

Decentralized innovative treatment of ammonium-rich urban wastewater

PROJECT PRESENTATION

LIFE DeNTreat INFO DAY

March 7th, 2019

SCR - Stamperia di Cassina Rizzardi



Life DeNTreat

LIFE16 ENV/IT/000345

The project stems from the need to develop sustainable solutions to deal with the problem of increasing nitrogen concentrations in industrial discharges of digital textile printing.

- ❑ Phase 1 preliminary study (10.2014 – 06.2015)
- ❑ Phase 2 continuous laboratory pilot plant (07. 2015 – 04.2016)
- ❑ Phase 3 Life project - demonstration plant (07. 2017 – 06.2020)

For the presentation of the proposal, the project had the support of Unindustria Como, Confindustria Lombardia, Sistema Moda Italia, Comodepur, Consorzio Alto Seveso and Livescia



Life DeNTreat OVERVIEW

| | |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Project Number: | LIFE16 ENV/IT/000345 |
| Title: | Decentralized innovative treatment of ammonium-rich urban wastewater |
| Acronym : | LIFE DeNTreat |
| Partners: | Lariana Depur SpA (IT, Coordinating Beneficiary) Politecnico di Milano (IT, Partner), Stamperia di Cassina Rizzardi SpA (IT, Partner) CITEVE - Centro Tecnológico Industrias Têxtil Vestuário Portugal (P, Partner) EURATEX - European Apparel and Textile Confederation (BE, Partner) |
| Duration: | 36 months |
| Starting date: | 1 st July 2017 |
| Conclusion date: | 30 th June 2020 |
| Total project budget: | € 1,391,893 |
| Project website: | www.life-dentreat.eu |

Project Coordinator



Project Partners



BUDGET

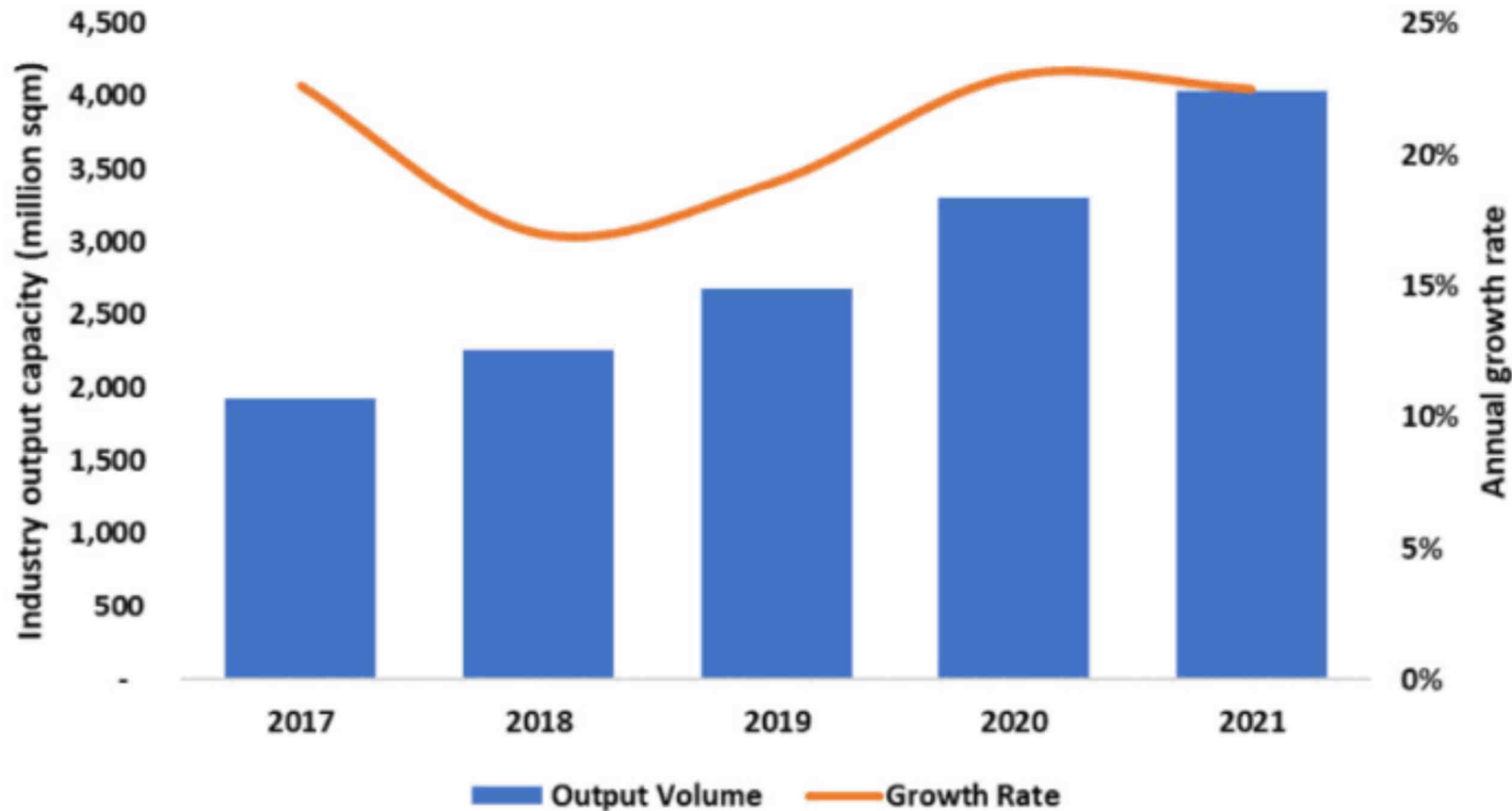
| Coordinating Beneficiary's contribution | | | | |
|------------------------------------------------|------------------------|-------------------------------------------------------|-------------------------------------|------------------------------------------|
| Country code | Beneficiary short name | Total costs of the actions in € (including overheads) | Beneficiary's own contribution in € | Amount of EU contribution requested in € |
| IT | LARIANA | 625,056 | 250,023 | 375,033 |

