

Assessment of POREM the new bio-activator for better soil management

Alessandra Strafella, Elena Salernitano, Federica Bezzi, Alice Dall'Ara

Laboratory of Materials Technologies Faenza (TEMAF), Italian National Agency for New Technologies, Energy and sustainable economic development (ENEA),
Via Ravegnana 186, 48018 Faenza (Italy)

PROJECT OBJECTIVES

The European Project LIFE17 ENV/IT/000333 POREM proposes the **innovative bioactivator POREM** to restore the soil by bioremediation.

Location: Italy, Spain, Czech Republic; **Duration:** 1/10/2018 – 30/9/2021 **Raw materials:** poultry dejections, litter, manure

Objectives: implementation of the innovative and low-cost technologies for production of POREM bioactivator and efficiency demonstration of its applicability for soil restoration/bioremediation (low organic matter soils, semiarid areas)

Innovative functions: the specific POREM use for bioremediation of very poor in Organic Matter soils
 → fertility recovery
 → C sink in soils, struvite formation (N and P sink, slow release)
 → biological quality (properties of soil improver/amendment → edaphic fertility)

Innovative process: a simplified, static, energy saving biotreatment: poultry manure + natural enzyme preparation from plants EU patent (EP 1314710).

Mechanisms: struvite formation + static process → **the double goal** of reducing environmental impact and to enhance the nutrients and carbon retention



EXPERIMENTAL RESULTS

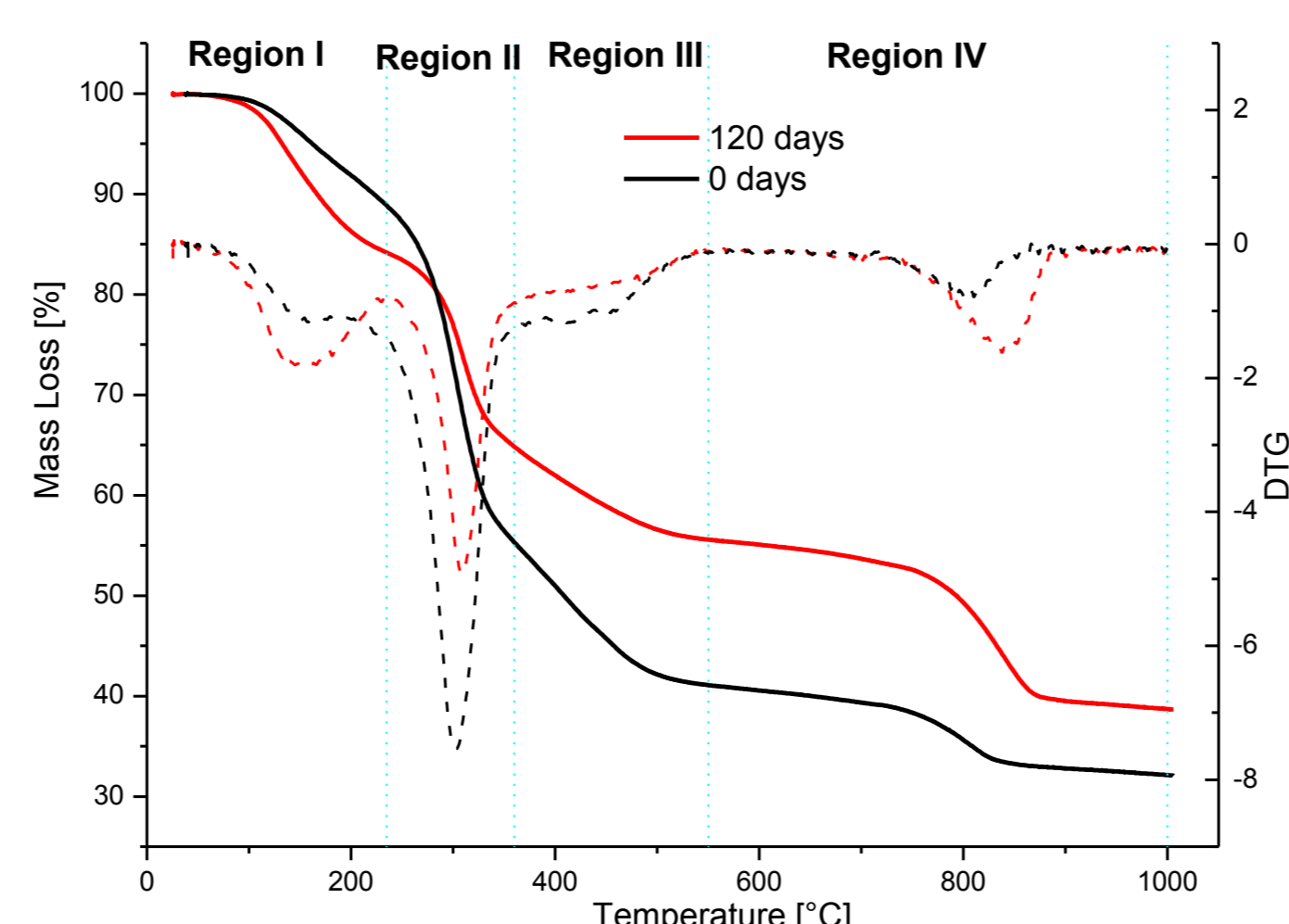
Design of experiments:

