LISAP

LABORATORIO DI INGEGNERIA SANITARIA AMBIENTALE DELLA UNIVERSITÀ DI PISA

Team

Full Professor

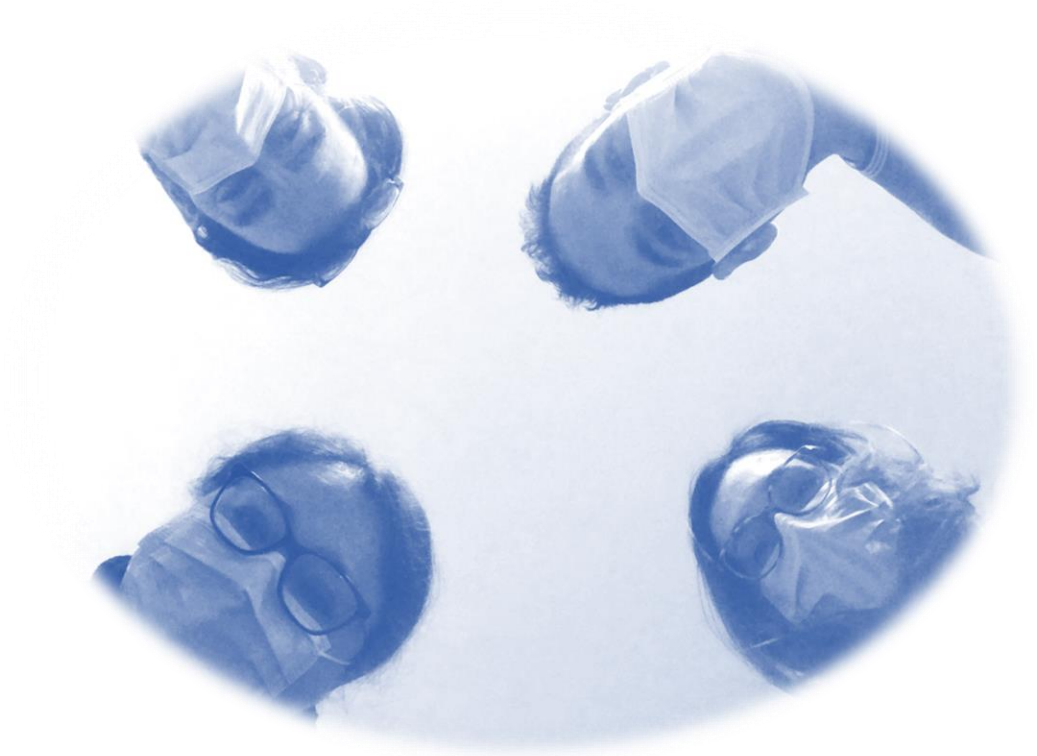
- Renato Iannelli

Assistant Professor

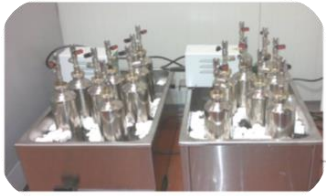
- Isabella Pecorini

PhD students

- Elena Rossi
- Francesco Pasciucco



Research and Laboratory activities

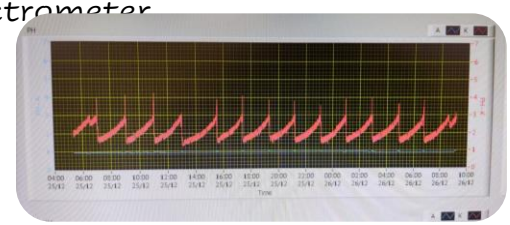


LISAP focuses on three main research lines

- **Waste >>>** Municipal Solid Waste and Biowaste
  - ✓ Biological stability of organic substrates
  - ✓ Innovative strategies for bioenergy and bioproducts recovery
- **Remediation >>>** Decontamination of sediment
  - ✓ Electrokinetic remediation of marine sediments
- **Water >>>** Wastewater treatment
  - ✓ Technical-economic optimization for the centralization of the wastewater treatment
- **Air >>>** Odor control and climate change mitigation

