Laboratori
WALAB (Water, Wastewater and Waste treatment)
Sedimenti contaminati

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GIORNATA DI ORIENTAMENTO
SCUOLA DI INGEGNERIA

Firenze, 27 Ottobre 2014

Il gruppo di ricerca

Claudio Lubello e Piero Sirini - Professori

Riccardo Gori e Giulio Munz - Ricercatori

Cecilia Caretti, Mariangela Grassi e Giuseppe Cocchi – Collaboratori a progetto

Tommaso Lotti, Alberto Mannucci – Assegnisti

Giacomo Bellandi, Sara Sguanci, Laura Palli, Francesca Giaccherini – Dottorandi










Principali sedi di ricerca

UNALAB - Laboratorio congiunto tra UNIFI, Publiacqua SpA, Acque SpA. La sede è presso l'impianto di depurazione di S. Colombano.

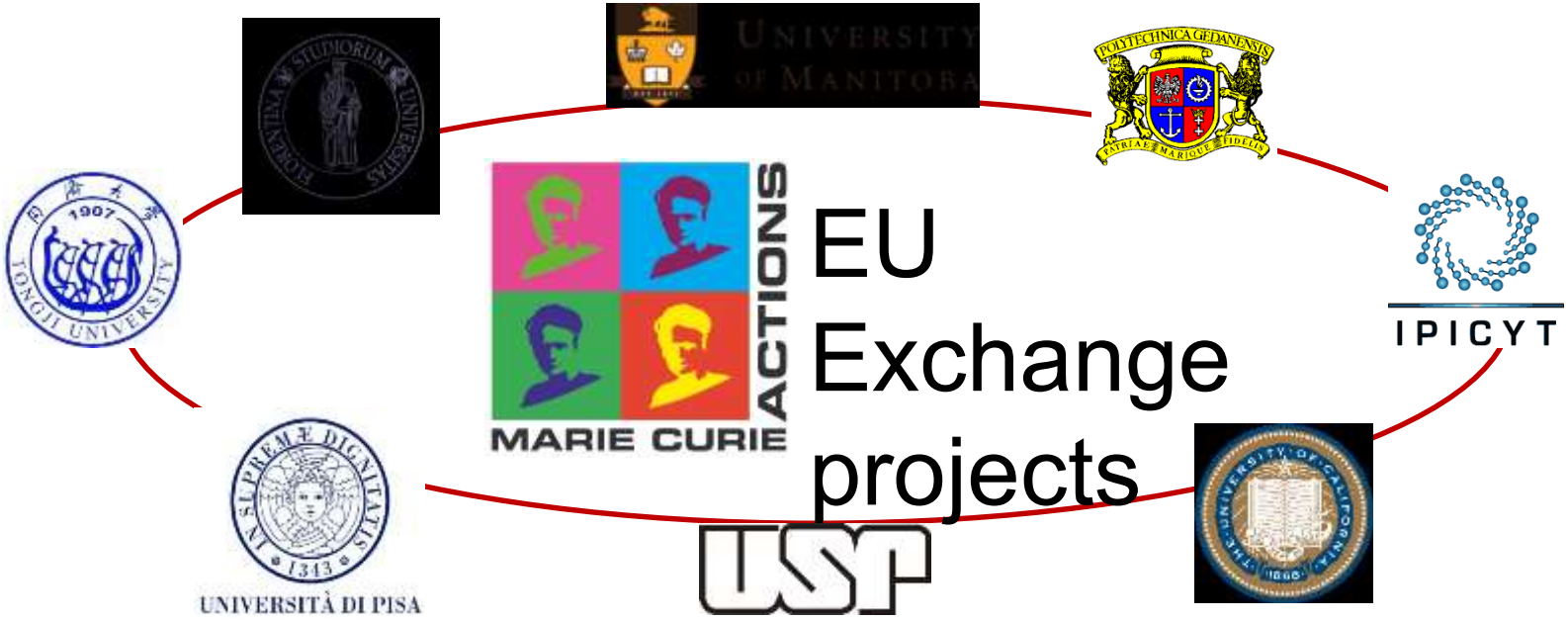
CER2CO - Laboratorio congiunto tra UNIFI e Cuoiodepur. Sede: c/o Impianto Cuoiodepur

GIDA SpA – Impianto di Baciacavallo e di Calice

Quadrifoglio SpA – Impianto di Case Passerini

Laboratorio presso la scuola di ingegneria nella sede di S. Marta

CARBALA PROJECT
Carbon Balancing for nutrient removal



Temi di ricerca

Applicazione di processi e tecnologie innovative a diverse scale:

- laboratorio;
- pilota;
- piena scala.