- **Production of POREM bioactivator** in pilot scale for field application
- Chemical/Physical **characterizations** of POREM bioactivator: TGA, SEM, XRD
- **Bioactivator characteristics monitoring** (evolution of chemical, physical, microbiological and biochemical parameters, such as element content and availability, enzymatic activity for C, N & P cycle)
- **Gas monitoring both at lab and pilot scale** (CO₂, NH₃, CH₄, H₂S)

First year results (before soil application):

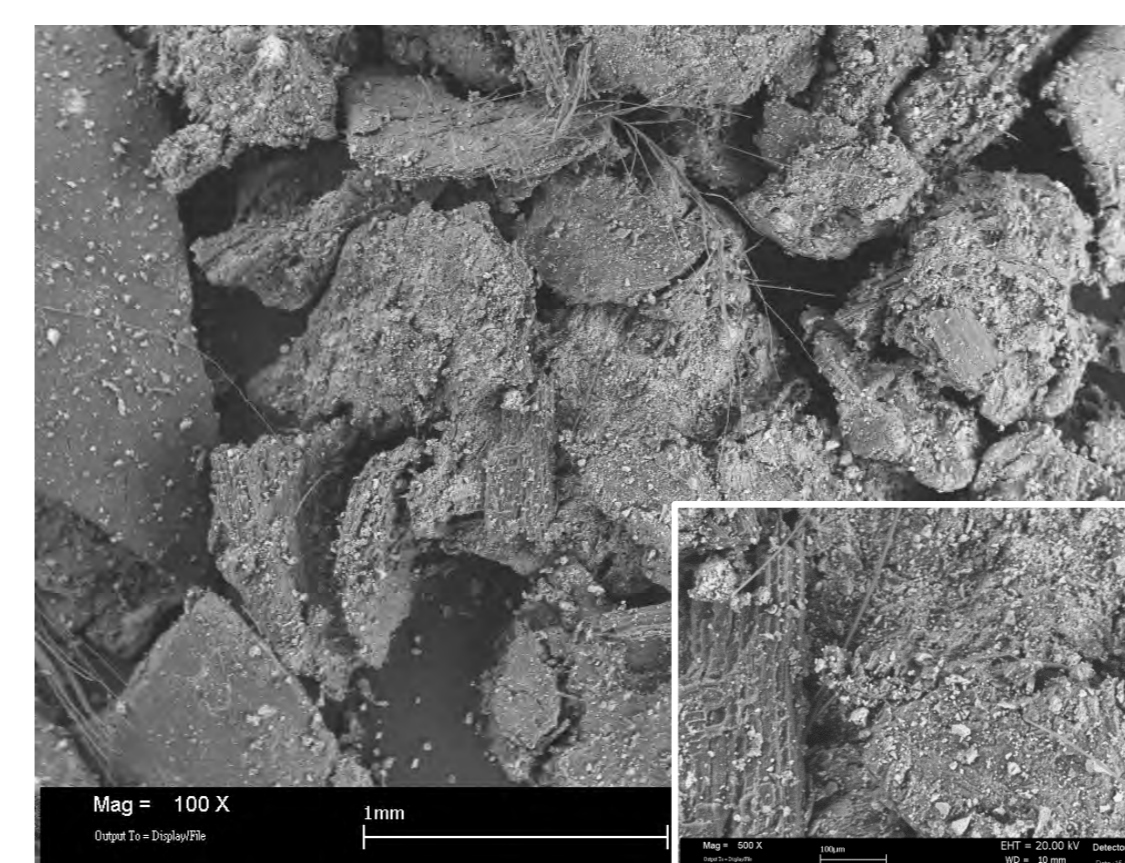
- POREM samples at different time of maturation (until 120 days) were characterized
- The replicability of measured properties was highlighted both at piles and samples level
- Analyzing the properties of POREM, the time trend appears promising

TGA
Thermal stability and decomposition phases (ΔT and %mass loss)

