LIFE DeNTreat DEMONSTRATION PLANT PERFORMANCE AND MANAGEMENT

THE LIFE DeNTreat Project

What is the problem?

Digital textile printing (DTP) has recently become a widely used printing technology in many European textile districts.

Although it brings certain environmental advantages, DTP requires dipping the entire fabric in urea, which is then completely washed out after printing and ends up as nitrogen residue in wastewaters. Certain European textile districts experience nitrogen-rich wastewater in concentrations not efficiently supported by the local wastewater treatment plants.

How can DeNTreat address the problem?

Life DeNTreat technology aims at reducing the amount of nitrogen content in urban wastewater in a sustainable and cost-efficient way using an on-site wastewater treatment module based on the anammox microbial process (PN/Anammox process).

DEMONSTRATION PLANT PERFORMANCE AND MANAGEMENT

Company and Wastewater Characteristics

The company prints fabrics mainly with digital textile printing (DTP) technology, with a minor proportion of textile printed in the traditional way. The prevalence of DTP leads to a decrease in the COD/N ratio and to a substantial increase in the nitrogen load discharged to the public sewer. At present, the concentration of nitrogen in the wastewater is higher than the regulatory limit of 100 mgN/l and the company obtained a specific derogation to be allowed to continue its activity.

The company only provides a partial equalization of the volumes discharged by all production processes, but does not provide any specific treatment.

The nitrogen that is discharged into the equalization tank is mainly in organic form, resulting from the use of urea, which is partially decomposed into ammoniacal nitrogen, by ureolysis that occurs spontaneously in the tank. In 2018, at the start of the Project, the COD/TKN ratio, was 6.4 but over time it decreased down to 4.7 gCOD/gTKN favouring the PN/Anammox process over the conventional nitro-denitro process. Another characteristic of the wastewater is that it has a rather low alkalinity, in spite of a high pH, around 8.5-9.3, which may lead to a scarcity of inorganic carbon, which is essential for the growth of autotrophic organisms. For some processes, the company uses quaternary amines and amines, substances recognized in the literature as biocides, which are subsequently found in the wastewater: the direct effects on the Anammox component are not yet known, but they have an inhibiting effect on the AOB organisms.

Plant Criticalities and Resolution

The main criticalities of the plant have been due partly to plant problems and partly to the composition of the wastewater. First of all, it has not been possible to get continuous data of ammonia and nitrate concentration, because the dedicated probes were installed on an external recycle circuit that caused degranulation of the biomass. In addition, these probes could not be installed directly in the reactor, not allowing the automatic control of the oxygen dosage, which had to be managed manually.

Another problem at the plant level is due to limitation in the oxygen transfer capacity, which was not sufficient for both nitritation and oxidation of the COD, especially due to the variation of the hydraulic head during the loading, reaction and unloading cycles. Also, the high variability of the chemical characteristics of the wastewater posed operational problems, mainly due to frequent scarcity of ammonia in input, the presence of inhibitors used in the processes and conditions of low concentration in the feed during shutdown periods.