Temi di ricerca

- ✓ Rimozione dei nutrienti (Rimozione azoto da reflui concentrati per mezzo del processo SHARON-ANAMMOX)
- ✓ Sviluppo di processi biotecnologici innovativi
- ✓ Trattamento di acque di miniera
- ✓ Ottimizzazione dei processi di trattamento di acque e rifiuti
- ✓ Recupero di energia e materia dalle acque reflue e dai rifiuti
- ✓ Trattamento di effluenti gassosi (Rimozione solfuri e VOC da streams gassosi)
- ✓ Affinamento di reflui industriali ai fini del loro riutilizzo (processi di ossidazione avanzata, processi a membrana)
- ✓ Trattamento di reflui industriali (conciari, tessili, cartari, etc.)
- ✓ Recupero di energia e materia dalle acque e dai rifiuti
- ✓ Bonifica dei siti contaminati (rimozione dell'arsenico dalle acque)
- ✓ Trattamento dei residui della depurazione e dei trattamento dei rifiuti
- ✓ …

THE USE OF FUNGI IN BIOREMEDIATION

Non-specific Extracellular enzymes

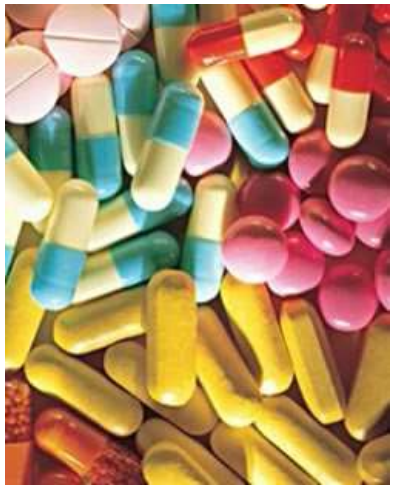
- ***Laccase***
- ***Lignin Peroxidase***
- ***Manganese Peroxidase***

Involved in the degradation and/or mineralization of:

- Olive mill wastewaters

- Textile dyes

- Pharmaceutical compounds



- Pesticides

PETROCHEMICAL WASTEWATER

- ✓ Batch and bioreactor tests on **petrochemical wastewater**
- ✓ Signficant COD removal after **combined treatment** with activated sludge
- ✓ Need of an **external growth substrate** (glucose or ligno-cellulosic material)

PHARMACEUTICALS DEGRADATION

Experiments conducted on:

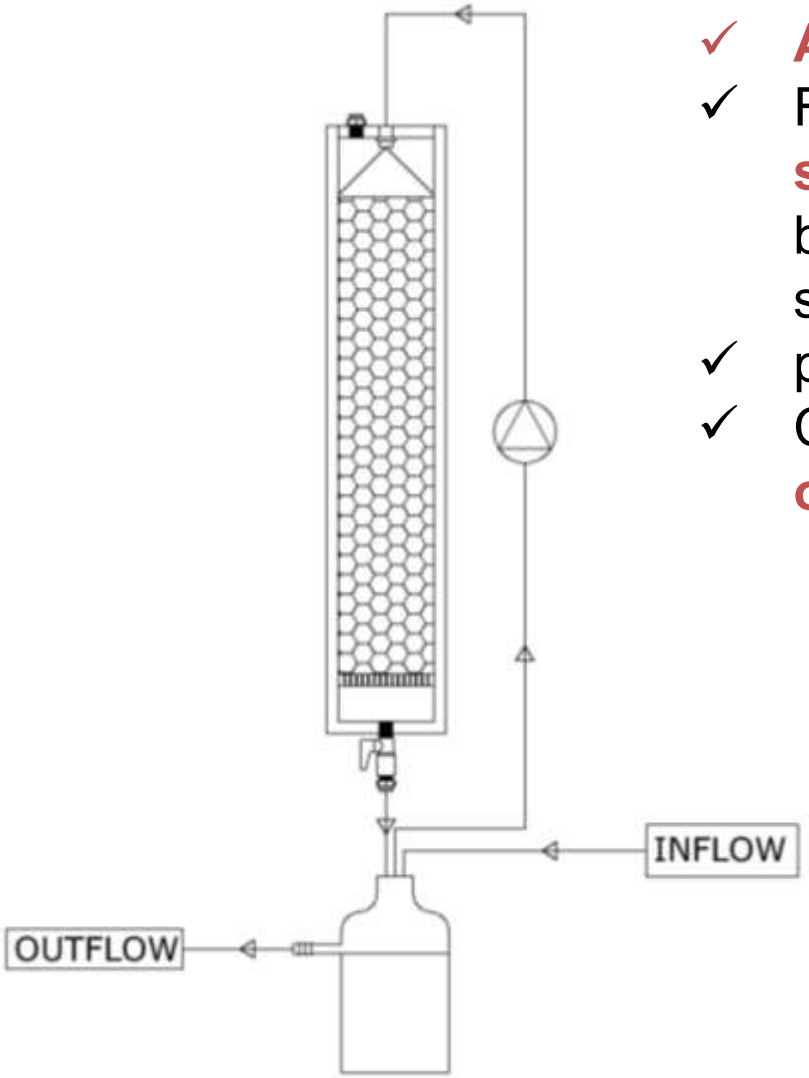
- ✓ ***Atenolol:*** beta-blocker, used for treatment of hypertension and some cardiac arrythmias
- ✓ ***Diclofenac*** : non-steroidal anti inflammatory, used as antirheumatic and analgesic
- ✓ ***Ketoprofen***: non-steroidal anti inflammatory, with analgesic and antipyretic action, used for treatment of rheumatoid arthritis and osteoarthritis

Tests conducted during a stay at the "Universitat Autònoma de Barcelona"

BIOREACTOR

- Pulsed-air bioreactor
- V=1.5L
- Biomass: 2.5 ÷3.5 g/L
- pH=4.5
- Carbon source: glucose
- HRT (in continuos process): 40h