Main Laboratory equipment

- Optical Emission Plasma Spectrometer
- Gas cromatography



Projects

- TAAB Project
- GRRinPort Project

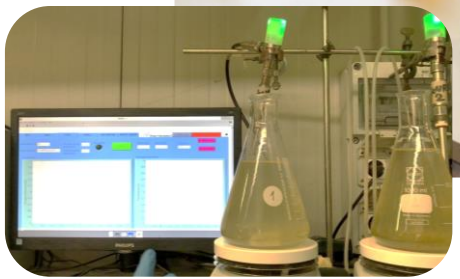
➢ Waste >>> Municipal Solid Waste and Biowaste

✓ **Biological Stability – REGULATION (EU) 2019/1009 rules on the making available on the market of EU fertilising product**

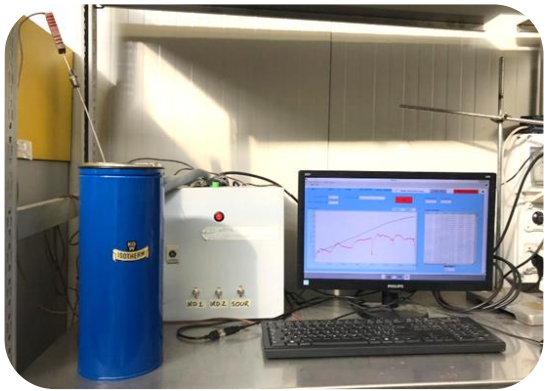
❖ ***Oxygen Uptake Rate – UNI EN 16087-1:2020***

Oxitop-IDS WTW GmbH

❖ ***Specific Oxygen Uptake Rate***



❖ ***Self heating test – UNI EN 16087-2:2011***

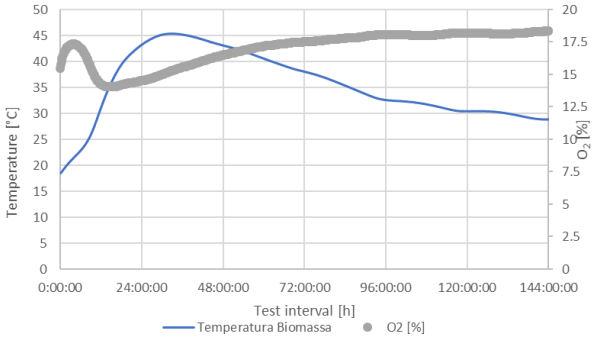


➢ Waste >>> Municipal Solid Waste and Biowaste

✓ **Biological Stability – REGULATION (EU) 2019/1009 rules on the making available on the market of EU fertilising product**

❖ ***Dynamic Respirometric Index (DRI) – UNI 11184:2016***

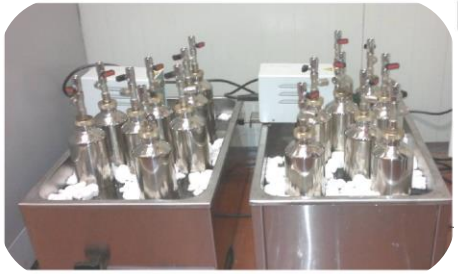
- *Method A Potential Dynamic Respirometric Index (PDRI)*
- *Method B Real Dynamic Respirometric Index (RDRI)*



➢ Waste >>> Municipal Solid Waste and Biowaste

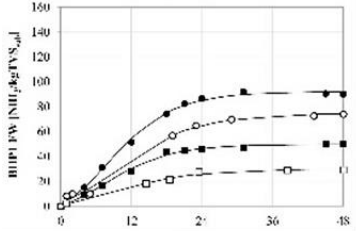
- ✓ **Biological Stability - REGULATION (EU) 2019/1009 rules on the making available on the market of EU fertilising product**
  - ❖ ***Biochemical methane potential (BMP) test – UNI/TS 11703:2018***

