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Analytical Methodologies for Monitoring Micro(nano)plastics: Which are Fit for Purpose?

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Abstract

Since 2004, when microplastics appears in literature, thousands of researchers focussed on this topic and analysed microplastics in almost every environmental compartment. However, there is still a lack of standardisation, and therefore, used methodologies varied widely. Most researchers performed controversially discussed visual examination, but it became more and more a supporting tool to reduce measuring effort. To that account, especially infrared or *Raman* microscopy were used for chemical characterisation. This indicates that dimensions of analysed microplastics changed to micrometre scaling. However, those microscopy technologies were used for particle by particle characterisation, and therefore, it is still challenging to handle the mass of data. Alternatively, thermal extraction and desorption gas chromatography is a useful integrating analysis approach, which allows a multicomponent characterisation of environmental samples without any complex sample preparation.

Keywords: Microplastics, Nanoplastics, FTIR, Raman, Overview

1. Introduction

Since 2004, when *Thompson* [1] and colleagues pointed up marine microplastics as a new problem of high concern for our global ecosystems, over 2100 researchers published approximately 600 scientific articles on this topic (*web of science*)[1]. In this context, microplastics identification within a broad variety of environmental compartments e.g. aquatic systems, sediments or organisms is an important aspect [2]. However, researchers criticise the lack of standardised analysis techniques and protocols which lead to insufficient result comparability [3–5], or even worse, uncertain conclusions [4, 6]. Therefore, we have worked through more than 170 peer reviewed research papers that were published between 2015 – 2017 and deal with microplastics analysis to figure out, how identification of microplastics is currently performed. However, before starting to analyse microplastics, overriding objectives should be defined in the first place, because each method provides different kinds of information. Respecting this, a representative cross-section of analytical methods for microplastics is presented within this article with a special focus on the key question: *Which method can be used to analyse a certain type of microplastics and what kind of information can be obtained by its using?*

2. Current State & Techniques of Microplastic Analysis

2.1. Microplastics ≠ Microplastics: A Question of Size

When looking for a definition of microplastics to find adequate analytical methods, there exists not one but many different approaches [7–11], which is not surprising as most microplastics are unique. However, there is one aspect, all researchers can agree with: a practical identification method for microplastics is always connected to their dimensions [6, 7, 9]. According to this, the smaller microplastics are, the more demanding analysis will be. This means that in case of real microparticles, spectroscopic measurements or comparable alternatives are unavoidable [9]. Conversely, visual inspection of large microplastics often fits the purpose, and there exist suitable identification protocols that allow accurate analysis [7–11]. Although accuracy should always be the most prioritized objective, analysis of microplastics is a high sample throughput task, and therefore, practicability becomes very important. All those aspects suggest that particle dimensions determine the identification method.

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[1]Keyword: microplastics, time range: 2004 – 2017, URL: http://www.webofknowledge.com

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