

Biotic and Abiotic degradation of rubber compounds: establishing a baseline and assessing the changes on rubber surface and bulk



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Elastomeric polymers: what about regulations?



Among synthetic polymers, plastics dominate over rubber-like materials. As a result, extensive efforts have been made to study plastic degradation, leading to the development of international standards for assessing their degradation and biodegradability. In contrast, our understanding of elastomeric polymers degradation remains limited. Recently, Tyre and Road Wear Particles (TRWPs) have received growing attention.

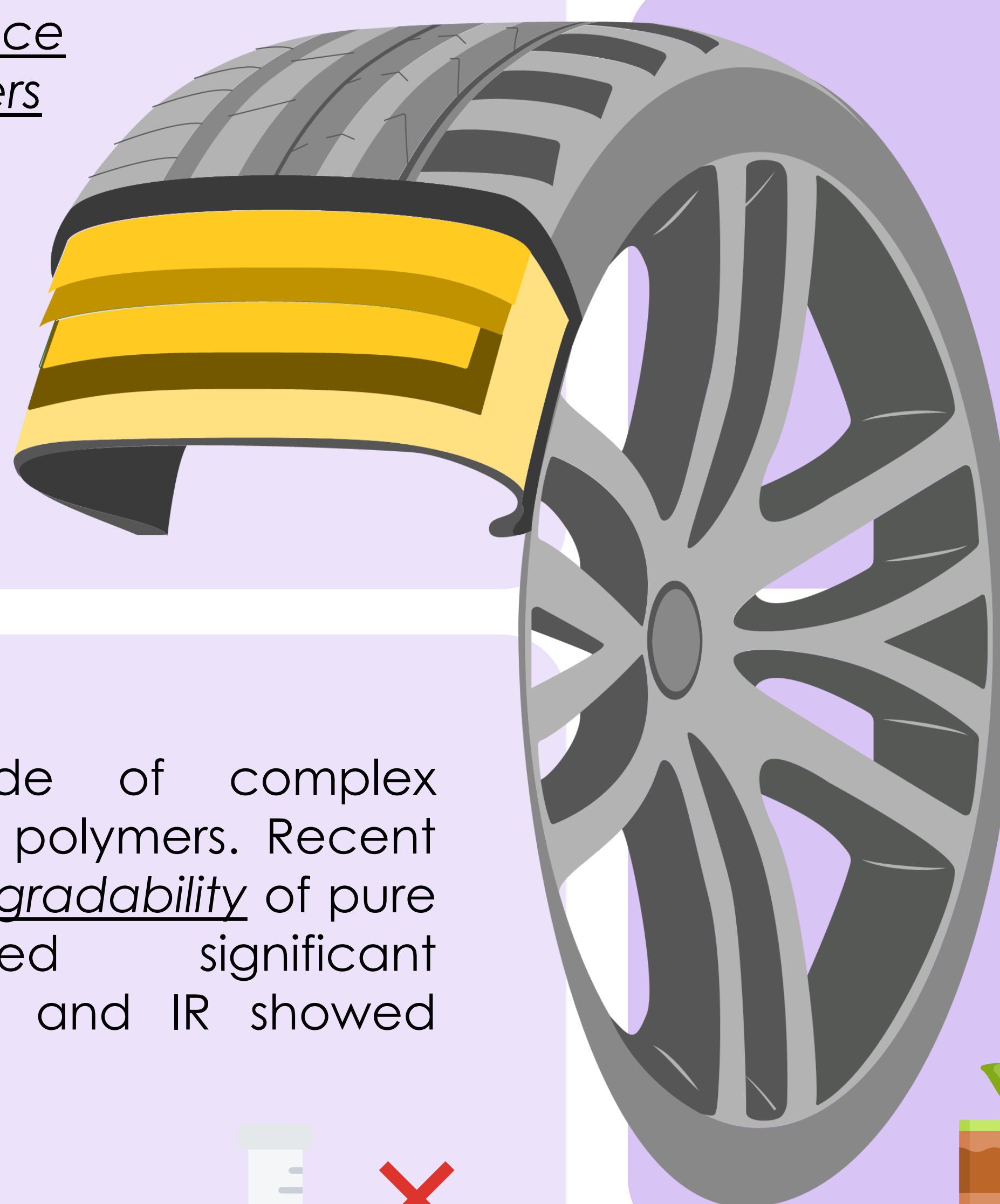
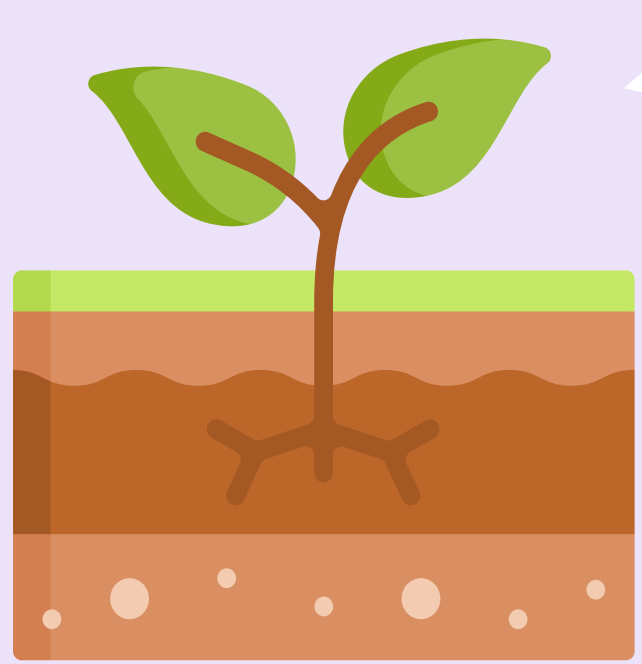
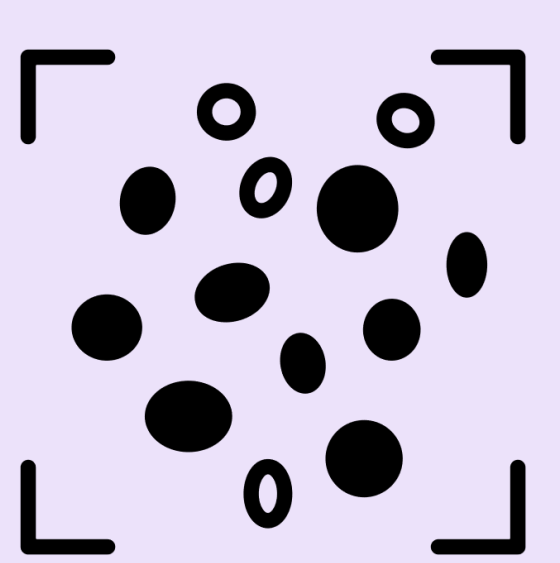
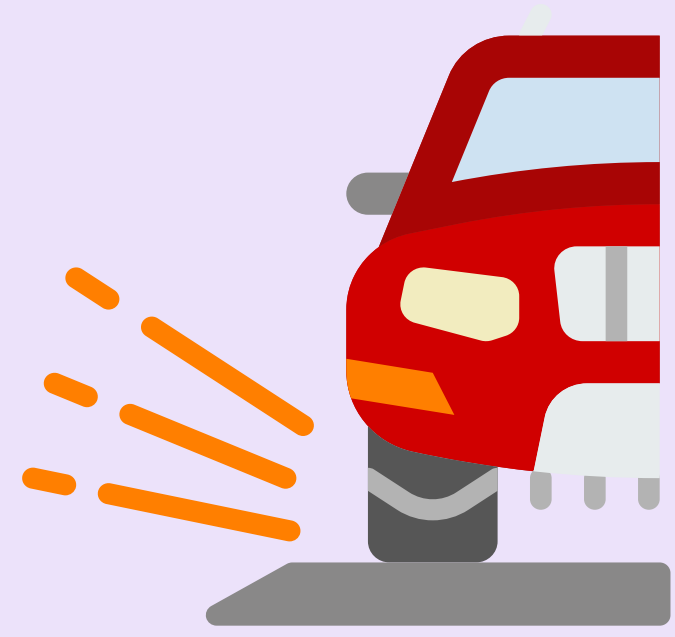


