
## THE CONTEXT

Digital Textile Printing (DTP) has drastically changed the way textiles are printed, and everything happened in the last ten years moving from large batches of standardized drawings to (up to) one square meter large lots, where every piece of the textile substrate may have different patterns and colours. Nowadays, in the Como textile district (and the same trend occurs in other European countries), more than 60% of the production volume is processed using DTP. DTP requires the fabric to be fully pre-treated using urea in order to let the ink properly penetrate. Urea is then completely washed-out and the resulting wastewater is extremely rich in nitrogen, remarkably overloading the existing wastewater treatment plants (WWTP).

## PREVIOUS LAB-SCALE ACTIVITIES

The project has been prepared by a long-term experimental activity (named "N-free printing") at Politecnico di Milano, funded by Lariana Depur and Comodepur, Como-based WWTP, which included the evaluation of AAO (anaerobic ammonia oxidizers) activity on DTP effluents from different factories and the operation of a lab-scale gas-lift SBR (12 L volume) treating a real DTP effluent. The results looked very promising with nitrogen removal efficiency of 85% at a loading of 1,38 gN L-1 d-1 as reported in a M.Sc. Thesis (https://www.politesi.polimi.it/handle/10589/123642).

## OBJECTIVE

LIFE DeNTreat aims at demonstrating an on-site wastewater treatment module meant to sustainably abate nitrogen pollutants from selected points of discharge in order to reduce nitrogen content of overall urban wastewaters, including those coming from DTP manufacturers.
The "Urban Waste Water Treatment Directive" (UWWTD-91/271/EEC) prompts the adoption of wastewater collection systems and treatment plants for all discharges of urban wastewater (a combination of domestic and industrial sewerage). Actually, wastewater characteristics are quite invariant with time, except when major changes occur in the served wastewater basin. That's what happened in the last 15 years in almost all the textile manufacturing districts due to the emergence of DTP, that currently accounts for 60% of textile printing in Como – Italy, 20% of Portuguese manufacturers, and an average 25% of the European textile printing industry. Even if economically and technically better than traditional printing, DTP is also responsible of an increase of more than 200% of nitrogen in wastewater, resulting in an increase of wastewater processing costs, N2O emissions, sludge volumes, and also inhibiting some WWTP from being compliant with regulations in force.

### LIFE DENTREAT WILL SUSTAINABLY ABATE THE N CONTENT FROM POLLUTING SOURCES RESULTING IN:

- a residual N content below 100 mg/l in the wastewater released in the collection system
- accomplishing Directive 91/271/EEC art.5 requirements asking to ensure that the minimum percentage of reduction of the overall load entering all urban WWTP in a given area is at least 75% of the total nitrogen produced
- respect of residual nitrogen concentration in WWTP discharges, to be maintained below 10 mg/l.

### WITH THE FOLLOWING IMPACTS:

- an actual saving of up to 40% in investment and operational costs in the treatment of N-rich wastewater
- a reduction of the N2O emissions during biological wastewater treatment to less than 20% of the currently adopted technologies
- a decrease of the sludge produced as a result of the nitrogen abatement process to less than 25% of the currently adopted technologies.

## CONCEPT OF THE PROJECT

The LIFE DeNTreat project is designed as a preliminary step before developing a PN/Anammox process operating at an industrial scale and aims at evaluating its environmental and economical performances. LIFE DeNTreat is actually a Demonstration project: PN/Anammox is new for the specific application context, but with a proven efficacy in other industries (e.g.: sewage sludge reject waters, landfill leachate, digested liquid fractions, food industry effluents). Criteria leading to prefer decentralised treatment rather than a centralised solution are the following;
1) the sewerage system where the industrial activities discharge their wastewater is a combined sewer, including industrial wastewater (around 50%, considering Lariana WWTP, 32% of them are rich in nitrogen), and domestic wastewater;
2) using a centralized system, during rain events storm-water overflows discharge a considerable amount of nitrogen. Considering the evolution of legislation, in the medium-long term the regulatory authority would not allow direct discharge of such wastewater to the sewer without any pre-treatment for nitrogen removal;
3) the high temperature of the wastewater (30 to 40°C) at the point of discharge allows high removal rates all through the year, while temperature of the wastewater at the central wastewater treatment plant can drop down to 14°C or sometimes to 8-10°C in winter. Moreover, wastewater from domestic origin would dilute nitrogen concentration by a factor of 2 to 5, thus worsening the process rate;
4) finally, applying Anammox in a centralized plant would require a complete revision of the existing biological process, in order to reach a COD/N ratio suitable for the Anammox process (<3).

