

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

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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

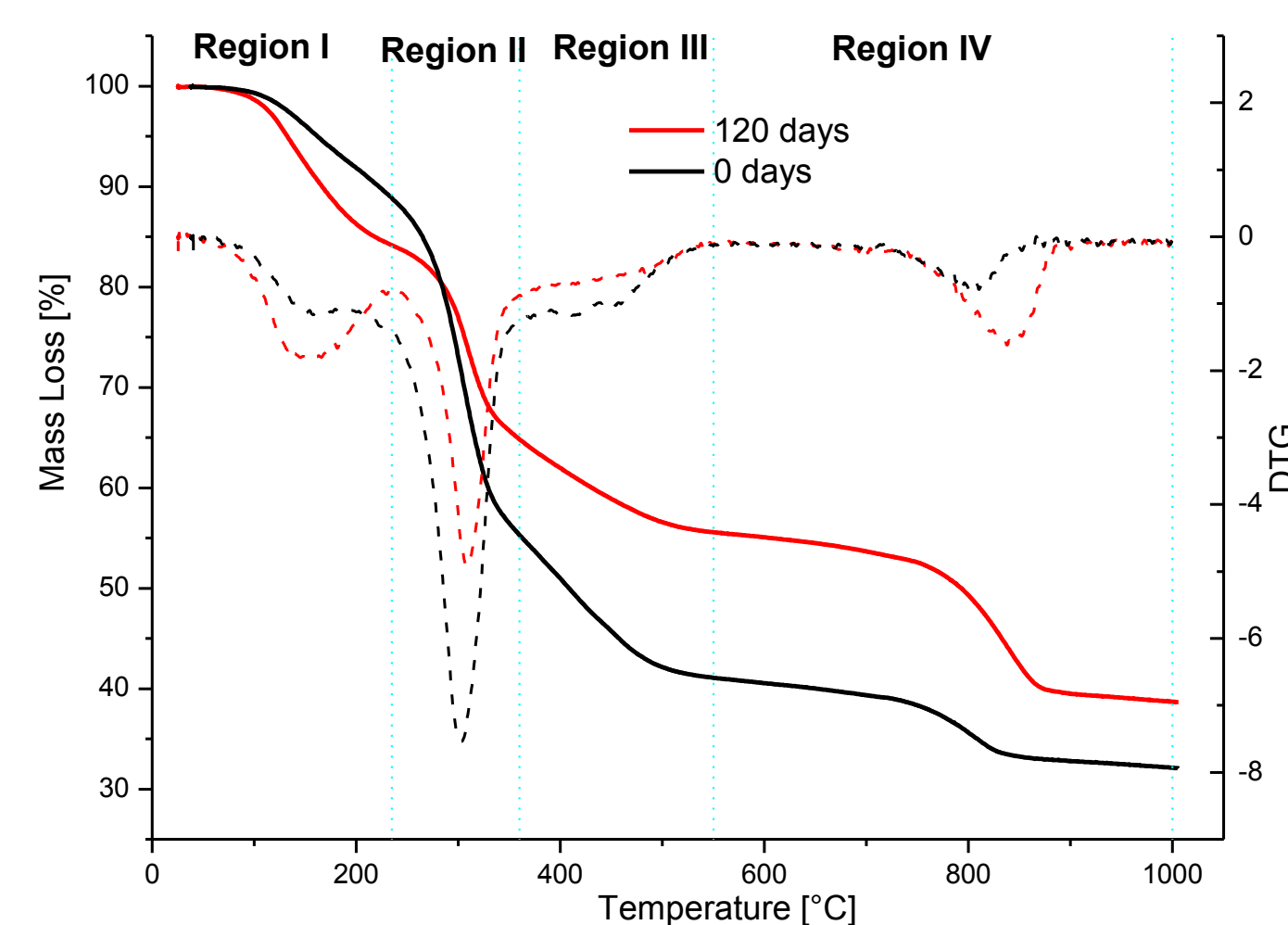
Design of experiments:

- **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):

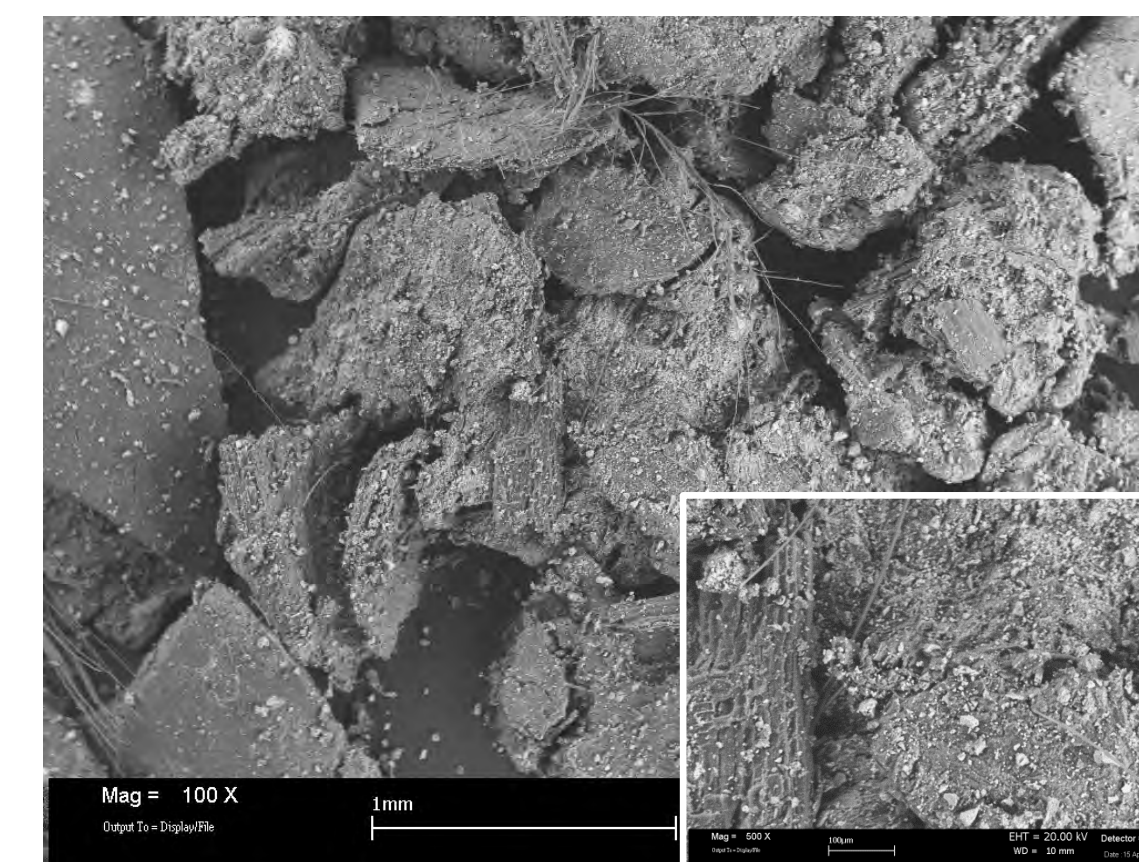
- POREM samples at different time of maturation (until 120 days) were characterized
- The replicability of measured properties was highlighted both at piles and samples level
- Analyzing the properties of POREM, the time trend appears promising

