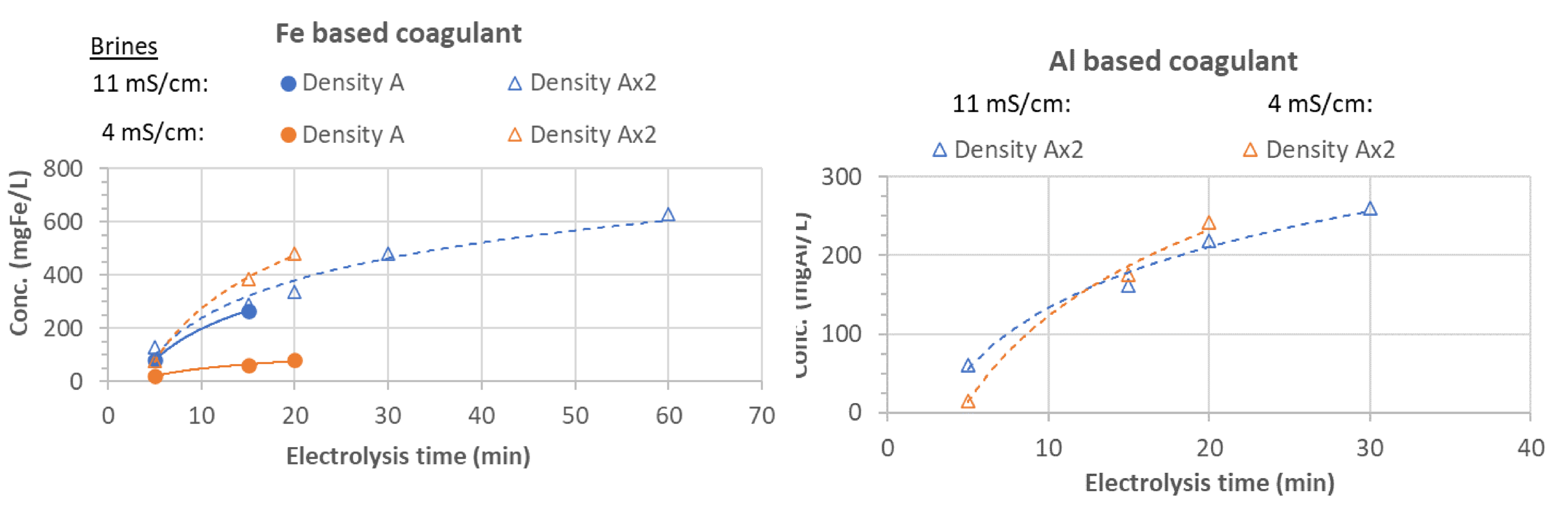


Figure 2-Metal concentrations (Fe and Al) in coagulant produced versus electrolysis time for different current densities (A/m2) and type of processed brine.

Different formulations of coagulants at slightly alkaline pH (8,10±0,31) were obtained operating at hydraulic times between 5-60 min and resulting in metal concentrations up to 625 and 250 mg/L for Fe and Al based coagulants, respectively.

The electrolysis time increases beyond 20-30 minutes did not proportionally increase the metal concentration in both, Fe and Al based coagulants.

Higher concentrations of Fe than Al were obtained using both brines, except with 4 mS/cm applying the lowest current density and hydraulic times higher than 15 minutes

Pilot Plant operation (100 L reactor)

- Scaling up and coagulant production optimisation.
- Product validation through Jar-Test, applying doses of 40 and 80 mL/L on secondary effluent from a WWTP.

Figure 3- Pilot plant for coagulants production.

