

Supplementary information

Michaelis Menten Model

A model of enzyme biodegradation based on the Michaelis-Menten equation was also used to reprocess the data, applied in its linearized form according to a Lineweaver-Burk plot.

$$\frac{1}{v} = \frac{1}{v_{max}} + \frac{K_M}{v_{max}[S]} \quad \text{eq. 6}$$

This model then furnishes the maximum speed of biodegradation of the substrate. The biodegradation rate as a function of the concentration of the substrate can also be calculated.

Values were calculated for the rate of product formation as incremental ratio between the amount of CO₂ formed and the time interval considered. The reciprocal of this speed has been reported as a function of the reciprocal of the mass of substrate (polymer) residue at the considered time *t*. The approach is simplified, since it should consider the concentration, unknown, of the polymer. It is assumed, however, that the dilution of the polymer in compost remains approximately constant and therefore we made use of the only known datum, *i.e.* the mass of polymer. The data of formulate A are represented by a non-linear diagram.

A non-linear pattern was obtained, which did not significantly improve even limited to the apparently linear zones. The linearisation, even with the approximation of the case, indicated a maximum rate of biodegradation of *ca.* 14 mg/day. Calculating the speed corresponding to a 50% biodegradation, it would take 27 days to get a conversion of 50 % that roughly represents the experimental value.

The linear regression of the data for the B formulate was applied only to the first data subset and led to a forecast of the half-life of *ca.* 8.5 days, to be compared with the experimental value of 9 days.

Finally, the application of the Michaelis Menten approach through the Lineweaver Burk linearization applied to the C formulate returned a maximum rate of biodegradation of *ca.* 12.8 mg/day. The forecasted time for 50% degradation in such a case would be 7 days, which is of course much underestimated with respect to the experimental value.

Zero and second order kinetics

The degradation data for material A have been regressed according to an integrated zeroth order kinetics through the formula:

$$m(t) = m^{\circ} - kt$$

Plotting the residual mass of the polymer vs. time did not return a linear plot, so this approach was not considered appropriate.

Second order kinetics with respect to the substrate was also tested through the following integrated kinetic equation:

$$\frac{1}{m(t)} = \frac{1}{m^{\circ}} + kt$$

Also in this case the results were not correctly linearized, so also this approach was abandoned. The same zeroth and second order models were unsuitable for linearization of the kinetic data of materials B and C.

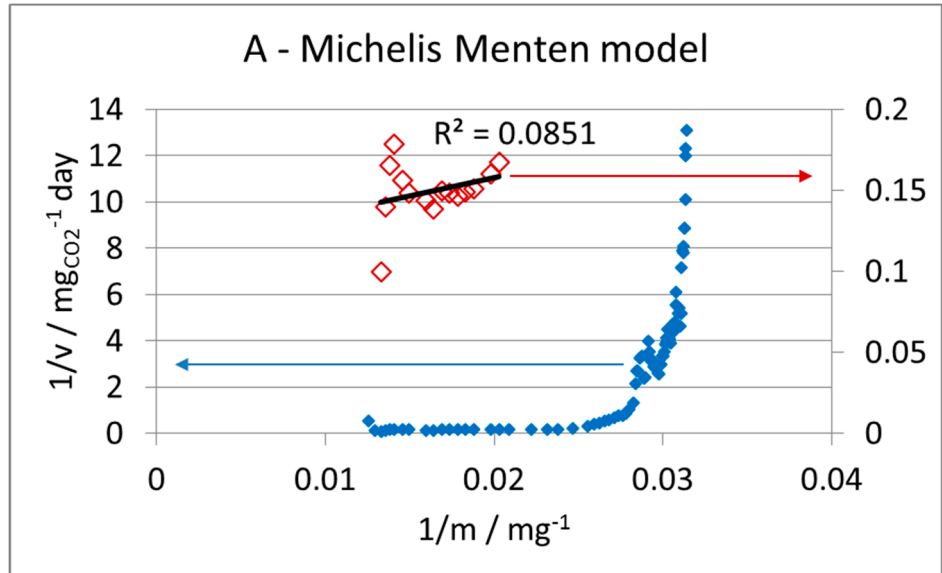


Figure S1. Michaelis Menten elaboration according to a Lineweaver Burk plot of the biodegradation data of material A. Red void symbols represent a zoom of the linearization used.