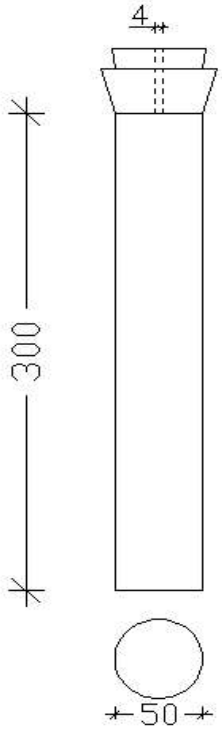
TRICKLING FILTER



- ✓ **Attached** biomass
- ✓ Filter bed made of **biodegradable supports** (e.g. *luffa cylindrica*), which acts both as physical support and growth substrate for fungi
- ✓ pH = **4.5 ÷ 5.5**
- ✓ Capture of reactor off-gas for **monitoring of fungal growth** by CO_2 production

THE BIOREACTOR

- ✓ **Packed** bed bioreactor
- ✓ Bed made of **straw**
- ✓ **Continuous** process
- ✓ HRT = **3 d**
- ✓ Influent **pH = 7**
- ✓ **Non-sterile** conditions
- ✓ Work time: **3 months**



Observed parameters:

- ✓ pH (daily)
- ✓ Lac and MnP production (daily)
- ✓ Polymers concentrations by HPLC (3 times/week)
- ✓ COD (weekly)
- ✓ bCOD (monthly)

INTRODUCTION

GRANULAR BIOMASS APPLICATION

- **Dense and strong microbial structure**
- **Excellent settleability**
- **High biomass retention**
- **Ability to withstand high organic loading rates**
- **Tolerance to toxic compounds**

AEROBIC

ANAEROBIC (ANAMMOX)

About 100 Tanneries located between Florence and Pisa

Salinity

Sulphide
180 – 350 mg/L

Suspended solids
4 –11 gTSS/L

High nitrogen content
300 – 450 mgN/L

High organic load
8 - 20 gCOD/L

Tannins

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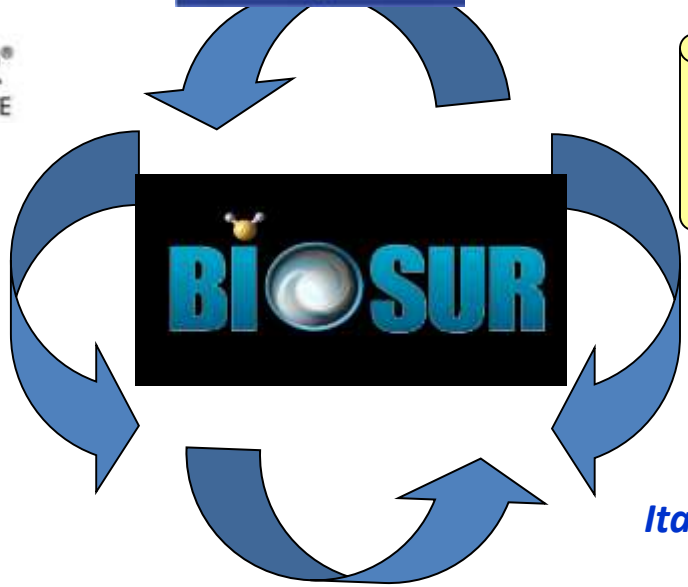
End user and demonstration site

CUOIODEPUR®
UN FILTRO TRA L'UOMO E L'AMBIENTE

University of Florence
Dept of Civil and Environmental Engineering

Biotechnologies for wastewater and gaseous effluents treatment



ITALPROGETTI engineering

Italprogetti Engineering SpA

Microbial communities characterization

University of Pisa
Dept of Biology

Design, construction, operation of the prototype

LIFE+11 ENV/IT/0075

"Rotating bioreactors for sustainable hydrogen sulphide removal"

