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Microplastic in an Arid Region: Identification, Quantification and Characterization on and Alongside Roads in Al Ain, Abu Dhabi, United Arab Emirates

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Abstract

Microplastic content was analyzed in road dust, soils alongside roads and stormwater run-offs in Al Ain City, Abu Dhabi. Apart from tire wear material, fibers and degradation products of meso- and macroplastics such as plastic bags and plastic bottle tops were found to be the most dominant plastic microparticles. Speed bumps and artificial turf/lawns were also evaluated as potential sources of microplastics on and alongside roads. It was found that in arid regions Aeolian transport of microplastics may be more important than transport by water.

Keywords

Road Wear, Microplastic, Artificial Turf, Glass Reflector Beads, Speed Bumps

1. Introduction

Microplastics (MPs) are plastic particles that have a diameter of less than 5 mm and, based on their origin, they can be primary or secondary MPs [1]. Primary MPs are plastic materials that have been synthesized in their small size for a specific purpose (Figure 1). They can be microbeads found in cosmetics and personal care products, resin pellets used in the plastic manufacturing industry, or plastic shots used in industrial abrasives. Secondary MPs are created by fragmentation due to the weathering or degradation of larger plastic items in the environment [2] [3]. Both primary and secondary MPs can find their way into the environment. In many temperate regions, through catchments and river network systems, but also through effluents from wastewater treatment plants and Aeolian movement, a significant proportion of the released MPs reach the marine environment, where oceans are seen as a sink for plastic materials, including MPs. This may be a reason that in 2018, it was stated that at the time the majority (87%) of studies on MP pollution focused on marine environments rather than on terrestrial and freshwater environments [4].

Figure 1(a) A typical example of primary microbeads used in a chemical research lab—PTFE beads used as anti-bumping stones. **Figure 1(b)** Pellets are made from an ABS-based copolymer from a pellet toy gun found on the streets of Al Ain. Pellet guns are still used extensively as toys in the GCC countries [5]. In both cases, the beads slightly exceed the 5 mm size, may, however, over time fragment to microbeads of smaller size.

Personal care products (PCPs) and cosmetics in form of plastic microbeads and clothing in the way of fibers were seen as the main sources of MPs [6] [7] that find their way into the marine environment, with the release of the amount of plastic microbeads from PCPs diminishing recently [8] [9] due to emerging legislation banning MP in PCPs in certain regions. Globally, also, approximately 3.370.000 tons of tire material [10] are released, much of that in form of MP. Since data on MP content in stormwater from roads is very scarce, it is, however, uncertain how much of these particles are transported to water recipients and how much of them are permanently deposited in the ground close to the road. The same is true for MP from artificial turf, from which in Sweden alone 2300 - 3900 tons of materials are emitted per year [11], and for which it is estimated that 18.000 - 72.000 tons of materials [12] reach the aquatic environment. Then, some plastics are dropped, one way or another, by the roadside, some of which

(a) (b)

Figure 1. (a) A typical example of primary microbeads used in a chemical research lab—PTFE beads used as anti-bumping stones; (b) Pellets are made from an ABS-based copolymer from a pellet toy gun found on the streets of Al Ain. Pellet guns are still used extensively as toys in the GCC countries [5]. In both cases, the beads slightly exceed the 5 mm size, may, however, over time fragment to microbeads of smaller size.

then fragment to MP over time. Again, the fate of such litter is uncertain.

How do things change when there is little flowing water in the natural surroundings that can move plastics/MPs into aquatic environments? There are few articles dealing with the presence, distribution, and fate of MPs in arid/semiarid regions [13] [14] [15], where natural water flow contributes little to the relocation of MPs and where MPs cannot be carried to standing aquatic environments via riverine systems. Here, MPs can be distributed by the wind and can collect in the soil, where it is not known how deep into the soil they penetrate over time. Furthermore, in arid regions, macro-plastic materials cannot be moved with flowing water and thus may come to lie in the terrestrial environment, out in the open, for a prolonged time, where they are in contact with air and sunlight. For polyalkenes such as polyethenes and polypropylenes, this can lead to the oxidation of the polymeric material and fission of polymeric strands, leading to the degradation of the material [16], where the authors have found that highly oxidized polythene or polypropylene-based plastic is more prone to fragmentation.

In the current communication, the abundance of MP in road dust samples, soil samples taken from alongside the roads, sediment samples from Wadi beds, and stormwater runoffs from the Al Ain area, Eastern region of the Abu Dhabi Emirate, is investigated (**Figure 2**).

Al Ain with its 750.000 inhabitants is the second largest city in the Emirate of Abu Dhabi. Al Ain has a hot desert climate (Köppen climate classification BWh), with long, hot summers and warm winters and with a mean annual rainfall of 96 mm and an average relative humidity of 60%. The city lies within an old Oasis complex, for the most part on a gravel plain, 120 km from the coast of the Sea of Oman (at Liwa, Oman) with a mountain range in-between and 140 km from the coast of the Arabian/Persian Gulf (in Dubai) with a desert in-between. There are no riverine connections from Al Ain to either of the coasts or to any other part of the country for that matter, although Wadis, riverbeds that seasonally carry water, transverse the city. The Wadis end by fanning out in the open desert.

In this contribution, special emphasis has been given to speed bumps and artificial turf/artificial lawns as examples of MP sources that have been receiving little attention in the literature [17]. The distribution and movement of micro-tires in the Al Ain region are not included in this paper, as it is the subject of a separate communication.

