

knowledge base

Lab Project at **RWZI Leiden**

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



RWZI Leiden

Type project Lab project

Sector Sewage treatment

Application P-removal

Lab project at RWZI Leiden

Objective

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

Plant Overview

RWZI Leiden Zuid-West is a municipal wastewater treatment plant operated by Hoogheemraadschap van Rijnland. According to publicly available sources, the plant was built in 1992 and is described as an ultra low-loaded activated sludge installation. The reported design population equivalent (p.e.) is 126,000 p.e. (at 136 g COD/p.e./day) / 114,240 p.e. (at 150 g COD/p.e./day), and the reported peak hydraulic capacity is 4,400 m³/h.

The water line typically includes mechanical pre-treatment (coarse/fine screening and grit removal), followed by primary clarification (where present), biological treatment based on activated sludge (aeration), and secondary clarification (final settling) prior to discharge. Iron chloride dosing is applied for (additional) phosphate removal. The sludge line typically includes excess sludge withdrawal from the biological stage, thickening and mechanical dewatering, and handling of reject water streams back to the head of the works.

Sampling notes & limitations

Influent water of RWZI Leiden Zuid-West, post-sieve, was collected on the 3rd of March 2025. The phosphate influent concentration was 5.8 mg P/L. For convenience and sample availability, sieved influent water was used. 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

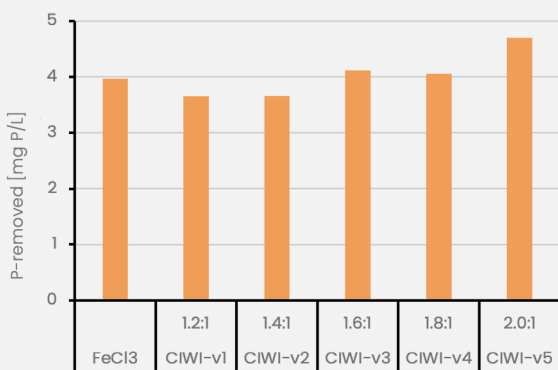
A fixed process condition was selected for CIWI's lab system; pH and salt matrix were fixed, and the formed product was tested for Fe content using HACH cuvette kits (LCK 321). The formed product was conditioned to enable phosphate removal; in these experiments this was achieved by HCl dosing to CIWI-Fe 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

The effectiveness of the CIWI-Fe product for the removal of phosphate was investigated. Results showed that similar P-removal to FeCl₃ (mg PO₄-P/L removed) could be achieved by CIWI-Fe dosing for a product with a H⁺/Fe-ratio of 1.6:1. Lower H⁺/Fe-ratio's resulted in slightly lower P-removal. The ideal ratio of 1.6 had a chloride-load equivalent to FeCl_{2.1} (with FeCl_{0.5} from the original product and FeCl_{1.6} by the HCl dosing). 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 products. Near-similar removal to FeCl₃ could be achieved by both CIWI-Fe, 1.2:1 and 1.6:1, products.

Data P-removal at different H⁺/Fe ratios



Data Phosphate removal by Fe dosing