From interdisciplinary research to application trhough pilot scale testing

Prof. G. Petroni
Dept of **Biology**
University of Pisa

Prof. C. Varese
Dept. of Biology
University Turin

Prof. M. Tredici
Dept. of **Agricultural Biotechnology**
University Florence

CER²CO

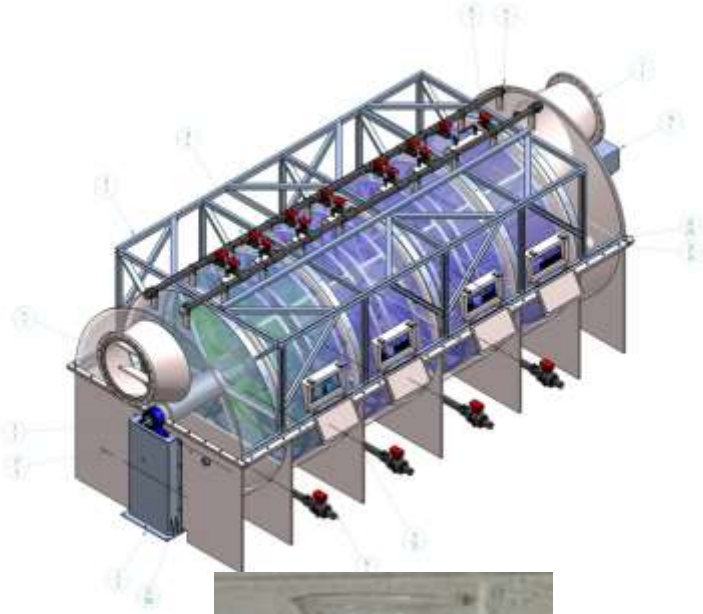
Eni

VEOLIA WATER

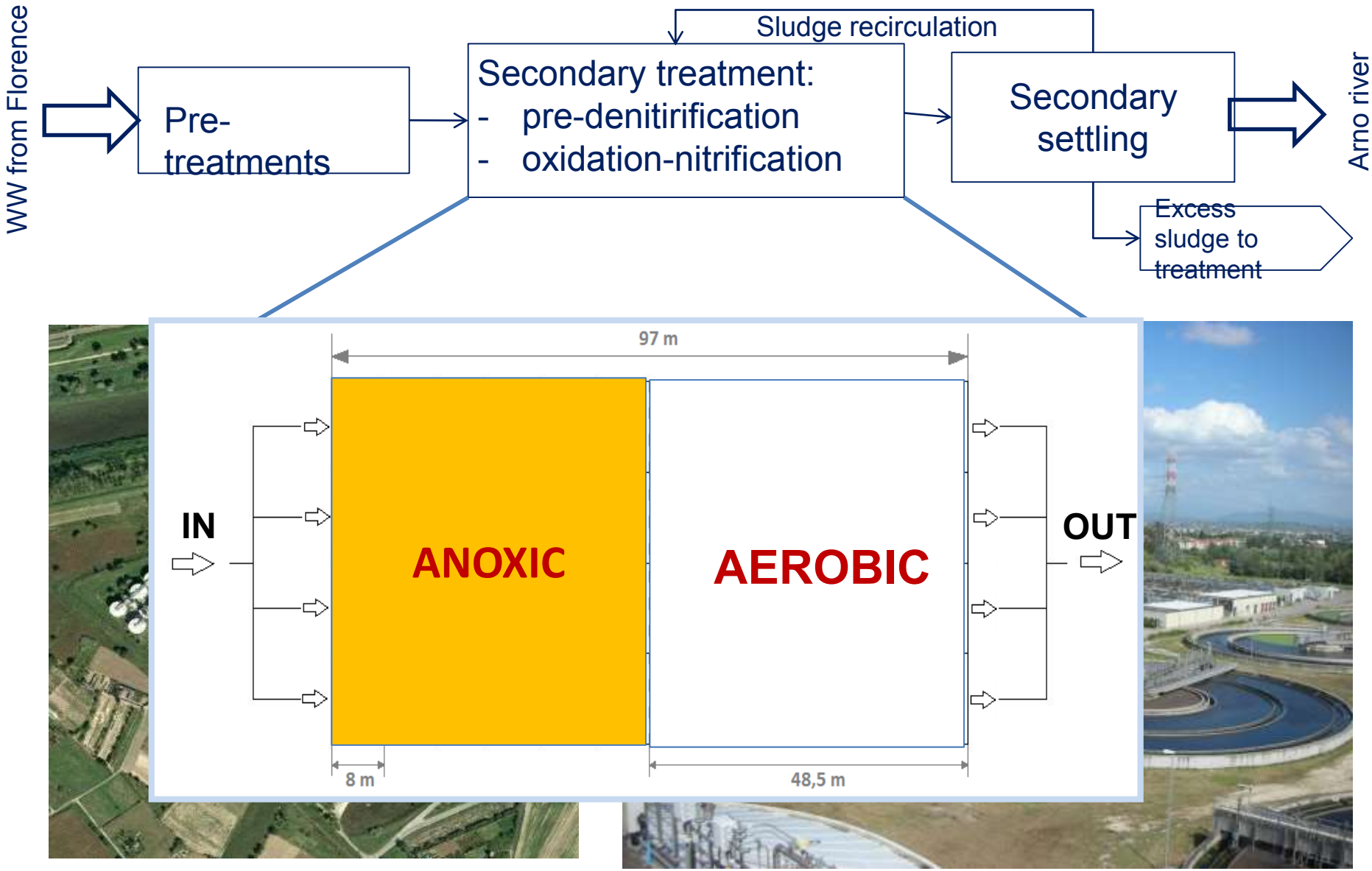
ZENON
Water for the World

ITALPROGETTI engineering

ALFA LAVAL



