Understanding the Atmospheric Cycle of Microplastics: From Emission to Deposition

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Table S1 A Summary of Atmospheric Microplastic Deposition Flux Reported in the Literature.

Country	Deposition Flux (particles • m^{-2} • d^{-1})	Polymer Type	Morphology	Size Range	reference
Brazil	Fibers:307.2±214.60 Particles:2.20±1.99	Fibers: Polyester(100%) Particles: PE (59%) PP (26%) SIS (4%) PEA(4%) PET(4%) PVA(3%)	Fragments (64%) Foam(23%) Film(9%) Granule(4%)	Fibers: 50.00-989.12μm Particles: 50.03-510.67μm	[1]
Brazil	Fibers:105.45±50.03 Particles17.75±16.26	Fibers: Polyester(76%) PET(9%) PVC(9%) PAN(6%) Particles: PE (67%) PET (25%) PS (8%)	Fragments (74%) Foam(13%) Film(8%) Granule(5%)	most common: 100-200 μm	[1]
Turkey	Fibers:13.6-155.7 Fragments+Films: 2.4-11.2	PE(85%)	Fibers(84%) Fragments(10%) Films(6%)	Fibers:0.5-2mm Films:0.5-1mm and 200-300 μm	[2]
United Kingdom	Fibers: 510-925 Non-fibers:12-99	Fibers: PAN(66.7%)PET(18.8%) PA (9.4%) Other (5.2%) Non-fibers: PP(12.5%) PVC(9.4%) PE (12.5%) PET(11.5%) PS (18.8%) PUR(11.5%) Pol. Petr. Res.(9.4%) Acrylic(5.2%) Others (9.4%)	Fibers: Cellulose(69.3%), Petro-chemical(16.9%) NI(10.0%) R.Cellulose(3.8%) Non-fibers: Fragments(63.6%)Films(25%) Granules(6.8%) Foams (4.5%)	Fibers: 905±641μm Non-fibers: 164±167μm	[3]
Iran	24.0-2455.2	PET(53%), PVC, PTFE, PS, PP, PE, Nylon	Fibers dominant	<100,100-250, 250-500,500-1000, >1000μm	[5]
Iran	40.8-309.6	PET, PVC, PTFE, PS, PP, PE, Nylon	Fibers dominant	<100,100-250, 250-500,500-1000, >1000μm	[5]
Iran	0-1416.0	PET, PVC, PTFE, PS, PP, PE, Nylon	Fibers dominant	<100,100-250, 250-500,500-	[5]

				1000, >1000μm	
Iran	0-662.4	PET, PVC, PTFE, PS, PP, PE, Nylon	Fibers dominant	<100,100-250, 250-500,500-1000, >1000μm	[5]
Iran	0-2419.2	PET, PVC, PTFE, PS, PP, PE, Nylon	Fibers dominant	<100,100-250, 250-500,500-1000, >1000μm	[5]
Iran	0-1116.0	PET, PVC, PTFE, PS, PP, PE, Nylon	Fibers dominant	<100,100-250, 250-500,500-1000, >1000μm	[5]
Colombia	Fibers:5,375,000 Films:1,685,000 Fragments:1,255,000	PS, PE, PP, PVC, PET	Fibers Films Fragments	10–5000 μm	[8]
Colombia	Fibers:10,312,000 Films:2,932,000 Fragments:2,472,000	PS, PE, PP, PVC, PET	Fibers Films Fragments	10–5000 μm	[8]
Colombia	Fibers:1,386,000 Films:516,000 Fragments:756,000	PS, PE, PP, PVC, PET	Fibers Films Fragments	10–5000 μm	[8]
China	353.83 ± 159.17	PET, PE, PA, PS, PVC, PMMA	Fragments(44.4%)Fibers(47.5%)	50-500 μm	[10]
China	302.31±107.40	PA(61%) PP(6%) PE(11%) PES(11%) EP(10%)Others (2%)	Fragments(80%) Fibers (16%) Others(4%)	20-50μm(22%) 50-100μm(51%) 100-200μm(13%) 200-500μm(5%) 500-1000μm(5%) 1000-5000μm(5%)	[13]
Germany	183 ± 124	PP(38%), PE (24%), PET(9%), PVC(8%), Others	Fragments(96.9%), Fibers (2.9%) Spheres(0.2%)	Fragments: 11-522 μm Fibers: 499-1945μm	[19]
Germany	73 ± 21	PP(46%), PE (14%), PET(7%), PVC, PS, SI(11%),Others	Fragments(96.9%), Fibers (2.9%) Spheres(0.2%)	Fragments: 11-522 μm Fibers: 499-1945μm	[19]
Germany	114 ± 81	PP(35%), PE (18%), PET, PVC(8%), PS(16%), SI,PAN,EVAc,ABS, PBT,Others	Fragments(96.9%), Fibers (2.9%) Spheres(0.2%)	Fragments: 11-522 μm Fibers: 499-1945μm	[19]
Germany	59 ± 30	PP(37%), PE (10%), PET(41%), Others	Fragments(96.9%), Fibers (2.9%)	Fragments: 11-522 μm	[19]

