

**Eco-friendly and energy efficient sewage SLUDGE deWaTeRing through  
novEl nanomAterials and elecTro-osmotic process**

# SLUDGEtreat

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**WP n °5 – Dissemination and means for long-term ToK**  
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Project Coordinator organisation name: **Politecnico di Milano**

Dissemination Level		
PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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## Table of Contents

1. Introduction.....	3
2. DISSEMINATION ACTIVITIES: 2014/2016.....	4
3.1 Year 2014/2015.....	4
3.2 Year 2015.....	5
3.3 Year 2016.....	6
3.4 Year 2017.....	8
3.5 Year 2018.....	10
3.6 FUTURE ACTIVITIES.....	12

## 1. Introduction

Several dissemination activities have been planned along the SLUDGETREAT Project period.

During the **first year** of the project, dissemination has been focused in the web pages of the different partners' institutions and some technological magazines. Moreover, during the visits of some wastewater treatment plants around the area of Milan (ITALY), the partners introduced the SLUDGETreat Project showing some detailed explanations and indications about sludge electro-dewatering. Later on, during the **second year**, when the first scientific results have been achieved, the partners have shown some of the preliminary results and attended some conferences. During the **third year**, partners have attended other conferences in Europe and published papers in some scientific journals.

## 2. DISSEMINATION ACTIVITIES: 2014/2016

### 3.1 Year 2014/2015

1. **WEB PAGE** of the SLUDGEtreat project was released some months after the starting of the Project. The web page explains the project from a scientific point of view and shows the workplan of each partner of the consortium. Moreover, dissemination activities, calls for recruitments of new researchers and contacts of the partner coordinators are reported.

LINK: <http://sludgetreat.eu/>

2. **PRESS NOTES** were released.

AIN-boletín: Technological magazine from AIN. *Boletín Tecnológico 66*, June 2015, Pages 16-17.

LINK: [http://www.ain.es/wp-content/archivos/boletin-AIN\\_TECH-20151.pdf](http://www.ain.es/wp-content/archivos/boletin-AIN_TECH-20151.pdf)

3. Links of the different **partners' institutions websites** where SLUDGEtreat Project is published:

- A.S.T: <http://www.astautomation.it/>
- FLUBETECH: <http://www.flubetech.com/flubetech-colabora-con-el-politecnico-de-milano/>
- POLIMI: <http://www.polimi.it/>
- AIN: <http://www.ain.es/tech/boletines-tecnologicos/>

4. **LINKS FOR THE RECRUITMENT to AIN:**

<http://seleccion.ain.es/detalle.asp?referencia=15027>

<http://rseq.org/empleo/ofertas-de-empleo/item/703-phd-experienced-technologist>

5. **LINKEDIN and other social networks of the partners and scientific people involved in the Project.**