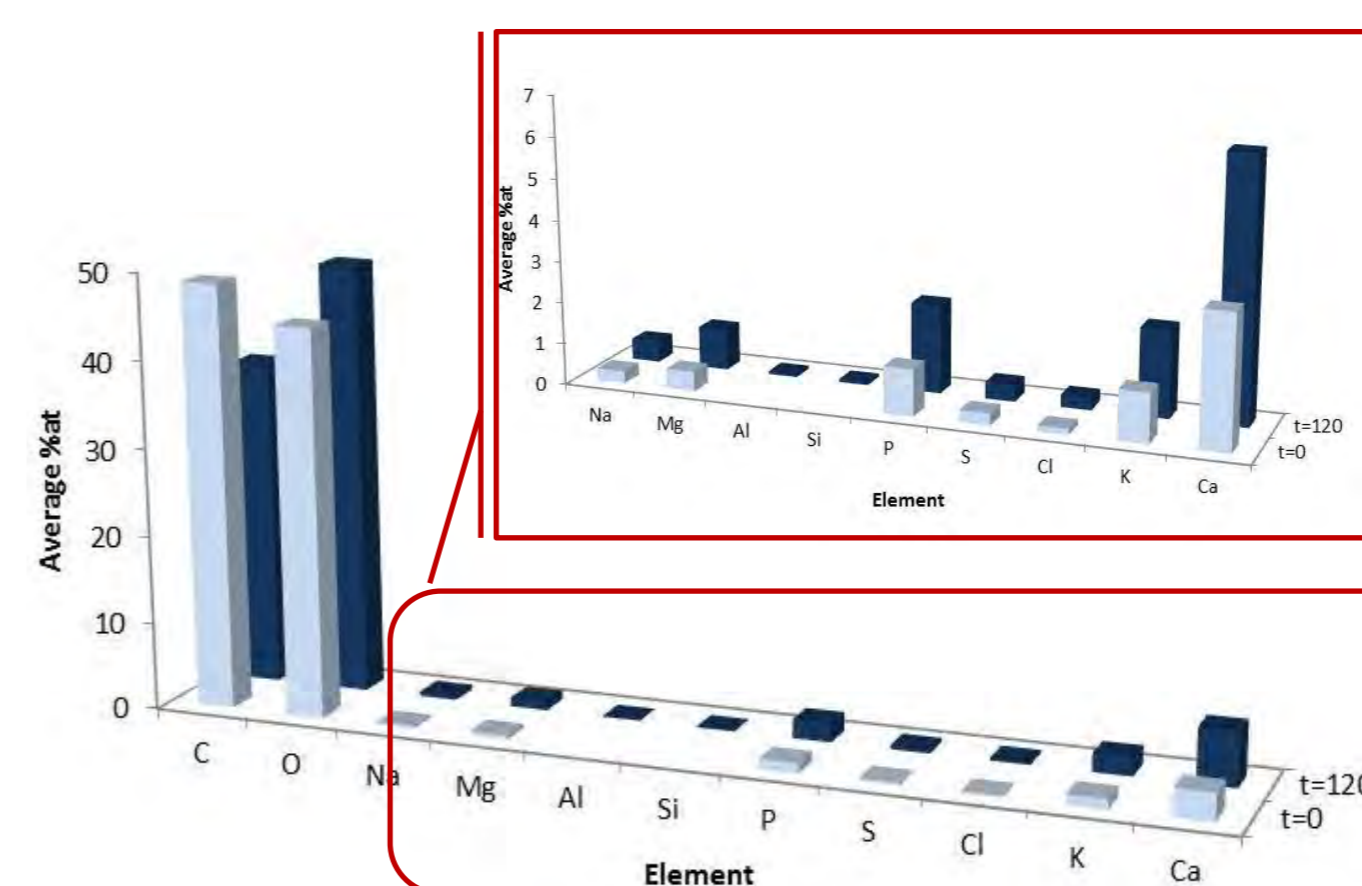


- The main steps of mass loss:
Region I → [0-200] °C: water removal
Region II → [200-360] °C: aliphatic fraction (carbohydrates and alkyl labile systems)
Region III → [360-550] °C: aromatic moieties
Region IV → [550-1000] °C: inorganic components of poultry manure chars
- The inorganic fraction increases over the time → better thermal stability