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

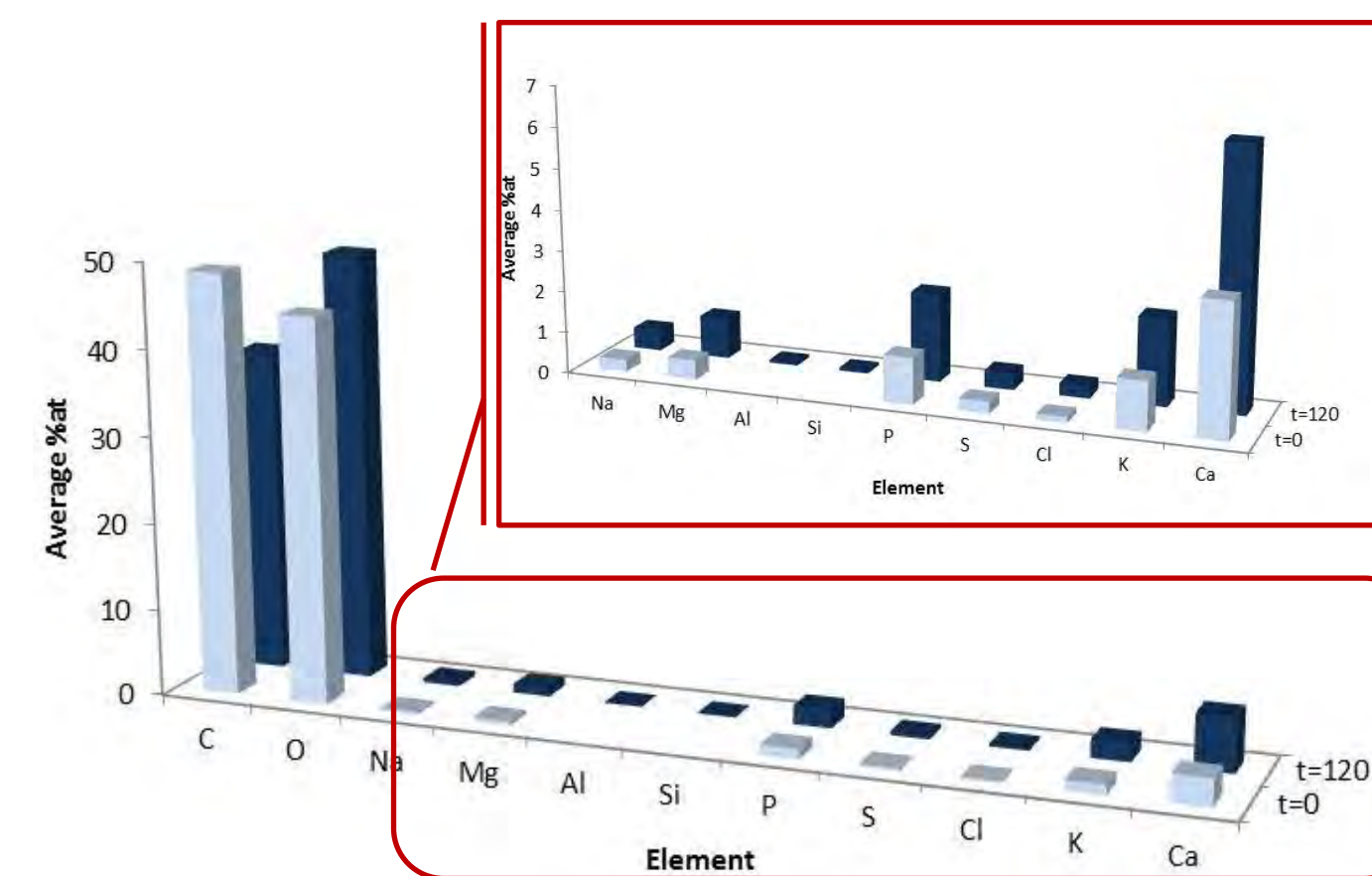


- The main steps of mass loss:
Region I → [0-200] °C: water removal
Region II → [200-360] °C: aliphatic fraction (carbohydrates and alkyl labile systems)
Region III → [360-550] °C: aromatic moieties
Region IV → [550-1000] °C: inorganic components of poultry manure chars
- The inorganic fraction increases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