<http://www.fabiodisconzi.com/open-fp7/projects/191799/index.html>

<https://www.linkedin.com/in/robertocanziani>

<https://www.linkedin.com/in/carles-colominas-464a0326>

<https://www.linkedin.com/in/aristide-stradi-026a8565>

<https://www.linkedin.com/in/cdiazjimenez>

<https://www.linkedin.com/in/ggfuentes>

## 3.2 Year 2015

### 1. SCIENTIFIC COMMUNICATIONS AND ATTENDED CONFERENCES

**Meeting name:** SMT 30 The 30<sup>th</sup> International Conference on Surface Modification Technologies

**Where:** Milan - Politecnico di Milano, ITALY

**When:** 29<sup>th</sup> June – 1<sup>st</sup> July, 2016

**Main topic:** Surface treatment

**Charged on:** Politecnico di Milano - CMIC/DICA

**Web site:** [www.smt30.org](http://www.smt30.org)

**Communication:** Evaluation of electrode surface treatments in sludge electro-osmosis dewatering.

**Abstract:** The drying of sludge produced by Wastewater Treatment Plants (WWTPs) is a very hard process due to the presence of the colloid fraction. Electro-osmosis could be a suitable technique to reduce the water content of the final sludge. Electric fields of 10 V/cm, 15 V/cm and 20 V/cm have been studied for electro-osmosis tests in a static or dynamic apparatus, obtaining a dry solids content up to 40-45%, with respect to 25-30% obtained by mechanical methods. In order to optimise the apparatus, the corrosion behaviour of the anodic material appears the main critical aspect, due to the high circulating current density. Moreover, wear may be detrimental for the surface of rotating electrodes. We then investigated the behaviour of materials used as electrodes mainly by evaluating the efficiency of the process and their surface aspect after treatment. The full understandings of the electrochemical reactions developed at the anode are a key factor for the material choice. We compared the efficiency and the corrosion resistance of anodes made of titanium MMO with respect to bare stainless steel (AISI 304) and stainless steel coated by PVD technique with TiN, AlTiN and DLC. Characterization of the anodes samples by roughness tests and by SEM, AFM and potentiodynamic tests, show that corrosion resistance of the DSA was the most suitable for our application. However, efficiencies of the electro-osmosis process for all the materials used have been found comparable, in terms of developed current densities and total energy consumptions, for short-test duration.

**Current status:** Attended with oral presentation

### 3.3 Year 2016

#### 1. SCIENTIFIC COMMUNICATIONS AND ATTENDED CONFERENCES

**Meeting name:** *Tecnologie ambientali innovative: rassegna ed esempi applicativi concreti*

**Where:** LIUC, Castellanza - ITALY

**When:** April 2016

**Charged on:** Politecnico di Milano - DICA

**Communication:** La disidratazione elettro-assistita dei fanghi di depurazione

**Current status:** Attended with oral presentation

**Meeting name:** *MM-Recupero di risorse negli impianti di depurazione*

**Where:** San Rocco WWTP, MILANO - ITALY

**When:** September 2016

**Charged on:** Politecnico di Milano - DICA

**Communication:** La disidratazione elettro-assistita dei fanghi di depurazione

**Current status:** Attended with oral presentation; a summary authored by Visigalli S., Gronchi P. and Canziani R., has been published on the Magazine "Servizi a Rete", issue Maggio-Giugno 2017, pages 91-92, Tecneditedizioni, Milan, Italy

**Meeting name:** *5<sup>th</sup> INTERNATIONAL CONFERENCE ON ADVANCES IN SUSTAINABLE SEWAGE SLUDGE MANAGEMENT*, The biodegradable waste in circular economy.

**Where:** Cracow - POLAND

**When:** 18<sup>th</sup> – 21<sup>st</sup> September 2016

**Main Topics:** Management of biowaste and other biodegradable waste according circular economy – resource recovery and by-products management; innovative technologies (wastewater, sewage sludge and biowaste); sustainability (energy balance, energy savings)

**Web site:** [www.assm2016.pl](http://www.assm2016.pl)

**Charged on:** DICA/Flubetech/AIN

**Communication:** Electro-osmotic dewatering of anaerobically and aerobically stabilised sludge

**Abstract:** Dewaterability of sludge produced by Wastewater Treatment Plants (WWTPs) is often poor, reaching less than 25% dry solids (DS). Electro-dewatering could be a suitable technique to reduce water content of the sludge by up to 20%. We investigated the parameters affecting pressure-driven electro-dewatering of anaerobically and aerobically stabilised, mechanically dewatered, sludge samples. The applied electrical fields have been set at 10, 15 and 20 V/cm in order to evaluate total energy consumption and final DS.

