

SUPPLEMENTARY MATERIAL

Morphological and chemical characteristics of microplastics in surface water of the Vaal River, South Africa

Dalia Saad^{a,b,*}, Gibbon Ramaremissa^a, Michelle Ndlovu^a, and Luke Chimuka^a

Table SM1: Description of sample locations

| Sample code(s) | Description |
|------------------------|--|
| L1 and L2 | L1 and L2 are at the edge of the Lethabo weir. |
| L3 and L4 | L3 and L4 are approximately 2.062 km apart, close to the Makouvlei Dam and Rand water Zuikerbosch pump station in Klipplaatdrift, Vereeniging. |
| L5 and L6 | L5 is at Three Rivers, Vereeniging between the confluences of the Klip, Suikerbosrand, and Vaal Rivers. L6 is close to Arcelor Mittal Vaal works and Riviera aquatics club. It is about 1.531 km from the Rand water Vereeniging pump station. The water was dark grey, and sewage was draining into the Vaal River. |
| L7 and L8 | Located near the R59 and Ascot On Vaal road. There are informal human settlements under the R59. L8 is near the North-West University Vaal Triangle Campus and the Vaal University of Technology in Vanderbijlpark. |
| L9 and L10 | L9 is located between the North-West University Vaal Triangle Campus and Emerald Resort animal world. L9 and L10 are approximately 1.352 km and 1.176 km away from the confluence of the Vaal River and Taaibosspuit River, respectively. The Aquadome and Eligwa boat club are located close to L10. |
| L13 and L14 | L13 is very close to the Vaal River Lodge and Spa and Compu-Kart Raceway. L14 is 2.048 km downstream of L13. |
| L15 and L16 | L15 is close to Duck Point Venue and about 0.287 km from the confluence of the Vaal River and Leeuspruit River. L16 is 1.355 km downstream of L15. The Leeuspruit River drains Sasolburg, Free state. |
| L17 and L18 | L17 and L18 are close to the residential areas of Adenworld AH and Malbank River estate AH in Vanderbijlpark. |
| L19, L20, L21, and L22 | All are in a region between the Waterfront Country lodge and Vaal barrage. They are located on the edge of the Vaal barrage near the confluence of the Rietspruit and Vaal Rivers. |

Table SM2: Volume sampled calculated from flowmeter readings

| Sample code | Initial flowmeter reading | Final flowmeter reading | Revolutions | Distance (m) | Volume sampled (m³) |
|--------------------|----------------------------------|--------------------------------|--------------------|---------------------|---------------------------------------|
| L1 | 287571 | 354598 | 67027 | 1801.2 | 88.5 |
| L2 | 354798 | 357245 | 2447 | 65.8 | 3.2 |
| L3 | 357734 | 359521 | 1787 | 48.0 | 2.4 |
| L4 | 359522 | 361323 | 1801 | 48.4 | 2.4 |
| L5 | 361236 | 362026 | 790 | 21.2 | 1.1 |
| L6 | 362049 | 392056 | 30007 | 806.4 | 39.6 |
| L7 | 392051 | 453944 | 61893 | 1663.3 | 81.7 |
| L8 | 453936 | 532428 | 78492 | 2109.3 | 103.6 |
| L9 | 523439 | 553779 | 30340 | 815.3 | 40.0 |
| L10 | 713303 | 774960 | 61657 | 1656.9 | 81.4 |
| L11 | 597773 | 656054 | 58281 | 1566.2 | 76.9 |
| L12 | 646195 | 712994 | 66799 | 1795.1 | 88.2 |
| L13 | 553689 | 597782 | 44093 | 1184.9 | 58.2 |
| L14 | 774984 | 847238 | 72254 | 1941.7 | 95.4 |
| L15 | 847238 | 921274 | 74036 | 1989.6 | 97.7 |
| L16 | 921270 | 860807 | 60463 | 1624.8 | 79.8 |
| L17 | 860807 | 801595 | 59212 | 1591.2 | 78.1 |
| L18 | 32095 | 76380 | 44285 | 1190.1 | 58.4 |
| L19 | 76393 | 114374 | 37981 | 1020.7 | 50.1 |
| L20 | 114374 | 148194 | 33820 | 908.9 | 44.6 |
| L21 | 148202 | 216716 | 68514 | 1841.2 | 90.4 |
| L22 | 216716 | 313116 | 96400 | 2590.6 | 127.2 |