			Spheres(0.2%)	Fibers: 499-1945µm	
Germany	48 ± 15	PP(35%), PE PET(16%), PS(14%) Others	Fragments(96.9%), Fibers (2.9%) Spheres(0.2%)	Fragments: 11-522 µm Fibers: 499-1945µm	[19]
Germany	29 ± 26	PP(65%), PE (8%) PET(9%), PVC(9%) PS(10%)	Fragments(96.9%), Fibers (2.9%) Spheres(0.2%)	Fragments: 11-522 µm Fibers: 499-1945µm	[19]
Poland	10 ± 8	PEST (41%) PP (18%) PE (14%) PVC (14%) EPM(9%) PVA(9%)	Fibers(60%) Fragments(26%) Films (14%)	Fibers:75-5000µm; Fragments:5-750µm; Films:10-1520µm	[20]
China	1434.57 ± 730.82	PA (19%), PET (21%), PP (11%), PVF (20%), PE,PVA+PE,Others(22%)	Fibers (71%) Films (21%) Granules (8%)	<500µm(68%), 500-1000µm (20%), 1000-3000µm (11%), 3000-5000µm	[21]
China	5094.93 ± 3431.01	PA (20%), PET (33%), PP (23%), PVF,PE,PVA+PE, Others	Fibers (79%) Films (16%) Granules (6%)	<500µm(61%), 500-1000µm (24%), 1000-3000µm (14%), 3000-5000µm	[21]
China	4072.81 ± 2904.33	PA (39%), PET (26%), PP (20%), PVF,PVA+PE, Others	Fibers (69%) Films (25%) Granules (5%)	<500µm(75%), 500-1000µm (15%), 1000-3000µm (9%), 3000-5000µm	[21]
China	1756.72 ± 1181.85	PA (28%), PET (33%), PP (15%), PVF (10%), PE, PVA+PE, PET+PP, Others	Fibers (73%) Films (18%) Granules (9%)	<500µm(76%), 500-1000µm (13%), 1000-3000µm (10%), 3000-5000µm	[21]
China	2619.74 ± 620.73	PA (30%), PET (21%), PP (20%), PVF, PE,PVA+PE, Others(10%)	Fibers (62%) Films (28%) Granules (10%)	<500µm(78%), 500-1000µm (15%), 1000-3000µm (7%)	[21]
China	4588.57 ± 3738.91	PA (29%), PET (27%),	Fibers (72%) Films (17%)	<500µm(69%), 500-1000µm	[21]