**Current status:** Attended with oral presentation

**Meeting name:** FILTECH The Filtration Event 2016

**Where:** Cologne - GERMANY

**When:** 11<sup>th</sup> – 13<sup>th</sup> October 2016

**Main topic:** Filtration & Separation tech. - All

**Web site:** [www.filtech.de/](http://www.filtech.de/)

**Charged on:** Politecnico di Milano - DICA/CMIC

**Communication:** Electro-osmotic dewatering of sewage sludge: preliminary results

**Abstract:** At present, the activated sludge process is the cheapest way to remove colloidal and soluble organic pollutants from sewage, but it produces a considerable amount of waste sludge, with a low dry solid (DS) content, rich in biodegradable organic substances. Therefore, it needs further processes to reduce its volume, by decreasing its water content, and to lower its polluting potential, due to its high content of biodegradable organic matter. Industrially, mechanical dewatering (centrifuge, filter press and belt press) increases the DS of sewage sludge up to 20- 25% to decrease transport and disposal costs. Electro-osmosis could be a suitable technique that can further reduce the water content of the dewatered sludge by the application of an electric field. Preliminary tests carried out by applying an electric field, from 10 to 20 V/cm, in a lab-scale device, confirmed the possibility to increase the final dry solid content (DSf) by 10% to 15% higher than the initial content, with a relatively low energy consumption if compared to thermal treatments. Here, we investigated the characteristics and properties of sludge that affect pressure-driven electro-dewatering. Sludge samples were taken from four different WWTPs around the city of Milan (Italy). First of all, we characterized the sludge samples by measuring capillary suction time (CST), time to filter (TTF) and the zeta potential of the filtered liquid fraction. Then, we measured the final solids percentage and energy consumption in a lab-scale device, under the application of an applied voltage of 15 V, at 3-bar pressure and tried to find a relation between the characteristics of sludge and DSf. Conditioned and thickened sludge samples reached  $\Delta$ DS between 8-17%. Results on mechanically dewatered sludge samples have shown an increase of DS content up to values around 14%, with a total primary energy consumption lower than the primary energy needed for thermal drying. This highlights the efficiency of electro-dewatering as a post dewatering treatment. Electro-dewatered sludge may self-sustain combustion at 850°C without any preliminary thermal drying. CST, TTF and zeta potential are not suitable predictors of the efficiency of the electro-dewatering process. A lab-scale test is necessary to assess the DSf that electro-dewatering can achieve.

**Current status:** Attended with oral presentation

## 3.4 Year 2017

### 1. SCIENTIFIC JOURNALS

**Journal name:** *Materials and Manufacturing Processes*

**Title:** Electrode surface treatments in sludge electro-osmosis dewatering

**When:** JANUARY 2017

**DOI:** 10.1080/10426914.2017.1279313

**Charged on:** Politecnico di Milano/FLUBETECH/AIN

**Current status:** Published

**Journal name:** *Environmental Research*

**Title:** Performance of electro-osmotic dewatering on different types of sewage sludge

**When:** MAY 2017

**DOI:** 10.1016/j.envres.2017.05.015

**Charged on:** Politecnico di Milano

**Current status:** Published

**Journal name:** *Journal of Environmental Chemical Engineering*

**Title:** Assessment of pressure-driven electro-dewatering as a single-stage treatment for stabilized sewage sludge

**When:** NOVEMBER 2017

**DOI:** 10.1016/j.jece.2017.11.034

**Charged on:** Politecnico di Milano

**Current status:** Published

### 2. ATTENDED CONFERENCES

**Meeting name:** *SLUDGETECH 2017*

**Where:** London - UNITED KINGDOM

**When:** 9-13<sup>th</sup> JULY 2017

**Web site:** <https://www.sludgetech.com/>

**Charged on:** Politecnico di Milano – DICA

**Communication:** Influence of sludge characteristics on pressure-driven electro-dewatering of stabilized sewage sludge

**Abstract:** The feasibility of the pressure-driven electro-dewatering (EDW) on aerobically and anaerobically stabilised sludge samples, taken from four different wastewater treatment plants around the metropolitan area of Milan (Italy), has been assessed. First, sewage sludges were characterized by measuring DS content, VS/DS ratio, pH, conductivity, zeta potential and capillary suction time (CST) of the liquid fraction. Then, after a preliminary centrifugation of the sludge samples in the laboratory, pressure-driven EDW tests have been performed in a lab-scale device, under the application of 300 kPa of pressure and an applied voltage of 15 V. The DS content increased up to 18.4-31.1%, (with an increase of 8.6% to 23.0% from the initial DS value) depending on the characteristics of the sludge samples and the polymer dosage. If compared with EDW tests,



the increase due to the sole effect of pressure ranged from 3 to 10% and strictly depended on polymer dosage. The characteristics of sludge that affect the increase of the DS content were investigated during both the pressure-driven stage and the EDW stage. Polyelectrolyte addition (4 and 8 g/kgDS) mainly affected the pressure-driven phase of the tests. However, the VS/DS ratio was the main factor affecting the pressure-driven stage on the unconditioned aerobically stabilised samples. CST values could also reliably predict the efficiency of this stage during experiments.

