The Wastewater Treatment Micro-Heroes Gallery

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Water is one of our most valuable resources, and keeping it clean is a challenge that concerns us all. Wastewater treatment plants (WWTPs) are home to an invisible workforce of microbial heroes that remove pollutants, break down organic matter, and recycle essential nutrients, ensuring that treated water can safely return to the environment. Like us, microbes form complex communities, each playing a specialized role in maintaining water quality. Some decompose organic waste, others remove nitrogen and phosphorus, and some even eliminate toxic substances like hydrogen sulfide (H_2S).

A few of these tiny specialists have become famous among microbiologists due to their crucial roles. So, let's meet some of these Micro-Heroes of wastewater treatment!

Bacteria

Organic Waste Degraders (Heterotrophic Bacteria)

In wastewater treatment, heterotrophs are by far the most abundant microorganisms in biological treatment systems. They act as the engine of the process by consuming organic matter and transforming it into new microbial biomass, carbon dioxide (CO_2), and water. By efficiently using available food, they help maintain a balanced microbial community and prevent unwanted organisms from taking over.

Thanks to these microbes, the system runs as expected. The activated sludge community includes bacteria from many genera, such as *Acinetobacter, Alcaligenes, Brevibacterium, Caulobacter, Comamonas, Cytophaga,* and *Flavobacterium*.

Pseudo (*Pseudomonas putida*)

Claim to fame: Versatile organic matter degrader, involved in the breakdown of complex hydrocarbons, pharmaceuticals, and other pollutants in wastewater.

Bacil (*Bacillus subtilis*)

Claim to fame: Produces hydrolytic enzymes (proteases, amylases) that break down proteins and starch in wastewater, improving organic matter removal.

Nitrogen Specialists

Broc (*Brocadia anammoxidans*) – the anammox bacterium.

Claim to fame: Cleaning our wastewater removing nitrogen via the anammox process, converting ammonium and nitrite directly into nitrogen gas without the need for oxygen. This process saves energy, reduces aeration needs, and lowers carbon emissions in modern wastewater treatment plants.

Sulfur Specialists

Thio-Boom (*Thiothrix Eikelboom*)

Claim to fame: It is a sulphur-oxidizing filamentous bacterium. Oxidize reduced sulphur compounds and has the ability to store sulphur granules inside its cells. While it can contribute to bulking problems if it overgrows, it also plays an important role in biofilms and sulphur cycling in wastewater systems.

T-Bac (*Thiobacillus spp.*, e.g., *T. thioparus*, *T. denitrificans*).

Claim to fame: Remove sulphur and sulphides from wastewater. Obligate chemo lithotrophic bacteria, oxidize sulphurous compound to sulfuric acid (H_2SO_4) in fully aerobic conditions. When immobilized in biofilters, these bacteria are key players in removing H_2S from air streams in WWTPs, preventing odour problems and protecting infrastructure from corrosion.

Archaea

Methano (*Methanosaeta concilii*)

Claim to fame: A methane-producing archaeon that thrives in anaerobic digesters. It converts organic waste into methane-rich biogas in anaerobic digesters, which can be used as renewable energy to power wastewater treatment plants.

Fungi

Tricho (*Trichoderma harzianum*)

Claim to fame: Breaks down complex organic compounds, including dyes and some pharmaceutical residues. It can also suppress harmful microbes, contributing to biological stability.

Protozoa

Vortice (*Vorticella convallaria*)

Claim to fame: Helps clean wastewater by feeding on free-swimming bacteria and suspended organic particles, improving effluent clarity and reducing bacterial overgrowth. These ciliates are attached to the substrate with a contractile peduncle and have the oral apparatus with a crown of cilia with which they form a current of water that drags the suspended particles and bacteria they eat.

Lemis (*Lecane inermis*)

Claim to fame: A rotifer that helps control filamentous bacteria responsible for bulking (such as *Thiothrix* or *Microthrix*). By grazing on bacteria and organic particles, it contributes to a clearer and healthier effluent.

Algae

Chloro (*Chlorella vulgaris*)

Claim to fame: Captures carbon dioxide (CO_2), removes excess nutrients (like nitrogen and phosphorus), and contributes to sustainable wastewater treatment with potential for biofuel production.

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