Table SM3: Area sampled calculated from GPS coordinates

| Sample code | Latitude | Longitude | Distance (km) | Area sampled (km ²) |
|-------------|------------|-----------|---------------|---------------------------------|
| L1 | -26.72876 | 27.99241 | 1.63 | 4.1×10 ⁻⁴ |
| L2 | -26.71453 | 27.99648 | 2.11 | 5.3×10 ⁻⁴ |
| L3 | -26.69557 | 27.9988 | 2.06 | 5.2×10 ⁻⁴ |
| L4 | -26.68169 | 27.985 | 2.22 | 5.6×10 ⁻⁴ |
| L5 | -26.67002 | 27.96685 | 2.64 | 6.6×10 ⁻⁴ |
| L6 | -26.69635 | 27.93224 | 2.45 | 6.1×10 ⁻⁴ |
| L7 | -26.70701 | 27.90505 | 2.95 | 7.4×10 ⁻⁴ |
| L8 | -26.71888 | 27.89533 | 1.63 | 4.1×10 ⁻⁴ |
| L9 | -26.73957 | 27.88345 | 2.58 | 6.5×10 ⁻⁴ |
| L10 | -26.74665 | 27.86203 | 2.27 | 5.7×10 ⁻⁴ |
| L11 | -26.75035 | 27.83427 | 2.79 | 7.0×10 ⁻⁴ |
| L12 | -26.74984 | 27.80157 | 3.25 | 8.1×10 ⁻⁴ |
| L13 | -26.75127 | 27.78104 | 2.05 | 5.1×10 ⁻⁴ |
| L14 | -26.76563 | 27.76807 | 2.05 | 5.1×10 ⁻⁴ |
| L15 | -26.7866 | 27.768 | 2.32 | 5.8×10 ⁻⁴ |
| L16 | -26.79814 | 27.76349 | 1.36 | 3.4×10 ⁻⁴ |
| L17 | -26.78595 | 27.74847 | 2.01 | 5.0×10 ⁻⁴ |
| L18 | -26.767881 | 27.738719 | 2.23 | 5.6×10 ⁻⁴ |
| L19 | -26.761625 | 27.714467 | 2.51 | 6.3×10 ⁻⁴ |
| L20 | -26.763786 | 27.684917 | 2.95 | 7.4×10 ⁻⁴ |
| L21 | -26.762375 | 27.707019 | 2.20 | 5.5×10 ⁻⁴ |
| L22 | -26.761311 | 27.728019 | 2.09 | 5.2×10 ⁻⁴ |

Vincenty's inverse formula was used to calculate the distance between two GPS coordinates. The distance between any two samples was determined using the Australian government geoscience

geodetic calculator available at: <https://geodesyapps.ga.gov.au/vincenty-inverse>. The area sampled was obtained by multiplying the geographical distance sampled with the width of the plankton net opening.

Area sampled = Width of the net opening \times distance travelled

$$\text{Area sampled (L1)} = 2.5 \times 10^{-4} \text{ km} \times 1.63 \text{ km}$$

$$\therefore \text{Area sampled (L1)} = 4.1 \times 10^{-4} \text{ km}^2$$

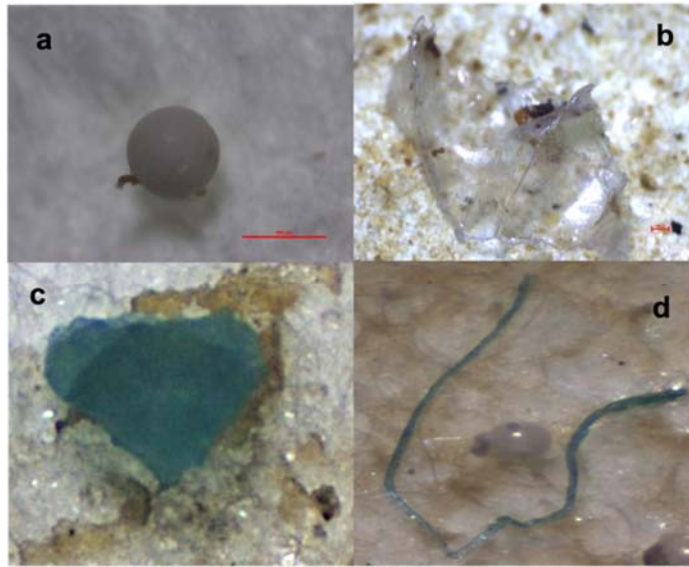


Fig SM1. Microplastic shapes as seen under the microscope: (a) pellet, (b) film, (c) fragment and (d) fiber

