

S.1 Soil column experimental setup

Each soil slice was inserted into a glass jar. All glass jars containing effluent, and soil samples were filled with sufficiently large volumes of approximately 400 *mL* of DI water (Zubris and Richards, 2005). DI water was used instead of a salt solution for the density separation process because LDPE floats on water due to its lower density.

The inverted immersed-in-water jar method was adopted for density separation to minimize the soil, specifically clay, collection on the filter membrane during filtration, as the overflowing density separation method usually disturbs the settled soil that may flow out with MPs during filtration (Qi et al., 2022). In this method, the jar was sealed, inverted, and stirred on the magnetic stirrer for one hour (Reddy et al., 2006). Subsequently, it was left inverted for 18 hours so that the soil could settle at the bottom and the MPs could float at the surface (Liu et al., 2020). Then, the inverted jar was partially immersed in DI water in a glass beaker, and lids were removed to prevent air from entering the jar (Fig. 1, Stage II). To remove the soil from the jar, the inverted, submerged jars were maintained in this position for three days. The remaining water and MPs in the jars were vacuum filtered using 47 *mm* Whatman glass microfiber filters (Grade GF/C) with a pore size of 1.2 μm (Ashiq et al., 2023). Finally, filters were stored in Petri dishes for drying (Fig. 1, Stage III). The steps of this procedure are illustrated in Fig. 1 (Stage-I).

As the next step, the MPs on the dry filter were stained with fluorescent Nile red for visualization under a fluorescence microscope (Fig. 1, Stage III). Fluorescence microscopy (Olympus BX43) analysis was carried out for quantification of MPs (Fig. 1, Stage-IV). The green light filter was used with 470 and 508 *nm* excitation and emission wavelengths, respectively (Ashiq et al., 2022; Bakhshaei et al., 2023). 10% of the filter area was analyzed by viewing four equally spaced parallel strips, and later, the results were extrapolated to represent the entire filter. This area

was significantly larger than what was reported in previous studies, which only considered 0.7–5% of the filter area (Song et al., 2017). This broader coverage is deemed to enhance the accuracy and reliability of the results. Additionally, control experiments were conducted to identify and eliminate potential MP contamination and verify the precision and reliability of the measurements.

Table S1 Difference between attachment, detachment and straining coefficients for various conditions w.r.t pristine microplastics and DI water

Soil type	Condition		$k_{att} \times 10^3$ (min ⁻¹)	Diff of k_{att} (%)	$k_{det} \times 10^3$ (min ⁻¹)	Diff of k_{det} (%)	$k_{str} \times 10^3$ (min ⁻¹)	Diff of k_{str} (%)
	Influent type	MPs exposure type						
Silt Loam	DI water	Pristine	18.0		2.0		34.8	
	HA Solution		8.0	56	1.2	40	17.7	49
	DI water	Photodegraded	10.0	44	1.8	10	28.8	17
	HA Solution		2.0	89	0.9	55	20.9	40
Silt	DI water	Pristine	16.0	11	1.6	20	32.0	8
	HA Solution		10.0	38	1.0	37	25.0	22
	DI water	Photodegraded	12.0	25	2.0	-25	24.5	23
	HA Solution		1.5	91	0.5	69	20.0	38

S.2 Zeta potential measurements

The following analysis is conducted in a Malvern Zeta sizer nano ZS instrument at room temperature. A 20 mg particle in 5 mL DI water dispersion was made for all the samples, and the pH was adjusted to 7. Three iterations were carried out to check the repeatability of the analysis method. Please note that each sample is run 3 times by the instrument, and results are provided.

Table S2 Zeta potential results of pristine and UV-photodegraded LDPE microplastics

Sample Name		Temp (K)	Zeta Potential (mV)	Mob ($\mu\text{mcm/Vs}$)	Cond (mS/cm)
Pristine LDPE					
Sample 1	Run 1	298.2	-39.6	-3.106	0.0358
	Run 2	298.2	-37.3	-2.926	0.0364
	Run 3	298.2	-32.3	-2.536	0.0352
Sample 2	Run 1	298.2	-31.8	-2.496	0.0321
	Run 2	298.2	-34.8	-2.725	0.0328
	Run 3	298.2	-33.2	-2.606	0.032
Sample 3	Run 1	298.2	-35.6	-2.788	0.0332
	Run 2	298.2	-32	-2.511	0.0335
	Run 3	298.2	-34.3	-2.689	0.0332
UV-Photodegraded LDPE					
Sample 1	Run 1	298.2	-38.8	-3.043	0.0286
	Run 2	298.2	-53.2	-4.173	0.00976
	Run 3	298.2	-41.2	-3.227	0.0113
Sample 2	Run 1	298.2	-46.5	-3.644	0.00716
	Run 2	298.2	-52.7	-4.133	0.0133
	Run 3	298.2	-46.9	-3.678	0.00669
Sample 3	Run 1	298.2	-44.3	-3.476	0.0274
	Run 2	298.2	-49.3	-3.868	0.0241
	Run 3	298.2	-50.1	-3.929	0.0214

References

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