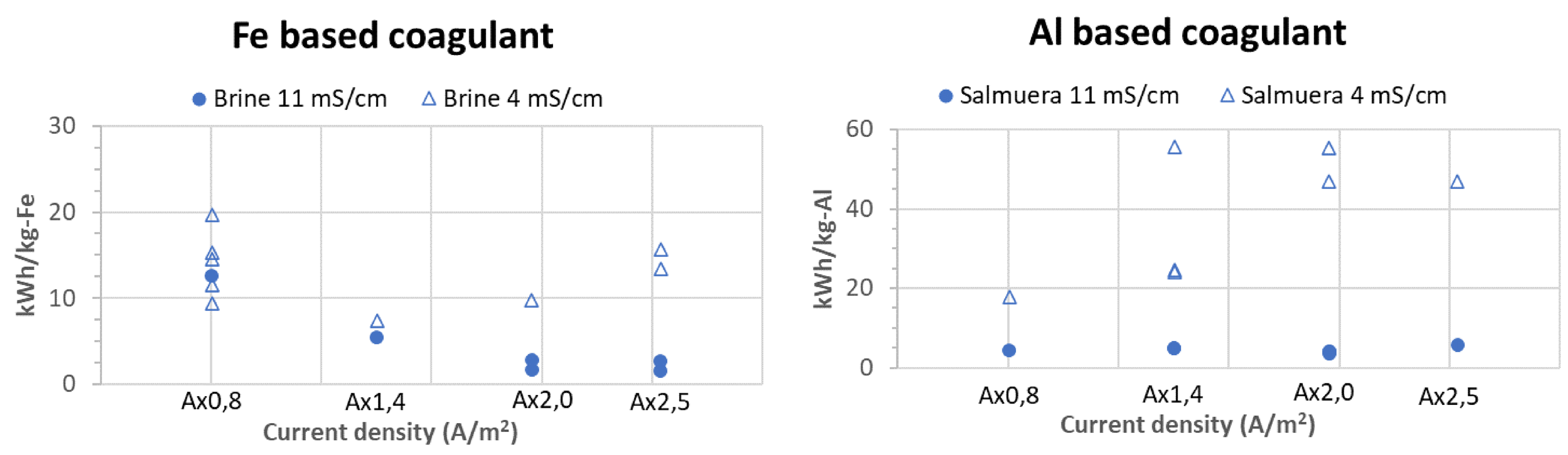


Figure 4-Energy consumption (EC) per Kg of metal obtained (Fe and Al) in coagulant produced versus the current density applied to the different brines. Electrolysis time of 15 minutes.

For Fe based coagulants the EC was lower than 6 kWh/kg applying current densities higher than Ax1,4 A/m² and using the brine with a conductivity of 11 mS/cm.

For Al based coagulants the EC was lower than 5 kWh/kg applying all the studied current densities and using the brine with a conductivity of 11 mS/cm.