| Associated Beneficiaries' contribution | | | | |
|-----------------------------------------------|------------------------|-------------------------------------------------------|------------------------------------------------|------------------------------------------|
| Country code | Beneficiary short name | Total costs of the actions in € (including overheads) | Associated beneficiary's own contribution in € | Amount of EU contribution requested in € |
| PT | CITEVE | 100,371 | 40,149 | 60,222 |
| BE | EURATEX | 114,639 | 45,856 | 68,783 |
| IT | POLIMI | 363,729 | 145,492 | 218,237 |
| IT | SCR | 188,098 | 75,240 | 112,858 |
| TOTAL Associated Beneficiaries | | 766,837 | 306,737 | 460,100 |

| | | | |
|--------------------------------|------------------|----------------|----------------|
| TOTAL All Beneficiaries | 1,391,893 | 556,760 | 835,133 |
|--------------------------------|------------------|----------------|----------------|

BACKGROUND

Global growth of Digital Textile Printing



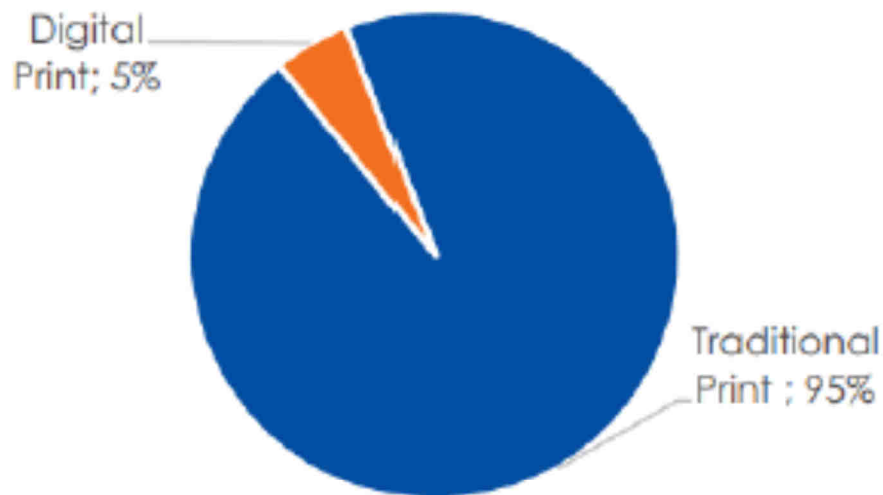
Source: Wtin, 2017

- In **2017** ,over **1.9 billion sqm** of fabric were digitally printed .
- The **annual growth rate** of digital textile textile printing is projected to **20 %** by volume through the period 2017 -2021.

