DEVELOPMENT OF A GRANULAR MEDIA BASED SOLID-LIQUID SEPARATION TECHNIQUE FOR AEROBIC BIOLOGICAL WASTEWATER TREATMENT

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Ongoing developments coupled with industrialization, urbanization and ever-growing population, impose heavy water demands, making pure water availability a global as well as national concern. Raw water sources are depleting day-by-day and the growing scarcity of fresh and clean water insist on water reuse; that in turn direct the wastewater treatment research to effluent reuse with economy. A satisfactory effluent quality with reuse norms may be produced by the application of techniques, striking a balance between the system efficiency, effluent quality and economy. Effective separation of biomass in a biological wastewater treatment process is very important for ensuring the final effluent quality.

This research study evaluates performance of granular media filtration for the removal of activated sludge bio-solids in biological wastewater treatment process, with an objective to provide an alternative to the membrane bio-reactor by replacing membranes with granular media. A granular media based solid-liquid separation technique is developed by coupling filtration reactor and the batch biological reactors. Two units of the experimental filtration reactors are indigenously designed that could use different filter media, different depths with provision to measure heads at different media depths and different backwash modes. Characteristics of the filter media (sand and coal), clean water headloss and media expansions during backwash were studied. Applications of air agitation and backwash with air were also studied. Batch bioreactors for different Solids Retention Time (SRT) were operated for biomass growth and this biomass was introduced as the feed in the filtration reactor. Besides, acclimated mixed liquor from aeration tank of an existing sewage treatment plant was also used. Granular sand and coal were used as single and dual media with depths varying from 100 to 400 mm at different hydraulic loadings (20 to 120 m\(^3\)/m\(^2\)/d), feed characteristics and backwash modes. The investigations were performed in two modes; viz – operations without backwash and operations with intermittent backwash during the process. The experimental reactor performances and optimal configurations in the respective modes were evaluated in terms of effluent turbidity, reactor throughput and backwash water requirements.
This study reveals the potential capability of sand and coal to retain high MLSS (4000 to 6000 mg/L), eliminating the requirement of secondary sedimentation and attain excellent effluent quality with simple operation. Evaluations of the present work correlate the operational parameters with the performances in terms of effluent quality, throughput and backwash water requirements. In operations without backwash, the lowest effluent turbidity was 1.2 NTU, the highest throughput was 77.8% and the lowest backwash water requirement was 21.5% of the effluent. In operations with intermittent backwash, the lowest turbidity was 3 NTU, highest throughput was 99.7% and the lowest backwash water requirement was 31%. Generic models relating headloss and time, BSRT (biological solids retention time) and SOR (surface overflow rate) have been developed for the experimental modules investigated. The granular media based solid-liquid separation technique, as an engineered system, can be a potentially effective, economical and sustainable technology for biological wastewater treatment operated with the concept of membrane bioreactor, replacing membranes with granular sand/coal media to retain the biomass and to produce high-quality effluent.