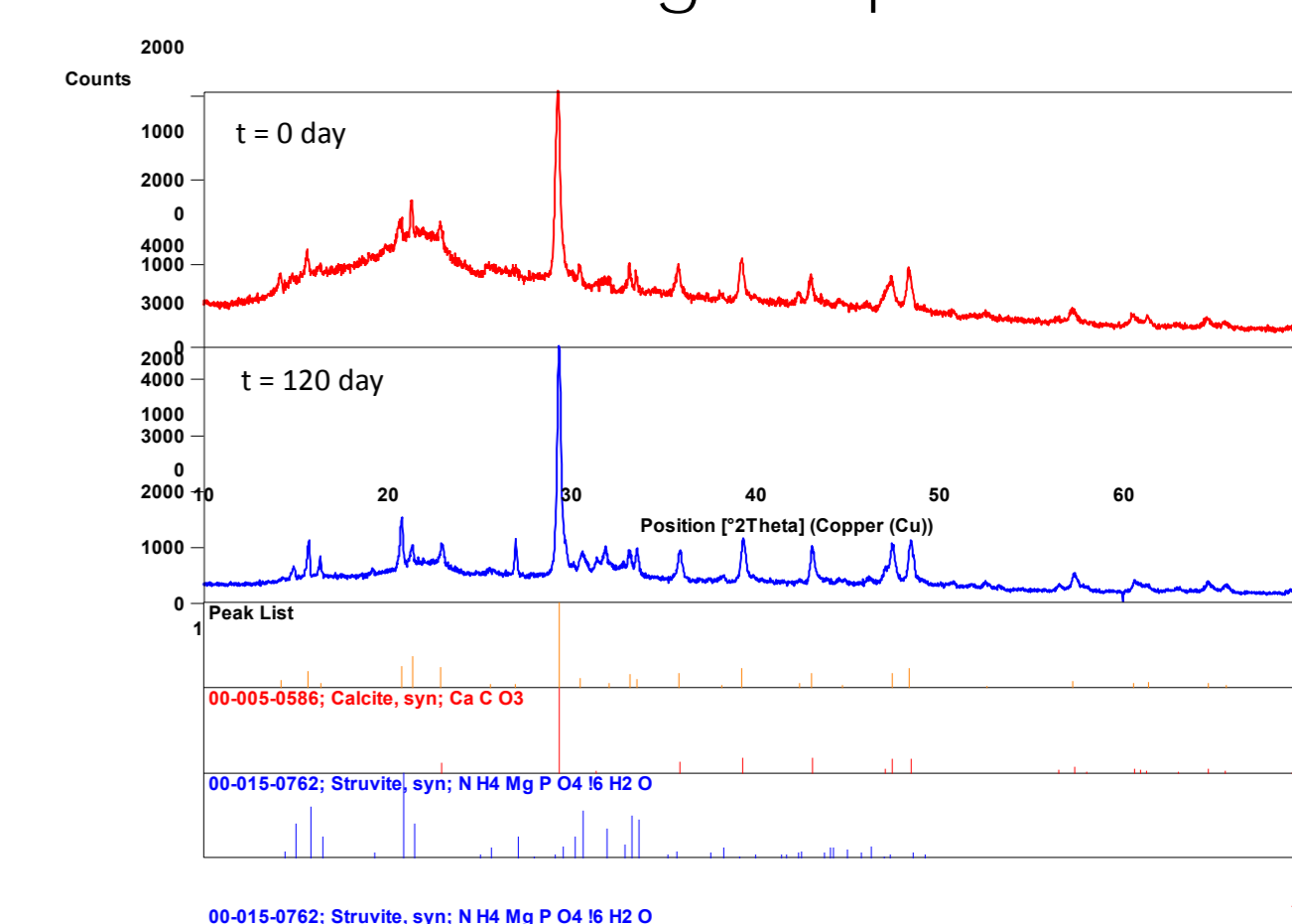
SEM
Morphological and semiquantitative analysis



- **heterogeneous morphology** (presence of various residues)
- **O and C are the main elements** (Ca, P, K, Cl, Mg, S are also detected)



XRD
Detection of mineralogical phases



- Two main crystalline phases: **Calcite** (CaCO₃) and **Struvite** (NH₄MgPO₄·6H₂O)
- The amorphous phase is clear present at the beginning but decreasing with maturation time
- The crystallinity and inorganic phases are more evident with maturation time
- The XRD results, correlated to time maturation, are consistent both with the thermal behaviour examined in TGA and with semi-quantitative results of SEM-EDX observations

COMMENTS

- The **replicability** of POREM production was demonstrated
- Demonstration of time trend of POREM bioactivator properties
- The characterization results are mutually consistent and highlight an improved bioactivator stability, correlated to the maturation time

Future development:

- **Mitigation of GHG and ammonia emissions during POREM production:** applicability of a treatment to convert poultry manure into an organic bio-activator with reduced odor impact (80% NH₃ emission in comparison with fresh ones)
- **Bioactivator quality:** reduced salinity (<5 dS/m), 40% P contained in struvite compound
- **Soil quality: organic C** (40%) and **water soluble C** (40%), **N_{tot}** and **P_{tot}** (25%) **increase** with **repeated** applications