BACKGROUND

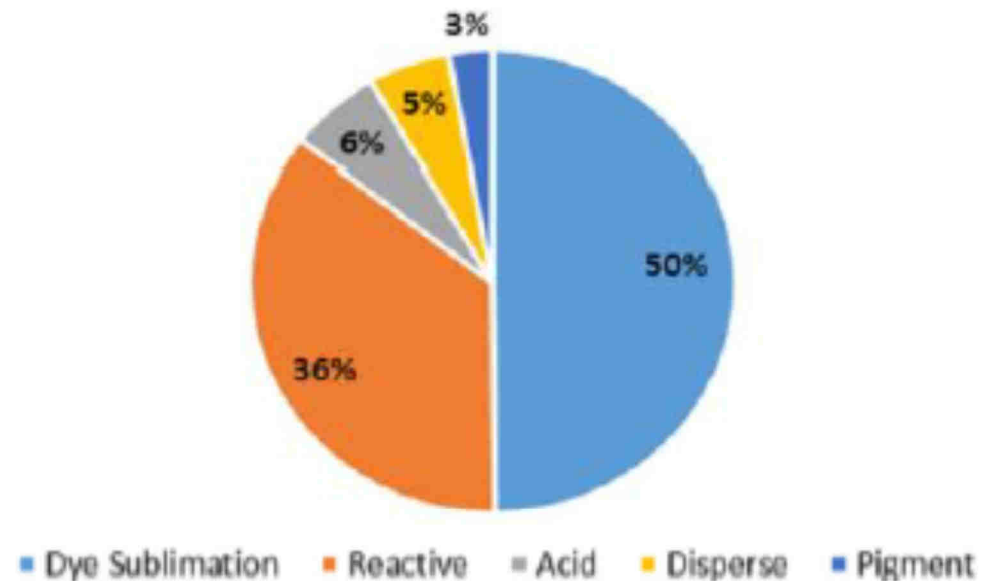
Global growth of Digital Textile Printing