Figure 1 – Demonstration plant

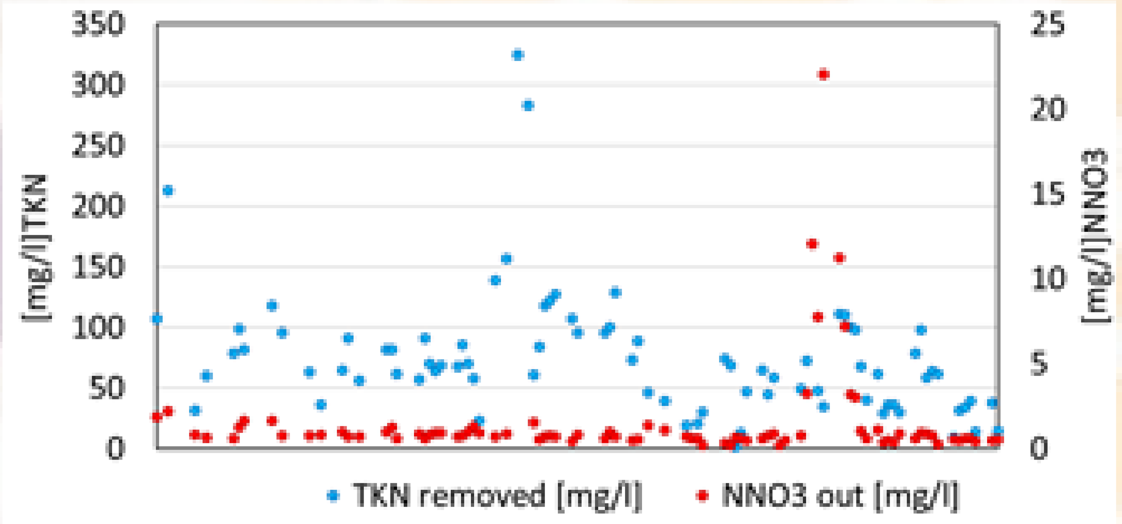

Figure 2 - TKN removed and nitrate concentration in the plant effluent

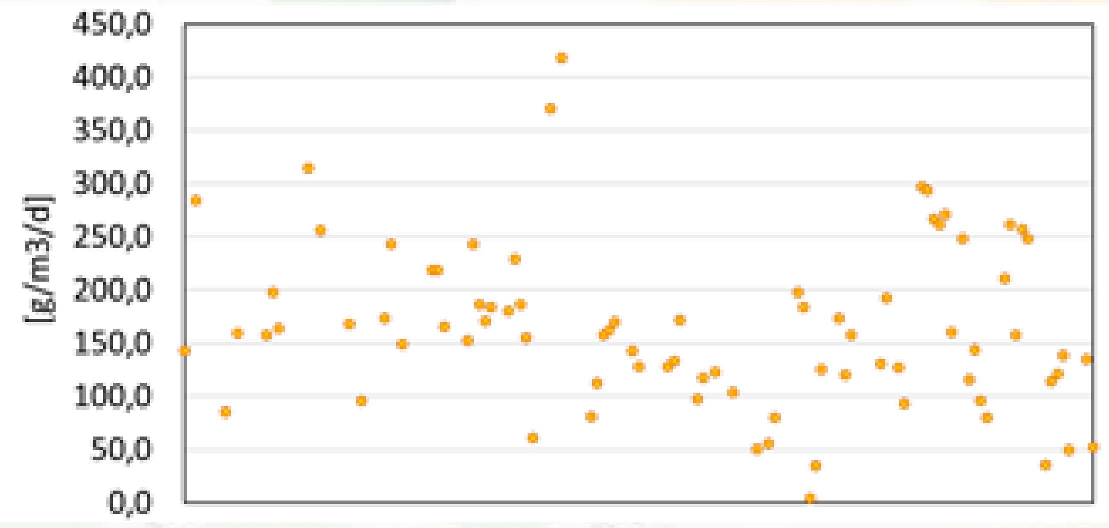

Figure 3 - Nitrogen Removal Rate

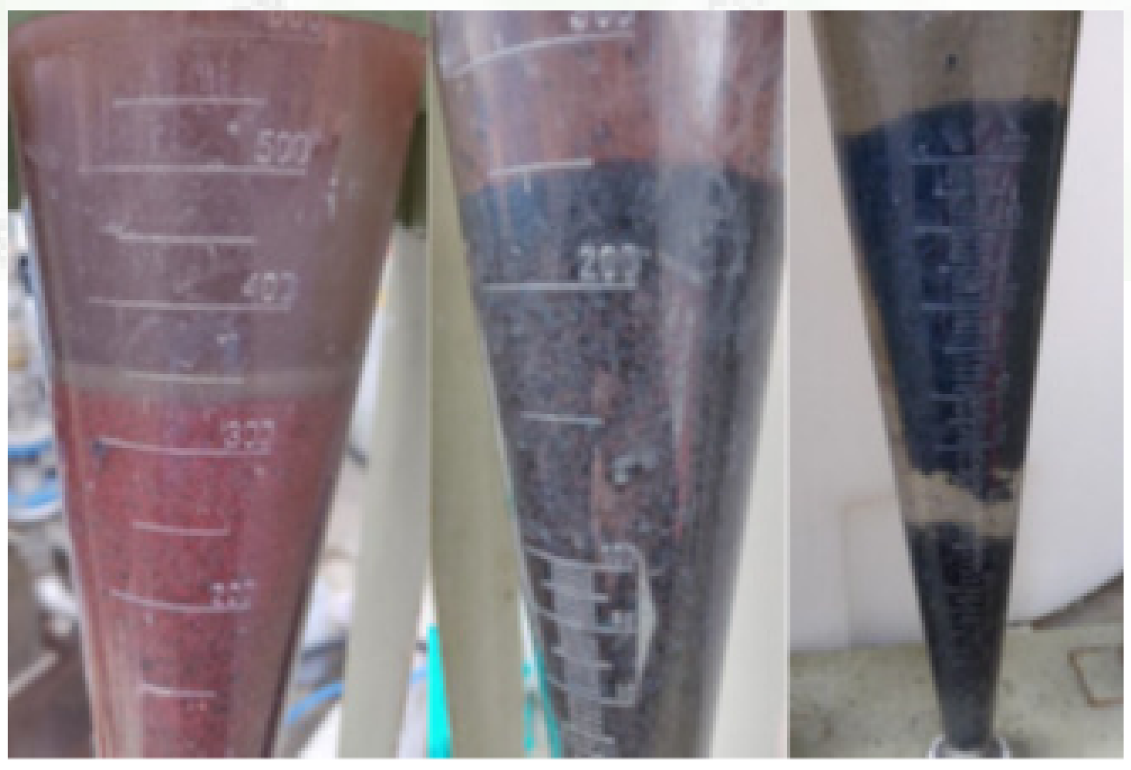

Figure 4 - Granular and flocculent biomass

Results

The issues encountered during the experimentation and the resolution strategies implemented led to several important results:

- Suppression of NOB biomass and excellent control on nitrate production: from September 2020, with new biomass inoculated and improved pH and DO control, the average nitrate concentration is 1.6 mg/l, with a peak of 25.7 mg/l. The ratio of NO3-N produced over TKN removed was 0.039±0.01 (figure 2)
- The average removal rates of TKN is 166 g/m3/d and the removal efficiency up to 85% (figure 2);
- If the ureolysis does not take place in the equalization tank, it was observed to take place without problems in the reactor and the recorded ureolysis rates were as high as 611 g/m3/d
- The granular biomass did not degranulate, despite all the issues encountered, and thanks to the washout of flocculent biomass
- The COD removed inside the reactor was on average 260 mg/l, analysed on the filtered sample, with an average inlet concentration of 692 mg/l.

Conclusion

Thanks to the experimentation it is possible to state that the wastewater is treatable with the PN/Anammox process. However, its severe variations in the chemical-physical and toxicological characteristics determine a difficult operational stability, which requires a precise and careful process control. The project made it possible to identify all the countermeasures to all the critical issues encountered, for which the “after plan” has a good chance of success. In fact, we have registered the interest of some companies for the implementation of the process in their specific cases. It was a complex job but it was very useful to learn lessons for all the aspects highlighted.

Project Coordinator

LARIANA DEPUR s.p.a.

Project Partners

EURATEX THE EUROPEAN APPAREL AND TEXTILE CONFEDERATION

SCR STAMPERIA DI CASSINA RIZZARDI

citeve TECNOLOGIA TÊXTIL

POLITECNICO MILANO 1863

The project has received funding from European Union´s LIFE Programme under Grant Agreement LIFE16 ENV/IT/000345