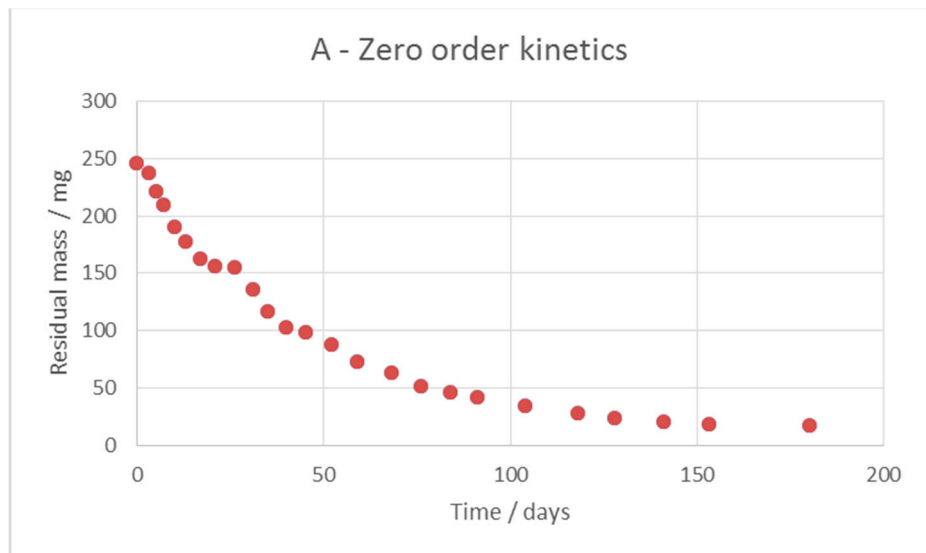


Figure S2. Zero order kinetic equation for the biodegradation data of material A.

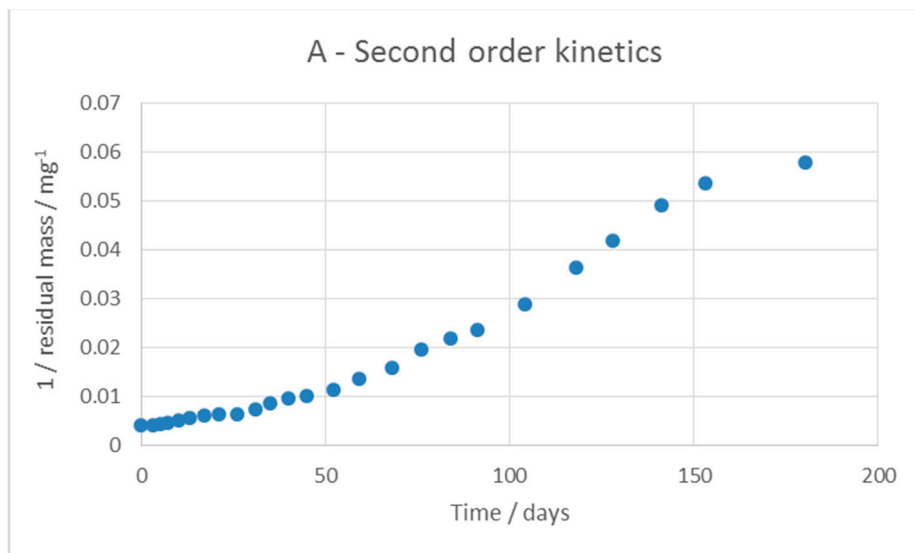


Figure S3. Second order kinetic equation for the biodegradation data of material A.