		PP (12%), PVF (22%), PE,PVA+PE,Others	Granules (11%)	(17%), 1000-3000μm (13%), 3000-5000μm	
India	21.27	PE (42.3%) PP (30.8%) PA (15.4%) PET (7.7%) PS (3.8%)	Fibers(>50%) Fragments Films	18.51-4917.23 μm	[22]
Malaysia	114-689	PA (40%) HDPE (16%) PES (13%) Nylon(7%) PP(7%) CP(9%) PVC(4%) Copolymer(4%)	Fragments (54%) Fibers (46%)	≤5-50μm (92.3%) 50-100 μm (<10%)	[23]
Malaysia	280-394	PA (40%) HDPE (16%) PES (13%) Nylon(7%) PP(7%) CP(9%) PVC(4%) Copolymer(4%)	Fragments (54%) Fibers (46%)	≤5-50μm (92.3%) 50-100 μm (<10%)	[23]
Malaysia	172-476	PA (40%) HDPE (16%) PES (13%) Nylon(7%) PP(7%) CP(9%) PVC(4%) Copolymer(4%)	Fragments (54%) Fibers (46%)	≤5-50μm (92.3%) 50-100 μm (<10%)	[23]
France	365 ±69	PS, PE, PP	Fragments Fibers Films	Fragments ≤300μm Fibers 100-750μm	[24]
China	114 ± 40	PET (71%) PAN (24%) PP(3.4%) PA(1.7%)	Fibers (77.6±19.1%), Fragments,Films, Microbeads	Fibers: 50μm-5mm Fragments: 50-200μm Films: 0.5-2mm Microbeads: <50μm	[25]
Thailand	Total：325 Wet：285 Dry：199	Wet: PP,Polyethylene acrylate, PU, PET, PBA Dry：PP, PET, PE, PU, Cellophane	Wet：Fibers (93%) Fragments (6%) Films (1%) Dry: Fibers (94%) Fragments (6%)	Wet: 121-4990μm Dry: 132-4541μm	[26]
Germany	260.6	PE(48.8%),EVAC(22.0%)	fragments(95%) fibers (5%)	<63 μm 63-300μm ＞300μm	[27]
Germany	246.9	PE(48.8%),EVAC(22.0%)	fragments(95%) fibers (5%)	<63 μm 63-300μm ＞300μm	[27]

Germany	136.5	PE(48.8%),EVAC(22.0%)	fragments(95%) fibers (5%)	<63 µm 63-300µm ＞300µm	[27]
Germany	331.4	PE(48.8%),EVAC(22.0%)	fragments(95%) fibers (5%)	<63 µm 63-300µm ＞300µm	[27]
Germany	512.0	PE(48.8%),EVAC(22.0%)	fragments(95%) fibers (5%)	<63 µm 63-300µm ＞300µm	[27]
Germany	343.1	PE(48.8%),EVAC(22.0%)	fragments(95%) fibers (5%)	<63 µm 63-300µm ＞300µm	[27]
Bangladesh	Indoor: 179×10^3	Polyester, Nylon, Regenerated cellulose, Natural fibers	Fibrous non-fibrous	100-180 µm	[29]
Bangladesh	Outdoor: 40.2×10^3	Polyester, Nylon, Regenerated cellulose, Natural fibers	Fibrous non-fibrous	<100 µm	[29]

Table S2 A Summary of Atmospheric Microplastic Deposition Flux Reported in the Literature

Country	Deposition Flux (particles • g^{-1})	Polymer Type	Morphology	Size Range	reference
China	38.85	PP PA PE PS PET Silicone PC PU PVC	Fragments(70.9%) Fibers(9.57%) Pellets/Spheres(19.53%)	20-100µm 100-200µm > 200 µm	[11]
China	7.25	PP PA PE PS PET Silicone PC PU PVC	Fragments(70.9%) Fibers(9.57%) Pellets/Spheres(19.53%)	20-100µm 100-200µm > 200 µm	[11]
China	13.64	PP PA PE PS PET Silicone PC PU PVC	Fragments(70.9%) Fibers(9.57%) Pellets/Spheres(19.53%)	20-100µm 100-200µm > 200 µm	[11]
China	172.73	PP PA PE PS PET Silicone PC PU PVC	Fragments(70.9%) Fibers(9.57%) Pellets/Spheres(19.53%)	20-100µm 100-200µm > 200 µm	[11]
China	481.39	PP PA PE PS PET Silicone PC PU PVC	Fragments(70.9%) Fibers(9.57%) Pellets/Spheres(19.53%)	20-100µm 100-200µm > 200 µm	[11]
China	22.95	PP PA PE PS PET Silicone	Fragments(70.9%) Fibers(9.57%)	20-100µm 100-200µm	[11]