Attività in piena scala



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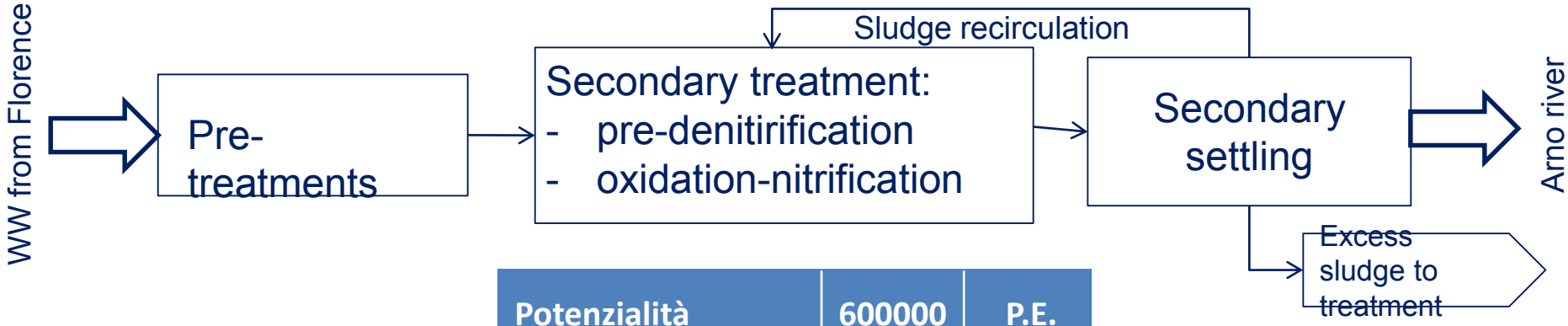
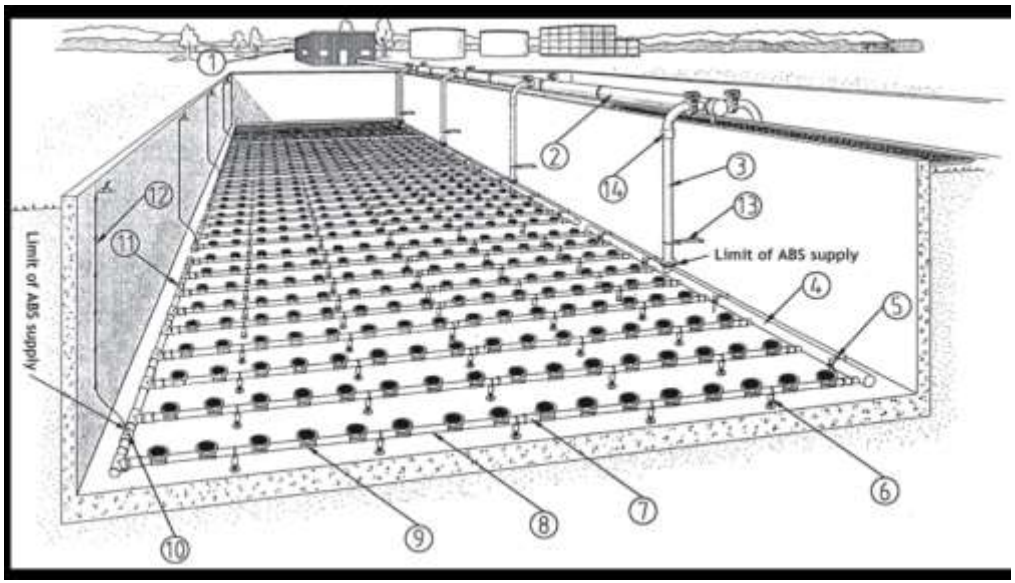


Potenzialità	600000	P.E.
Portata in ingresso	240000	m^3/d
Età del fango	20-30	d

Parameter	Unit	IN*	OUT*
$N\text{-}NH_4^+$	mg/l	19.4	0.51
$N\text{-}NO_2^-$	mg/l	-	n.d.
$N\text{-}NO_3^-$	mg/l	-	6.8
Ntot	mg/l	19.9	8.4
BOD	mg/l	48.3	3.6
COD	mg/l	145.6	16.8
P	mg/l	2.42	1.71
SST	mg/l	94.6	4.9