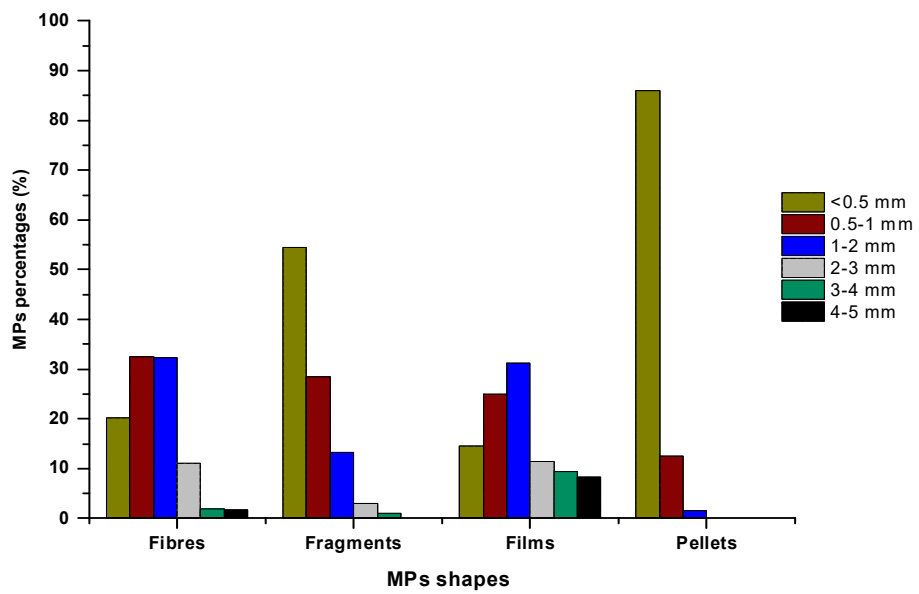


Figure SM2 Distribution of shapes across different size ranges

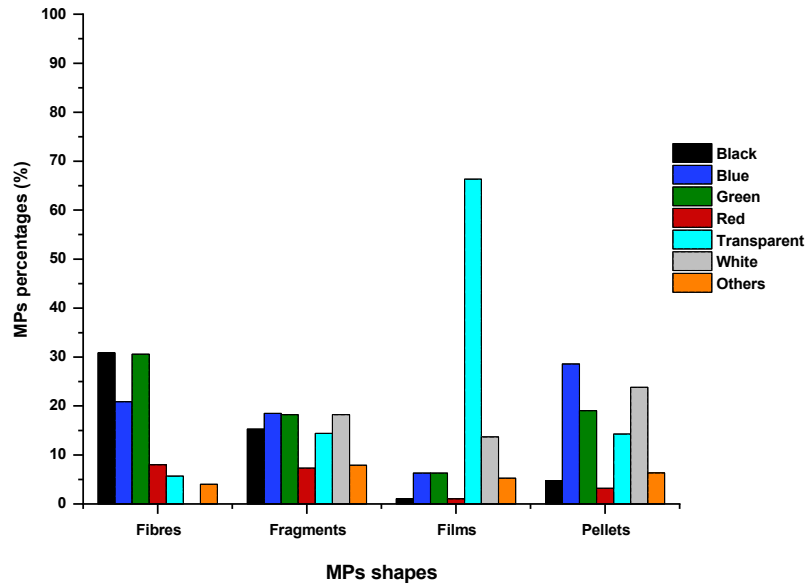
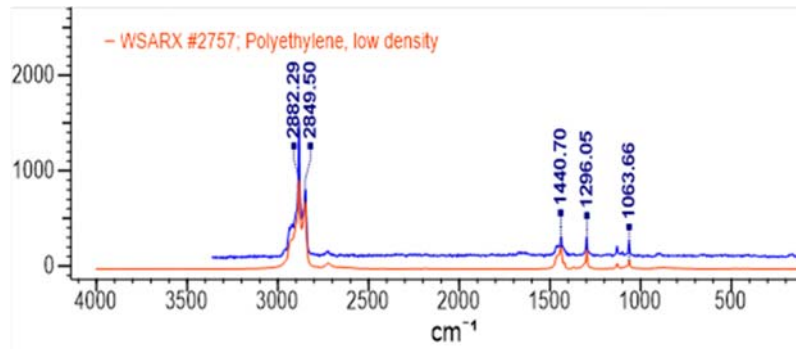
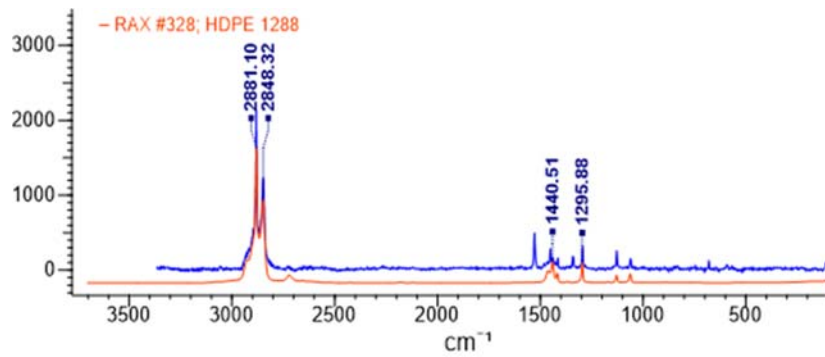