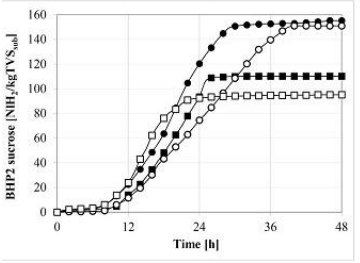
Residual Biogas Potential – RBP_{28} Nlbiogas/kgtvs



1l – Without automatic pH control

6l – With automatic pH control



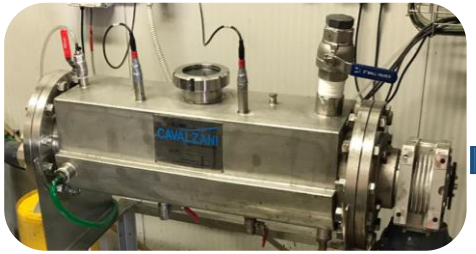


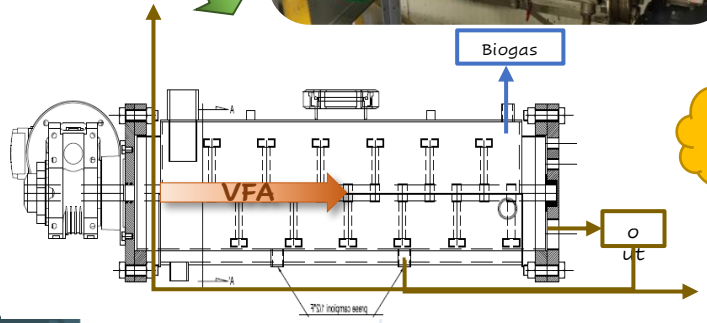
➢ Waste >>> Municipal Solid Waste and Biowaste

✓ Innovative strategies for bioenergy and bioproducts recovery

❖ *Dry Anaerobic Digestion*

30L Pilot-scale PFR





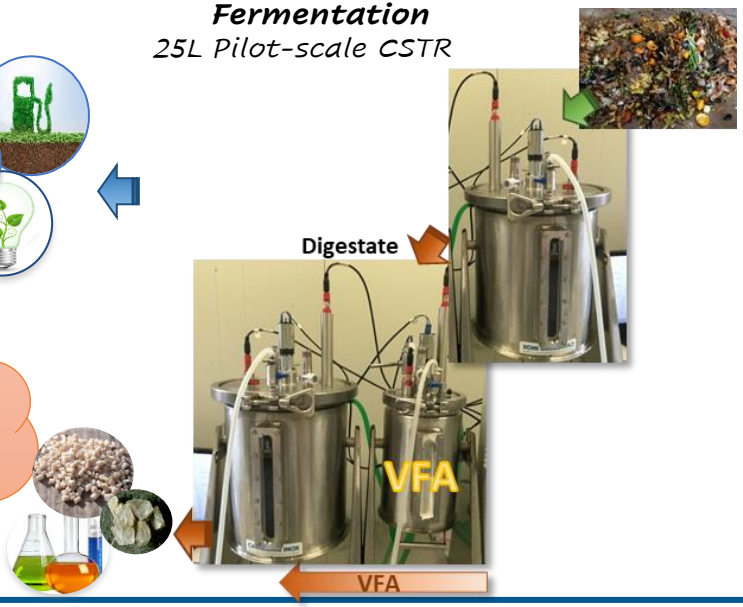
Biogas
Energy Recovery
Bio-fuels

Digestate
Material recovery
Biochemicals, Biopolymers – PHA
Nutrients (struvite)
Fertilizers