Background:

TRWPs origin & dispersion

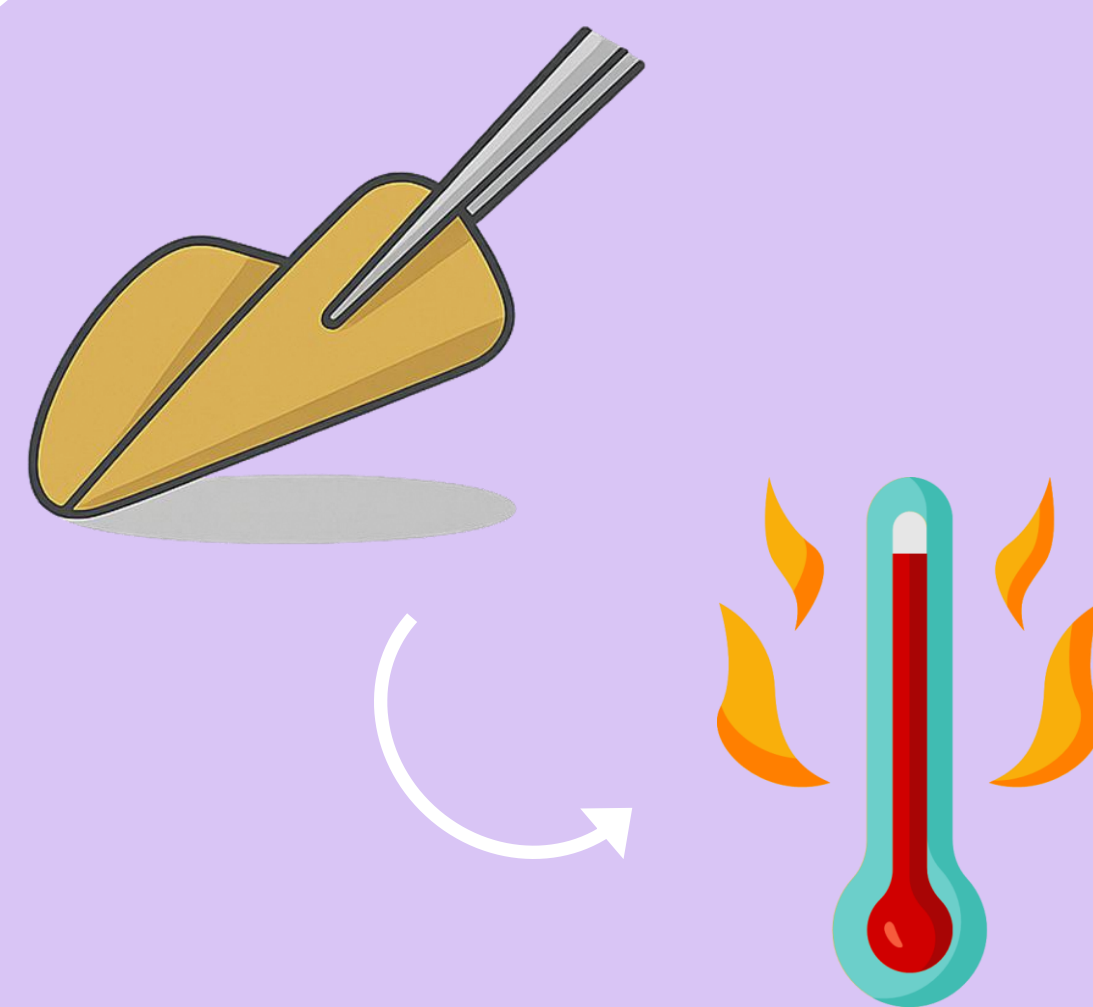
TRWPs consist of tread-derived materials mixed with road-origin particles. The majority of TRWPs accumulate in soil, while a smaller fraction is released into surface waters.

