Supporting Information

Heteroaggregation of PS microplastic with ferrihydrite leads to rapid removal of microplastic particles from the water column

Johanna Schmidtmann[a*], Hassan Elagami[a,b], Benjamin S. Gilfedder[a,b], Jan H. Fleckenstein[c,d], Georg Papastavrou[e], Ulrich Mansfeld[f], Stefan Peiffer[a]

[a] Department of Hydrology, University of Bayreuth, Bayreuth Center for Ecology and Environmental Research (BayCEER), Bayreuth, Germany

[b] Limnological Research Station, University of Bayreuth, Bayreuth Center for Ecology and Environmental Research (BayCEER), Bayreuth, Germany

[c] Department of Hydrogeology, Helmholtz-Center for Environmental Research, Leipzig, Germany

[d] Hydrologic Modelling Unit, Bayreuth Center of Ecology and Environmental Research (BayCEER), University of Bayreuth, Bayreuth, Germany

[e] Department of Physical Chemistry II, University of Bayreuth, Bayreuth, Germany

[f] Bavarian Polymer Institute (BPI), Keylab Electron and Optical Microscopy, University of Bayreuth, Bayreuth, Germany

*corresponding author: j.schmidtmann@uni-bayreuth.de

List of Figures

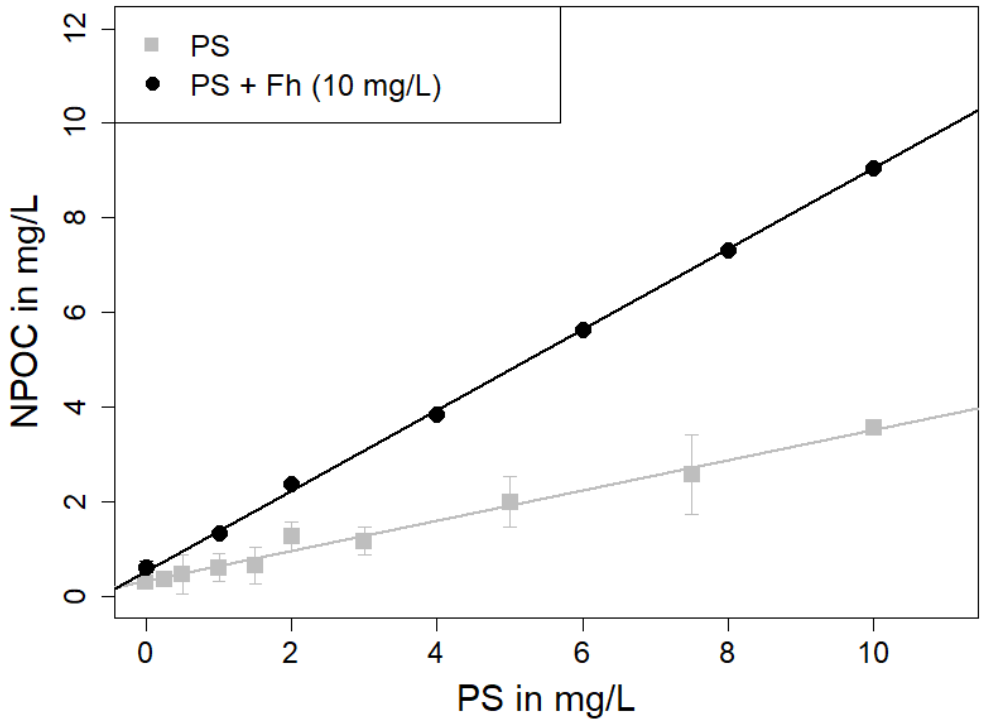


Fig. S1: Calibration curves of 1 µm PS (grey, NPOC[mg/L] = 0.3198*PS[mg/L] + 0.303, R^2 = 0.9851) and 1 µm PS with 10 mg/L ferrihydrite (Fh) (black, NPOC[mg/L] = 0.8522*PS[mg/L] + 0.5355, R^2 = 0.9997) for TOC measurements. On the x-axis, the prepared PS concentrations are plotted and on the y-axis the corresponding non-purgeable organic carbon (NPOC) concentrations measured with the TOC Analyzer. We assume that the presence of ferrihydrite has an unknown catalytic effect on the oxidation of PS. Therefore, the recovery of the PS concentration is significantly enhanced in the presence of ferrihydrite.