		PC PU PVC	Pellets/Spheres(19.53%)	> 200 µm	
China	202.29	PP PA PE PS PET Silicone PC PU PVC	Fragments(70.9%) Fibers(9.57%) Pellets/Spheres(19.53%)	20-100µm 100-200µm > 200 µm	[11]
China	115.19	PP PA PE PS PET Silicone PC PU PVC	Fragments(70.9%) Fibers(9.57%) Pellets/Spheres(19.53%)	20-100µm 100-200µm > 200 µm	[11]
China	197.03	PP PA PE PS PET Silicone PC PU PVC	Fragments(70.9%) Fibers(9.57%) Pellets/Spheres(19.53%)	20-100µm 100-200µm > 200 µm	[11]
China	24.42	PP PA PE PS PET Silicone PC PU PVC	Fragments(70.9%) Fibers(9.57%) Pellets/Spheres(19.53%)	20-100µm 100-200µm > 200 µm	[11]
China	224.76	PP PA PE PS PET Silicone PC PU PVC	Fragments(70.9%) Fibers(9.57%) Pellets/Spheres(19.53%)	20-100µm 100-200µm > 200 µm	[11]
China	170.55	PP PA PE PS PET Silicone PC PU PVC	Fragments(70.9%) Fibers(9.57%) Pellets/Spheres(19.53%)	20-100µm 100-200µm > 200 µm	[11]
Poland	0.076-0.295 dry deposition	Fibers: PP Fragments: PS,PE	Fibers, Fragments Granules, Films	<500 µm (55%-82%)	[16]
China	0.13542 ± 0.04958 dry deposition	PE, PP, PS, PET, Nylon (PA)	Fibers(54.46%) Fragments(25.23%) Granules(18.77%) Foam(1.23%) Films(0.31%)	0.63 ± 0.43 mm	[17]
India	0.105-0.475	PP, PET, HDPE, PS, SAA copolymer, plasta zinc	Fibers,Fragments, Foams,Films,Pellets	<5mm	[18]
India	0.125-0.4575	PP, PET, HDPE, PS, SAA copolymer, plasta zinc	Fibers,Fragments, Foams,Films,Pellets	<5mm	[18]
India	0.072.5-0.2225	PP, PET, HDPE, PS, SAA copolymer, plasta zinc	Fibers,Fragments, Foams,Films,Pellets	<5mm	[18]

Country	Deposition Flux (particles • m^{-2})	Polymer Type	Morphology	Size Range	reference
Ireland	25,919	PET (71%), PAN (11%),	Fibrous	Median0.89 mm	[28]

		PE (11%), PP (4%)			
Ireland	23,526	PET (71%), PAN (11%), PE (11%), PP (4%)	Fibrous	Median0.93 mm	[28]
Ireland	29,410	PET (71%), PAN (11%), PE (11%), PP (4%)	Fibrous	Median0.98mm	[28]
Ireland	37,217	PET (71%), PAN (11%), PE (11%), PP (4%)	Fibrous	Median0.73mm	[28]
China	27,000	Cellophane(＞50%) PET(＞30%) PP, EPDM, PU, PA, PEA, ALK, PVAc	Fibers Films Fragments Granules	<1 mm 1-2 mm 2-3 mm 3-4 mm 4-5 mm	[30]
China	89,000	Cellophane(＞50%) PET(＞30%) PP, EPDM, PU, PA, PEA, ALK, PVAc	Fibers Films Fragments Granules	<1 mm 1-2 mm 2-3 mm 3-4 mm 4-5 mm	[30]
China	73,700	Cellophane(＞50%) PET(＞30%) PP, EPDM, PU, PA, PEA, ALK, PVAc	Fibers Films Fragments Granules	<1 mm 1-2 mm 2-3 mm 3-4 mm 4-5 mm	[30]

Table S3 A Summary of Atmospheric Microplastic Density in the Air Reported in the Literature.

