

knowledge base

# Lab Project at **RWZI Alkmaar**

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



**RWZI Alkmaar**

**Type project** Lab project

**Sector** Sewage treatment

**Application** P-removal

# Lab project at RWZI Alkmaar

## Objective

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

## Plant Overview

**RWZI Alkmaar** is a municipal wastewater treatment plant operated by Hoogheemraadschap Hollands Noorderkwartier (HHNK). The installation treats wastewater from Alkmaar and surrounding municipalities before discharge to regional surface waters in North Holland. The plant has a reported biological capacity of 97,000 population equivalents (i.e.) and a hydraulic peak capacity of 2,000 m<sup>3</sup>/h (peak wet-weather flow).

The treatment train comprises headworks (screening and grit removal), primary clarification, activated sludge treatment (aeration) and secondary clarification; the sludge line includes thickening and anaerobic digestion, followed by dewatering for off-site processing.

## Sampling notes & limitations

Influent water of RWZI Alkmaar, as direct influent, was collected on the 20th of February 2025. The phosphate influent concentration was 14.6 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<sup>+</sup>/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<sup>+</sup>/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

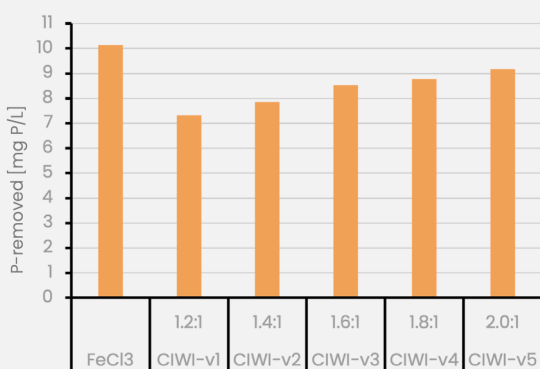
A fixed process condition was selected for CIWI's lab system; pH and salt matrix were fixed, and the formed product was tested for Fe content using HACH cuvette kits (LCK 321). The formed product was conditioned to enable phosphate removal; in these experiments this was achieved by HCl dosing to CIWI-Fe to reach a target H<sup>+</sup>/Fe ratio. Based on the determined Fe content, product was dosed to 200–400 mL beakers in a flocculator setup. CIWI-Fe or FeCl<sub>3</sub> 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 PO<sub>4</sub>-P concentration, samples were diluted when necessary.

## The Result

Comparative results at 10 mg Fe/L showed that the P-removal (mg PO<sub>4</sub>-P/L removed) for CIWI-Fe was lower than the P-removal of FeCl<sub>3</sub>. For a CIWI-Fe product with a H<sup>+</sup>/Fe-ratio of 1.6:1, a chloride-load equivalent of FeCl<sub>2.1</sub> (with FeCl<sub>0.5</sub> from the original product and FeCl<sub>1.6</sub> by the HCl dosing) could be obtained. Results for a range of Fe dosages (4, 7 and 10 mg Fe/L) showed the similarities in P-removal by FeCl<sub>3</sub> and CIWI-Fe 1.4:1 and 1.8:1 (FeCl<sub>1.9</sub> and FeCl<sub>2.3</sub>-equivalents), aligning with earlier observations for other RWZI's. These results seem to indicate that earlier differences in P-removal results for 10 mg/L might not be representative. Near-similar removal to FeCl<sub>3</sub> was achieved at dosages of 4 and 7 mg Fe/L, which could indicate that a CIWI-Fe 1.4:1 product would be desirable for application at RWZI Alkmaar.

Data P-removal at different H<sup>+</sup>/Fe ratios



Data Phosphate removal by Fe dosing