66-76% → soil
 12-20% → surface waters



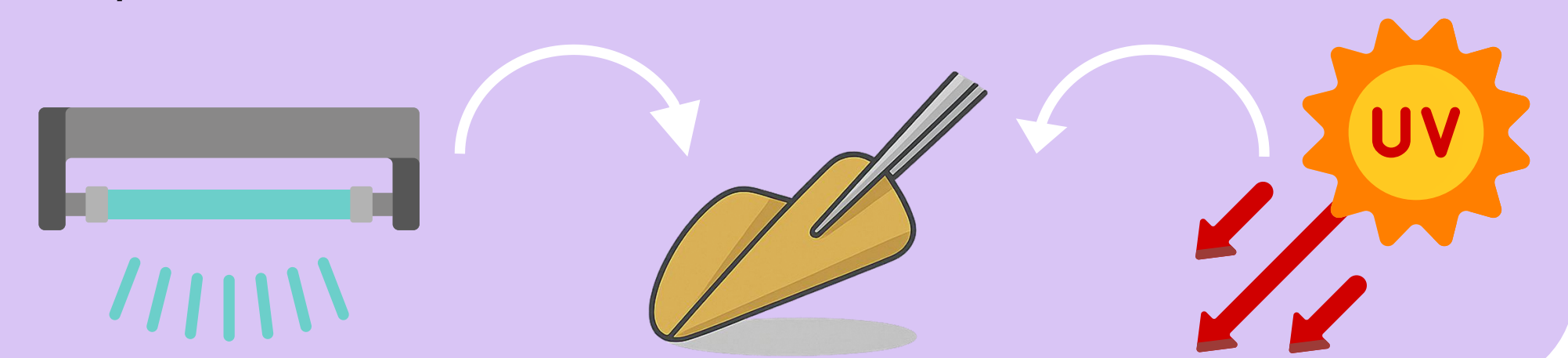
Experimental approach

Given the limited understanding of how degradation affects pristine vulcanized rubber compounds (not pure elastomers), we present a multidisciplinary approach to study their photo- and biodegradation in film form.



Abiotic degradation

Photo-oxidation, the main weathering process affecting TRWPs, was used to simulate environmental ageing of rubber compounds, via UV irradiation.



Background: previous studies

Tyre treads are typically made of complex formulations based on elastomeric polymers. Recent studies have investigated the biodegradability of pure elastomers. These confirmed significant biodegradation of NR, while SBR and IR showed negligible biodegradation rates.

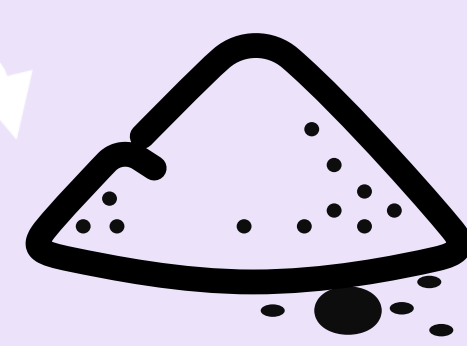
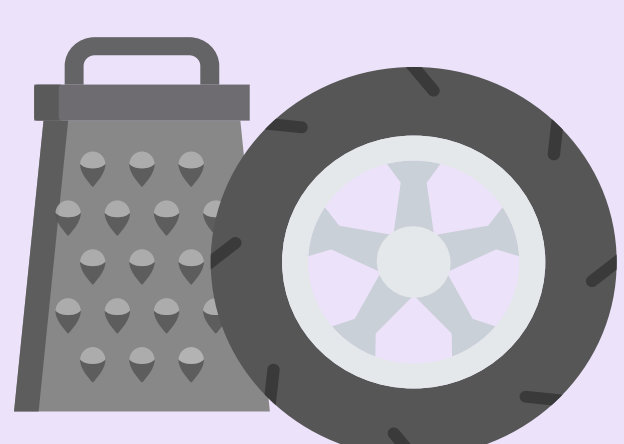


