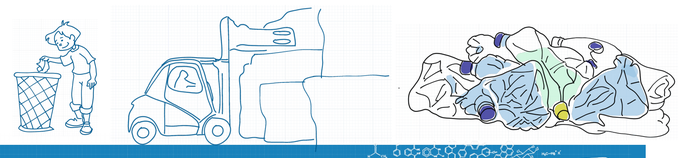
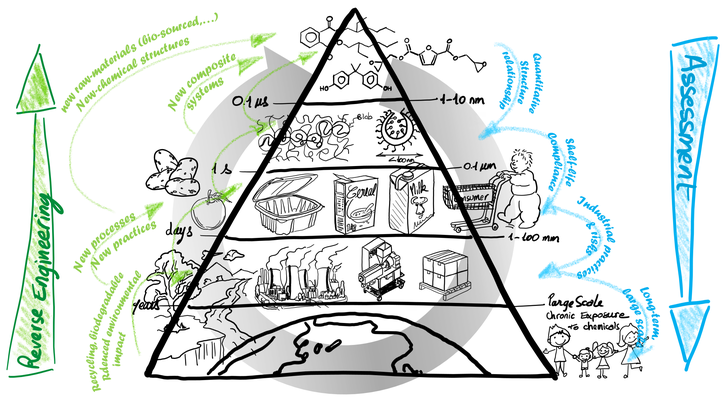
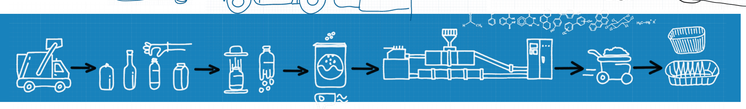
CROSS-CONTAMINATION OF PACKAGING
MASS TRANSFER WITHOUT CONTACT





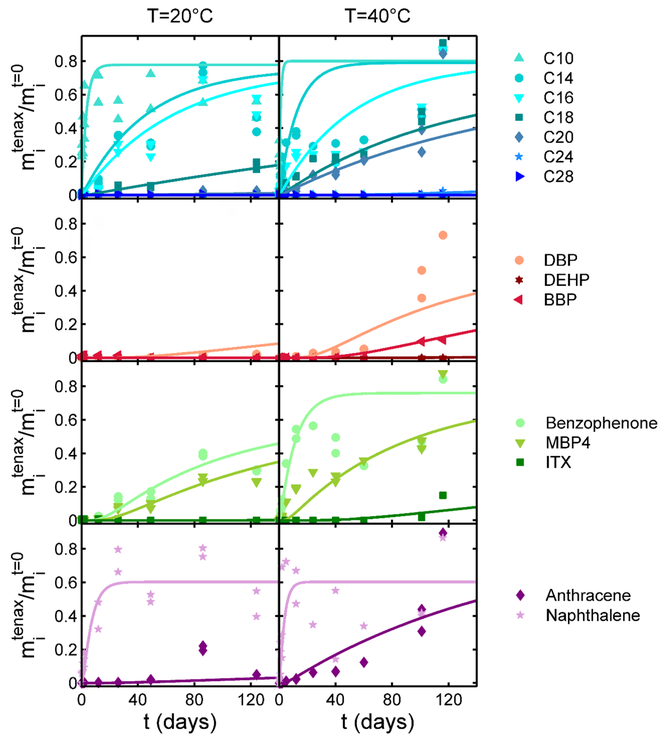
Summary



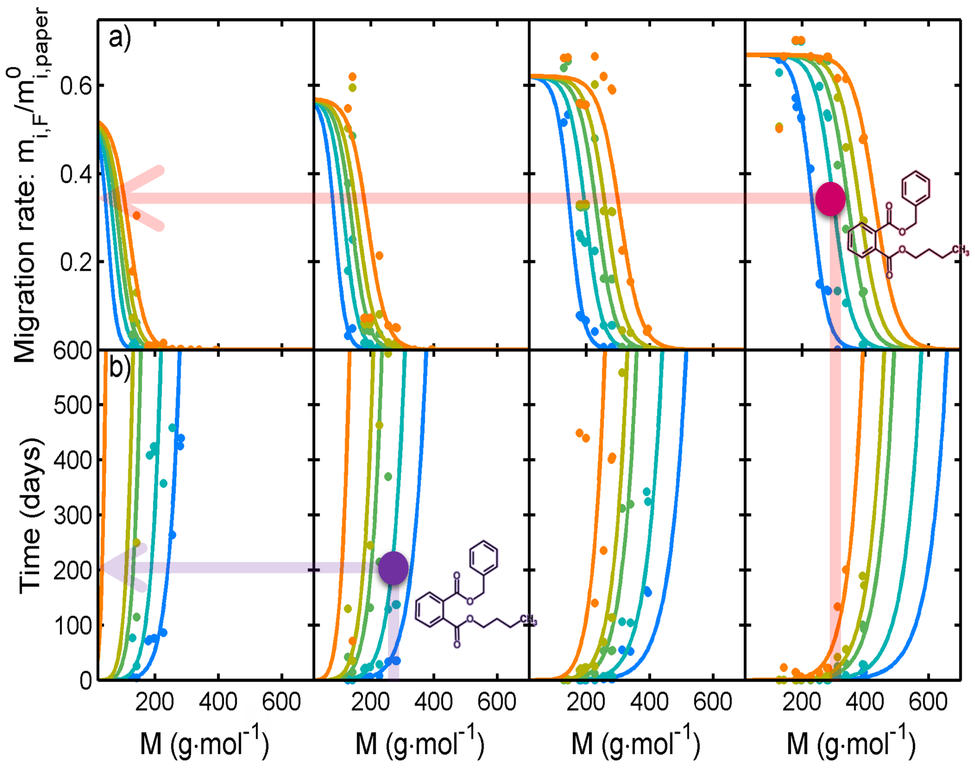
In circular economy, cross-mass transfer are ubiquitous and may be the dominating cause of non-intentionally added substances (**NIAS**) in recycled streams. They have been studied in situations where their consequences are dramatic due to the presence of food or sensitive content (biotechnological applications). They tend to occur against intuition even without contact and across barrier materials. Little was known before their underlying characteristics were determined by us. They motivated the authorities to consider secondary and ternary food packaging materials (mainly cardboard) as a potential source cardboards NIAS and mineral oils.