Worldwide Printed Textile bn m2



Source : "Menderes , Infotrends Digital Textile Forecast 2017-2022

Digital textile inks - Global



Source: Wtin, 2017

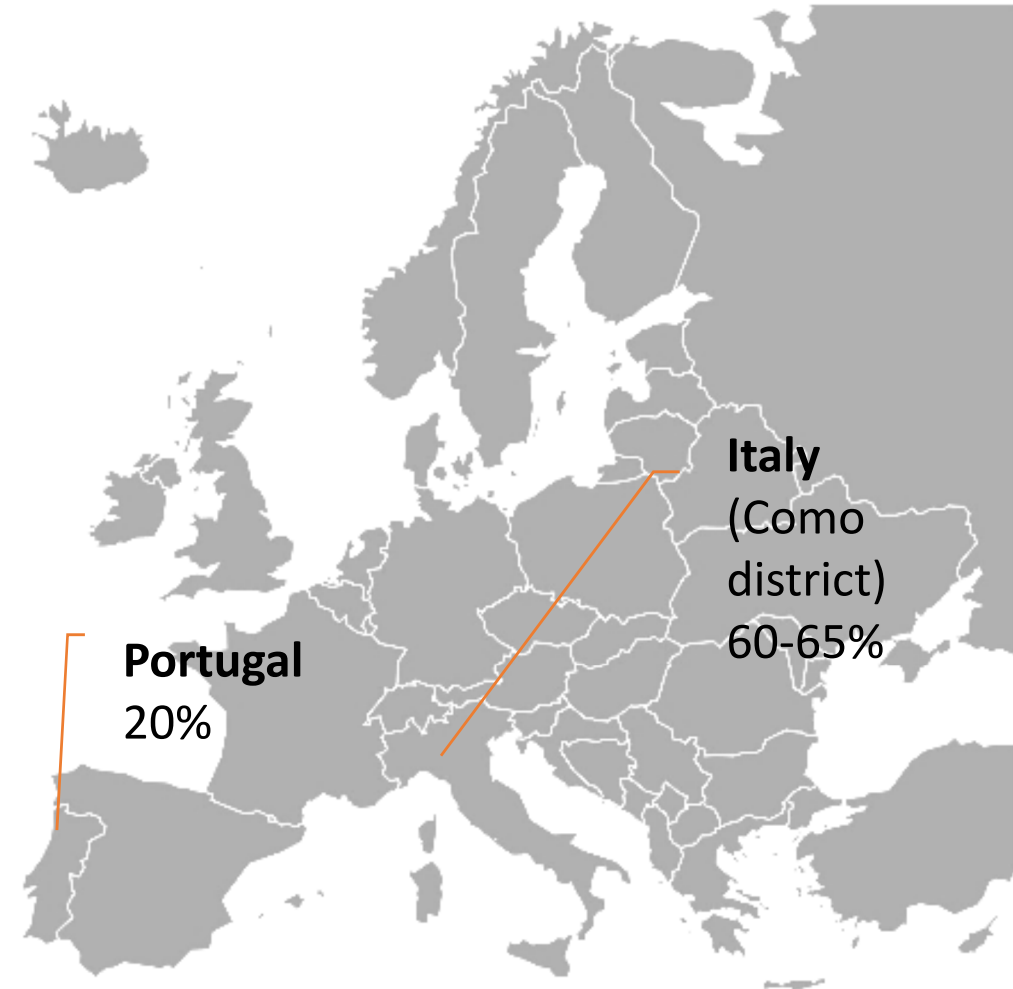
- Worldwide, digital textile printing has a **market share** of about **4-5%**.
- **Dye-sublimation ink** is the most consumed ink type, with a **50 % share** .
- **Reactive ink** follows with a **36 % share**.

BACKGROUND

Global growth of Digital Textile Printing

Digital textile printing growth in the last 15 years:

Average in Europe:
25%



BACKGROUND

Nitrogen: a new problem

Ink-jet printing requires a specific pre-treatment, where the reactive dye fixing agent carrier (urea) is applied

The specific pre-treatment with urea is applied to 100% all over of the textile material

Urea is then completely washed out after printing and fixation

Wastewater produced by DTP processes presents higher N concentration (in the forms of urea and ammonium)

Approximately 150 – 600 mg N/L

This increase correspond to an increase in nitrogen concentration in wastewaters of about 200%

THE PREVIOUS TARIFF

$$T_2 = F_2 + \{f_2 + dv + K_2 \left[\frac{O_i}{O_f} (db + Mdb + df + 1/3 df + Mdf) \right] + da + daN \} V$$

daN = cost coefficient of charges for the nitrogen treatment (0,03369 €/m³)

+

Fee per limit derogation (over 100 mgN/l) = 0,75 €/kgN

Wastewater with 200 mgN/l, 1.000 mg COD/l, 100 mgSST/l

Total tariff for ww treatment = 1,5809 + 0,075 = 1,6559 €/m³

Fee for N = 0,03369 + 0,075 = 0,10869 €/m³

Fee for N = 0,5435 €/kgN

THE NEW TARIFF

AEEGSI - DELIBERAZIONE 28 SETTEMBRE 2017 665/2017/R/IDR APPROVAZIONE DEL TESTO INTEGRATO CORRISPETTIVI SERVIZI IDRICI (TICSI), RECANTE I CRITERI DI ARTICOLAZIONE TARIFFARIA APPLICATA AGLI UTENTI

$$I_p^{ATO} = QF_p^{ATO} + QC_p^{ATO} + QV_p^{ATO} \cdot V_p$$

$$QV_p^{ATO} = If_{ind}^{ATO} + \max \left\{ 1; \left[\begin{aligned} & \%_{COD} \cdot \frac{COD_p}{COD_{rif}} + \%_{SST} \cdot \frac{SST_p}{SST_{rif}} + \%_N \cdot \frac{N_p}{N_{rif}} + \\ & + \%_P \cdot \frac{P_p}{P_{rif}} + \sum_j \%_{X_j} \cdot \frac{X_{j,p}}{X_{j,rif}} \end{aligned} \right] \right\} \cdot Id_{ind}^{ATO}$$

