Session: 3.07.P Beyond Microplastics: Analytics, Environmental Fate and Impacts of (Water-Soluble) Polymers and Biodegradable Polymers
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Development of a Modified Screening Method for Degradation of Polymers and Validation with ^{14}C-labelled Alginate

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The fate of polymers has been in the focus of the new restriction (Commission Regulation (EU) 2023/2055) issued by the European Commission on intentionally added microplastics to products used for specific purposes. The restriction is based on the biodegradation of polymers, which is determined with the help of OECD test guidelines (TG), for example TG 301 and TG 307. It only considers synthetic polymers. Therefore, producers strive to shift to natural polymers, which are considered degradable by default, and those synthetic polymers which show proof of fast biodegradation. The biodegradation rate and formed degradation products of a synthetic polymer are mostly unknown. During product development a fast screening is needed to obtain a projection of the polymer's biodegradation potential to decide if the polymer can be considered for the product.

In order to address the degradation of polymers a modified screening method has been developed, based on the OECD 301B guideline. As modifications the test volume was reduced, the duration of the experiment was shortened and a different measurement endpoint was chosen, which led to an adjusted experimental set-up. The chosen set-up saves time and space. Instead of the mineralisation the recovery of the total organic carbon content is measured. The modified screening method showed comparable results to the OECD 301B guideline and can be used to quickly determine if further testing for a polymer during product development is relevant.

For validation of the modified screening method ^{14}C-radiolabelled sodium alginate was used. The synthesis of the labelled alginate was done by a nucleophilic substitution (S_N2) of the alginate's hydroxyl groups with ^{14}C-labelled 2-bromoethanole. Post-synthetic chemical modification of polymers may represent a facile access to different natural ^{14}C-labelled polymers. Care must be taken to reduce the impact of the derivatisation on the physico-chemical properties and the biodegradation of the polymer. However, if performed successfully the resulting ^{14}C-labelled polymers can significantly improve the determination of the environmental fate of polymers. Details of the synthesis procedure and characterisation will be presented as well as the results of the validation experiments.