2. Experimental Procedures

2.1. Sampling Sites

The sampling was carried out from June 2020-August 2020. Road dust (n = 3), soils along roadsides (n = 13), sediments of 2 wadis (n = 11), and a stormwater (n = 1) sample were collected from the sampling sites shown on the map in **Figure 2(a)** and **Figure 2(b)**. The following sampling sites were chosen: Al Murahibeen St - Al Muwaij'i - Oud Bin Sag-Han - Abu Dhabi (R1), 1st St - 'Asharij -

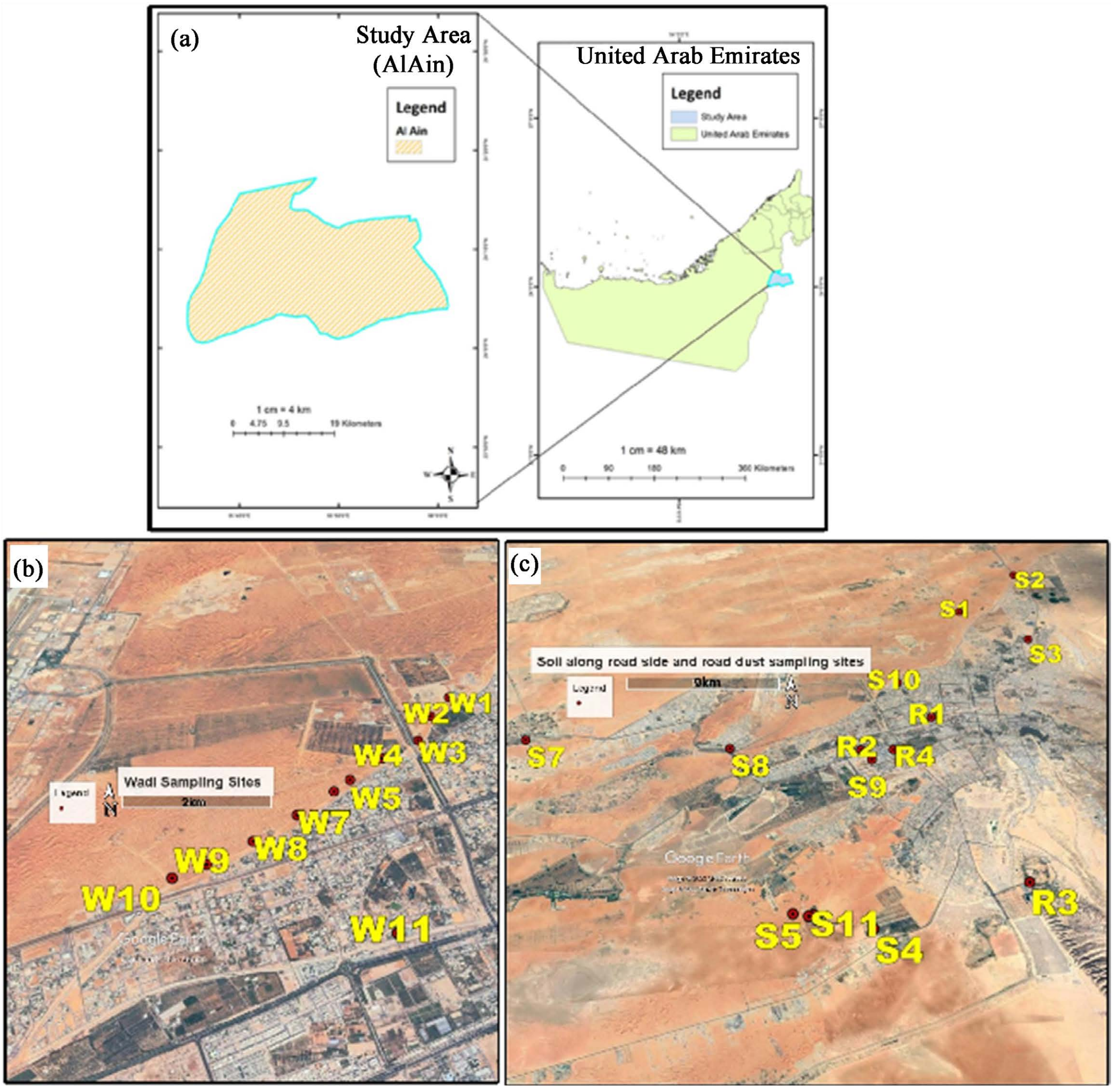

Figure 2. Sampling sites within Al Ain City and its environs In the current communication, the abundance of MP in road dust samples, soil samples taken from alongside the roads, sediment samples from Wadi beds, and stormwater runoffs from the Al Ain area, Eastern region of the Abu Dhabi Emirate, is investigated.

Shabhanet Ashrej - Abu Dhabi (R2), Mohammed Bin Zayed The First St - Al Tiwayyah - Abu Dhabi (R3), University street - Asharij - UAEU, Abu Dhabi (R4), E95 - Nahil Road (S1), E66 - Al Ain Dubai Road (S2), Dubai Al Ain Road (S3), E30- al Rawdha Road (S4), Zakher Lake - Zakhir - Abu Dhabi (S5), E30 - al Rawdha Road (S6), Al Sad - Abu Dhabi (S7), Abu Dhabi - Al Ain Rd - Al Salamat - Abu Dhabi (S8), University St - 'Asharij - Shabhanet Ashrej - Abu Dhabi (S9), Mohammed Bin Zayed The First St - Al Tiwayyah - Abu Dhabi (S10), Zakhir - Abu Dhabi (desert) (S11 - S13), Al Tiwayyah - Abu Dhabi (Wadi) (W1 - W10) and Al Markhaniyyah - Abu Dhabi Wadi (W11).

A short explanation of the sampling sites is as follows:

R1 and R2 are quiet residential areas within Al Ain City—the road dust was collected near speed bumps.

R3: the sample was taken from the verge of a 2-lane road.

R4: a stormwater sample was taken from a run-off from one of the UAEU parking lots.

S1: a soil sample taken from the side of a well-traveled road that connects Al Ain to Sweihan.

S2: a soil sample taken from the side of a less traveled road connecting Al Ain City with Al Foah.

S3: a soil sample taken from the side of a 6-lane way highway with heavy traffic.

S4: a soil sample taken from the verge of a 2-lane road.

S5: S20: a soil sample taken from the side of a medium-traveled 2-lane road.

S6: Sediment sample is taken from Zakher lake, a man-made lake within the city confines of Al Ain, about 17 km from the city center. The old truck road, which connects Al Ain with Abu Dhabi, runs by the lake at a distance of 300 m.

S7: a soil sample taken from the side of a 2-lane farm access road.

S8: a soil sample taken from the side of a 6-lane highway (Al Ain - Abu Dhabi).

S9: a soil sample taken from a medium traveled road.

S10: a soil sample was collected next to the main throughway.

S11 - S13: 3 soil samples from a desert location 50, 100, and 150 m away from a dead-end road.