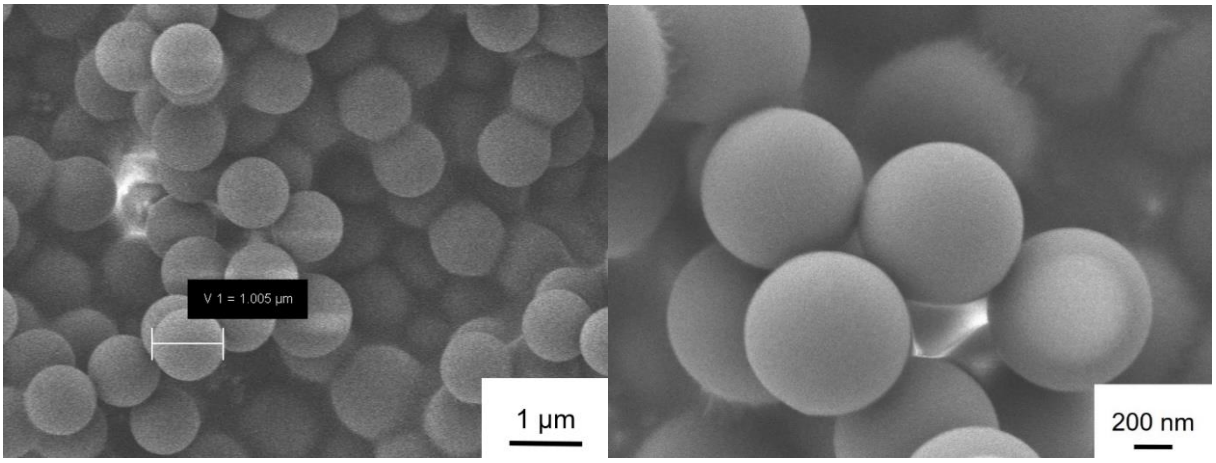


Fig. S2. SEM images of pristine 1 µm PS particles.

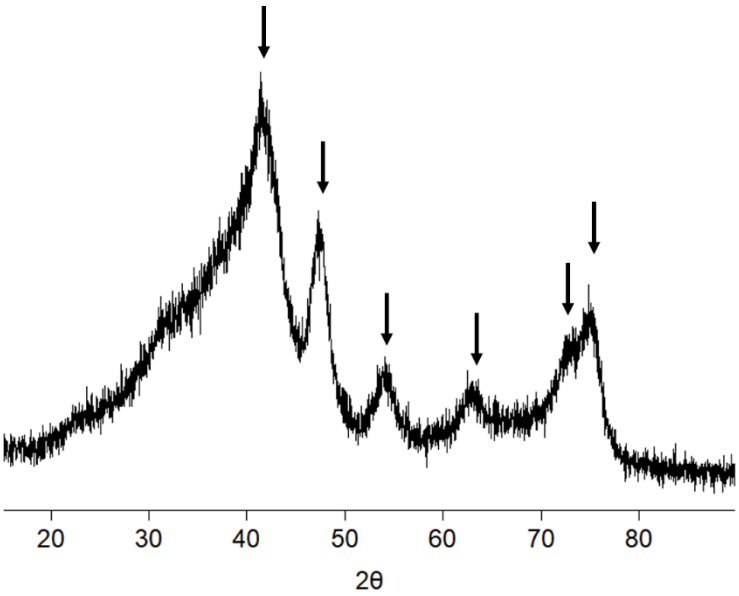
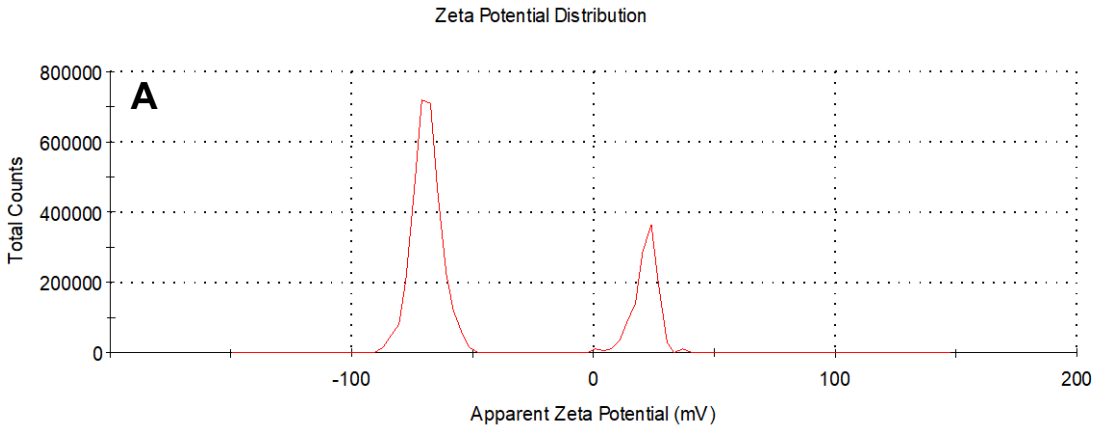


