From Wastewater to Strategic Resources: Industrial-Scale Metal Recovery for Electrochemical Surface Treatment

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Abstract

The transition of electrochemical surface treatment towards more sustainable and resource-efficient models requires rethinking how metal-rich wastewater is managed. Conventional wastewater treatment schemes, while effective for regulatory compliance, remain largely disposal-oriented, increasingly complex to operate with modern bath formulations, and result in the permanent loss of valuable metals.
Circular Materials addresses this challenge through RECOVER-IT, an industrial project structured around a centralized recovery-services hub model, recently recognized as a Strategic Project by the European Commission under the Critical Raw Materials Act (CRMA), providing off-site, service-based recovery of Critical and Strategic Raw Materials from industrial wastewater generated by galvanic and electrochemical surface treatment processes.
The presentation will first highlight the technical and operational limitations of current wastewater management practices in surface treatment, including variability of waste streams, volatility of disposal costs, increasing regulatory pressure, and limited recovery options within conventional physico-chemical treatment lines. An alternative, recovery-oriented service model based on Supercritical Water Precipitation (SWaP™) will then be introduced. SWaP is a proprietary technology operated by Circular Materials within its own industrial facilities, enabling the efficient recovery of metals such as nickel (Ni), copper (Cu), chromium (Cr), and platinum group metals (PGMs) across a wide range of concentrations and complex wastewater compositions, where traditional treatment approaches reach their limits, as demonstrated by industrial applications across multiple surface treatment sectors.
RECOVER-IT has progressed from industrial pilot validation at CMH0 in Padova (Italy) to industrial deployment through the development of CMH1, Circular Materials first industrial-scale recovery hub in Northern Italy, planned to be fully operational in 2027. CMH1 is designed to treat up to 20,000 tonnes per year of metal-rich industrial wastewater and represents a new model for centralized, outsourced metal recovery services, minimizing disposal and re-introducing recovered metals into industrial value chains.

Selected industrial case studies will be presented across key application sectors including General Manufacturing, Corrosion Protection & Functional Coatings, PCB and Electronics, Defense and Aerospace, Semiconductor Manufacturing, and Pharmaceutical & API production, illustrating how recovery-based wastewater management services can reduce environmental impact, improve operational resilience, and contribute to European raw material security.