W1-W10: Sediments taken from the bed of Al Towayyah Wadi, a large creek that originates in Oman and transverses Al Ain (east to west). A 6-lane highway runs parallel to the Wadi for 25 km from the Omani border westward. However, at the collection points W1 - W2 the nearest parallel running highly frequented road is a 4-lane road 500 m away from the Wadi. Midway is a highly frequented 4-lane road crossing the Wadi via a high box girder bridge.

W11: a sediment sample taken from a dry Wadi within the City confines. Two small service roads run parallel to the Wadi. Near the sampling site, a small road passes over the Wadi via a small box girder bridge.

TL-1: A road dust sample was taken from the curb of a roundabout, 150 cm away from an artificial lawn that is not frequented much. There is very irregular sweeping activity at the site.

TL-2: A soil sample bordering an artificial lawn at the UAEU that is used for sedentary recreational purposes. There is no sweeping activity at the site.

TL-3: A soil sample bordering an artificial grass turf of a heavily used football pitch. There is no sweeping activity at the site.

TL-4: A road dust sample neighboring a newly laid artificial lawn that is not much frequented. There is infrequent sweeping activity at the site.

2.2. Sampling Procedure

The collected road dust and soil samples were carefully placed into ziplock bags and sealed. Before transferring the samples, the ziplock bags were analyzed to make sure they were free of any contamination. All samples in the ziplock bags were carefully transported to the laboratory. A GPS device Garmin (Manotana

680) was used to record the coordinate points of the sampling sites.

2.3. Isolation and Identification of Microplastic

Triplicates of soil and road dust samples were weighed (each 1 g, electronic balance ABT 220-5DM) and photographed under a stereomicroscope (Model SZ2-ILST) for MP content. Visual identification was based on observable physical characteristics of the particles, the colour (*i.e.*, white black, red, blue-green, brown, and other colors), shape (*i.e.*, fiber, film, fragment, tubular microplastic, microbead or glass bead) and size of the particles [18] by using Fiji ImageJ software. The Ferret's diameter was used to represent the size of microplastics. The Ferret's diameter corresponds to the longest distance between any two points along the particle's boundary [19]. The stormwater (R4) was filtered through a Whatman filter paper (ashless, grade 42, 2.5 μm pore size). The infiltrate was air dried and weighed. The dried filter cake was gently mixed to obtain a cake in granular form and screened under the stereomicroscope. Triplicate samples of dried filter cake (1 g each) were used to screen the microplastic content. One gram of the dried sample was placed in a tray and thinly spread out. The entire sample was examined with a stereomicroscope and micro-photos were taken upon finding a microplastic particle in the sample (**Figure 2**). The photos containing microplastic particles were processed through Fiji ImageJ for characterization. The shape and color of the microplastic particles were also recorded. The microplastic composition was determined by using Fourier Transform (FT) Infrared Spectroscopy utilizing a Perkin Elmer Spectrum 2 FT-IR spectrometer.

2.4. Isolation and Identification of MP from Artificial Turf in Road Dust and Soil Samples

Triplicates of soil and road dust samples were weighed (electronic balance ABT 220-5DM). Thereafter, the soil or road dust sample (2.0 g) was floated in water (75 mL). The water was decanted and filtrated through filter paper (Schleicher & Schuell 597). Then, additional H_2O (75 mL) and NaCl (6.0 g, Scharlau reagent grade) were added to the remainder of the soil/road dust sample, which was thus refloated. The aq. NaCl solution was decanted and filtered through the same filter paper. This process was repeated upon the addition of H_2O (75 mL) and NaCl (12.0 g) and H_2O (75 mL) and NaCl (18.0 g), respectively. The withheld material in the filter was washed diligently with H_2O (3 × 50 mL) and subsequently dried at 38˚C for 4 h (Ecocell, MMM GmbH). The material was sorted manually under a stereoscope. The material stemming from artificial turf was weighed on an electronic balance (ABT 220-5DM) and studied under a stereoscope (Model SZ2-ILST).

2.5. XRD and SEM Measurement of the Material Collected from the Speed Bumps

The powder X-ray diffraction pattern was evaluated by SHIMADZU Lab X-XRD (Model: 6100) with a Cu-K_α line (λ = 1.5418 Å) running at 40 kV and a current of 30 mA. The XRD pattern was screened with a step stage of 0.02˚/min and ranged from 10˚ to 80˚. The XRD pattern was analyzed against the PDF-2 database for phase identification (ICDD).The microstructure of the speed bump material was examined using a JEOL scanning electron microscopy, SEM (Instrument: JSM-6010LA) with a 20 keV. The SEM photographs were captured using secondary electron imaging (SEI). The sample was placed on the brass stub with the help of a double-sided adhesive carbon tape. Fields of the sample were placed under a high-vacuum (ULVAC KIKO lnc, Model: G-100DB, Miyazaki, Japan) and micro-graphs of the sample were recorded using InTouchScope JSM software.

3. Results and Discussion

MPs in road dust samples have been studied in such diverse locations as Iran [13] [14], Japan [20], Vietnam [20], Nepal [20], Sweden [21], India [22] [23] and Australia [24] [25].

In the present study, the concentration of MPs was found to be high in the road dust samples (average number 22.0 ± 20.3 MP/g road dust) as compared to the soil along roadsides (12.21 ± 15.2 MP/g soil) and the sediments of Wadis (average number 5.6 ± 2.7 MP/g). The highest MP concentration in road dust and soil was found to be 44 particles/g and 47 particles/g, respectively. In both cases, the locations were along a highly frequented road. The numbers above exclude the microtire count as microtires were analyzed separately. The appreciable MP concentrations in the Wadis can be explained by the fact that there is off-roading in the Wadis. Furthermore, oftentimes macroplastics are illegally discarded in the Wadis.

Collection of run-off water from roads during a rare rainstorm event showed transport of MPs with the water from the road to the surrounding land. 43 MPs (18 fibers and 25 other MPs) were found in 16 L of stormwater, giving an average concentration of 2.7 MP/L. This is much less than for instance the concentration of MPs found in water run-offs in Tijuana, Mexico, with 66 and 191 particles per liter [15]. This means that the movement of MPs with water is not likely to be the major mode of dispersal. Most of the dispersal of MPs in the Al Ain area seems to be through the wind. That MP deposits away from the road can be seen when looking at samples S11 - S13, where samples were collected successively further away from a road, where even at 150 m from the road, MPs could be found (**Tables 1-3**).