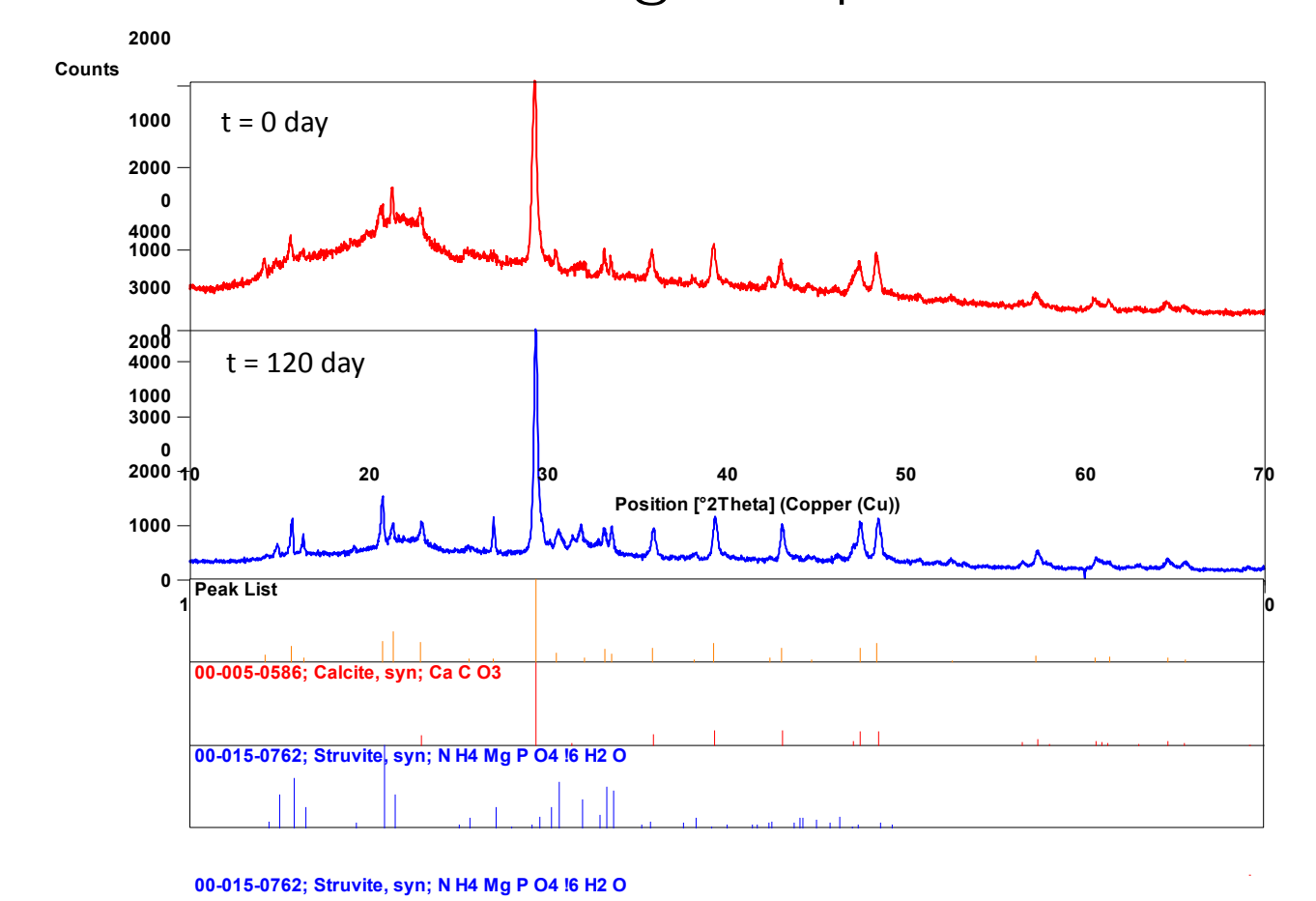
SEM
Morphological and semiquantitative analysis



- **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