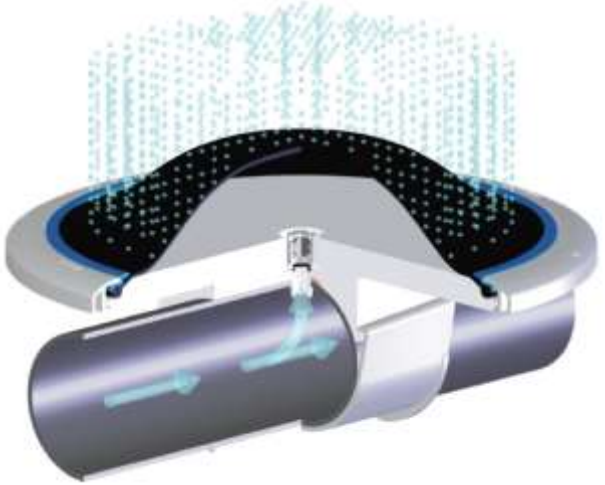
AERATION SYSTEM

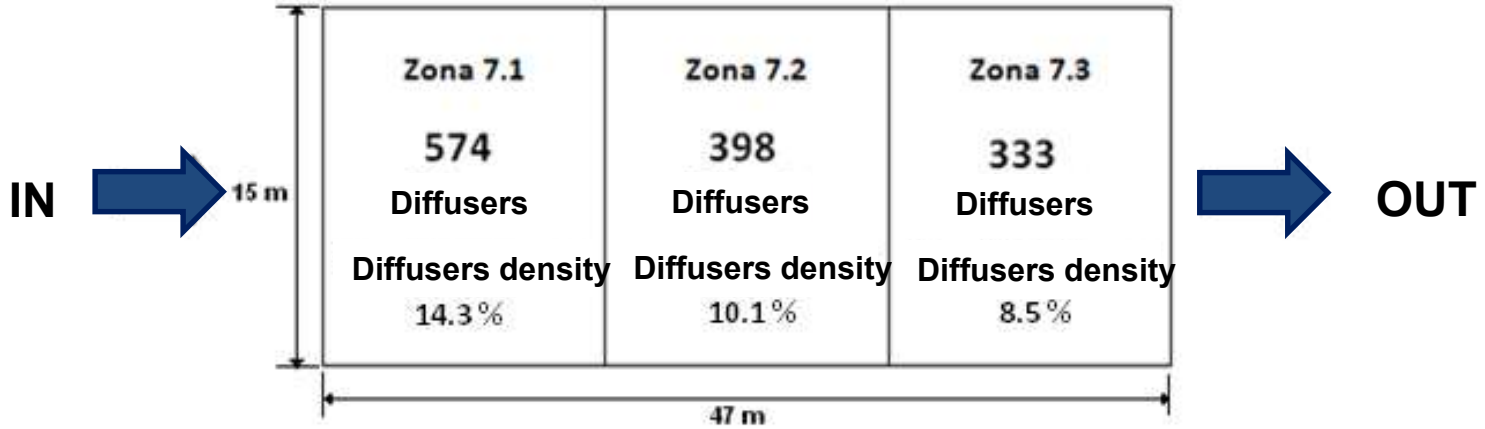


Microforated disks ABS PIK 300

Area of diffuser = 0.06 m^2

Diffusers/line = 1305





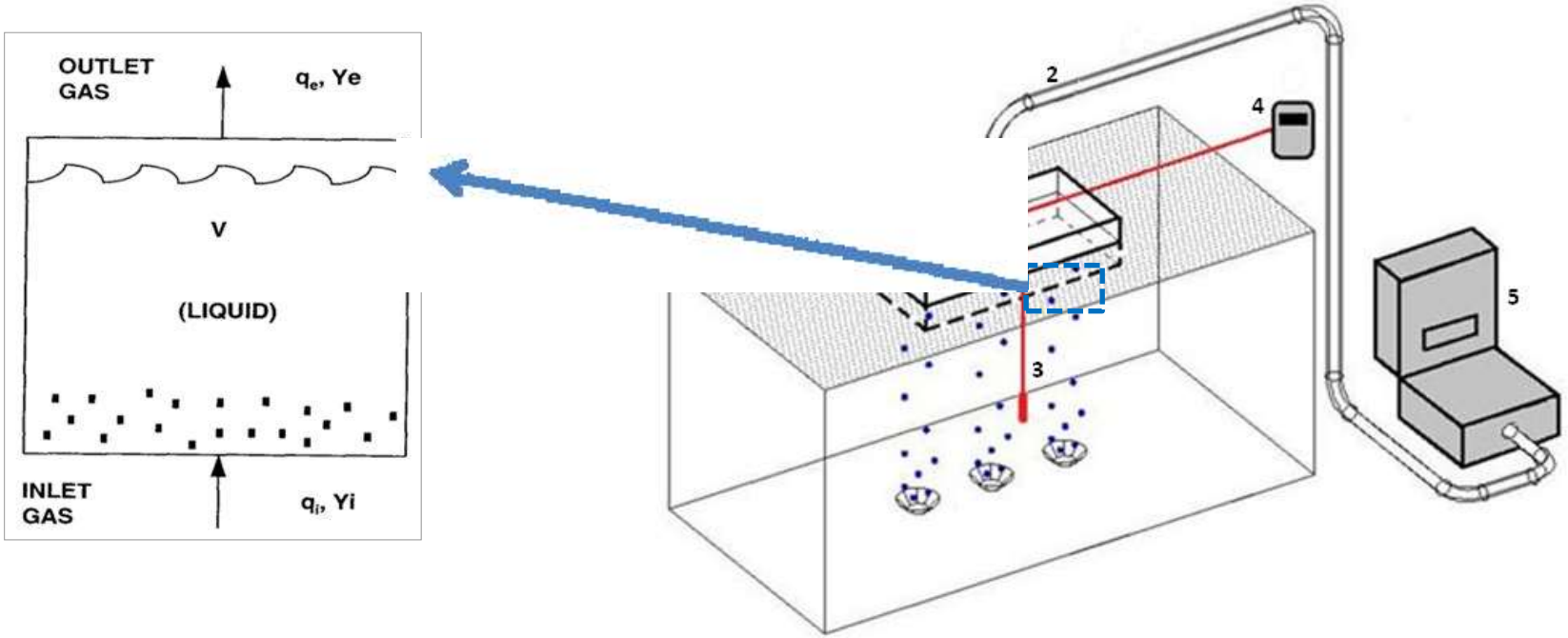
Attività in piena scala

