Development of new microplastic reference particles of different polymer types, shapes and sizes in pre-defined numbers

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Abstract

Today a variety of different techniques for sampling, extraction, purification and analysis are used in microplastic (MP) research hampering comparability between data sets. One essential basis for the evaluation and harmonization of different methods would be reference MP particles of different polymer types, sizes and shapes which can ideally be added to samples as a standard in an exact number. Although this has widely been recognized, MP reference systems beyond microbeads are not commercially available. Manual addition of a precisely defined number of MPs as a standard is inefficient, and the alternative use of MP suspensions always result in a particle concentration with a certain standard deviation. MPs of different plastic types, sizes and shapes can behave differently during sample preparation due to their properties such as density or surface charge. Thus, reference MPs with exactly defined numbers and properties are required to evaluate effects on recovery rates and analytical quality during MP analysis. Our goal was to develop a workflow for the production of reference MPs which can be I. designed with variable properties, II. are mounted in a soluble matrix and III. can be added to a sample in a predefined number. For this we tested two techniques: 3D-Printing and CNC milling of plastic columns with a small diameter followed by gelatin embedment and cryosectioning. Especially for smaller particle sizes ($<$ 400 μm) CNC milling was more promising. Using our approach we can define size, shape, number, and chemical composition of the MPs. We successfully produced coin and square shaped MPs in a size range of 80 - 1000 μm of five different polymers. Our approach also allows for adding fluorescent dyes or other markers to the MPs and thus opens possibilities for different studies from MP uptake to transport beyond analytical method validation.

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