Fig. S3: X-Ray diffractogram (monochromated $CoK\alpha_1$ radiation) of the synthesized ferric oxyhydroxides shows the characteristic six broadened lines of 6-line ferrihydrite.



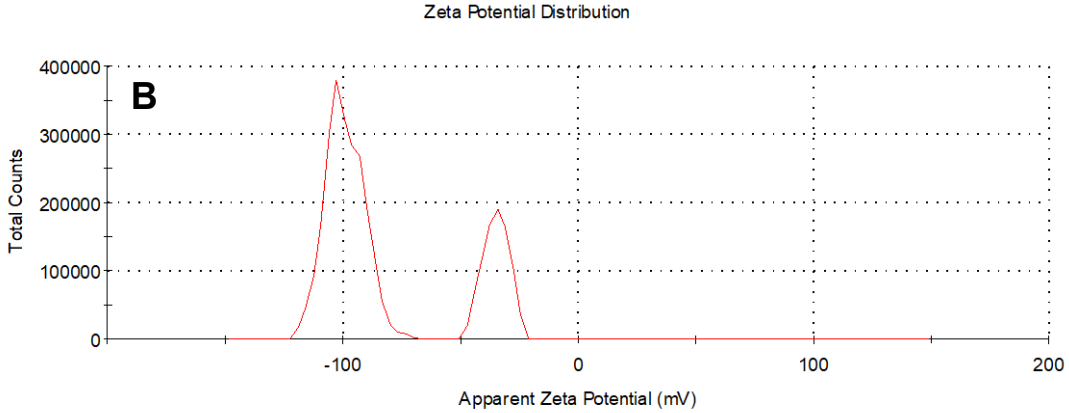


Fig. S4: Zeta Potential distribution of one single measurement of a sample with PS and ferrihydrite as an example for samples in which two zeta potential peaks were measured. A shows one measurement for a sample at pH 7.9 and B one measurement for a sample at pH 9.3. The zeta potential distributions do not show one but two distinct zeta potential peaks and therefore suggests the co-occurrence of PS and ferrihydrite particles that stay separated and that no (major) adsorption or aggregation takes place. The peak at more negative zeta potential values can be attributed to the PS particles and the peak at higher/less negative zeta potential values to the ferrihydrite particles.