Contamination from secondary cardboard packaging (across a plastic film)

(A) Migration kinetics (simulated and experimental) from carboard, through 50 µm boPP (no contact)



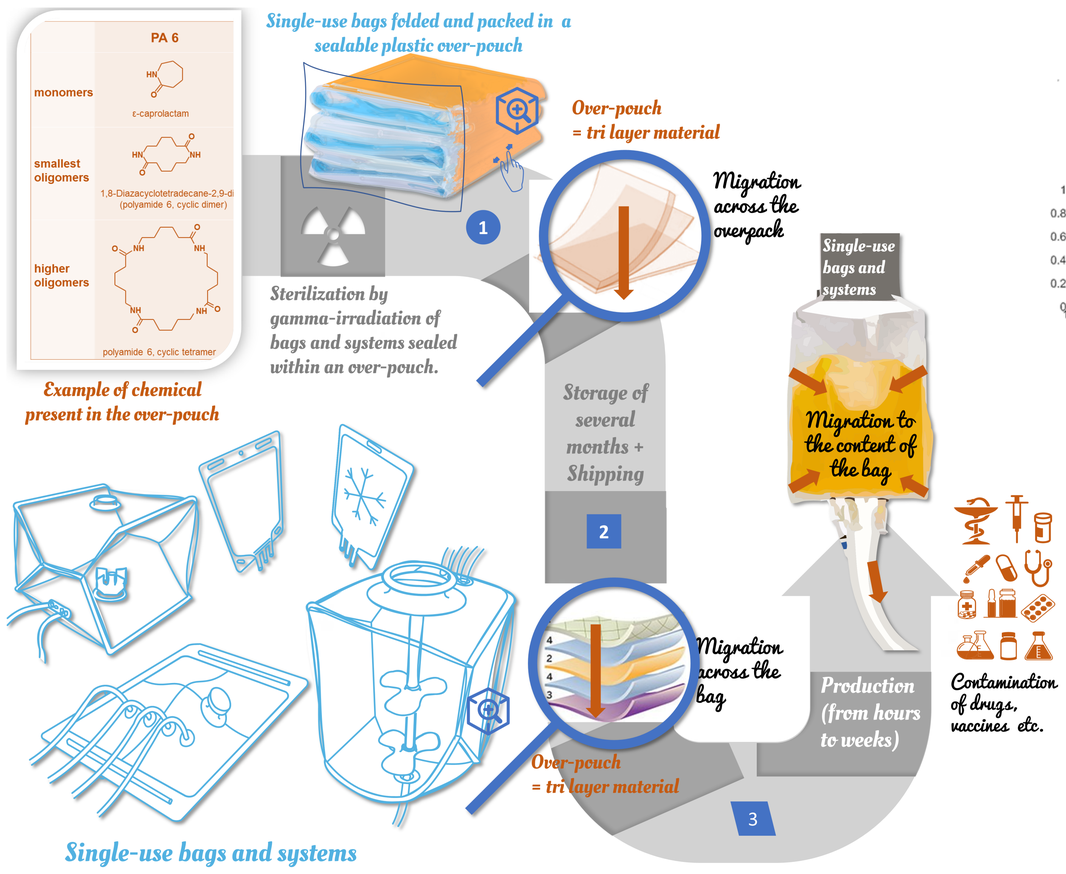
(B.a) Averaged iso-time and (B.b) iso-migration curves,