In the current study (**Figures 3-5**), fibers were the most abundant type of MPs (81%) found in all 24 samples followed by plastic files, fragments, tubular types of plastics and microbeads (**Figure 5**). Previous studies also confirmed synthetic fibers as the most dominant type of MP in road dust [26] [27] with suggested main sources including clothing/textiles, soft furnishings in households, vehicle interiors and certain industrial processes and practices. Our study also shows a high abundance of plastic files and films (**Figures 3-5**) in road dust samples

Table 1. Microplastic size, mean size and number of MP/per location wadi samples.

Sample	MP size range (μm)	Mean size of MP (μm)	No. of MP/g of location
W1	13.7 - 360.7	126.1 ± 51.3	7
W2	18.5 - 74.6	49.5 ± 13.6	4
W3	32.1 - 410.8	166.6 ± 39.4	12
W4	15.2 - 85.8	56.6 ± 11.3	6
W5	92.0 - 188.0	148.3 ± 14.5	7
W6	51.5 - 411.5	209 ± 59.4	5
W7	121.8 - 130.0	125 ± 4.1	2
W8	45.9 - 259.5	141.8 ± 45.3	4
W9	13.5 - 24.8	18.2 ± 3.4	3
W10	65.8 - 749.2	291.8 ± 126.2	5
W11	13.9 - 360.7	126.04 ± 51.3	7

Table 2. Microplastic size, mean size and number of MP/per location in road dust samples a = rainwater collected from the stormwater inlet.

Sample	MP size range (μm)	Mean size of MP (μm)	No. of MP/g of location
R1	34.0 - 371.8	112.8 ± 11.7	44
R2	40.0 - 230.9	98.1 ± 14.4	18
R3	68.0 - 294.4	148.4 ± 50.0	4
R4[a]	16.4 - 405.0	116.3 ± 14.0	2.70/L

Table 3. Microplastic size, mean size and number of MP/per location in soil along roadside samples a = 50 m away from road b = 100 m away from road c = 150 m away from the road.

Sample	MP size range (μm)	Mean size of MP (μm)	No. of MP/g of location
S1	47.7 - 414.0	160.9 ± 27	16
S2	34.3 - 30.2	628.2 ± 79.9	6
S3	68.5 - 403.3	182.8 ± 61.4	5
S4	92.0 - 188.0	148.3 ± 14.5	7
S5	51.5 - 411.5	209.2 ± 59.4	5
S6	121.8 - 130	125.9 ± 4.1	2
S7	45.9 - 259.5	141.8 ± 45.3	5
S8	188.1-188.1	188.1	1
S9	65.8 - 749.2	291.8 ± 126.2	7
S10	18.5 - 320.0	88.2 ± 9.6	47
S11[a]	79.0 - 377.8	203.7 ± 43.6	7
S12[b]	74.0 - 253.7	146.2 ± 18.7	10
S13[c]	102.1 - 185.7	141.6 ± 11.5	6

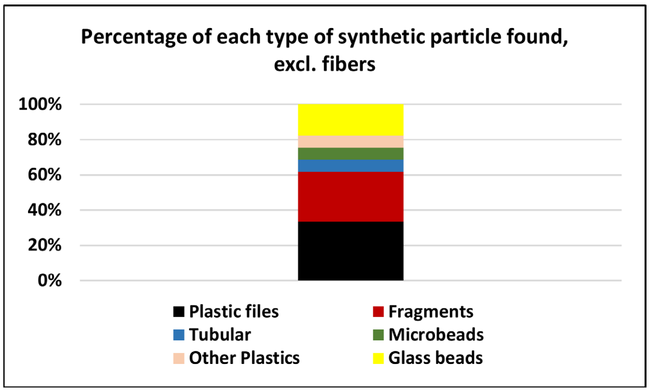

Figure 3. Percentage of each microplastic type found over all analyzed samples, excluding fibers but including glass beads.

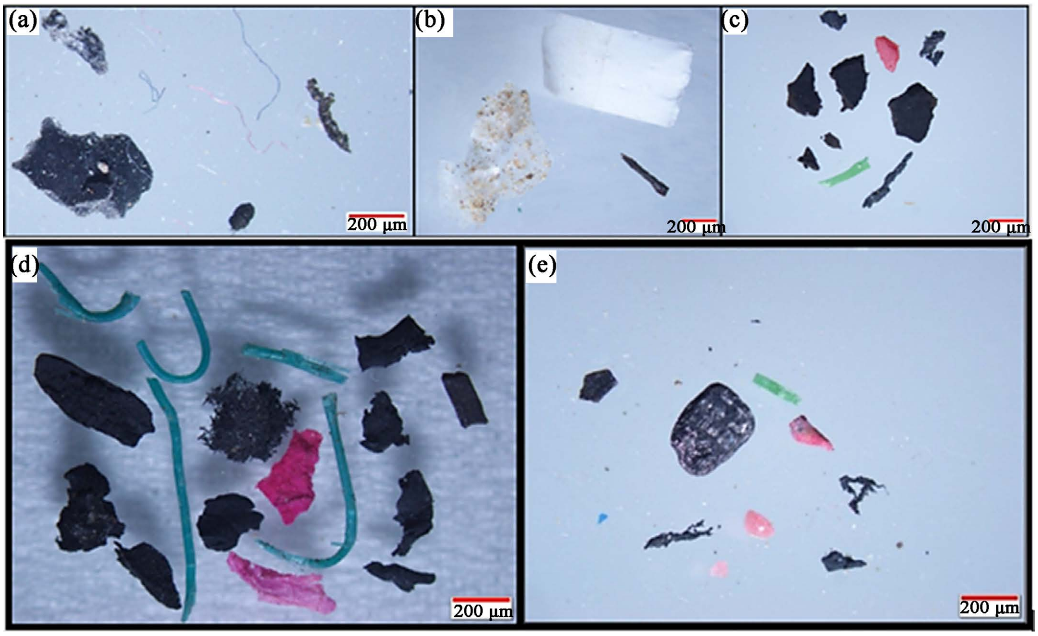

Figure 4. (a) Fiber; (b) Plastic file; (c) Plastic fragment; (d) Tubular plastic; (e) Broken microbead; (a)-(e): Micro tires throughout.

