# Experimental Parameterization of Microplastic Fragmentation and Degradation to Develop a Mechanistic Model of Micro- and Nanoplastic Fragmentation in the Environment

Katherine Santizo*†[1], Patrizia Pfohl[1], Wendel Wohlleben[1], Sam Harrison‡[2], Richard Cross[3], Joana Sipe[4], Mark Wiesner[4], Antonia Praetorius[5], Gbotemi Adediran[3], Brandon Lopez[4], Charlotte Catrouillet[5], and Claus Svendsen[3]

[1]BASF SE – Carl-Bosch-Strasse 38, 67056 Ludwigshafen, Germany
[2]UK Centre for Ecology and Hydrology – Lancaster, United Kingdom
[3]UK Centre for Ecology and Hydrology – Wallingford, United Kingdom
[4]Duke University – Durham, NC, United States
[5]University of Amsterdam – Amsterdam, Netherlands

**Abstract**

Microplastic abundance in the environment has been concerning thus there is a need to understand their pathways and rates for fragmentation and degradation in the environment. However, studies that provide data on rates in a systematic approach differentiating the rates related to specific degradation stressors is limited, and often confound multiple stressors. In this study we aim to address fragmentation and degradation of microplastics by stressing plastics with varying resiliency under different environmental conditions (LDPE, PP, HIPS, PU, PET, PLA, and PA). Using ISO4892, we subject microplastic powder at homogeneous UV intensity to varying exposure time, temperatures and relative humidity conditions. An adaptation of the OECD Hydrolysis Guideline (OECD Test No. 111) is also used to observe fragmentation and degradation of the microplastic powder over time under different pH, salinity, and temperature. To assess the pathways and quantify the rates, multiple analytics are utilized. The NanoRelease protocol, ISO22293:2020, was adapted to quantify the smallest fragments, 10nm to 1$\mu$m, thus allowing to show micro- to nano-plastic fragmentation. Chemical degradation is assessed via ATR-FTIR, TOC, and GPC analysis. In addition, microplastic fragments between 1-100 $\mu$m are analyzed with a particle counter. Preliminary results following two UV stresses show that HIPS and LDPE had the largest fragmentation with large particle counts in the size class of 1 and 2 $\mu$m while PP was most resilient with little to no fragmentation at these size classes. PP also had small changes in its Carbonyl Index whereas TPU and HIPS had the largest changes over UV exposure time. These information on fragmentation and chemical degradation per exposure allows rates to be developed for each polymer which can be implemented into models to understand and predict microplastic fragmentation in different environmental compartments. This is the ultimate goal of our collaborative project "cefic LRI ECO59, FRAGMENT-MNP".

*Speaker
†Corresponding author: katherine-y.santizo@basf.com
‡Corresponding author: sharrison@ceh.ac.uk

**Keywords:** microplastics, nanoplastics, fragmentation, degradation