Country	Density (particles • m^{-3})	Polymer Type	Morphology	Size Range	reference
China	27.6±14.7	PE(27.7%) PET(24.2%) PA(17.6%) PS(10.9%) PP(6.4%) PVC(4.7%) PC(3.6%) Other(5.1%)	Fragment(87.0%) Fiber(13.0%)	5.9-30μm(63%) 30-100μm(32%) 100-300μm(3.5%) 300-1000μm(1.4%) 1000-5000μm(0.6%)	[4]
China	15.6±4.4	PE(17.0%) PET(30.7%) PA(14.7%) PS(11.0%) PP(6.4%) PVC(10.1%) PC(3.7%) Other(6.4%)	Fragment(82.9%) Fiber(17.1%)	5.9-30μm(59%) 30-100μm(34%) 100-300μm(5%) 300-1000μm(1.6%) 1000-5000μm(0.4%)	[4]
China	8.1±3.0	PE(32.5%) PET(21.3%) PA(15.0%) PS(7.5%) PP(10.0%) PVC(5.0%)	Fragment(91.4%) Fiber(8.6%)	5.9-30μm(67%) 30-100μm(32%) 100-300μm(1%)	[4]

		Other(8.8%)			
China	Summer: 0.0925±0.0498	PA(37.5%) CPE(14.1%) PET(9.8%) PU(8.1%) PVC(6.3%)PE(5.2%) Fluororubber(3.7%) EVA(3.2%) EAA(2%) Others(10.1%)	Fibers(85.55%), Fragments (13.29%) Films(1.16%)	Summer:700.1± 682.16μm Autumn:785.59 ±558.56μm	[6]
China	Autumn: 0.0573±0.0397	PA(37.5%) CPE(14.1%) PET(9.8%) PU(8.1%) PVC(6.3%)PE(5.2%) Fluororubber(3.7%) EVA(3.2%) EAA(2%) Others(10.1%)	Fibers(85.55%), Fragments (13.29%) Films(1.16%)	Summer:700.1± 682.16μm Autumn:785.59 ±558.56μm	[6]
China	Summer: 0.0583±0.0557	PA(37.5%) CPE(14.1%) PET(9.8%) PU(8.1%) PVC(6.3%)PE(5.2%) Fluororubber(3.7%) EVA(3.2%) EAA(2%) Others(10.1%)	Fibers(85.55%), Fragments (13.29%) Films(1.16%)	Summer:700.1± 682.16μm Autumn:785.59 ±558.56μm	[6]
China	Autumn: 0.0455 ±0.0140	PA(37.5%) CPE(14.1%) PET(9.8%) PU(8.1%) PVC(6.3%)PE(5.2%) Fluororubber(3.7%) EVA(3.2%) EAA(2%) Others(10.1%)	Fibers(85.55%), Fragments (13.29%) Films(1.16%)	Summer:700.1± 682.16μm Autumn:785.59 ±558.56μm	[6]
China	Summer: 0.0925±0.0498	PA(37.5%) CPE(14.1%) PET(9.8%) PU(8.1%) PVC(6.3%)PE(5.2%) Fluororubber(3.7%) EVA(3.2%) EAA(2%) Others(10.1%)	Fibers(85.55%), Fragments (13.29%) Films(1.16%)	Summer:700.1± 682.16μm Autumn:785.59 ±558.56μm	[6]
China	Autumn: 0.0573±0.0397	PA(37.5%) CPE(14.1%) PET(9.8%) PU(8.1%) PVC(6.3%)PE(5.2%) Fluororubber(3.7%) EVA(3.2%) EAA(2%) Others(10.1%)	Fibers(85.55%), Fragments (13.29%) Films(1.16%)	Summer:700.1± 682.16μm Autumn:785.59 ±558.56μm	[6]
China	Summer: 0.0742±0.0083	PA(37.5%) CPE(14.1%) PET(9.8%) PU(8.1%) PVC(6.3%)PE(5.2%) Fluororubber(3.7%) EVA(3.2%) EAA(2%) Others(10.1%)	Fibers(85.55%), Fragments (13.29%) Films(1.16%)	Summer:700.1± 682.16μm Autumn:785.59 ±558.56μm	[6]
China	Autumn:	PA(37.5%) CPE(14.1%)	Fibers(85.55%),	Summer:700.1±	[6]