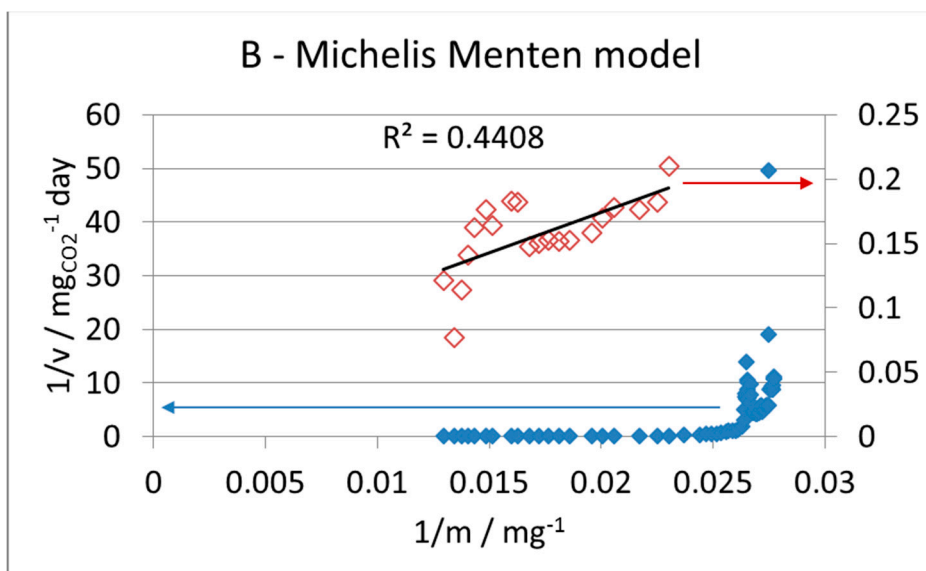


Figure S4. Michelis Menten elaboration according to a Lineweaver Burk plot of the biodegradation data of material B. Red void symbols represent a zoom of the linearization used.

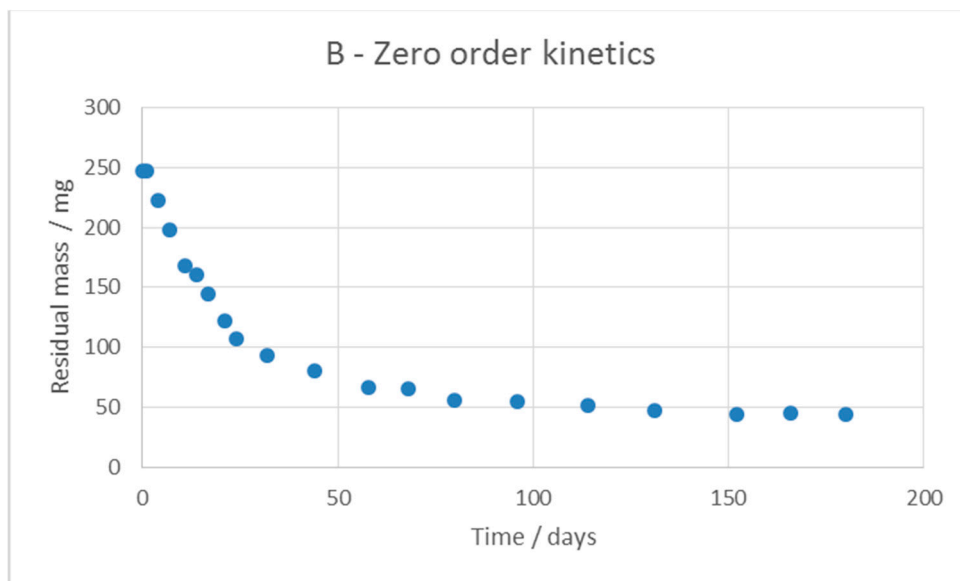


Figure S5. Zero order kinetic equation for the biodegradation data of material B.