VFA

❖ *Wet Anaerobic Digestion and Dark Fermentation*

25L Pilot-scale CSTR



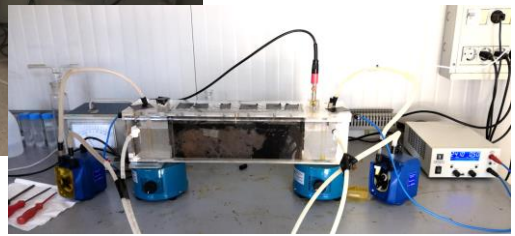
➢ Remediation >>> **Decontamination of sediment**

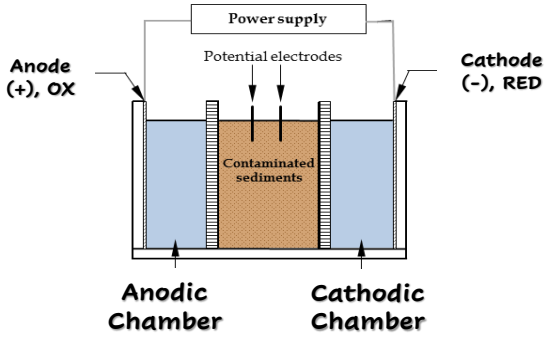
✓ **Electrokinetic remediation of marine sediments**

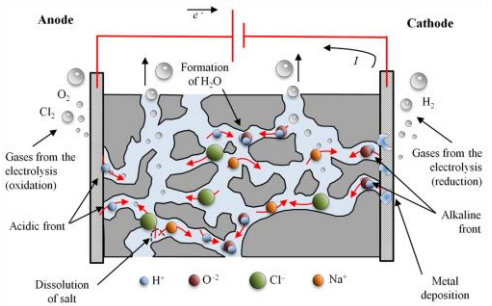
50 kg

SCALE UP

3-5kg







➢ Water >>> Wastewater treatment

✓ **Technical-economic optimization study for the centralization of the wastewater collection and treatment services**

GOALS:
- ❖ Reduction in the operating expense (OPEX)
- ❖ Improvement in the status of the environment
- ❖ Sustainable development

BioWin

SimaPro

GAIA S.p.A. SERVIZI IDRICI

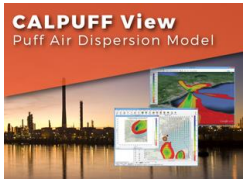
OBJECTIVES AND FIELDS OF INTEREST

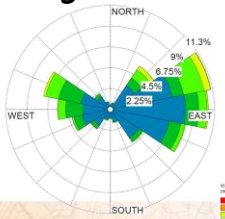

Reduction of energy consumption

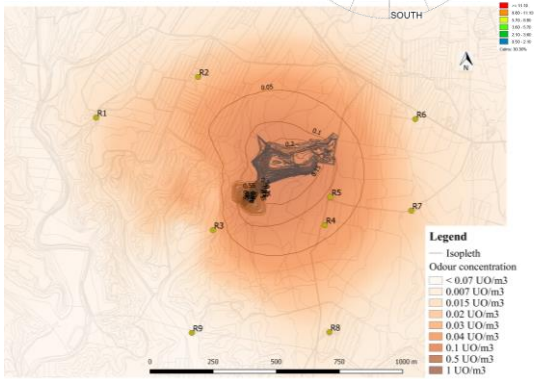

Resource recovery (water and sludge)

➢ Air >>> Odor control and climate change mitigation

❖ **Pollutant and odour dispersion modelling**



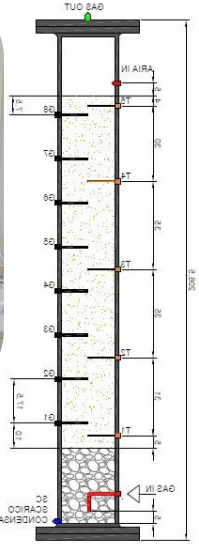




❖ **Human Health Risk Assessment**

Risk =
Hazard x Exposure

❖ **Landfill gas treatment and methane oxidation efficiency of compost**



Column A -> moisture content 20%
Column B -> moisture content 30%
Column C -> moisture content 40%

