



Valorisation of Brines and Scrap Metals for Coagulant Production to Boost Circular Economy in the Water Sector

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Motivation: Conventional production processes for metal-based coagulants, employed in drinking water and wastewater treatment, require a high consumption of energy and raw materials, which are the main contributors to their carbon footprint. Concurrently, brines, a by-product generated in desalination and demineralisation processes characterised by a high concentration of salts, are mostly discharged into the environment, negatively affecting soils, sediments, water bodies and marine communities.

Novelty: The LIFE Waste2Coag project (grant agreement LIFE20 ENV/ES/000430) pioneers the Electrolytic System (ELS), a novel technology for the production of coagulants for urban and industrial wastewater treatment from the valorisation of brines and scrap metals. The ELS utilises an electrolytic process to obtain solid coagulants from the application of electrical current to electrodes, made from metal scraps, immersed in brines obtained from different industrial processes (Figure 1).

Key Results: This project has demonstrated that the ELS coagulants are non-toxic to autotrophic and heterotrophic bacteria in activated sludge as per respirometry tests carried out. The ELS coagulants were effective in removing phosphorus from urban wastewater, obtaining effluent values $<0.13 \text{ mgP-PO}_4^{3-}/\text{l}$ through jar-test, and were also validated in treating industrial wastewater, with best results obtained with Al-based coagulants. A removal efficiency for Cu, Ni, Zn and Cr(IV) between 92-99% was obtained from real wastewater resulting from the manufacturing of technical parts in Zamak (Table 1).

Impact: Within the LIFE Waste2Coag project, the innovative ELS technology valorised 3 different types of brines, producing coagulants with a metal concentration of 1200 mgFe/l and 700-1000 mgAl/l, at energy consumptions ranging 2-11 kWh/kg metal, valorising up to 55 m³ of brines. By providing an alternative to

commercial coagulants through on-site generation and consumption, the ELS avoids the environmental impacts of brine disposal without brine treatment and sourcing of raw materials, while recovering value from waste materials, like brines and scrap metals.



Figure 1. The ELS installed in one of the LIFE Waste2Coag demonstration sites

Table 1. Industrial wastewater average characterisation before (inlet) and after (outlet) the dosing of Al-based coagulants produced with the ELS in 4 different days (Day 1-4) of tests and related effluent limits by EPSAR (Entidad Pública de Saneamiento de Aguas Residuales de la Comunidad Valenciana). EPSAR_{avg}: EPSAR's wastewater effluent limits for daily average concentration. EPSAR_{max}: EPSAR's wastewater effluent limits for maximum instantaneous concentration

Parameter	Day 1		Day 2		Day 3		Day 4		EPSAR _{avg}	EPSAR _{max}
	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet		
pH	7.29	9.11	6.78	8.90	7.11	8.76	7.32	8.46	5.5	9.0
Conductivity (µs/cm)	2613.2	4665.7	2131.6	5296.4	2016.2	4809.2	2087.5	4782.5	3000	5000
Cu (ppm)	22.35	0.02	74.01	0.65	65.22	0.67	72.52	1.01	1	3
Ni (ppm)	8.11	0.16	3.70	0.19	3.57	0.27	3.85	0.61	5	10
Zn (ppm)	1.76	0.02	5.61	0.04	5.27	0.04	5.49	0.07	5	10
Cr(VI) (ppm)	<0.02	<0.02	0.263	0.016	0.185	0.005	0.201	0.005	0.5	0.5
Al (ppm)	0.23	0.09	0.41	0.80	0.42	0.72	0.50	0.46	10	20
Fe (ppm)	0.31	0.10	1.40	0.03	1.27	0.03	1.39	0.03	5	10
COD (ppm)	48	37	42	57	57	43	48	43	1000	1500