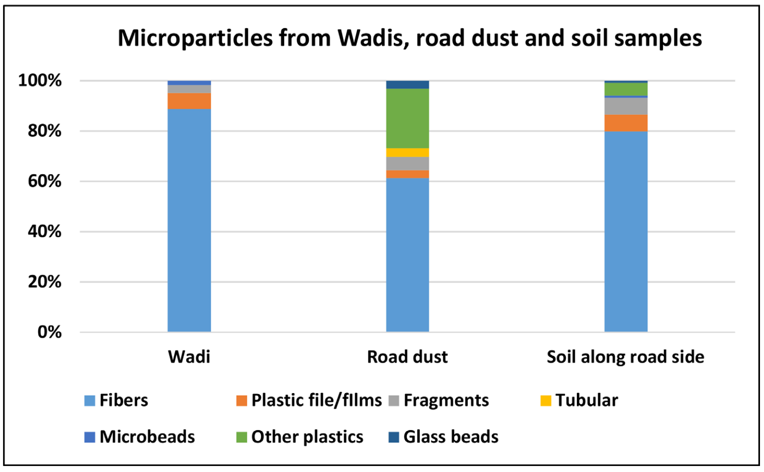

Figure 5. Types of microplastic found in wadi, road dust and soil samples.

which reflects that the United Arab Emirates has the highest annual consumption of plastic shopping bags per capita in the world, a consumption that has led the Abu Dhabi government to ban single-use plastic bags in the Emirate [28]. Then, there are MPs derived from plastic fragments, oftentimes from plastic tops of plastic bottles or from plastic netting that cordons off construction sites. As mentioned above, polyalkenes oxidize readily under the conditions found in sunny, arid environments to become more fragile over time. In fact, past studies have found plastic fragments as the second most abundant type of MP in road dust samples [24]. The tubular plastic fragments shown in **Figure 4(d)** are mainly used for decorative purposes. MPs extracted from road dust samples vary in coloration. In a few cases, more than one color was found for one particle. In all analyzed samples, white (32%) was the dominant color, followed by black (19.5%), red (22.5%), blue (14.5%) green (6.5%) and brown (1.8%) with other colors making up the remaining 2.5% (**Figure 6**). Previous studies from Iran [13] found white to be the dominant color for MPs identified in road dust samples, also.

3.1. Glass Beads from Speed Bumps

In the literature, road markings are an appreciable source of MPs [29] [30]. To enhance the visibility of road markings, especially at night, reflective glass beads are worked into the markings. These glass beads can be used to estimate the MP emission through the degradation of the markings [31]. We realized that glass beads can also be used to better understand the distribution of MPs off-road as the presence of glass beads off-road shows the pathways road storm run-offs take. Especially speed bumps in the Al Ain area are heavily coated with small reflective beads. These then loosen over time and can be found in the road dust. The samples collected from the road bumps abundantly contain glass beads (**Figure 7**). The beads cannot only be found in the road dust, but also in the soil

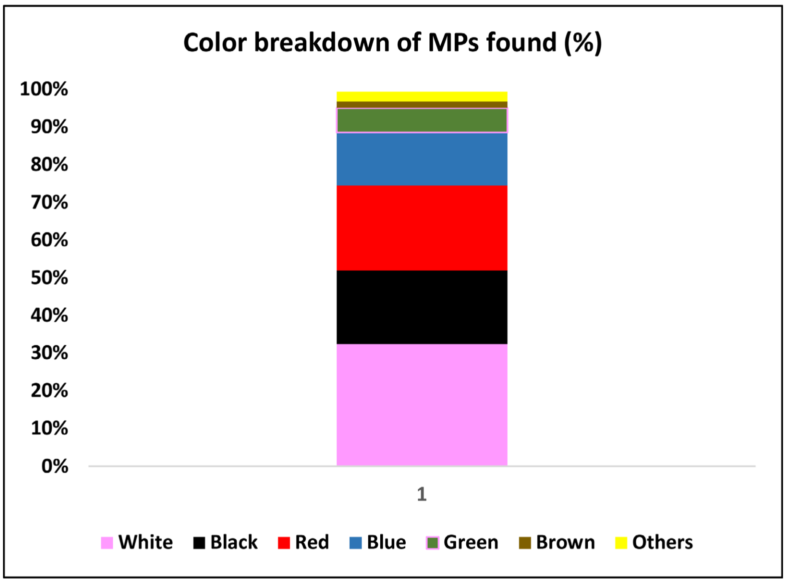

Figure 6. Percentage of coloration of the MPs over all analyzed samples.

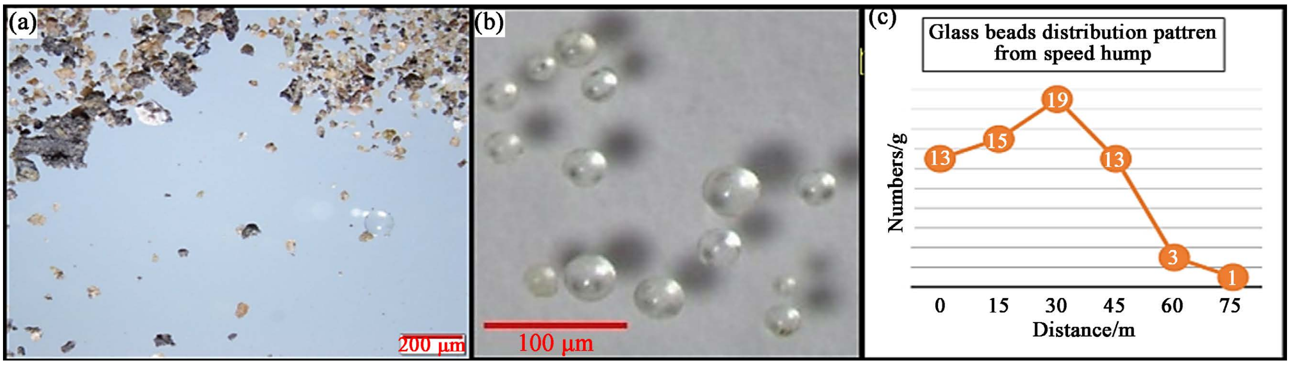

Figure 7. (a) A glass microbead in road dust; (b) a Micro photo of glass beads used in road markings; (c) Number of beads in the road dust as a function of distance from a speed hump.

next to roads, where sweeping operations and the occasional water runoff have moved them. Also, with the movement of cars, they move away from the original location of the pavement marking on the road. Glass beads were also found in the stormwater. The line graph in Figure 7(c) shows that they could be found up to 75 m away from a speed bump, where in that case a maximum concentration of 19 glass beads per g of road dust was observed 30 m away from the speed bump. The glass beads are not uniform in size. Their mean average size in the Al Ain area was found to be 26.8 ± 7.3 µm with a size range of 15.2 - 40 µm.