N_{rif} = 10 mg/l
%N = 15

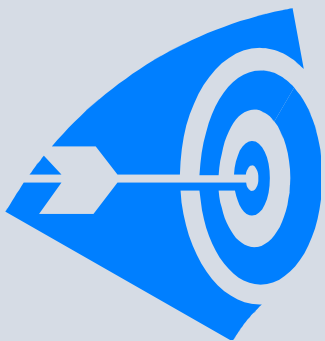
Wastewater with 200 mgN/l, 1.000 mg COD/l, 100 mgSST/l

Total tariff for ww treatment = 2,1166 €/m³ (+28%)

Fee for N = 0,9270 €/m³ (8,5 times the previous tariff)

Fee for N = 4.635 €/kgN (8,5 times the previous tariff)

PROJECT AIM



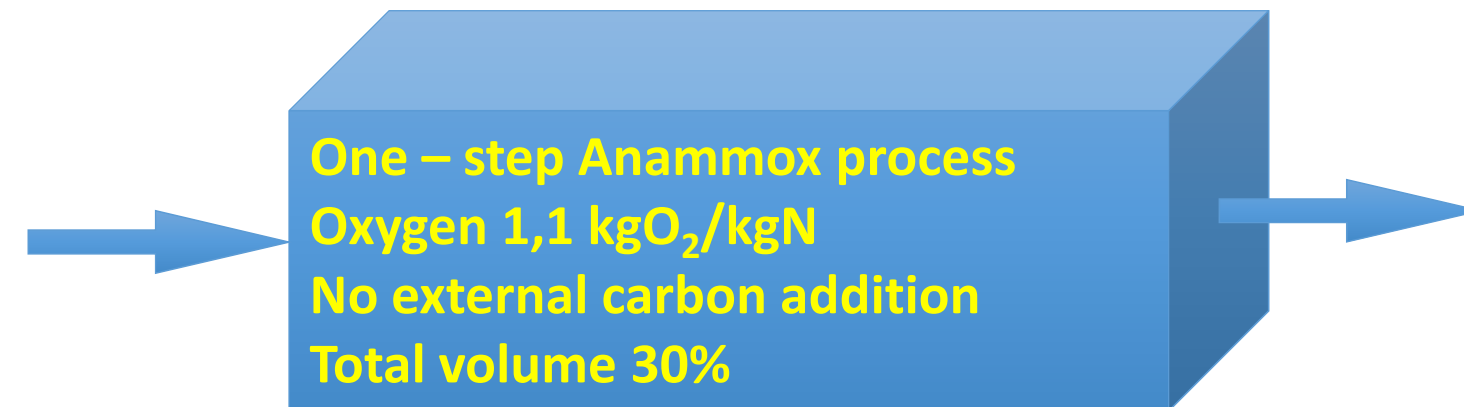
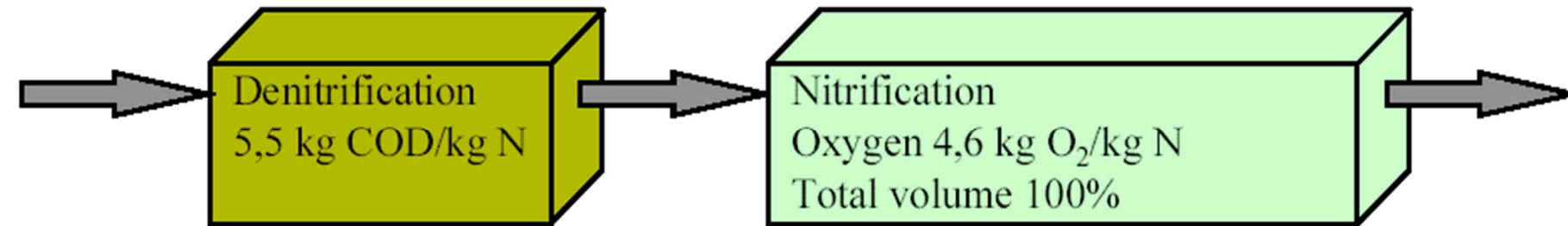
Life DeNTreat aims at demonstrating an **on site wastewater treatment module using Anammox** (Anaerobic AMMonium OXidation) technology to reduce nitrogen contents of wastewaters resulting from the **DTP process** and of overall urban ww