Laboratory equipment

➢ Optical Emission Plasma Spectrometer (ICP-OES)

❖ *Thermo-Fisher Scientific Inductively Coupled Optical Emission Plasma Spectrometer (ICP-OES) (Model iCAP 7000 series)*

The ***Inductively Coupled Optical Emission Plasma Spectrometer*** can analyze samples of water, soils, rocks, inorganic solids and also organic samples and can detect:

Li, Be, B, Na, Mg, Al, K, Ca, V, Cr, Fe, Mn, Co, Ni, Cu, Zn, Rb, Si, Sr, Ge, As, Se, Mo, Ag, Cd, Ba, Tl, Hg, Pb, U, Bi on water samples

Ag, As, Ba, Bi, Cd, Co, Cr , Cs, Cu, Ga, Hf, Hg, Li, Mn, Mo, Nb, Ni, Pb, Rb, Se, Sr, Ta, Th, Ti, Tl, U, V, Y, Zn, Zr, Tl, plus all the Rare Earths from La to Lu on rocks, soils or solids or previously "digested" samples

As, Ba, Bi, Cd, Co, Cr, Cs , Cu, Hg, Li, Mn, Mo, Ni, Pb, Rb, Se, Sr, Ta, Ti, U, V, Zn on organic samples

Laboratory equipment

- **Gas cromatography analyses to identify Volatile Fatty Acids and Biogas composition**

❖ *Gas chromatograph 7890B Agilent Technology*

Measures VFAs (acetic, propionic, butyric, iso-butyric, valeric, isovaleric and caproic acids)
H_2 gas carrier
CPFFAP column (0.25 mm/0.5 µm/30 m)
Flame ionization detector (250°C).
The temperature ramp 60°C-250°C with a rate of 20 °C/min.

❖ *3000 Micro GC (INFICON; Switzerland)*

MEMS (Microelecromechanical System) injection
He gas carrier for H_2S and CO_2 - column PLOTQ (10 µm /320 µm/8 m)
T=55°C
Ar gas carrier for CH_4, H_2, 0_2, NO - column Molsieve (30 µm / 320 µm / 10 m) T=50 ° C.

Academic courses

Professor Renato Iannelli

- Solid Waste Management and Remediation of contaminated sites (Cod. 220HH) - MSc program in Civil and Environmental Engineering
- Sanitary and Environmental Engineering (Cod. 062HH) - MSc program in Civil and Environmental Engineering

Borrow or shared courses:

- Appliacations of Environmental Engineering (Cod. 018HH) – Master Degree in CONSERVAZIONE ED EVOLUZIONE
- Sanitary and Environmental Engineering (Cod. 062HH) - MSc program in Structural and Architectural Engineering

Isabella Pecorini, PhD

- Solid Waste Management and Remediation of contaminated sites (Cod. 220HH) - MSc program in Civil and Environmental Engineering (co-teaching with Professor Renato Iannelli)
- Environmental Impact Assessment (Cod. 264HH) MSc program in Civil and Environmental Engineering

Current Projects

➢**TAAB Project**

Technological transfer of advanced technologies of anaerobic digestion process towards the Biorefinery concept

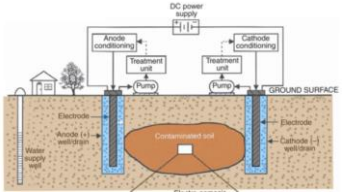
➢**GRRinPort Project** – http://interreg-maritime.eu/web/grrinport/progetto

Work in Progress

Recent MSc Thesis

- ✓ Pilot-scale experimental test on one-stage and two-stage Anaerobic co-digestion of Organic Fraction of Municipal Solid Waste and sewage sludge

- ✓ Human Health Risk Assessment and characterization of a site potentially contaminated with heavy metal



- ✓ GRRinPORT Project: analysis and performance evaluation of laboratory-scale electrokinetic decontamination system of marine sediment and design of a pilot plant

- ✓ Waste Management in the harbors of Corsica and Tuscany and experimental tests on decontamination of marine sediments

- ✓ Technical - economic optimization study for the centralization of the wastewater collection and treatment services in the territorial conference no.1 - toscana nord

- ✓ Pilot-scale plug-flow reactor for anaerobic digestion of Organic Fraction of Municipal Solid Waste: experimental tests.