**Current status:** Attended with oral and poster presentation

- 3. WEB PAGE** of the SLUDGEtreat project was updated with the new partner of the Consortium X2 Solutions and the calls for the researchers recruitments of FLUBETECH and AIN.

LINK: <http://sludgetreat.eu/>

- 4. RESEARCHGATE** Project web page: <https://www.researchgate.net/project/Sludgetreat>

## 3.5 Year 2018

### 1. SCIENTIFIC JOURNALS

**Journal name:** *Ingegneria dell'Ambiente*

**Title:** La disidratazione elettro-assistita dei fanghi: influenza del dosaggio di polielettrolita e dei parametri operativi

**When:** MAY 2018

**Web site:** [http://www.ingegneriadellambiente.net/vol5\\_n1/2\\_IdA1-2018\\_Visigalli.pdf](http://www.ingegneriadellambiente.net/vol5_n1/2_IdA1-2018_Visigalli.pdf)

**Charged on:** Politecnico di Milano

**Current status:** Published

**Journal name:** *Journal of Cleaner Production*

**Title:** Environmental and economic assessment of electro-dewatering application to sewage sludge: a case study of an Italian wastewater treatment plant

**When:** JULY 2018

**Charged on:** Politecnico di Milano

**Current status:** Under Review

### 2. ATTENDED CONFERENCES

**Meeting name:** *Sludge Management in Circular Economy – SMICE 2018*

**Where:** Rome - ITALY

**When:** 23-25<sup>th</sup> May 2018

**Web site:** <https://smice2018.com/>

**Charged on:** Politecnico di Milano - DICA

**Communication:** Pressure-driven electro-dewatering applied for sludge: Economic & environmental life cycle assessment

**Current status:** Attended with oral presentation

**Meeting name:** *EcoSTP 2018*

**Where:** London, Ontario - CANADA

**When:** 25-27<sup>th</sup> June 2018

**Web site:** <http://conference.uwo.ca/ecoSTP2018/>

**Charged on:** Politecnico di Milano - DICA

**Communication:** The electro-dewatering of sludge: influence of the polyelectrolyte dosage and the operating conditions

**Current status:** Attended with oral presentation

**Meeting name:** *IFAT 2018*

**Where:** Messe München - GERMANY

**When:** 14-18<sup>th</sup> May 2018

**Web site:** <https://www.ifat.de/index-2.html>

**Charged on:** X2 Solutions Srl

**Communication:** Exhibitions of the EDW machine prototype

**Current status:** Attended in hall A.401

**Meeting name:** 32nd International Conference on Surface Modification Technologies - SMT32

**Where:** San Sebastián - SPAIN

**When:** 27-29<sup>th</sup> June 2018

**Web site:** <http://www.smt32.org/>

**Charged on:** AIN

**Communication:** A comparative study on the behavior of zr, ta, nb and hf coatings for electrode materials

**Current status:** Attended with oral presentation

3. **WEB PAGE** of the SLUDGEtreat project was updated - LINK: <http://sludgetreat.eu/>

4. **RESEARCHGATE** Project web page: <https://www.researchgate.net/project/Sludgetreat>

### 3.6 FUTURE ACTIVITIES

#### 1. SCIENTIFIC COMMUNICATIONS AND CONFERENCES

**Journal name:** *to be defined*

**Title:** Technical and economic assessment of an electro-dewatering system for sewage sludge: towards an innovative industrial application

**When:** SEPTEMBER 2018

**Charged on:** Politecnico di Milano

**Current status:** To be submitted

**Journal name:** *to be defined*

**Title:** Assessment of the corrosion behaviour of anodes coated with different materials exposed to harsh environments under oxygen evolution

**When:** November 2018

**Charged on:** Politecnico di Milano, AIN, Flubetech

**Current status:** Draft

**Meeting name:** Electrodewatering "2.0": a new frontier in sludge treatment technology

**Where:** Politecnico di Milano

**When:** February 2018

**Charged on:** Politecnico di Milano, AIN, Flubetech, X2 Solutions

The partners of the consortium are planning a detailed dissemination activity for the future months.