	0.0290±0.0030	PET(9.8%) PU(8.1%) PVC(6.3%)PE(5.2%) Fluororubber(3.7%) EVA(3.2%) EAA(2%) Others(10.1%)	Fragments (13.29%) Films(1.16%)	682.16μm Autumn:785.59 ±558.56μm	
Iran	Outdoor:0.47 ± 0.06 Indoor:0.41 ± 0.04	Outdoor: PET(30.1%) PP (21%) Nylon(2.9%) PE(46%) Indoor: PET(30.1%) PP (29%) Nylon(5.9%) PE(35%)	Outdoor: Fibers (72.4%) Fragments(21.3%) Pellets(6.3%) Indoor: Fibers (60.0%) Fragments(18.3%) Pellets(5.3%) Others(16.4%)	Outdoor: <100μm(42.1%) 100- 500μm(23.8%)5 00- 1000μm(19.6%) >1000μm(14.5 %) Indoor: <100μm(35.3%) 100- 500μm(40.0%)5 00- 1000μm(24.7%)	[7]
Iran	Outdoor:0.78 ± 0.07 Indoor:0.65 ± 0.06	Outdoor: PET(19.8%) PP (32%) Nylon(10.2%) PE(38%) Indoor: PET(10%) PP (39%) Nylon(10%) PE(40%)	Outdoor: Fibers (84.4%) Fragments(15.6%) Indoor: Fibers (74.3%) Fragments(15.6%) Pellets(6.74%) Others(3.36%)	Outdoor: <100μm(22.4%) 100- 500μm(32.5%)5 00- 1000μm(34.0%) >1000μm(11.1 %) Indoor: <100μm(42.4%) 100- 500μm(19.1%)1 500- 1000μm(24.7%)	[7]
Iran	Outdoor:0.85 ± 0.09 Indoor:0.73 ± 0.07	Outdoor: PET(24.3%) PP (21.3%) Nylon(11%) PE(43.4%) Indoor: PET(30.3%) PP (20.3%) Nylon(11%) PE(38.4%)	Outdoor: Fibers (87.6%) Fragments(11.4%) Pellets(1%) Indoor: Fibers (93.2%) Fragments(6.8%)	Outdoor: <100μm(20.3%) 100- 500μm(25.3%)5 00- 1000μm(18.0%) >1000μm(36.4 %) Indoor: <100μm(30.3%) 100-	[7]

				500μm(35.3%)500-1000μm(34.4%)	
Japan	0.12-0.3	PE,PP,PS,PET	Particles, fibers	<20 μm	[9]
New Zealand	0.03-0.12	PP,PS	Particles, fibers	40-100 μm	[9]
Iran	0.002-0.017	PET, Nylon,PA, PP, PS	Fibers	≤100μm 100-250μm 250-500μm 500-1000μm ＞1000μm	[12]
Iran	0.002-0.015	PET, Nylon,PA, PP, PS	Fibers	≤100μm 100-250μm 250-500μm 500-1000μm ＞1000μm	[12]
China	Terrestrial transport: 32.0 Marine transport: 14.7	Terrestrial transport: Rubber(20.6%) PA(14.1%) Marine transport: PFR(14.8%) PMMA(14.2%)	Fragments(78.1%) Fibers(16.6%) Granules(5.3%)	20-271μm	[14]
China	0-0.062	PES, PET, PE, PP, PS, PE-PP, PVC, PMMA	Fibers, Granules, Fragments, Films, Microbeads	<1.0 mm 0.1-0.3mm 0.3-0.5mm 0.5-1mm 1-2.5mm 2.5-5mm	[15]