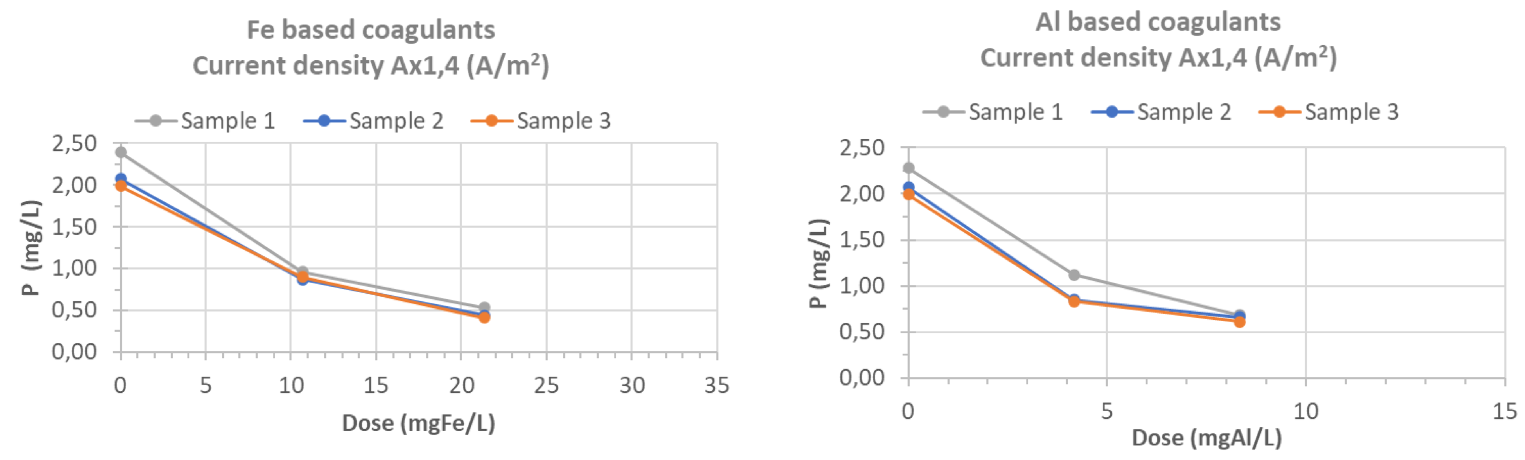


Figure 5-Phosphorus concentration in secondary WWTP effluent versus dose of produced coagulant (Fe and Al) at current density of Ax1,4 A/m² and using the brine of 11 mS/cm of conductivity.

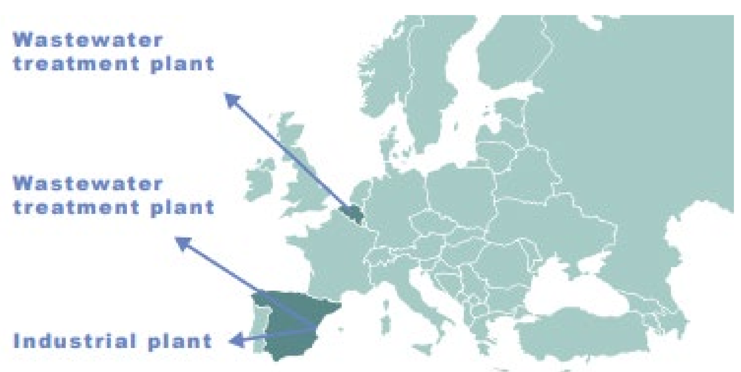
Application of the coagulants produced showed their suitability for the removal of pollutants in wastewaters, reaching removal percentages between 70-80% for COD, P and turbidity.

Phosphorus concentration was reduced from 2,15±0,21 mgP/L to 1,01±0,02 mgP/L applying a coagulant concentration of 5,72 mgFe/L, decreasing to 0,49±0,01 mgP/L when a concentration of 11,49 mgFe/L was used.

In the case of Al based coagulants, the phosphorus concentration was reduced from 2,11±0,19 mgP/L to 0,96±0,09 mgP/L using 2,69 mgAl/L, and down to 0,62±0.07 mgP/L with 5,38 mgAl/L.

LIFE WASTE2COAG

- 3 demosites located in Spain and Belgium.
- Urban WWTP & Industrial WWTP.
- Different brines origins: from drinking water treatment plant and from different industries.
- Different quality effluent and different discharge limits to test the coagulants produced.



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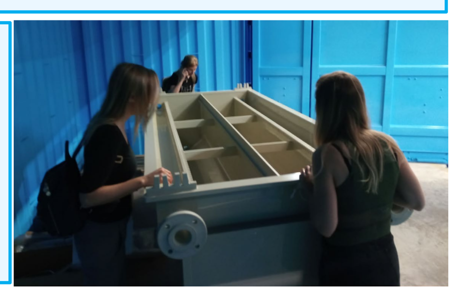
Demonstration plant (1000 L reactor)

OUTCOMES

- 60 m³ brines/day of maximum production capacity.
- Produce coagulants with 400-2,000 mg Fe/L and 250-700 mg Al/L and compare their efficiency against commercial coagulants.
- Valorization of 0.4-2 kg Fe and 0.25-0.7 kg Al per m³ of brine processed.
- Quantification of the economic and environmental feasibility of the ELS by conducting LCC, LCA and S-LCA.



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