Thermogravimetry and FT-IR spectroscopy: efficient approaches for organic amendments stability analysis?

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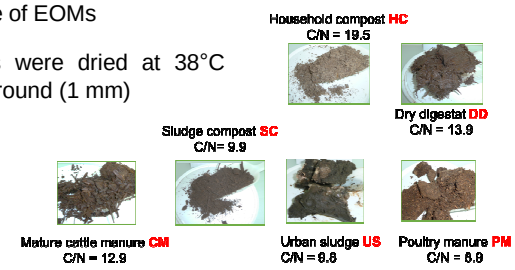
Introduction

- Spreading of exogenous organic material (EOMs) is un opportunity to provide nutrients for crops, improuve soil fertility and decrease chemical fertilizers
- EOMs have different physico-chemical characteristics, which depend on their origin and the processes of their treatments. These characteristics can strongly influence their behavior and nutrient release after spreading
- **Objective :** Develop technical solutions easy to implement and able to predic EOM behaviour in soils

Materials and Methods

- Six organic materials representative of the large classe of EOMs
- EOMs were dried at 38°C and ground (1 mm)



- Three analytical techniques and 4 replicates :

FT-IR spectroscopy : 4000–400 cm^{-1}, resolution set to 4 cm^{-1} and 32 scans recorded

Van Soest biochemical fractionation [1] & 3 days carbon mineralization in soil [2] : biological stability of EOMs **(I_{ROC} indicator[3])**

Thermogravimetric analysis (TG) : Oxidizing atmosphere (80% O_2/ 20% N_2) between 23-900°C, for calculated **thermal stability index R1** **(Fig 1)**

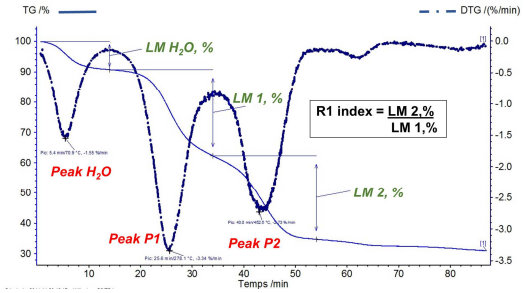


Fig 1. Example of TG profile (TG: loss mass curve,% ; DTG : first derivative, LM% : Loss Mass

Results

FT-IR spectra :

- EOMs show different compositions in biochemichal functions **(Fig. 2)**, specifically in Alipahtic and Amide functions

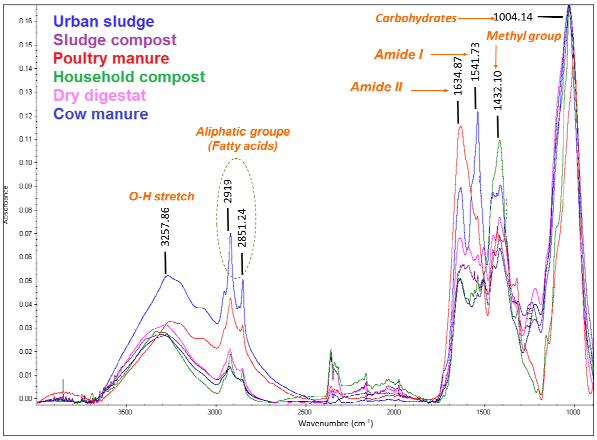


Fig 2. Infrared spectroscopic characteristics for EOMs

TG analysis :

- Two exothermal peaks of combustion: Aliphatic peak (268-300°C) as cellulose and lignocellulosic and aromatic peak (441-497°C) for recalcitrant compound (results not shown)

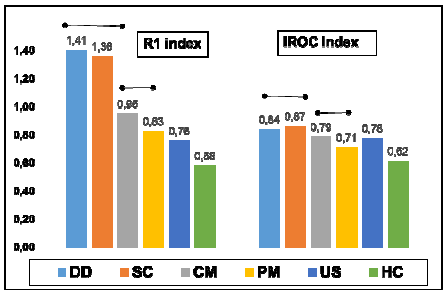


Fig 3. : Stability of OEMs with R1 and I_{ROC} indexes
: sclae of stability

- Similar classification of EOMS stability between R1 and I_{ROC} indexes **(Fig 3)** : **Very strong** (digestat, sludge compost); **middle** (manures), **low** (sludge, household compost)

Conclusions & Perspectives

- TG and IR spectra show they potential to provide a classification of EOMs according to their stability
- FT-IR analysis could be further refined to develop an indicator such as R1 or I_{ROC}
- As a perspective, these approaches should be compared with sequential chemical extractions coupling with 3D fluorescence spectroscopy [4]

[1] Lashermes et al. 2009. Europ. J.of Soil Sci., 60, 297-310 ; [2] AFNOR, 2009. French standard XPU 44-162 ; [3] AFNOR, 2009. French standard XPU 44-163 ; [4]. Jimenez, J. et al. (2014). Water Res. 50, 359–72.

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