RP2017

AEROBIC GRANULAR SLUDGE FOR ENERGY EFFICIENT WASTEWATER TREATMENT AND REUSE

Research Question

What impact does the conversion of a conventional activated sludge microbial floc to aerobic granular sludge have on process energy consumption, greenhouse gas emissions and treated effluent water quality?

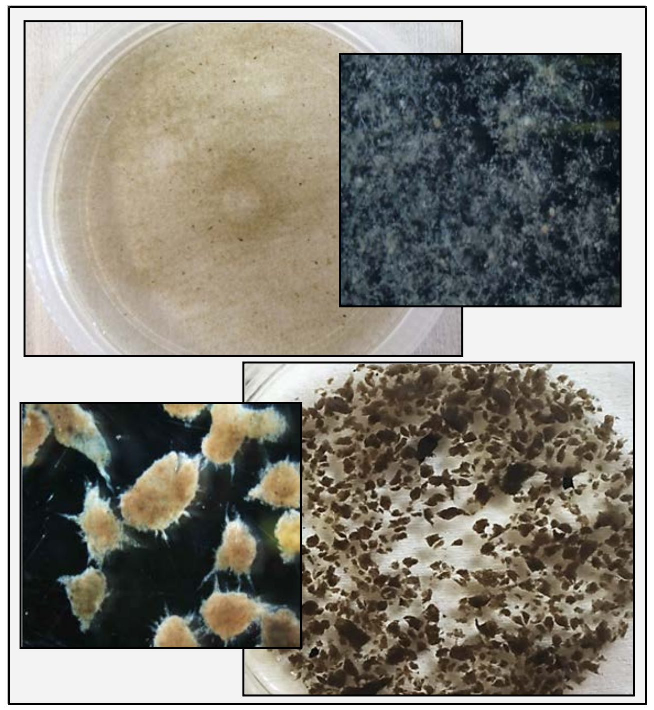


Figure 1: Comparison of conventional activated sludge flocs (top) to aerobic granular sludge microbial granules (bottom); 10× magnification.

Background

Wastewater treatment commonly occurs in three stages at municipal wastewater treatment plants (WWTPs): primary; secondary; and tertiary treatment. During secondary wastewater treatment, wastewater is added to treatment basins where sewage is treated using microbial flocs (Figure 1) to remove nutrients such as carbon, nitrogen and phosphorus. Secondary aeration and mixing processes also comprise a large fraction of overall WWTP energy use and associated carbon footprint (≈50%).

There is a new and emerging alternative to microbial flocs which involves their conversion to dense, fast-settling microbial 'granules'. This so-called aerobic granular sludge (AGS) process allows for greater volumes of wastewater to be treated, as biomass is more concentrated, settles more quickly and wastewater reactor cycle times can be reduced. Rapid settling AGS also allows for reduced energy requirements for secondary aeration and clarification, as well as reduced physical WWTP footprint which means lower embodied carbon in WWTP infrastructure.

Granular sludge retrofits to existing floc-based systems may also allow for increased hydraulic capacity in WWTPs, which has the potential to delay costly infrastructure upgrades for water utilities, allowing capital to be spent elsewhere.

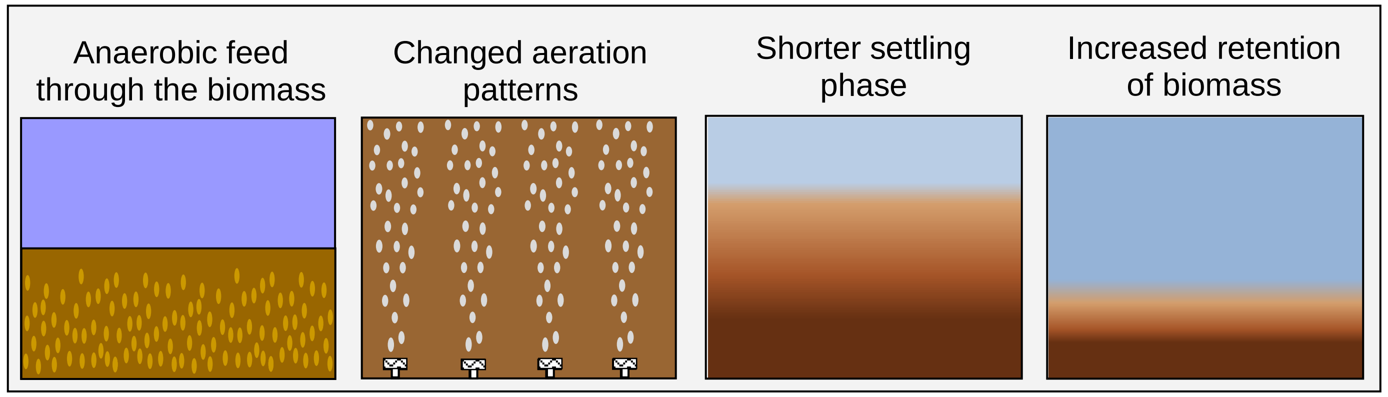
Issues

AGS allows for increased hydraulic capacity or reductions in WWTP size, with potential for reduced aeration energy requirements. However these benefits could potentially be offset by increased energy requirements for tertiary treatment processes such as UV or chlorine disinfection, or by elevated direct process greenhouse gas (GHG) emissions such as nitrous oxide. These potential trade-offs need to be fully understood before the water sector can fully embrace this new AGS technology.

Research Aims

This study aims to investigate multiple facets of novel AGS operation and performance and compare these to conventional activated sludge (current *status quo*). This will be done at pilot scale, allowing true side-by-side comparison of the two treatment processes. Several research areas have been defined as areas of key interest to industry partners; these include:

- The effect that conventional-to-AGS conversion has on direct process GHG emissions and the net effects on WWTP carbon footprint from any associated savings in energy use and/or increased hydraulic capacity
- The effects of various AGS operating conditions on pathogen removal performance and stability, to determine the likely downstream impacts of conventional-to-AGS conversion in terms of overall energy efficiency of water recycling systems
- Investigate the changes to microbial community composition from conventional-to-AGS conversion, and linking these to operating conditions and process performance



How does aerobic granular sludge compare to conventional activated sludge for energy efficient wastewater treatment?

Further information

http://bit.ly/2e4IJq1

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