Recent Publications 1/2

- Pecorini, I., Baldi, F., & Iannelli, R. (2019). Biochemical hydrogen potential tests using different inocula. Sustainability (Switzerland), 11(3) doi:10.3390/su11030622
- Baldi, F., Iannelli, R., Pecorini, I., Polettini, A., Pomi, R., & Rossi, A. (2019). Influence of the pH control strategy and reactor volume on batch fermentative hydrogen production from the organic fraction of municipal solid waste. Waste Management and Research, 37(5), 478–485. doi:10.1177/0734242X19826371
- Baldi, F., Pecorini, I., & Iannelli, R. (2019). Comparison of single-stage and two-stage anaerobic co-digestion of food waste and activated sludge for hydrogen and methane production. Renewable Energy, 143, 1755–1765. doi:10.1016/j.renene.2019.05.122
- Frasi, N., Rossi, E., Pecorini, I., & Iannelli, R. (2020). Methane oxidation efficiency in biofiltration systems with different moisture content treating diluted landfill gas. Energies, 13(11) doi:10.3390/en13112872
- Pecorini, I., Bacchi, D., & Iannelli, R. (2020). Biodrying of the light fraction from anaerobic digestion pretreatment in order to increase the total recovery rate. Processes, 8(3) doi:10.3390/pr8030276
- Pecorini, I., & Iannelli, R. (2020). Characterization of excavatedwaste of dierent ages in view of multiple resource recovery in landfill mining. Sustainability (Switzerland), 12(5) doi:10.3390/su12051780
- Pecorini, I., & Iannelli, R. (2020). Landfill GHG reduction through different microbial methane oxidation biocovers. Processes, 8(5) doi:10.3390/PR8050591

Recent Publications 2/2

- Pecorini, I., Peruzzi, E., Albini, E., Doni, S., Macci, C., Masciandaro, G., & Iannelli, R. (2020). Evaluation of MSW compost and digestate mixtures for a circular economy application. Sustainability (Switzerland), 12(7) doi:10.3390/su12073042
- Pecorini, I., Rossi, E., & Iannelli, R. (2020). Bromatological, proximate and ultimate analysis of OFMSW for different seasons and collection systems. Sustainability (Switzerland), 12(7) doi:10.3390/su12072639
- Pecorini, I., Rossi, E., & Iannelli, R. (2020). Mitigation of methane, NMVOCs and odor emissions in active and passive biofiltration systems at municipal solid waste landfills. Sustainability (Switzerland), 12(8) doi:10.3390/SU12083203
- Rossi, E., Frasi, N., Pecorini, I., & Ferrara, G. (2018). Methane oxidation efficiency and NMVOCs reduction in a full-scale passive biofiltration system for the treatment of residual landfill gas. Procedia Environmental Science, Engineering and Management, 5(3), 147-152. Retrieved from www.scopus.com
- Rossi, E., Pecorini, I., & Iannelli, R. (2020). Methane oxidation of residual landfill gas in a full-scale biofilter: Human health risk assessment of volatile and malodours compound emissions. Environmental Science and Pollution Research, doi:10.1007/s11356-020-08773-6
- Rossi, E., Pecorini, I., & Iannelli, R. (2019). Risk assessment of a methane oxidizing biofilter for reducing landfill gas emissions from a post-closure landfill. Procedia Environmental Science, Engineering and Management, 6(2), 209-219. Retrieved from www.scopus.com

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