Leaching of additives and fragmentation of plastics in semi-terrestiral environments

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The pervasive use of plastics together with inadequate waste management has led to a global contamination of ecosystems with end-of-life plastic products. Global plastic pollution has been shown to pose a planetary threat because it is causing planetary-scale exposure that is not readily reversible. Plastic particles released in the environment are subjected to various aging process including biotic (biofilm formation) and abiotic aging (UV radiation, oxidation, and physical stress). These processes lead to an alteration in the physical and chemical properties of the polymeric particle and may ultimately result in an embrittlement and fragmentation. The additive release in turn depends on the chemical compatibility of the additive with the polymer, the exposure and aging of the plastic in the environment, and the type of bonding between the additive and the polymer (chemical or physical). The aging of plastic particles under environmental conditions, the leaching of plasticizers, and the fragmentation of are some of the most pressing research priorities in microplastic exposure and risk assessment.

In this contribution, the current understanding of abiotic polymer aging and its role in the release of polymer plasticizers will be addressed for the example of polyvinyl chloride (PVC). While the release for example of bis(2-ethylhexyl) phthalate (DEHP) from PVC used as medical devices (e.g. blood bags) or children articles has been studied quite intensively there is very little information on the release of plasticizers from PVC plastics into aquatic environmental systems, and how aging influences polymer properties and additive release. Results from a recent mescocosm study within the AQACOSM project will be presented, where these processes were investigated for PVC plastic testbodies containing two most commonly encountered additives using stream pond systems mimicing semi-terrestrial environments.