Demo Case Update (1/2)

KWR – KWR WATER B.V.

Waternet – Wastewater Treatment Plant Amsterdam West

EURECAT – Technology Centre in Catalonia

22 november 2021

Waternet has dedicated one of the seven treatment lanes of the wastewater treatment plant (WWTP) Amsterdam West to investigate AI based process control strategies for energy optimization and N2O reduction using FIWARE system components for data exchange.

Researchers from KWR, Eurecat and Waternet have been working on influent data collection, training of the reinforcement learning (RL) agent for real-time control of the research lane, and development and deployment of near real-time soft sensors within the FIWARE system to estimate air flow, respectively. Furthermore, KWR has been working on training of an AI auto-encoder model for anomaly detection and correction of real-time ammonium and nitrate measurements.

This article is the first of a series of two articles.

Influent data collection

Currently the influent flow (forecast) is used as an indirect parameter to predict the organic- and nitrogen load going to the wastewater treatment. By adding real loads based on influent composition data to the environment model the AI based process control strategies are expected to improve. Influent measurements are not common practices in municipal wastewater treatment plants and they come with their own challenges. The first challenge is to provide a permanent sample flow to the analyzers as the required influent pre-screening tended to clog rapidly. Improvements, e.g. a backflush system, have been made to ensure a more permanent flow and will still require attention the coming time. The influent Total Organic Carbon (TOC), total nitrogen (TN), ammonium (NH4) concentration are measured to obtain the organic and nitrogen load and phosphate (PO4) is measured as a control parameter for the phosphorous removal. The TOC and TN analyses are performed directly on the (pre-settled) influent. This a new analyzer for Waternet, its performance is currently studied by a student, preliminary results are very promising and show that the measurements are similar to lab measurements. The ammonium and phosphate analyzers require particle free water, the influent should therefore be pre-treated. For this purpose an ultrafiltration membrane unit has been installed. Direct ultrafiltration of this type of wastewater has proven to be a challenge as well. Students are working on obtaining the right filtration and membrane cleaning settings to provide a permanent sample flow to the analyzers. Steady progress has been made on increasing the operation time of the membrane unit.

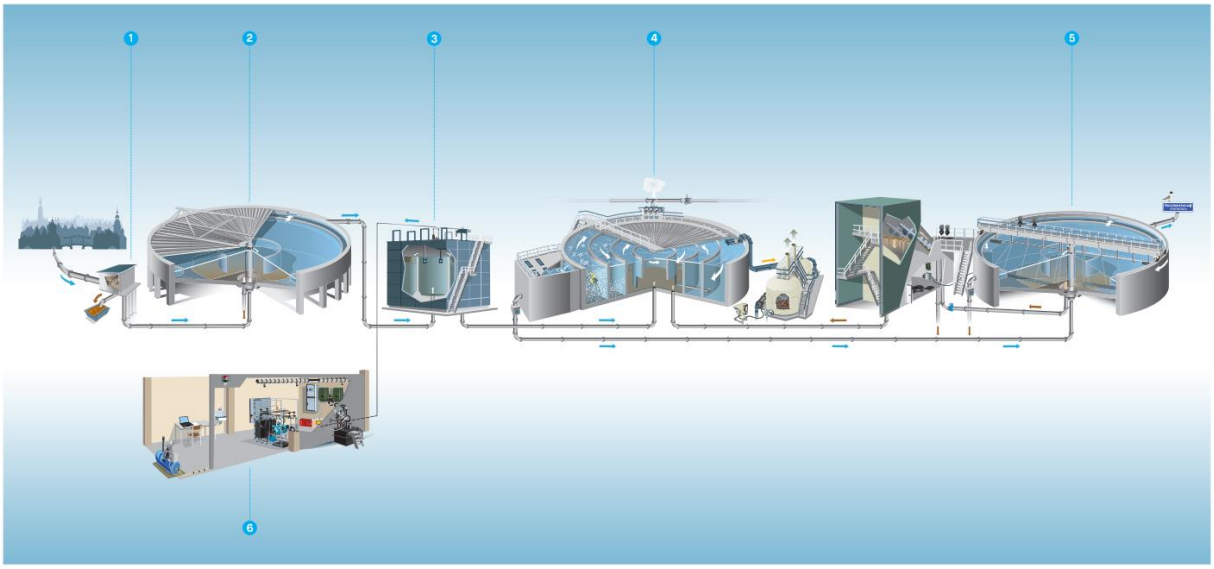

Figure 1 Overview of the research lane at wastewater treatment Amsterdam West, (3) the point from which wastewater is taken to the research room (6) where influent measurements are performed

Fiware implementation

The FIWARE setup consists of Docker containers with the Orion Context Broker, IoT Agent JSON, and Cygnus and are connected to a MongoDB and PostgreSQL database as well as a Grafana dashboard. The whole setup is connected to the Waternet legacy system and includes a soft sensor model. Currently, FIWARE runs continuously and near real-time, receiving the latest data of multiple sensors and actuators while running the AI soft sensor model. The soft sensor estimates the amount of air that is provided to the seven different treatment lanes, including the research lane. The next steps are to incorporate a Docker that can retrieve any process data of sensors, actuators and setpoints of the research lane to be used for smart apps within FIWARE and to implement the anomaly detection and correction AI model (cf next article).

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Project Consortium

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant agreement No. 821036.