The ***off-gas method*** is a tecnique developed for monitoring the oxygen transfer efficiency of air diffused aeration systems (*Redmon et al., 1983*).

Mass balance of oxygen in gas phase

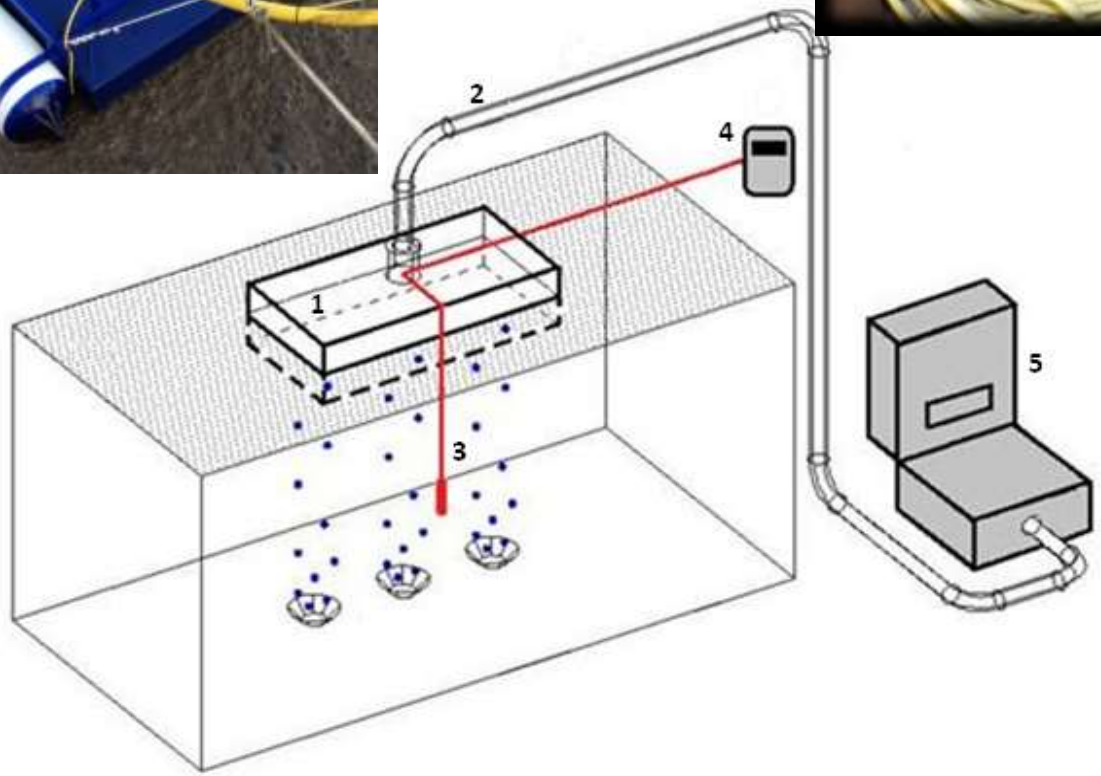
Oxygen transferred to the liquid phase = oxygen removed from the gas phase

