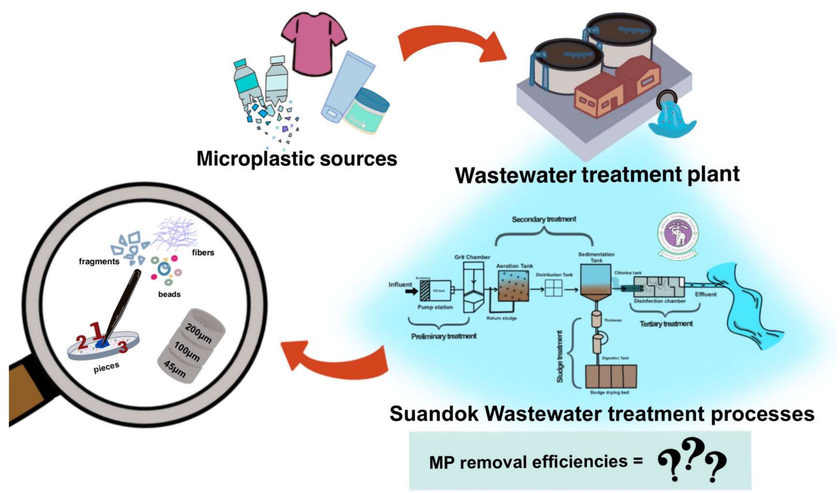
Microplastics in Suandok wastewater treatment plant: distribution and removal efficiencies

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INTRODUCTION

- Microplastics (MPs, <5 mm) originate from plastic breakdown of plastic products.
- MPs are transported to conventional WWTPs, which are not specifically designed for their removal.
- Removal efficiency varies depending on treatment processes and particle characteristics, and overall performance remains uncertain.



OBJECTIVES

1. To evaluate the overall removal efficiency and distribution of MPs across the treatment units at Suandok wastewater treatment plant
2. To calculate the removal efficiencies of MPs at each treatment stage

METHODS

1. Wastewater sample

1.1 Collection



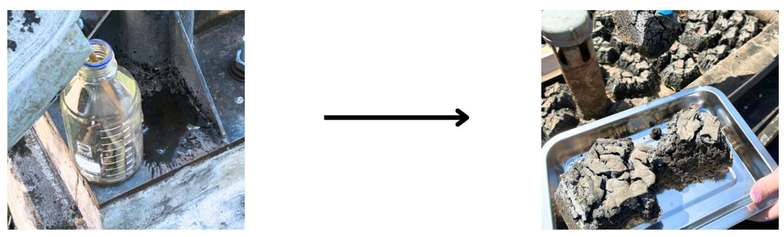
Collected 20 L wastewater at each point → Filtered through 200, 100, and 45 µm sieves → Rinsed with DI water, and stored at 3–5 °C

1.2 Pre-Treatment

Organic matter digestion using Fenton's reagent ➤ Density separation with 5.73 M NaCl ➤ Samples were vacuum-filtered (Whatman No. 93) ➤ Dried at 60 °C until completely dry

2. Sludge sample

2.1 Collection



Collected sludge using 1.0 L glass jar or aluminium tray → Stored at 3–5 °C

2.2 Pre-Treatment

Dried at 105 °C ➤ Density separation with 5.73 M NaCl ➤ Organic matter digestion using Fenton's reagent ➤ Vacuum-filtered and dried at 60 °C until dry

3. Sample Analysis

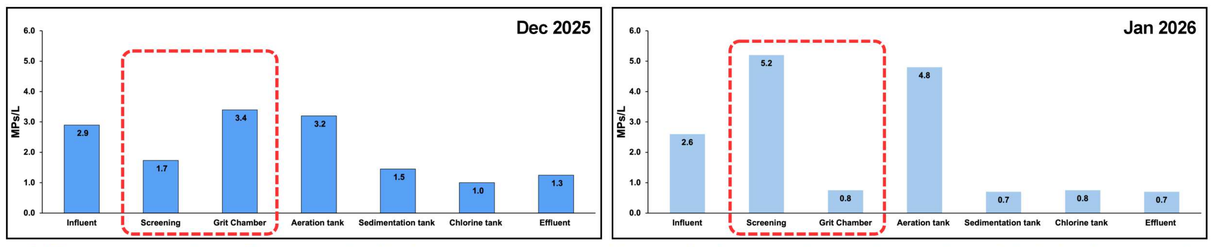
Size classifications: >200 µm, 100-200 µm and, 45-100 µm