The Life DeNTreat technologies will allow to:

- obtain a residual N content below 100 mg/l in the wastewater released in the collection system
- easily accomplish 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% for total nitrogen produced
- assure the respect of residual nitrogen concentration in WWTP discharges, to be maintained below 10 mg/l enabling
- an actual saving of up to 40% in investment and operational costs
- a reduction of the N₂O emissions during biological wastewater treatment to less than 20% of the currently adopted technologies
- an abatement of the sludge produced as a result of the nitrogen abatement process to less than 25% of the currently adopted technologies.

PROBLEM:

cheap removal of N from N-rich wastewater



**Max conversion efficiency
= 88,8%**

Reduced volume

Opex reduction due to:

- ✓ Low O₂ consumption
- ✓ COD dosing absent
- ✓ Lower sludge production

MAIN ACTIVITIES AND TASKS

A PREPARATORY ACTIONS

A.1 Characterization of the addressed wastewater and requirements collection

B IMPLEMENTATION ACTIONS

B.1 Demonstration plant design and construction

B.2 Water treatment demonstration plant operation

B.3 Laboratory tests on digital textile printing company wastewater

B.4 Sustainability, transferability and replication of project results

C MONITORING OF THE IMPACT OF THE PROJECT ACTIONS

C.1 Environmental, social and economic impacts analysis

D PUBLIC AWARENESS AND DISSEMINATION OF RESULTS

D.1 Dissemination of project results

E PROJECT MANAGEMENT

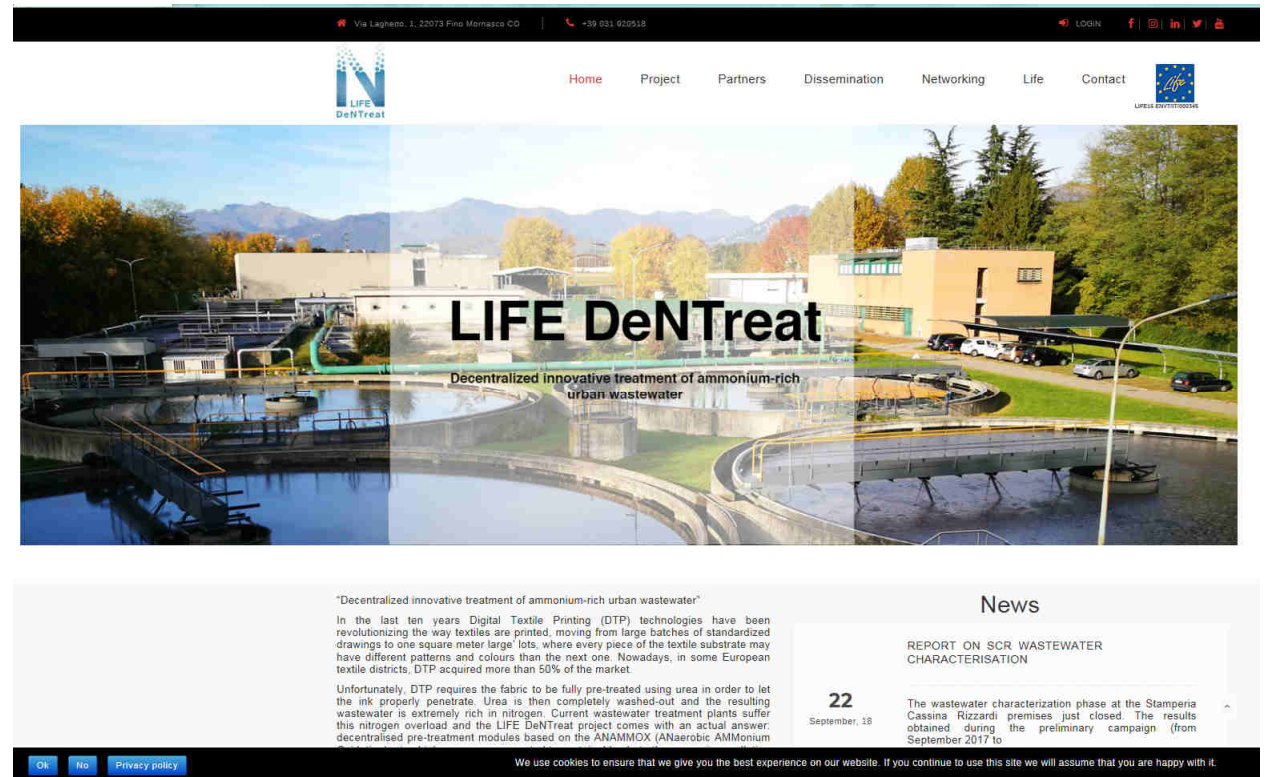
E.1 Management and reporting to the EC

E.2 After Life N-free

PUBLIC AWARENESS AND DISSEMINATION OF RESULTS

Website homepage

<http://www.life-dentreat.eu>



SocialNetworking&SocialMedia

Instagram: <https://www.instagram.com/lifedentreat/>

Youtube: https://www.youtube.com/channel/UCCxC2kkDoe3slGRd6eIfmHQ?disable_polymer=true

Linkedin: <https://www.linkedin.com/company/lifedentreat/>

Twitter: <https://twitter.com/LIFEDentreat>

Facebook: <https://www.facebook.com/LIFEDentreat/>

PUBLIC AWARENESS AND DISSEMINATION OF RESULTS

Newsletter

Newsletter n° 1 - 16/07/2018



