

Quantitative assessment of visual microscopy as a tool for microplastic research: Recommendations for improving methods and reporting

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ABSTRACT

Microscopy is often the first step in microplastic analysis and is generally followed by spectroscopy to confirm material type. The value of microscopy lies in its ability to provide count, size, color, and morphological information to inform toxicity and source apportionment. To assess the accuracy and precision of microscopy, we conducted a method evaluation study. Twenty-two laboratories from six countries were provided three blind spiked clean water samples and asked to follow a standard operating procedure. The samples contained a known number of microplastics with different morphologies (fiber, fragment, sphere), colors (clear, white, green, blue, red, and orange), polymer types (PE, PS, PVC, and PET), and sizes (ranging from roughly 3–2000 μm), and natural materials (natural hair, fibers, and shells; 100–7000 μm) that could be mistaken for microplastics (i.e., false positives). Particle recovery was poor for the smallest size fraction (3–20 μm). Average recovery ($\pm\text{StDev}$) for all reported particles $>50 \mu\text{m}$ was $94.5 \pm 56.3\%$. After quality checks, recovery for $>50 \mu\text{m}$ spiked particles was $51.3 \pm 21.7\%$. Recovery varied based on morphology and color, with poorest recovery for fibers and the largest deviations for clear and white particles. Experience mattered; less experienced laboratories tended to report higher concentration and had a higher variance among replicates. Participants identified opportunity for increased accuracy and precision through training, improved color and morphology keys, and method alterations relevant to size fractionation. The resulting data informs future work, constraining and highlighting the value of microscopy for microplastics.

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