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The fate of microplastics in an Italian Wastewater Treatment Plant

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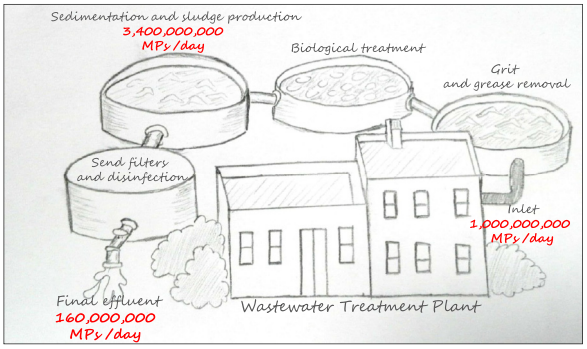
HIGHLIGHTS

- Selected Wastewater Treatment Plant (WWTP) removes the 84% of microplastics (MPs).
- 160,000,000 MPs were released daily by selected WWTP.
- 3,400,000,000 MPs were deposited daily in 30 tons of sludge by selected WWTP.
- WWTPs are a source of MPs in both aquatic and terrestrial environment.

GRAPHICAL ABSTRACT



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ABSTRACT

The emerged threat of microplastics (MPs) in aquatic ecosystems is posing a new challenges in environmental management, in particular the civil Wastewater Treatment Plants (WWTPs) which can act both as collectors of MPs from anthropic use and as a source to natural environments. In this study, MP fate was investigated in one of the biggest WWTPs of Northern Italy, built at the beginning of the 2000s and which serves a population equivalent of about 1,200,000, by evaluating their presence at the inlet (IN), the removal efficiency after the settler (SET) and at the outlet (OUT), and their transfer to sludge. Samples were collected in three days of a week and plastic debris was characterized in terms of shape, size and polymer composition using the Fourier Transform Infrared Microscope System (μFT-IR). The number of detected MPs was 2.5 ± 0.3 MPs/L in the IN, 0.9 ± 0.3 MPs/L after the SET and 0.4 ± 0.1 MPs/L in the OUT, indicating a total removal efficiency of 84%. However, considering that this WWTP treats about 400,000,000 L wastewaters/day, the potential release of MPs to the receiving aquatic system would be approximately 160,000,000 MPs/day, mainly polyesters (35%) and polyamide (17%). Furthermore, a great amount of MPs removed from wastewater was detected in the recycled activated sludge, with 113 ± 57 MPs/g sludge dry weight, corresponding to about 3,400,000,000 MPs deposited in the 30 tons of sludge daily produced by this WWTP. Given the possible re-use of WWTP sludge in fertilizers for agriculture, our results highlight that WWTPs could represent a potential source of MPs also to agroecosystems.

1. Introduction

Plastic materials have a pivotal role in the modern society and synthetic polymer production increased worldwide in the last decades,

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