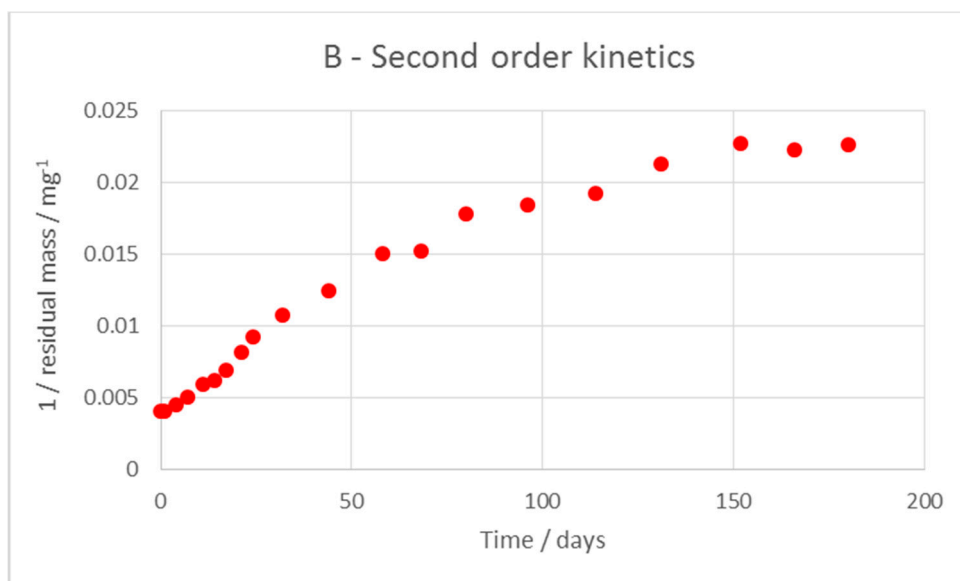


Figure S6. Second order kinetic equation for the biodegradation data of material B.

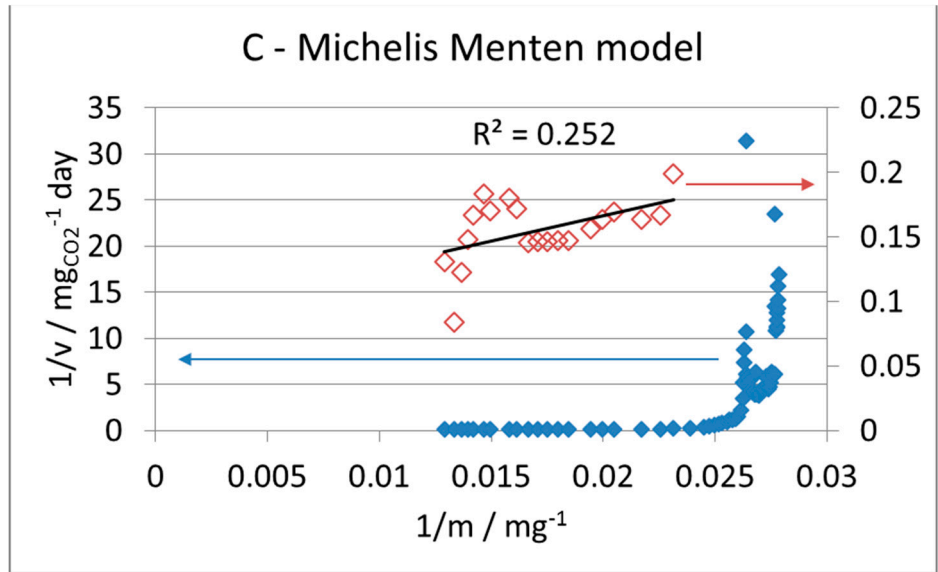


Figure S7. Michelis Menten elaboration according to a Lineweaver Burk plot of the biodegradation data of material C. Red void symbols represent a zoom of the linearization used.

