Recovery of raw materials from sewage sludge through integrated thermo-chemical processes

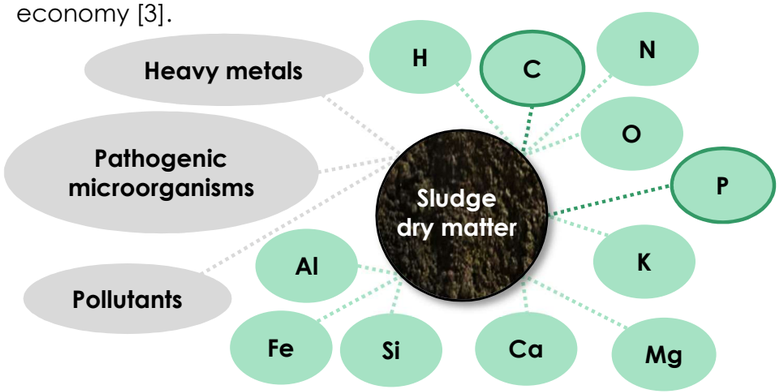
Marta Di Bianca
Department of Civil and Environmental Engineering (DICEA), University of Florence
E-mail: marta.dibianca@unifi.it

UNIVERSITÀ DEGLI STUDI FIRENZE

PhD program in Civil and Environmental Engineering

INTRODUCTION

Sewage sludge is the main by-product generated by wastewater treatment plants (WWTPs), and its handling represents a major **criticality** in the wastewater treatment sector, due to the large **quantity** of sludge produced (~10 Mt sludge dry matter/y in the EU [1]) and to the high associated **costs** (~20-60% of total WWTP operating costs [2]), mainly related to sludge water content (99-94 %) to be reduced. Sewage sludge is classified as a **waste**, and its disposal is estimated in the order of hundreds of €/t dry matter. In the view of the EU's transition to a circular economy, enhancing sludge reuse/recycling and minimising landfilling is vital. Although sludge holds a significant part of the contaminants removed from wastewater, it contains some valuable **raw materials** as well, including **carbon and phosphorous,** the latter being listed as phosphate rock among the critical raw materials for the EU economy [3].



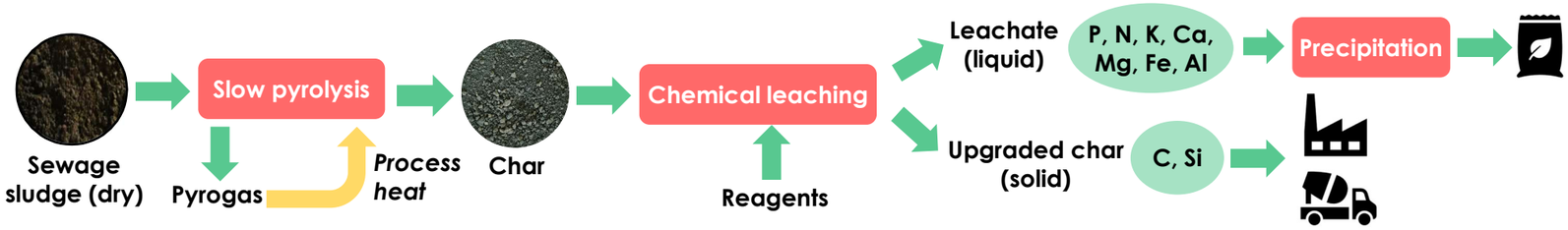
RESEARCH OBJECTIVES

- Study of the **integration** of **thermochemical processes** (slow pyrolysis, hydrothermal carbonization) **and chemical processes** (leaching, precipitation) applied to different **sewage sludges**, aimed at the **recovery of raw materials** from sludge in the form of **applicable products**.
- **Optimization** of the wastewater and sludge **treatment processes** at the origin of sewage sludge, aimed at minimizing chemicals consumption and improving the **quality** of the products from the integrated system.

RESERCH CORE

Integration of slow pyrolysis and chemical leaching for the **recovery of raw materials** from sewage sludge:

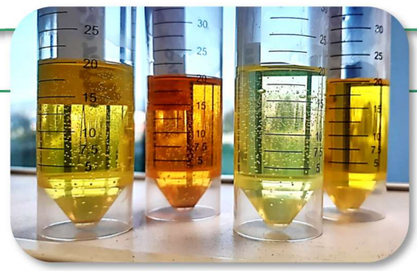
- **Slow pyrolysis:** thermochemical process in which the feedstock is decomposed by heating (no oxygen, 400-600 °C [4]), aimed at the production of a solid carbonaceous matrix (char).
- **Chemical leaching:** chemical process in which one or more soluble compounds are extracted from a solid material by a solvent.



- **Hydrothermal carbonization:** thermochemical process in which the wet feedstock is converted (in sub-critical water, at autogenous pressure, 180-280 °C) into a solid peat-like product (hydrochar) [5].

TO BE FURTHER INVESTIGATED

- → Integration of **hydrothermal carbonization** (pre-treatment)
- → Application of the integrated processes to **aerobic granular sludge (AGS)**
- → **Metals behaviour** during slow pyrolysis and chemical leaching
- → **Selective Al** and other metals recovery
- → **Silicates** & **carbon** extraction
- → Application of **recovered carbon** for sustainable materials production



METHODOLOGY

- Literature **research**
- Characterization of **sewage sludge** from different WWTP technologies
- **Laboratory & pilot-scale tests**
- **Products** characterization
- **Products application** tests & **quality** validation
- Assessment of **WWTPs processes** for raw materials recovery

Processes optimization

Leaching pilot plant
RE-CORD headquarter - Scarperia e San Piero (FI)

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