3.2. Speed Bumps as an Underappreciated Major Source of Microplastics in the Environment

Speed bumps are made from a number of materials such as asphalt, mostly from inorganic materials but also including organic polymers, which can be rubber, polyvinyl chloride, polyurethane and polythene. Some of the plastic used can be recycled material. Throughout Al Ain, speed bumps of different materials are being used.

The authors noted that some of the speed bumps showed deterioration (Figure 8 & Figure 9), where a significant amount of debris in form of small particles was found on the road surface in the neighborhood of the speed bumps, mostly, when in travel direction, in front of the speed bumps. To investigate this further, two types of speed bumps were chosen, one deteriorating only slightly and one with very significant deterioration. When the collected wear material of the speed bump exhibiting significant deterioration was thermally treated in the presence of air at 600˚C for 2 h, only 58.6% ± 1.2% to 62. % ± 1.3% of the material remained, indicating that roughly 37.9% - 41.6% of the initial matter is combustible, carbon-based material. Here, infrared spectroscopy showed that the inorganic component of the speed bumps that the authors had looked at was mostly calcium carbonate (calcite) [32]. Although the absorption bands of calcium carbonate in the infrared region are known to be intense and thus potentially can hide components with less intense bands, an X-ray diffraction spectrum of the combusted speed bump material showed a textbook example of a diffraction pattern of calcium carbonate (in form of calcite, Figure 10).

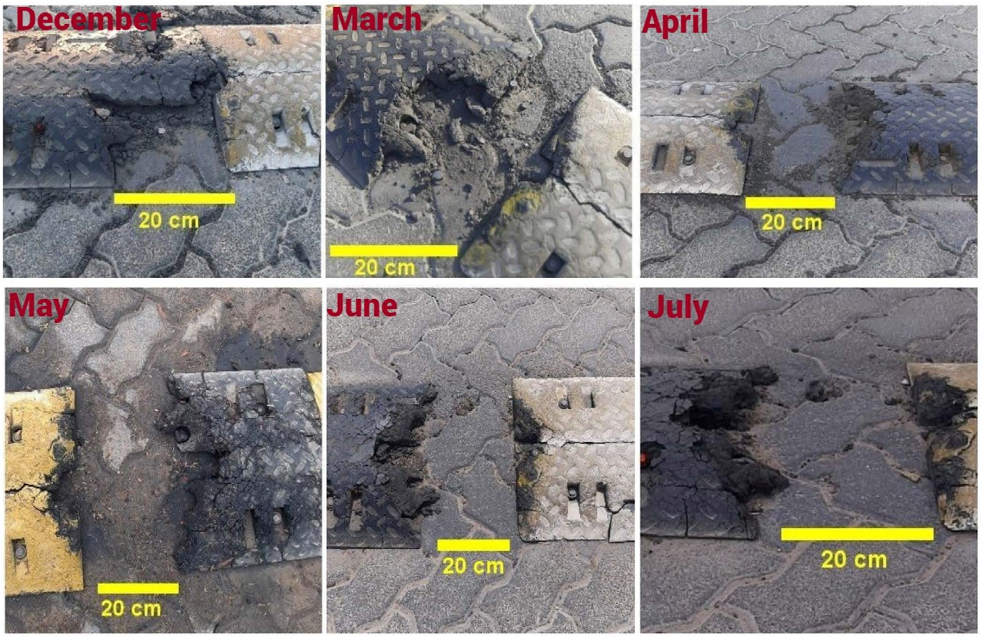

Figure 8. The deterioration of a speed bump in the time period December 2021-July 2022.