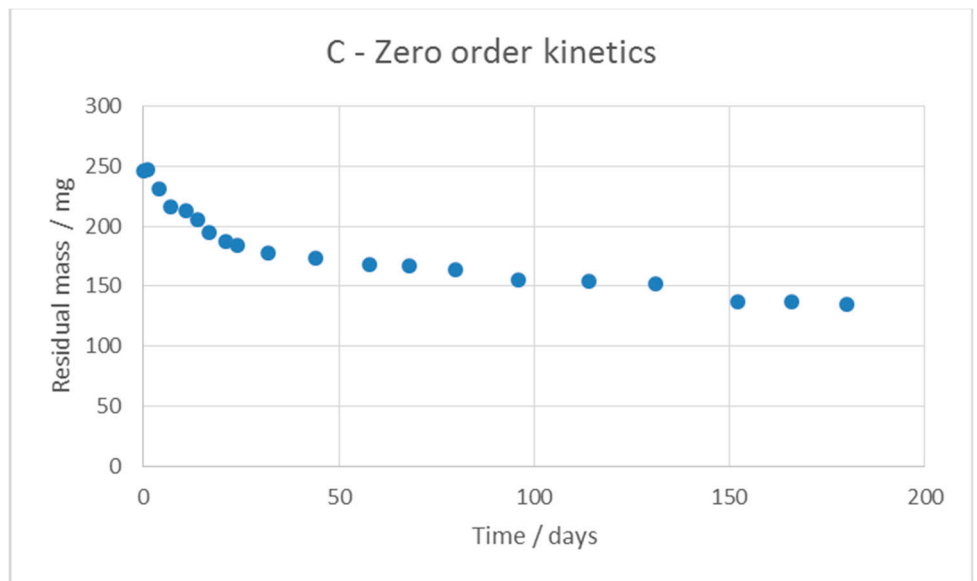


Figure S8. Zero order kinetic equation for the biodegradation data of material C.

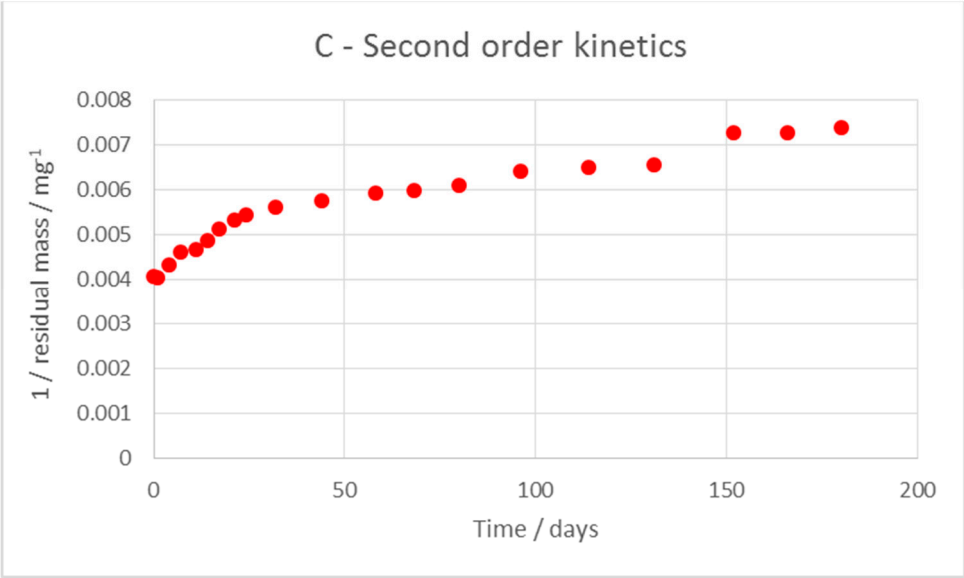


Figure S9. Second order kinetic equation for the biodegradation data of material C.