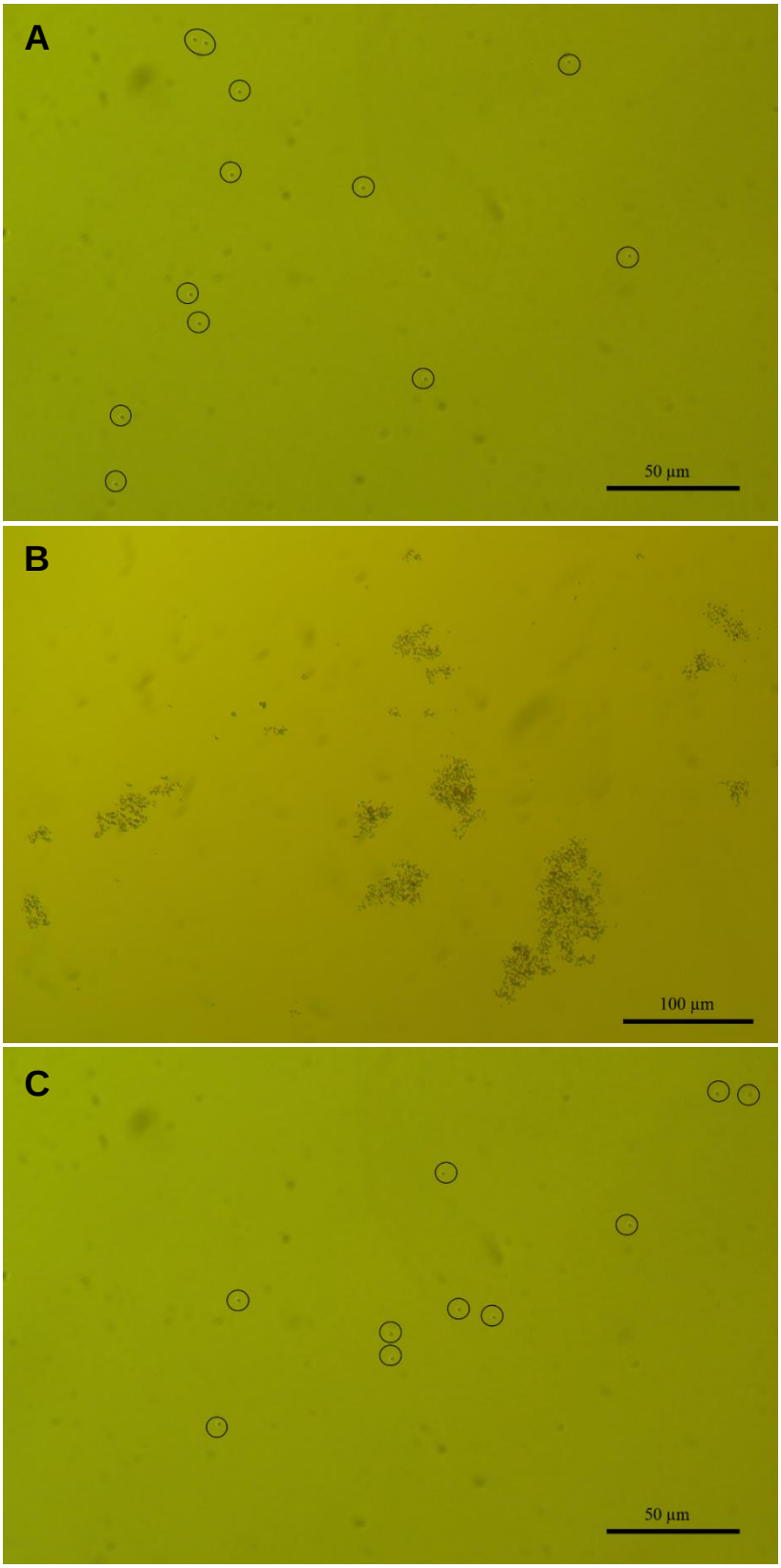


Fig. S5: Microscope image of PS and ferrihydrite after a reaction time of 1 week at pH 4 (A), pH 6.5 (B) and pH 10 (C). At pH values of 4 and 10 only single PS particles were identified (encircled), but no larger aggregates were found as it was the case at pH 6.5 (B). At pH 6.5, heteroaggregates ranging in size from a few micrometers up to 100 µm were observed.