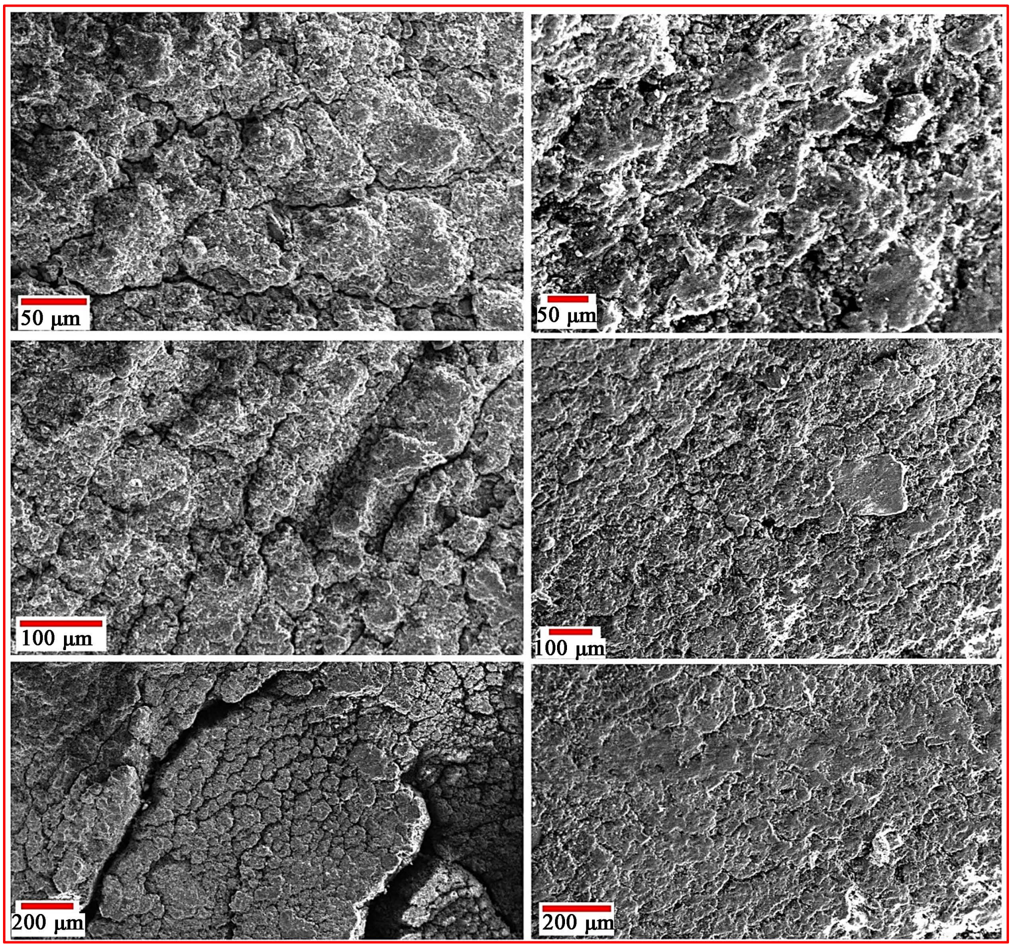

Figure 9. SEM micrographs of two different types of speed bumps analyzed in the studyshow in the lower left-hand corner a significant lack of surface cohesion.

When the areas just before speed bumps were analyzed for wear material from the speed bumps, it was found that as much as 16.5 g of wear material/m^2 could be collected. This equals to 6.25 g - 6.86 g/m^2 of carbon-containing wear material that could over time convert to microparticles. No road sweeping activity was found in this area.

3.3. MPs from Artificial Turf

Areas around four different locations with artificial turf (**Figure 11**) have been

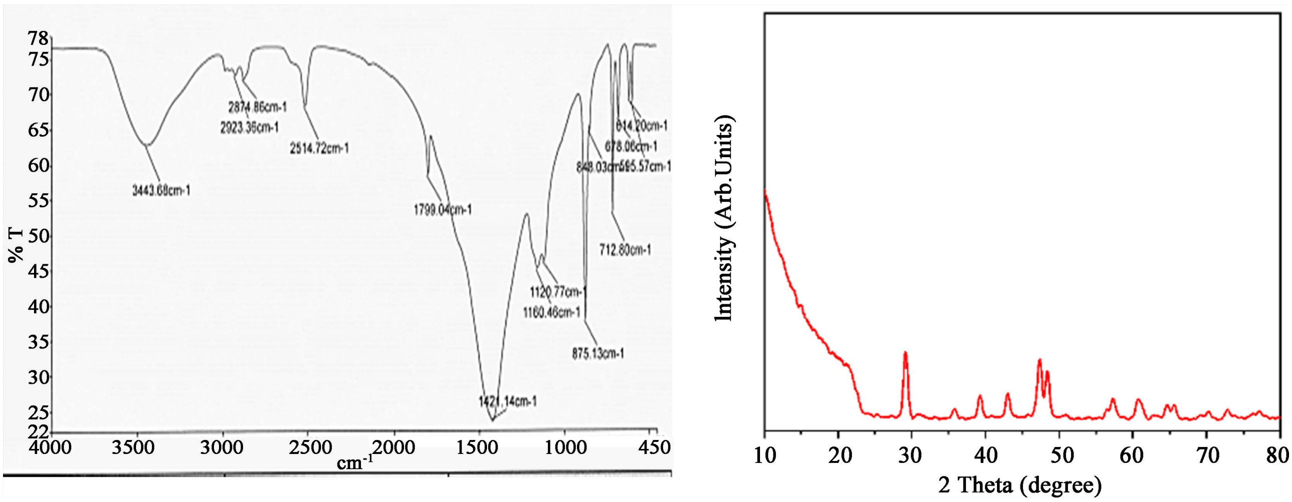

Figure 10. Infrared and XRD spectrum from the ashed material of a speed bump from Al Ain. While the IR spectrum shows $CaCO_3$ as the main constituent, the XRD spectrum shows the diffraction pattern of $CaCO_3$ (calcite). Blue arrows show absorptions from components that are not calcite.

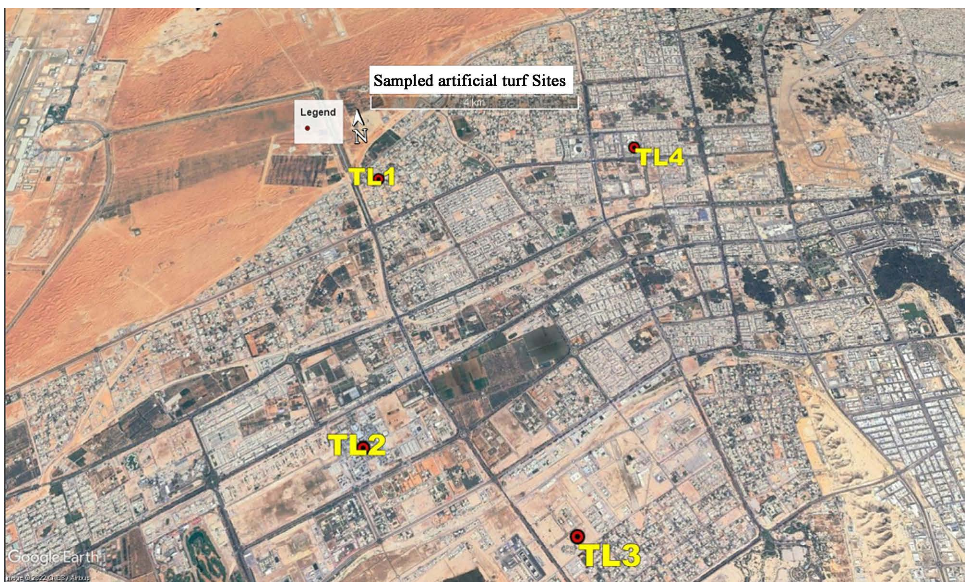

Figure 11. Locations of the 4 areas with artificial turf investigated in this study: TL1 - artificial turf on the central island of a round-about (550 m^2) - the road dust was taken from the round-about itself; TL2 - artificial recreational lawn (130 m^2) in front of a lab building at UAEU – here a soil sample next to the lawn was examined for MP; TL3 - heavily used artificial sports pitch (9800 m^2); TL4 - 1.5-year-old artificial lawn, marking the end of a cul-de-sac (40 m^2).

analyzed for MPs stemming from the turfs, which include a heavily used sports pitch, a small recreational lawn within a university, an artificial lawn on the central island of a roundabout, and an artificial lawn at the end of a cul-de-sac. Two of the sites (TL-2 and TL-3) had the artificial turf laid down more than 7 years ago, while the other two turfs were of younger origin (TL-1 and TL-4, <2.5 years old). In all cases, the authors concentrated solely on the presence of the artificial "grass" blades of the turfs (**Figures 12-14**).

