Long-term biodegradability of Poly-Lactic Acid (PLA) in soil by measuring carbon dioxide evolution in a closed system

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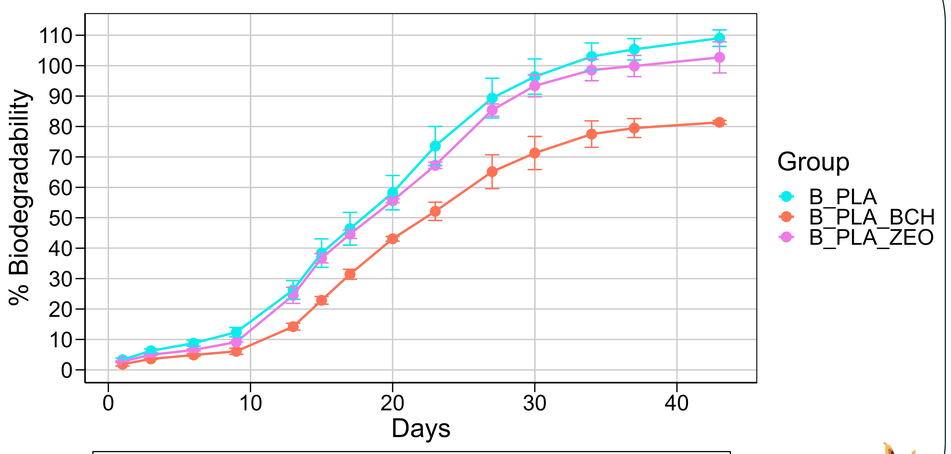
Modified method ISO 14855-1:2012

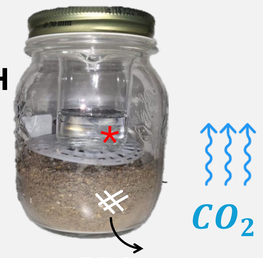
CONTROL: Biodegradability of PLA in composting conditions



- PLA in composting conditions has 100% biodegradability (control)
- T °C= 58
- No light

Method ISO 17556:2012

1 CO_2 evolution in closed chamber



Experimental Groups

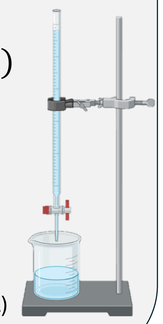
BLK	Soil
ZEO	Soil + Zeolite (10%)
BCH	Soil + Biochar (10%)
CELL	Soil + Cellulose (10%)
PLA	Soil + PLA net
PLA_ZEO	Soil + PLA net+ Zeolite
PLA_BCH	Soil + PLA net+ Biochar

2 Titration with HCl for measuring CO_2 mg

$$mmolCO_2 = (V_{HCl}) \times (M_{HCl})$$

$$mg\ CO_2 = mmolCO_2 \times 44$$

$\boldsymbol{V_{HCl}}$ = ml of HCl used for titration
$\boldsymbol{M_{HCl}}$ = HCl Molarity (mol/L)
44 = CO_2 molecular weight (g/mol)



3 Measurement of the % of biodegradability of PLA through CO_2 emissions

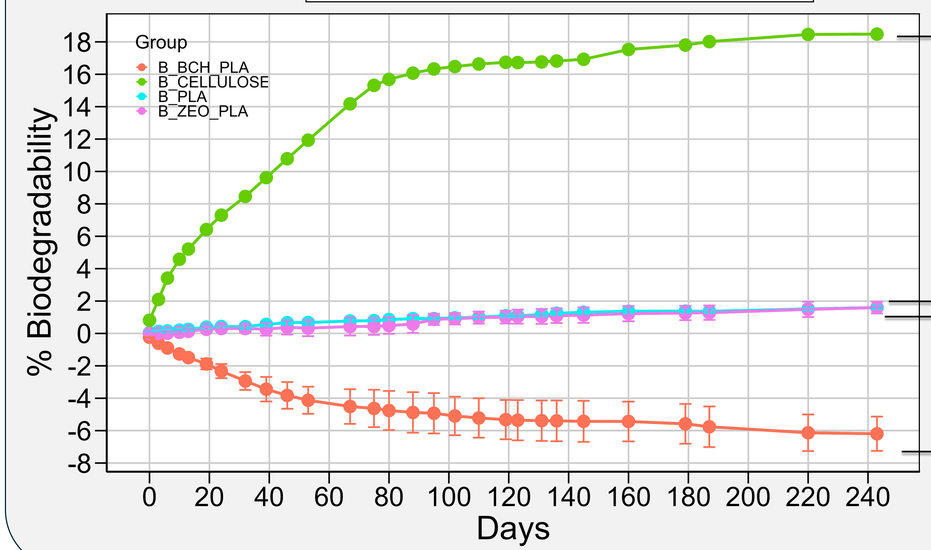
$$ThCO_2 = S \times TOC(\%) \times \frac{44}{12}$$

$$\mathbf{B\ \%} = \left(\frac{\boldsymbol{mg\ CO_2}}{\boldsymbol{ThCO_2}}\right) \times \mathbf{100}$$

$\boldsymbol{ThCO_2}$= theoretical amount of evolved CO_2
S = amount of PLA in closed chamber (mg)
TOC = TOC of plastic material (PLA) or reference material (Cellulose) divided by 100
12 = C molecular weight (g/mol)
B% = percentage of Biodegradability

4 Biodegradability of PLA in different soil conditions

- 243 days (now) – end of experiment: 14/07/2025 (365 days)
- T °C= room temperature
- No light



Cumulative CO_2 emissions per *g* of soil in different conditions