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 jobs, 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 Comodapur, 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.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 wastewater, 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, even 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 efficiency 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 POLIM. 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.
- POLIM, SCR and LARIANA performed the characterization analysis of the influent.

| | COD _{TH} | COD _{CH} | BOD ₅ | BOD ₂₀ | bCOD | TKN | bCOD/TKN |
|---------|-------------------|-------------------|------------------|-------------------|------|-----|----------|
| | | | | | mg/l | | |
| Average | 828 | 727 | 224 | 366 | 396 | 195 | 2.09 |


analyses found also that the concentration of heavy metals (Pb, Cd) is lower than critical 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 of the equalized flowrate from SCR. Designed inlet wastewater characteristics are as follows:

| | 800 | |
|--------------------|---------|------|
| COD | 800 | |
| BOD ₅ | 235 | |
| VSS | 64 | |
| TSS | 80 | |
| NH ₄ -N | 200 | |
| N _{tot} | 35 | mg/l |
| NO ₃ -N | 0 | |
| NO ₂ -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 mgN/TOTA (5% NLE = 100 mgN/l) and < 0.6 mgN NO₂. Outlet wastewater will be discharged into SCR's sewage system and subsequently sent to the centralized LARIANA WWTP.

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 LESSWAT - <https://www.lesswatproject.eu/>

PROJECT REFERENCES:

LIFE10 ENV/IT/000340

Locations:

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

Partners:

Project coordinator:

LARIANA DEPUR

Project Partners:

SCR
SHAPER DI CASSA REZZACA

Politecnico di Milano

UNIVERSITA' DI CASSINO

citeve
TEXTILE TECHNOLOGY

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

CONTACT

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SUBSCRIBE TO OUR NEWSLETTER:
<http://www.life-dentreat.eu/contact-us/>

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

The project has received funding from European Union's LIFE Programme under Grant Agreement LIFE16 ENV/IT/000340

Sign Up
Newsletter
at the website

Thank you

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