Abbreviation	**Full Name**
AMPs	Atmospheric Microplastics
PE	Polyethylene
PP	Polypropylene
SIS	Styrene-Isoprene-Styrene Block Copolymer
PEA	Polyethyl Acrylate
PET	Polyethylene Terephthalate
PVA	Polyvinyl Alcohol
PVC	Polyvinyl Chloride
PAN	Polyacrylonitrile
PS	Polystyrene
NI	Not Identified
PA	Polyamide
PUR	Polyurethane
Pol. Petr. Res.	Petroleum Resin

PTFE	Polytetrafluoroethylene
PMMA	Polymethyl Methacrylate
PES	Polyethersulfone
EP	Epoxy Resin
EVAc	Ethylene Vinyl Acetate Copolymer
ABS	Acrylonitrile Butadiene Styrene
PBT	Polybutylene Terephthalate
SI	Silicone
PEST	Polyester
EPM	Ethylene Propylene Monomer
PVF	Polyvinyl Fluoride
HDPE	High-Density Polyethylene
CP	Chlorinated Polypropylene
PBA	Polybutyl Acrylate
PU	Polyurethane
PC	Polycarbonate
SAA	Styrene-Acrylic Acid Copolymer
EPDM	Ethylene Propylene Diene Monomer
ALK	Alkyd Resin
PVAc	Polyvinyl Acetate
CPE	Chlorinated Polyethylene
EVA	Ethylene Vinyl Acetate
EAA	Ethylene Acrylic Acid
PFR	Phenolic Formaldehyde Resin
PE-PP	Polyethylene-Polypropylene Copolymer

Table S4. Comparison of Common Analytical Methods for Atmospheric Microplastics

Method	Typical size detection limit	Quantification output	Polymer identification	Shape / size information	Key advantages	Main limitations
Filtration + visual microscopy	~20-300 μm (dependent on membrane pore size and magnification)	Particle number (counts)	No (visual inference only)	Yes (shape, color, size)	Simple, low cost, suitable for large particles and preliminary screening	High false-positive risk; polymer type cannot be confirmed; poor resolution for small particles
Filtration + μFTIR imaging	~10–20 μm (down to ~5 μm with FPA imaging)	Particle number	Yes (polymer-specific spectra)	Yes (particle-resolved size and shape)	Widely accepted; relatively standardized; suitable for polymer confirmation	Limited detection of very small MPs; time-consuming; affected by filter material
Filtration + μRaman spectroscopy	~1 μm (submicron possible under ideal conditions)	Particle number	Yes (polymer-specific spectra)	Yes (particle-resolved size and shape)	High spatial resolution; suitable for small MPs	Fluorescence interference; long analysis time; higher uncertainty for weathered particles
Pyrolysis–GC/MS	No explicit size limit (bulk analysis)	Mass concentration (e.g., ng m^{-3}, μg m^{-2} d^{-1})	Yes (polymer-specific pyrolysis products)	No (no particle size or morphology information)	High sensitivity; robust polymer quantification;	Cannot provide particle number, size distribution, or shape; destructive analysis

SEM-EDS (auxiliary)	~1 μm (morphology-dependent)	Particle number (semi-quantitative)	Limited (elemental, not polymer-specific)	Yes (surface morphology, cracks, roughness)	Useful for aging and surface characterization	Cannot reliably identify polymer type alone
SERS	Submicron to nanoscale (method- and substrate-dependent)	Particle number (semi-quantitative)	Yes (enhanced Raman fingerprints)	Limited (requires coupling with microscopy)	High sensitivity; reduced fluorescence interference; potential for nanoplastic detection	Substrate-dependent reproducibility; limited standardization; currently applied mainly in laboratory or proof-of-concept studies

Reference

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