Figure SM3 Distribution of colours across different shapes

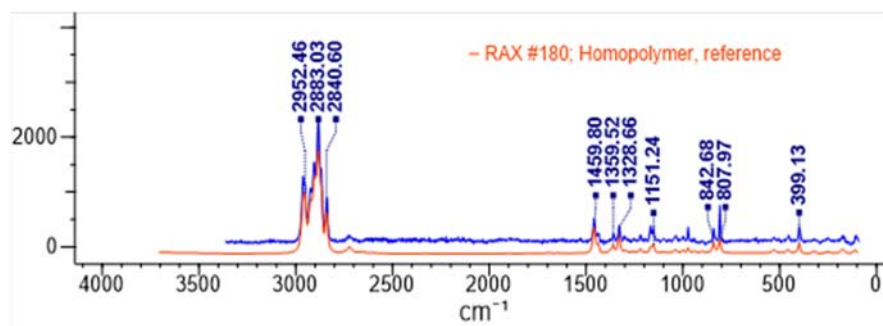
a)



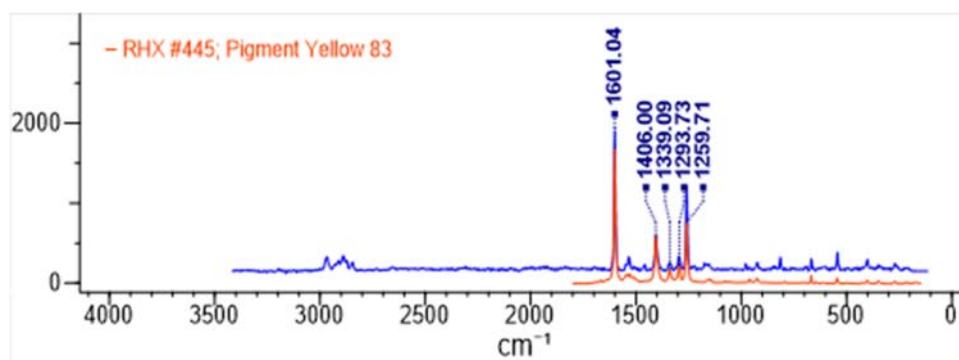
b)



c)



d)



e)

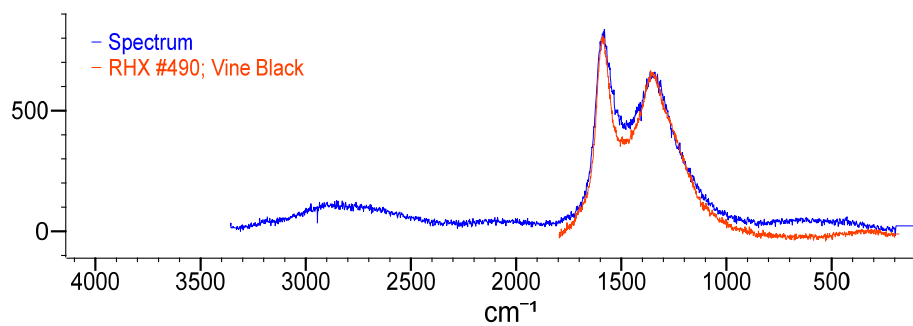


Fig SM4. Raman spectra of (a) LDPE (b) HDPE (c) PP (d) Pigment Yellow 83 and (e) Vine black.