Optimizing lab-scale wastewater treatment reactors operation for enhanced assays

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Wastewater treatment plants (WWTP) comprise a complex set of sequenced operations that ensure the safe discharge of water, previously contaminated by anthropogenic activities, into the environment. Roughly, these operations are divided in: preliminary treatment, primary treatment and secondary treatment. The secondary treatment is the most critical operation, encompassing a feeble equilibrium between physicochemical conditions and biological processes. It commonly consists in an aeration tank and a clarifier [1].

The microbial community present in the aeration tank is responsible for metabolizing most of the influent nutrient load. Pure oxygen, or air, is injected in this process to guarantee an adequate concentration of dissolved oxygen, in order to promote a rapid aerobic metabolism. Simultaneously preventing anoxic conditions, which denote a slower nutrient consumption and the generation of foul substances. Worldwide, the most commonly used microbial community for this process in the WWTP is activated sludge. Consisting of a highly complex community comprising bacteria, fungi, small protozoa and protozoa, the activated sludge "healthiness" is a critical factor for the efficiency of the wastewater treatment process. In addition, "healthy" activated sludge also possess a key physicochemical property for the downstream process of the aeration tank, namely, flocculation. In the clarifier the activated sludge flocs will sediment by the sole action of gravity, thus preventing a high microbial load in the effluent [2].

As a critical step of WWTP, the secondary treatment process must be thoroughly analysed. This work envisages the optimization of two laboratory scale reactors to accurately mimic the physicochemical and biological parameters regularly observed in a full scale WWTP. The reactors of approximately 4 L, each comprising an aeration tank a clarifier, and were feed with a real influent collected form a municipal WWTP. The physicochemical and biological parameters analysed include: pH, sludge volume index (SVI), total suspended solids (TSS), volatile suspended solids (VSS), fixed suspended solids (FSS), dissolved oxygen (dO_2), food to microorganism ratio (F/M), solid retention time (SRT), and characterization of the bacteria community through Gram and Neisser coloration. Moreover, the removal efficiency of chemical oxygen demand, biological oxygen demand, total nitrogen, total phosphorous and ammonium where also determined.

After optimization the reactors exhibited parameters equivalent to WWTP. Therefore, the reactors are now ready for the accurate characterization of tailored made influents. Particularly, influents loaded with toxics, biocides, nanomaterials or dominant bacterial species, among other factors, in order to predict, and solve operational problems in WWTP.

References

[1] Tchobanoglous, G, Burton, FL, Stensel, HD, Wastewater Engineering: Treatment and Reuse, *New York, McGraw-Hill Education*, 2003.

[2] Wanner, J, Grau, P, Identification of filamentous microorganisms from activated sludge: a compromise between wishes, needs and possibilities. *Water Research* 23: 883–891, 1989.