$$OTE\ [\%] = \frac{O_{2\ IN} - O_{2\ OUT}}{O_{2\ IN}} \cdot 100$$



Attività in piena scala

1. Hood for off-gas collection
2. Connection pipe between the hood and the analyzer



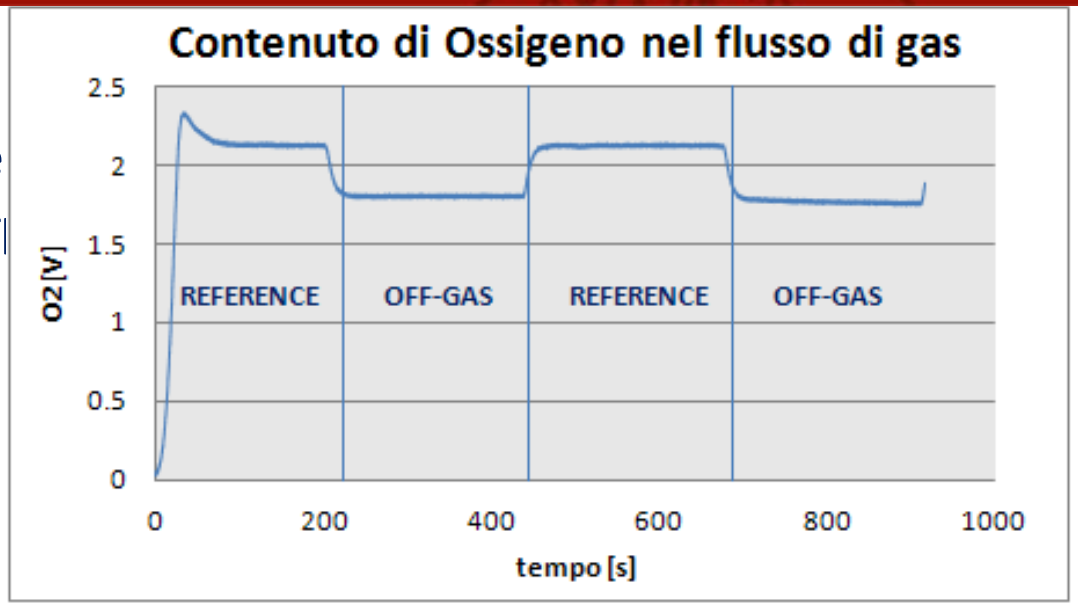
3. LDO probe

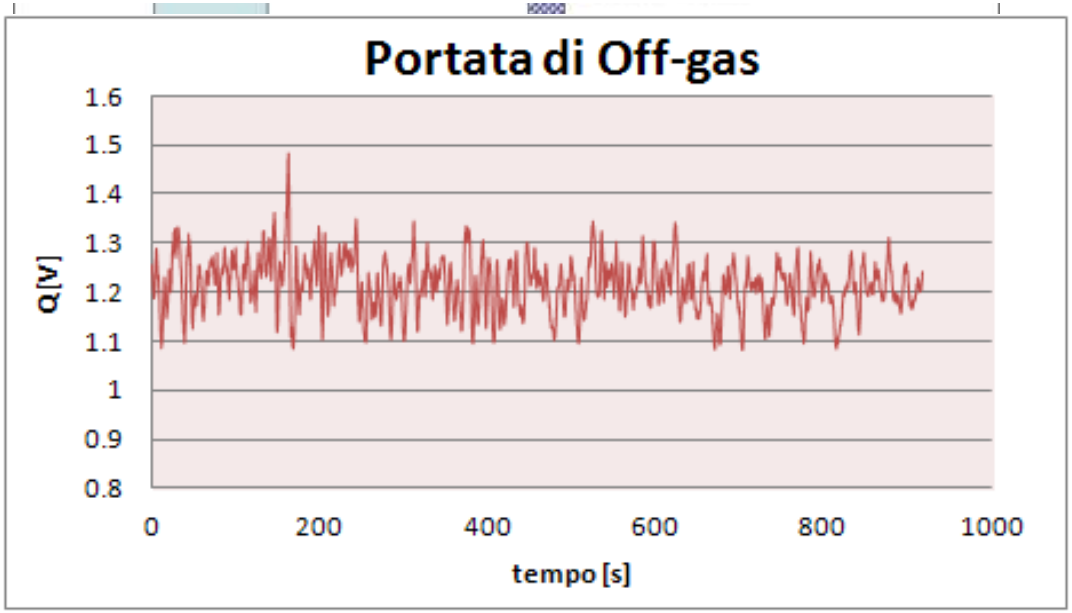
4. Oxymeter

5. Off-gas analyzer

Off-gas analyzer

- Measurement of oxygen conce
- Measurement of the off-gas fl





Attività in piena scala

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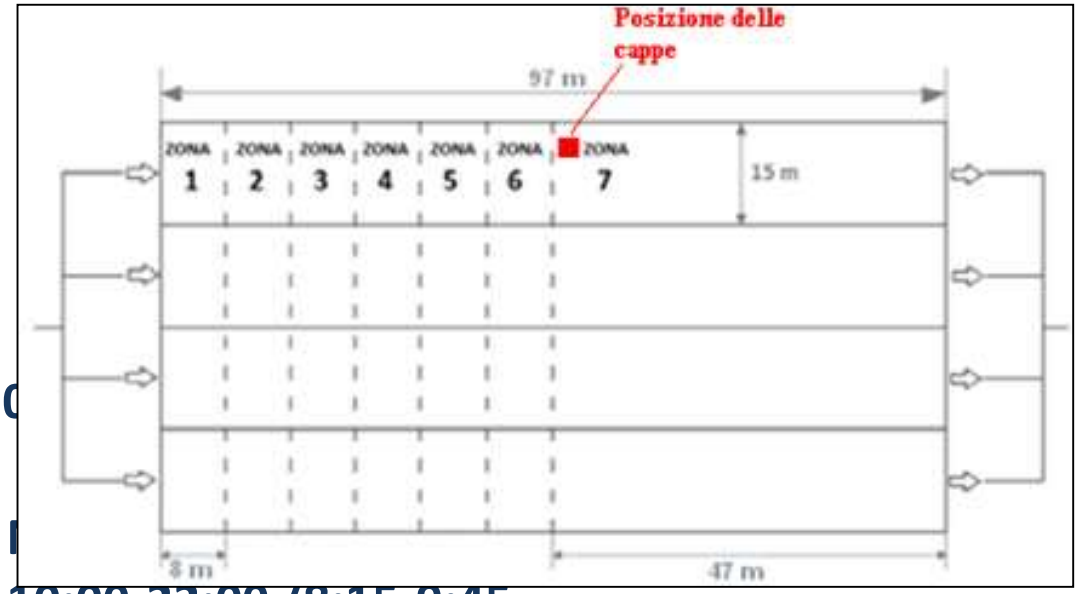
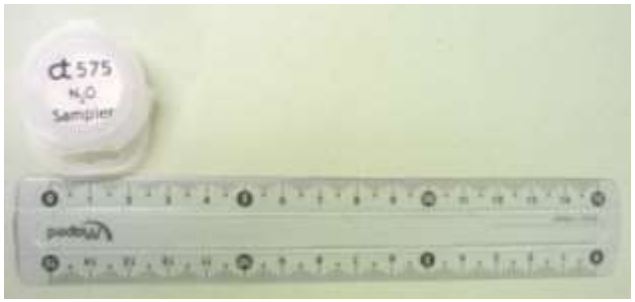


- Tedlar bag (10 l, Pumping rate 0

- Passive sampler



✓ I

✓ 10:00-22:00 /8:15-9:45

✓ F

✓ T

✓ N

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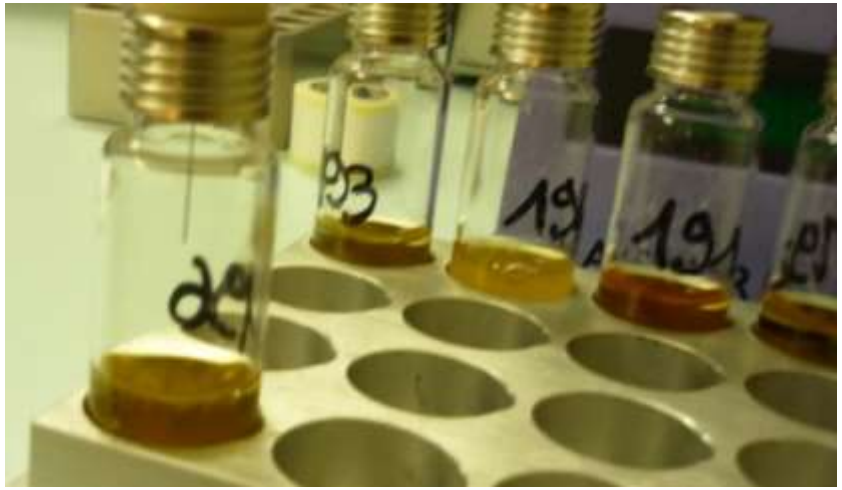
Attività in piena scala

- Samples in vials close to off-gas hoods

Sample frequency: 1 h

N_2O e VOCs



- Sampling of both WWTP's and oxidation tank influent and effluent (close to off-gas hoods)

COD, N-NH_4, N-NO_2, N-NO_3, Ntot

Grazie per l'attenzione!

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