Addressing Microplastic Pollution through Decentralized Wastewater Treatment Systems (DEWATS) in the Philippines

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Microplastics in our oceans

Microplastics were detected in 66 out of 68 samples taken during the global race.

- Levels in the mid-Atlantic were consistent, on average 55 particles/m².
- European waters contained up to 307 particles/m².
- Highest level was recorded in the South China Sea, 349 particles/m². Nearby Philippine Sea sample contained 243 particles/m².
- South Indian Ocean close to Antarctic waters contained up to 25 particles/m².
- Even Point Nemo, the most remote part of the world’s ocean, is polluted with microplastics 26 particles/m².
- Only two samples contained no microplastics.

Preliminary data provided by Dr Ing. Sören Gutekunst & Dr Tobias Trepte.
GEOForschungsZentrum Potsdam (GFZ) Department of Earth Observation Studies.
Microplastics Occurrence
in Surface Waters and Sediments in Metro Manila Rivers

Figure taken from:
The Microplastics in Metro Manila Rivers: Characteristics, Sources, and Abatement
M. A. N. Tanchuling and E.D Osorio

In:
Friederike Stock, Georg Reifferscheid, Nicole Brennholt and Evgeniia Kostianaia (eds.),
Plastics in the Aquatic Environment - Part I: Current Status and Challenges,
Microplastics were ubiquitously detected in all surface water and sediment samples extracted from the mouth of the five rivers (Cañas, Meycauayan, Parañaque, Pasig and Tullahan River) draining to Manila Bay.
Shape of Microplastics

a) **fragment** - hard, jagged, angular small piece; b) **film** - very thin, soft layer; c) **pellet or granule** - hard ovoid sphere shape or disc-shaped or cylindrical; d) **line or fiber** - elongated and thin, or fibrous appearance; e) **sheet** - irregular flat and flexible piece; f) **foam** - lightweight, porous and sponge-like plastic.
Shape of Microplastics

Percentage distribution of different shapes of microplastics identified from the mouths of the rivers: (from innermost to outermost circle) (a) Cañas, (b) Meycauayan, (c) Parañaque, (d) Pasig, and (e) Tullahan.
Percentage distribution of different polymer types of microplastics identified from the mouths of the rivers: (from innermost to outermost circle) (a) Cañas, (b) Meycauayan, (c) Parañaque, (d) Pasig, and (e) Tullahan.

Note that values less than 5% were not indicated.
## Microplastics in wastewater treatment systems

<table>
<thead>
<tr>
<th></th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw wastewater</td>
<td>3160 particles/L</td>
</tr>
<tr>
<td>Treated wastewater</td>
<td>125/L</td>
</tr>
<tr>
<td>Sludge</td>
<td>$170.9 \times 10^3$ particles/Kg</td>
</tr>
<tr>
<td>Removal Efficiency</td>
<td>72% - 99.4% using primary and secondary treatment</td>
</tr>
</tbody>
</table>

Source: Gatidou, 2018  
https://doi.org/10.1016/j.jhazmat.2018.12.081
Wastewater flow in the Philippines

- Direct Sewerage (no Septic Tank) <4%
- Septic Tanks with Sewerage <1%
- Septic Tanks NO Sewerage 84%
- Other On site 9%
- Open Defecation 3%

Total wastewater treated ~4%
Septage safely collected 30%
Septage safely disposed /treated 10%
Septage wastewater unsafely disposed

# Treatment systems in the Philippines

<table>
<thead>
<tr>
<th>Type of Area</th>
<th>Sewerage System</th>
<th>Septage system</th>
<th>DEWATS</th>
<th>Septic Tanks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly urbanized cities (HUCs)</td>
<td>Highly urbanized cities (HUCs)</td>
<td>First class cities and municipalities</td>
<td>2(^{nd}) to 6(^{th}) class municipalities; schools, markets, hospitals</td>
<td>Individual households</td>
</tr>
<tr>
<td>First class cities and municipalities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wastewater treated</td>
<td>Domestic and industrial wastewater</td>
<td>Septage from septic tanks</td>
<td>Domestic wastewater</td>
<td>Domestic wastewater</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sludge from DEWATS systems</td>
<td></td>
</tr>
<tr>
<td>Construction period</td>
<td>&gt; 5 years</td>
<td>3 – 5 years</td>
<td>&lt; 1 year</td>
<td>1 – 3 months</td>
</tr>
<tr>
<td>Financial requirement</td>
<td>Very high</td>
<td>High</td>
<td>Low</td>
<td>Very low</td>
</tr>
</tbody>
</table>
Need for DEWATS systems

• Wastewater treatment plants may capture the microplastics content in wastewater

• Conventional and off-site centralized domestic wastewater treatment approach often require a huge investment cost and highly specialized knowledge and technical expertise for operation and maintenance

• Not a viable solution to many Local Government Units (LGUs) and Water Districts due to their limited funding and technical expertise in planning, design, construction and operations of these centralized systems.

• **DEWATS is the more appropriate strategy for many LGUs and Water Districts**
Thank you for the attention!

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