## ACTIVITIES HAVE STARTED

• EURATEX defined a punctual questionnaire for textile company and interviews in Italy, Germany, Spain and Belgium have been proposed to selected textile companies.
• Socio-economic impacts assessment has started with some literature overview and contacts between partners. Unindustria Como (the industrial association in the Como area) has been contacted to organize a meeting on social impacts of the effluents from DTP processes and benefits deriving from applying the proposed technology.
• Biomass activity tests on AOB (ammonia oxidizing bacteria) and AAO are carried out by POLIMI. Samples will be also used as a feed to lab-scale pilot plant together with SCR equalized effluents. Later on, some samples (3 or 4) from Portuguese DTP discharge, as selected by CITEVE, will be processed to further test the technology.
• POLIMI, SCR and LARIANA performed the characterization analysis of the influent:

| | $COD_{TOT}$ | $COD_{FLT}$ | $BOD_5$ | $BOD_{20}$ | bCOD (estimate) | TKN | bCOD/TKN |
|---|---|---|---|---|---|---|---|
| | mg/l | | | | | | |
| Average | 828 | 727 | 224 | 366 | 396 | 195 | 2,09 |

analyses found also that the concentration of heavy metals (HMs) is lower than critic thresholds for inhibition of AOB and AAO.
• The plant has been designed and is now under construction.

## DEMONSTRATION PLANT DESIGN

The bioreactor (volume 13 m3) will treat 10 to 40 m3/d of the equalized flowrate from SCR. Designed inlet wastewater characteristics are as follows:

| | | |
|---|---|---|
| COD | 800 | mg/l |
| $BOD_5$ | 235 | |
| VSS | 64 | |
| TSS | 80 | |
| $NH_4$-N | 200 | |
| $N_{ORG}$ | 35 | |
| $NO_2$-N | 0 | |
| $NO_3$-N | 0 | |
| TKN | 235 | |
| $P_{TOT}$ | 2 | |
| DO | 0 | |
| pH | 9 | - |
| Temperature | 20 – 50 | °C |

The target of the demonstration plant is to achieve an effluent with < 50 mgNTOT/l (5%-ILE = 100 mgN/l) and < 0,6 mgN-NO2/l. Outlet wastewater will be discharged into SCR's sewage system and subsequently sent to the centralized LARIANA WWTP.

Isometric view of the demonstration plant site

The demonstration plant will be fully running starting from end of August 2018 and until end of the project.

## NETWORKING

Up to now we are in contact with two projects:

- LIFE14 ENV/ES/000633 (Spain) LIFE SAVING-E http://saving-e.eu/

- LIFE16 ENV/IT/000486 LESSWATT - https://www.lesswattproject.eu/it/

## PROJECT REFERENCES:

LIFE16 ENV/IT/000345

Locations:
- Como, Italy (Demonstrator installation site)
- Braga, Portugal
- Brussels, Belgium

Partners:

Project coordinator

LARIANA DEPUR S.p.A.

Project Partners

POLITECNICO MILANO 1863

SCR STAMPERIA DI CASSINA RIZZARDI

EURATEX THE EUROPEAN APPAREL AND TEXTILE CONFEDERATION

citeve TEXTILE TECHNOLOGY

Duration: 01-JUL-2017 to 30-JUN -2020 -
Total project budget: € 1,391,893 - www.life-dentreat.eu

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