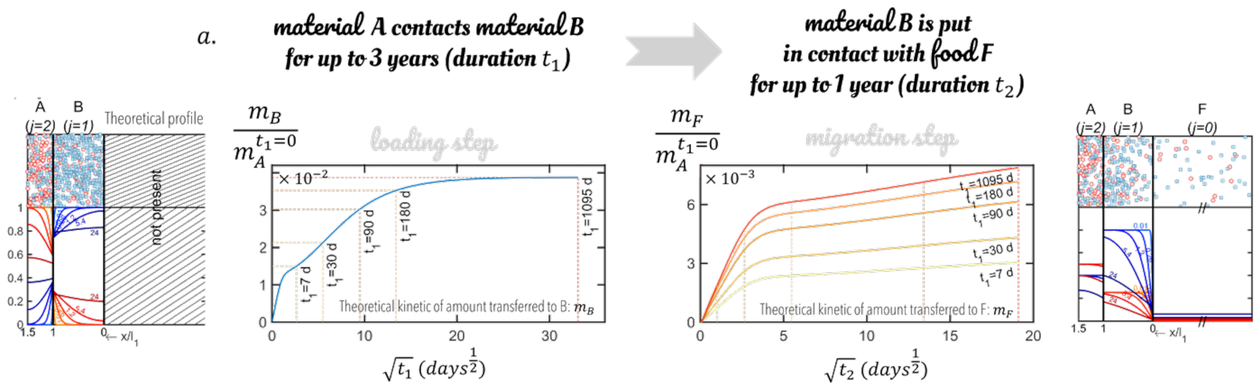


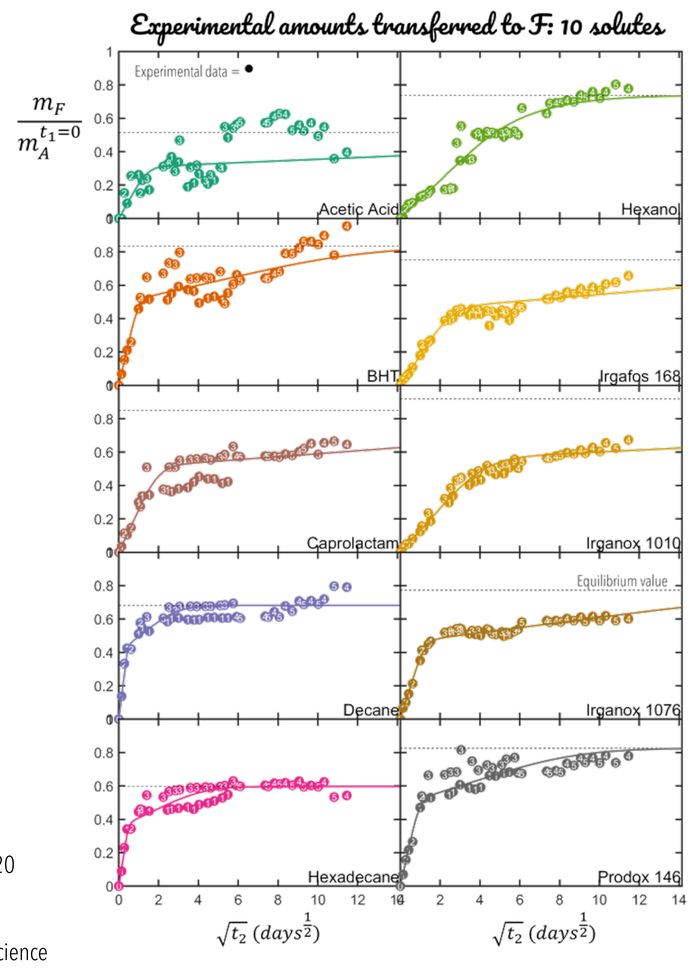
Temperature fluctuations and heating accelerates dramatically the risk of cross contamination. Functional barriers are mandatory for recycled P&B

(A) migration kinetics of n-alkanes (C10-C28), phthalates (DBP: dibutyl phthalate, DEHP: di-2-ethylhexyl phthalate, BPP: benzyl and butyl phthalate), photoinitiators (benzophenone, MBP4 : (4-methylphenyl) (phenyl) methanone, ITX: 2-Isopropyl-9H-thioxanthen-9-on) and aromatic mineral oils (anthracene and naphthalene) in a dry food simulant (Tenax©) through a bioriented-air polypropylene air-film system. The symbols represent the experimental points and the continuous curves the predictions of FMECAengine. (B) Mean abacus for the 15 studied substances. Detailed simulations are represented by the symbols.

Delayed contamination from the overpackaging in biotech applications







The figure illustrates the migration in ethanol 95% (***F***) of different surrogates present only in the material ***A*** (overpackaging).

a. Theoretical description of cross mass transfer during the "loading" and "migration" steps. Note that ***A*** (overpackaging) and ***B*** (packaging) are multilayer structures put in contact without strong pressure.

b. Corresponding experimental values after 6 months (t_1) of loading.

Cross-mass transfer may have consequences much later in the supply chain even if the source of contaminants has been removed. It is essential to lower contact times and keep distances between non-food grade materials (collected, recycled, printed, etc.) and food-grade contact layers.

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