NR= natural rubber

SBR= styrene butadiene rubber

IR= isoprene rubber

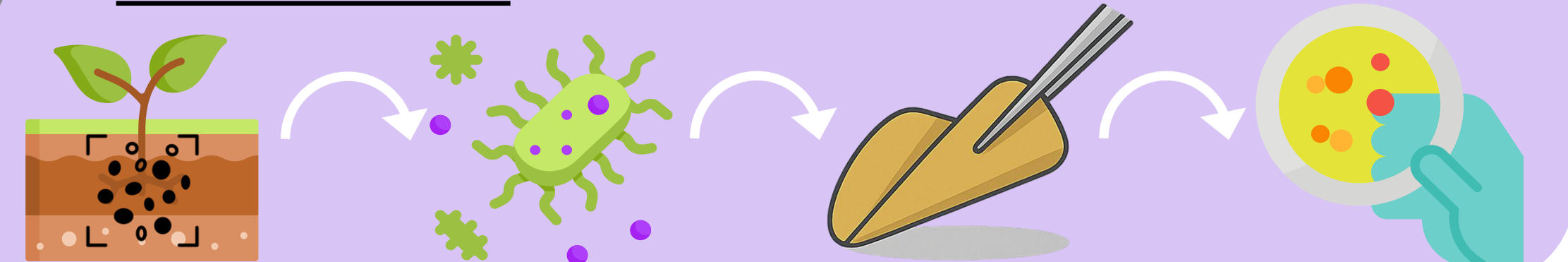
Milled rubber from used tyres or pure elastomers does not fully represent the complexity and heterogeneity of actual TRWPs.



NOT FULLY REPRESENTATIVE

Biotic degradation

Microbial consortia were enriched from soils potentially exposed to TRWPs by using rubber compounds as the sole carbon source, promoting the growth of polymer-degrading communities.



Bulk & surface analyses



Py-GC/MS

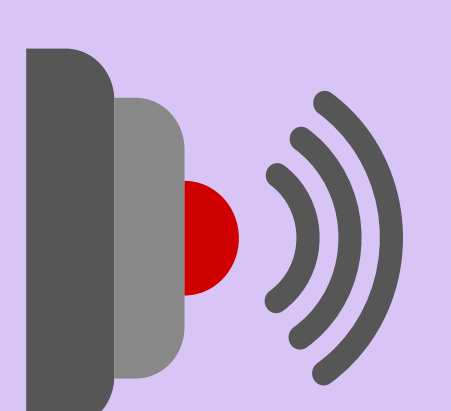


Weight-loss & TGA

SEM imaging

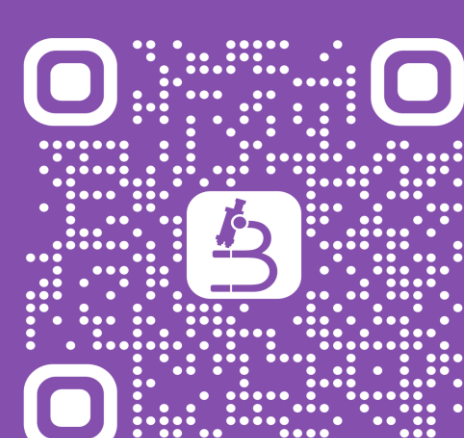


FT-ATR IR



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