knowledge base

Lab Project at **RWZI Dokhaven**

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

CIWI

ciwi.earth

Lab project at **RWZI Dokhaven**

Objective

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

Plant Overview

RWZI Dokhaven (Rotterdam) is a large municipal wastewater treatment plant operated by Waterschap Hollandse Delta, treating sewage from a large part of Rotterdam before discharge into the Nieuwe Maas. The plant has a biological capacity reported around 540,000–622,000 population equivalents (i.e.) and a hydraulic capacity of approximately 9,100 m^3/h (ADWF) up to 19,000 m^3/h (PWWF). A distinctive feature of Dokhaven is that it is built fully underground and uses a compact two stage AB biological treatment concept: in the high loaded A stage organic matter is largely adsorbed to sludge (instead of oxidised) and chemical phosphate removal is applied (iron dosing), followed by settling; the low loaded B stage provides further removal and nitrification. Dokhaven is also known for nitrogen removal innovation projects (e.g., mainstream anammox research) and the presence of SHARON/Anammox rejectwater treatment in the broader Dokhaven/ Sluisjesdijk setup.

Sampling notes & limitations

Influent water of RWZI Dokhaven (direct influent) was collected on 19 February 2025. At the time of sampling, the phosphate concentration was 4.23 mg P/L. In the full-scale Dokhaven process, iron sludge is recirculated and fresh FeCl3 is continuously/periodically dosed to this recirculation stream to maintain phosphate removal performance. 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

Custom-made **dosing** for P-removal

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).

CIWI

knowledge base

The **Procedure**

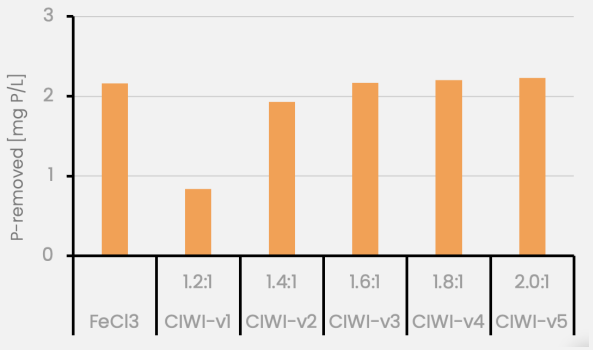
A fixed process condition was selected for CIWI's lab system; pH and salt matrix were fixed, and the formed product was tested for Fe content using HACH cuvette kits (LCK 321). The formed product was conditioned to enable phosphate removal; in these experiments this was achieved by HCl dosing to CIWI-Fe 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 $FeCl_3$ 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_4-P concentration, samples were diluted when necessary.

The **Result**

Results showed that similar P-removal (mg PO_4-P/L removed) could be achieved by CIWI-Fe dosing for a product with a H+/Fe-ratio of 1.4:1. Lower H+/Fe-ratio's resulted in decreased P-removal. The ideal ratio of 1.4 had a chloride-load equivalent to $FeCl_{1.9}$ (with FeCl0.5 from the original product and $FeCl_{1.4}$ by the HCl dosing).

Data P-removal at different H+/Fe ratios



Data Phosphate removal by Fe dosing