Visual identification analysis: Digital Microscope

Morphological classification: Fragment, Fiber, Bead

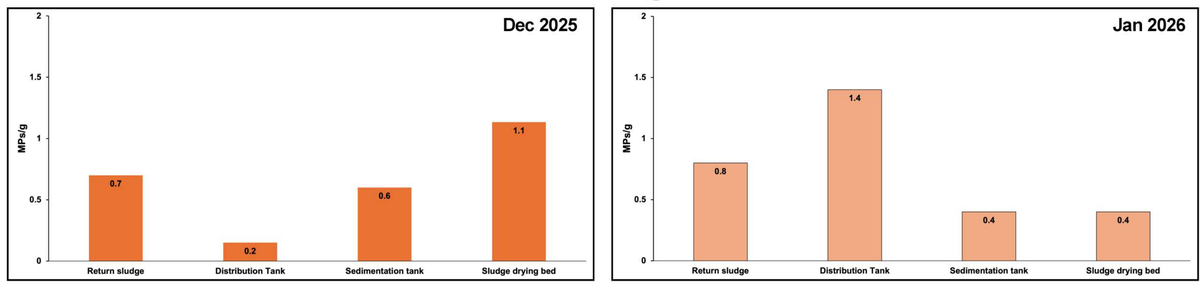
RESULTS AND DISCUSSION

Concentration of MPs in wastewater



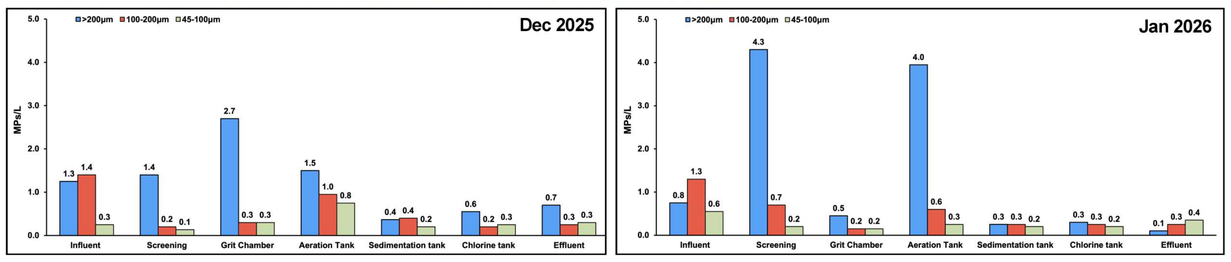
- MP concentrations fluctuated with low to no removal in preliminary units and remained high in the aeration tank, but decreased significantly after the aeration process.

Concentration of Microplastics in sludge



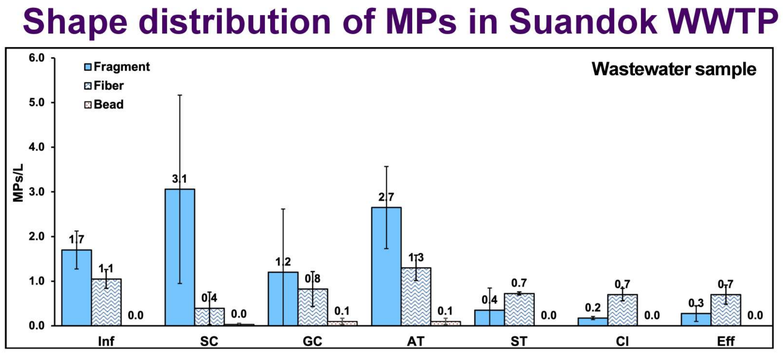
- MPs were detected in sludge and sludge related units, shows that MP possibly transfer from the water phase to sludge during treatment.

Size distribution of MPs in Suandok WWTP

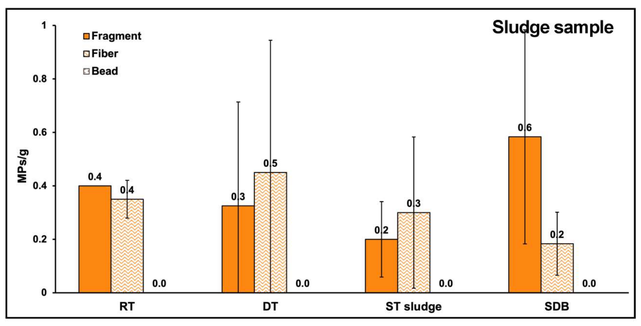


- Larger MPs were more observed in the initial stages and showed higher removal, whereas smaller size were more likely to remain suspended and discharged with the effluent.

Shape distribution of MPs in Suandok WWTP

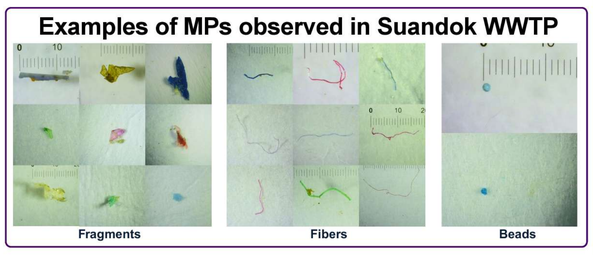


- Fragments were more prevalent in the initial stages and exhibited the highest removal efficiency, while fibers tended to persist until the effluent stage.



- Fragments and fibers were observed in comparable proportions.

Examples of MPs observed in Suandok WWTP



Removal Efficiency of MPs in Suandok WWTP

Treatment unit	MPs/L	% Removal after each unit	Cumulative % removal
Screening	3.5 (± 2.45)	-26.1 ± 99.2 %	−26.1%
Grit Chamber	2.1 (± 1.87)	40.1 ± 128.5 %	24.10%
Aeration Tank	4.0 (± 1.13)	-92.8 ± 386.0 %	−45.5%
Sedimentation tank	1.1 (± 0.53)	73.1 ± 21.7 %	60.90%
Chlorine Tank	0.9 (± 0.28)	18.6 ± 27.0 %	68.20%
Average removal efficiency	**64.5 ± 11.4 %**		

Treatment stage	% Removal after each stage	Cumulative % removal
Preliminary	24.5 ± 62.5 %	24.55%
Secondary	48.2 ± 35.8 %	60.91%
Tertiary	9.3 ± 9.8 %	64.55%

CONCLUSIONS

- MPs were observed at all treatment stages, with an overall removal efficiency of ~64%, indicating WWTP processes cannot completely eliminate MPs.
- Smaller MPs and fibers were more likely to remain in the effluent, while a considerable portion accumulated in sludge, posing potential environmental risks.
- Further process optimization and the application of advanced analytical techniques (e.g., FTIR/Raman) are recommended to improve removal performance and identification accuracy.

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