The samplings from location TL-2 (**Figure 13**) showed a heavy load of MPs in the surrounding soil mimicking shorn grass blades from the artificial lawn, at 9.84 ± 0.17 mg MP/g soil. In samples from location TL-3, 1.26 ± 0.12 mg MP/g soil was obtained. A lower load of 0.074 ± 0.083 mg MP/g road dust was found for TL-1 (**Figure 12**). No MP particles were found at site TL-4. Interestingly, depending on the nature of the artificial lawn, the size distribution of emitted MPs can differ from turf to turf. This can be seen in **Figures 12-14**, where the

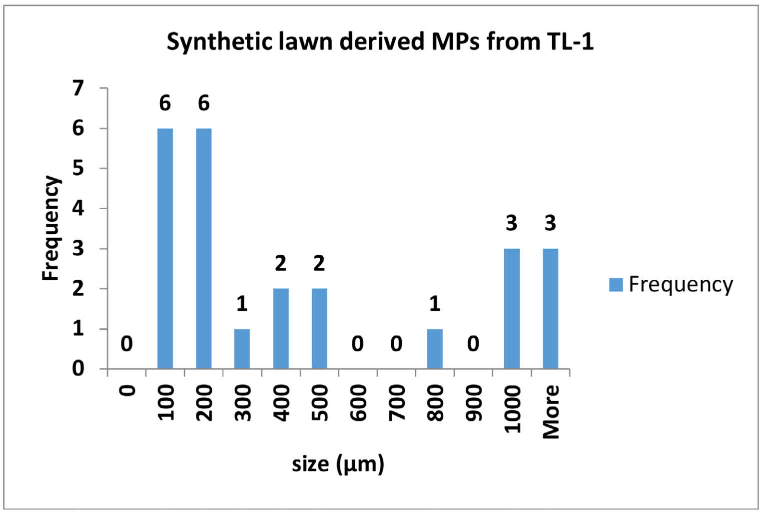

Figure 12. Size distribution of plastic microparticles obtained from the road dust next to the artificial lawn TL-1.

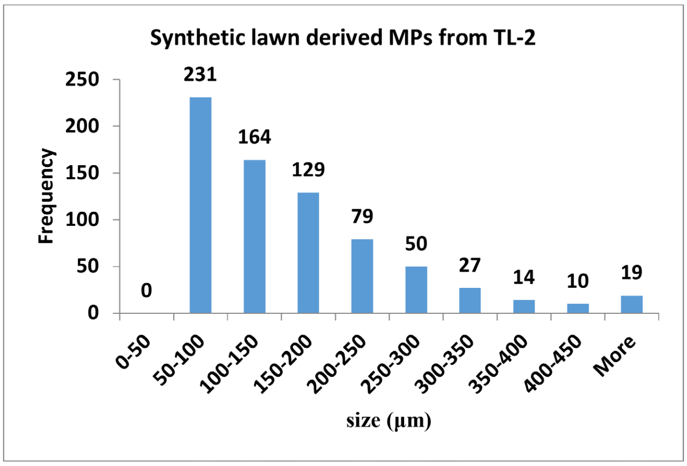

Figure 13. Size distribution of plastic microparticles obtained from the soil next to the artificial lawn TL-2.

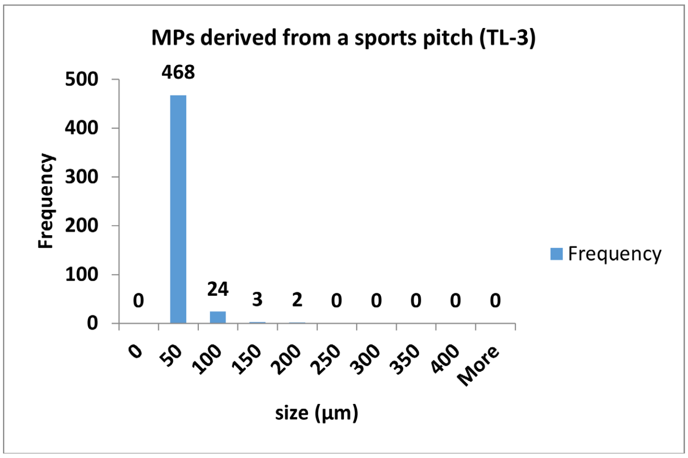

Figure 14. Size distribution of plastic microparticles obtained from a sports pitch (TL-3).

size of MPs obtained from an old and well-used sports pitch (**Figure 14**) is relatively small and exhibits only a small size range. This contrasts with the MP size distribution from a newer artificial lawn, where both the MP size and size range are larger, but where the frequency of MPs quickly drops off with increasing size (**Figure 13**).

4. Conclusion

The authors have studied the presence of MPs in road dust and soils neighboring roads in the arid environment of Al Ain City, Abu Dhabi. Fibers were found to be the most dominant MP type, with white being the most dominant color. The highest MP concentration was observed to be 47 particles/g soil and 44 particles/g road dust, both excluding tire-wear material. Apart from tire-wear material, the authors identified the abrasion of discarded macro- and mesoplastics, including plastic bags, the wear and degradation of speed bumps and the emission of MPs from artificial turfs near roads as some of the sources of MPs. While artificial turfs/lawns can be a significant source of MPs, the amount of MPs released depends very much on the type of turf/lawn, its age and its usage. Little to no MP release was found with new turfs/lawns that are very rarely utilized and only serve decorative purposes. For heavily used, aged lawns/turfs the MP emission can be very significant, leading up to 9.84 ± 0.17 mg MP/g surrounding soil. Speed bumps that contain plastic or rubber material can be a significant source of MP particles over time and more time should be devoted to a more detailed study in this respect in the future. In addition, due to their markings, they also can be a significant source of glass beads. Because of their high mobility, glass beads can be used to identify paths MPs take in their distribution into the environment. In arid regions, this includes the dispersal of MPs in infrequent run-offs from the road surface to the surrounding soil.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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