

knowledge base

Lab Project at **RWZI Zwolle**

Phosphate removal using CIWI-Fe product produced by CIWI-ME Lab system to demonstrate potential of the technology.



 RWZI Zwolle

Type project Lab project

Sector Sewage treatment

Application P-removal

Lab project at RWZI Zwolle

Objective

Phosphate removal using CIWI-Fe product produced by CIWI-ME Lab system to demonstrate potential of the technology.

Plant Overview

RWZI Zwolle is a large municipal wastewater treatment plant operated by Waterschap Drents Overijsselse Delta, treating sewage from Zwolle and surrounding municipalities before discharge into the IJssel. It has a biological capacity of ~180,000–200,000 population equivalents and a hydraulic capacity of about 5,500 m³/h, making it one of the larger RWZIs in the eastern Netherlands. The site is notable for its centralised sludge treatment and anaerobic digestion, producing biogas and functioning as an energy-neutral/energy-positive “energy factory”, supplying electricity beyond its own demand.

Sampling notes & limitations

Influent water from WTP Zwolle was collected on 17 January 2025, downstream of the pre-settling step. At the time of sampling, the phosphate concentration was 11.2 mg P/L. For practical reasons, biologically treated water, normally used for chemical phosphorus polishing at the plant, was not available for sampling. Instead, tests were performed on influent water, which is not part of RWZI Zwolle’s standard operational dosing strategy. It should be mentioned that this would not be a full replication of the full-scale RWZI process configuration (including stage separation, sludge recirculation and on-site chemical dosing points), as biological processes were not simulated.

Nevertheless, the results provide a practical indication of phosphate removal performance with CIWI-Fe under controlled conditions. Different coagulant H⁺/Fe-ratios were tested using acid (HCl), varying in product acidity and iron speciation and so affecting phosphate binding and floc formation. Varying the H⁺/Fe-ratio allows to identify a practical operating window that achieves the required P-removal while limiting unnecessary acid addition (and associated chloride load and pH impact).

Custom-made dosing for P-removal

The Procedure

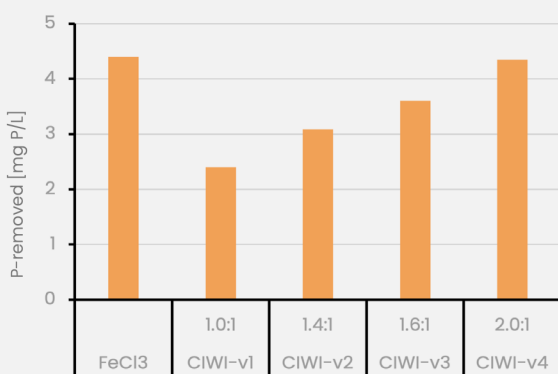
A fixed process condition was selected for CIWI's lab system; pH and salt matrix were fixed, and the formed product was tested for Fe content using HACH cuvette kits (LCK 321). The formed product was conditioned to enable phosphate removal; in these experiments this was achieved by HCl dosing to CIWI-Fe to reach a target H⁺/Fe ratio. Based on the determined Fe content, product was dosed to 200–400 mL beakers in a flocculator setup. CIWI-Fe or FeCl₃ was dosed to the beaker containing water from the selected RWZI to achieve the desired Fe dose (4–10 mg Fe/L).

The general procedure followed a standard jar-test approach: dosing during rapid mixing (200 rpm), followed by medium-intensity mixing (50 rpm) for 2 minutes and slow mixing (10 rpm) for 15 minutes. After 15–30 minutes of settling, supernatant samples were taken for phosphate analysis. HACH kits (LCK 348 & 349) were used to determine PO₄-P concentration, samples were diluted when necessary.

The Result

Results for a range of Fe dosages (4, 7 and 10 mg Fe/L) showed the similarities in P-removal by FeCl₃ and CIWI-Fe 1.6:1 and 2:1 (FeCl_{2.1} and FeCl_{2.5}-equivalents). These results seem to indicate that earlier differences in MEP results might have been the consequence of a faulty experiment (10 mg Fe for 1.6:1 seems to be off-trend). Near-similar removal to FeCl₃ could already be achieved by a CIWI-Fe 1.6:1 product.

Data P-removal at different H⁺/Fe ratios



Data Phosphate removal by Fe dosing

