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Optimization of the Co-Precipitation of Industrial Waste Metals in a Continuous Reactor System

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Abstract : A continuous copper precipitation treatment (CCPT) system was conceived at Intel Chandler Site to serve as a first-of-kind (FOK) facility-scale waste copper (Cu), nickel (Ni), and manganese (Mn) co-precipitation facility. The process was designed to treat highly variable wastewater discharged from a substrate packaging research factory. The paper discusses metals co-precipitation induced by internal changes for manufacturing facilities that lack the capacity for hardware expansion due to real estate restrictions, aggressive schedules, or budgetary constraints. Herein, operating parameters such as pH and oxidation reduction potential (ORP) were examined to analyze the ability of the CCPT System to immobilize various waste metals. Additionally, influential factors such as influent concentrations and retention times were investigated to quantify the environmental variability against system performance. A total of 2,027 samples were analyzed and statistically evaluated to measure the performance of CCPT that was internally retrofitted for Mn abatement to meet environmental regulations. In order to enhance the consistency of the influent, a separate holding tank was cannibalized from another system to collect and slow-feed the segregated Mn wastewater from the factory into CCPT. As a result, the baseline influent Mn decreased from 17.2<u>+</u>18.7 mg¹L⁻¹ at pre-pilot to 5.15<u>+</u>8.11 mg¹L⁻¹ post-pilot (70.1% reduction). Likewise, the pre-trial and post-trial average influent Cu values to CCPT were 52.0<u>+</u>54.6 mg¹L⁻¹ and 33.9<u>+</u>12.7 mg¹L⁻¹, respectively (34.8% reduction). However, the raw Ni content of 0.97<u>+</u>0.39 mg¹L⁻¹ at pre-pilot increased to 1.06<u>+</u>0.17 mg¹L⁻¹ at post-pilot. The average Mn output declined from 10.9<u>+</u>11.7 mg¹L⁻¹ at pre-pilot to 0.44<u>+</u>1.33 mg¹L⁻¹ at post-pilot (96.0% reduction) as a result of the pH and ORP operating setpoint changes. In similar fashion, the output Cu quality improved from 1.60<u>+</u>5.38 mg¹L⁻¹ to 0.55<u>+</u>1.02 mg¹L⁻¹ (65.6% reduction) while the Ni output sustained a 50% enhancement during the pilot study (0.22<u>+</u>0.19 mg¹L⁻¹ reduced to 0.11<u>+</u>0.06 mg¹L⁻¹). pH and ORP were shown to be significantly instrumental to the precipitative versatility of the CCPT System.

Keywords : copper, co-precipitation, industrial wastewater treatment, manganese, optimization, pilot study
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