



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: Aerobic Granulation in Sequencing Batch Reactors for Treating Wastewater Laden with Phenol, Thiocyanate, Ammonium and Nitrogenous Heterocyclic Compounds

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SHORT ABSTRACT

Aerobic granular sludge (AGS) technology is developed in the last two decades for the treatment of wastewater. Because of having unique properties like high settling behavior, compact structure and ability to withstand high and toxic loading, AGS has been used in the treatment of various kinds of domestic and industrial wastewater. Phenol, thiocyanate (SCN^-), ammonia-nitrogen ($\text{NH}_4^+\text{-N}$), pyridine and indole found in many industrial wastewater, such as coking industry, requiring an economic and sustainable treatment technology before being disposed to surface water bodies. In this work, AGS were developed by optimizing operational parameters for the treatment of multiple toxicants in sequencing batch reactors (SBRs). The first aim of the current research work was to optimize the cycle time followed by the air flow rate for aerobic granulation by using toxic phenol as a carbon source along with SCN^- and $\text{NH}_4^+\text{-N}$. For cycle time and air flow rate study, synthetic wastewater containing phenol (400 mg L^{-1}), SCN^- (100 mg L^{-1}) and $\text{NH}_4^+\text{-N}$ (100 mg L^{-1}) was treated in the three SBRs. At 6 h cycle time and 2.5 L min^{-1} air flow rate, granules showed good characteristics and pollutant removal performances.

Furthermore, the investigation on rapid granulation seeded with the refinery sludge with two different substrates (400 mg L^{-1} phenol in R1 and 1220 mg L^{-1} of sodium acetate in R2) along with 100 mg L^{-1} of $\text{NH}_4^+\text{-N}$ was carried out in two different SBRs. Faster granulation in just 40 days was observed in R1 with better granular characteristics. After 75 days of stable operation, granules started to break down in R1, therefore the impact of toxic SCN^- on granule reformation was evaluated in R1. Reformation of disintegrated granules were observed after gradual addition of SCN^- ($10\text{-}340 \text{ mg L}^{-1}$) with better granular characteristics along with the recovery of nitrification efficiency.

In addition, two SBRs with two different kinds of industrial sludge; refinery sludge (R1) and brewery sludge (R2), were operated to observe the impact of high loading of phenol ($5.71 \text{ kg COD m}^{-3} \text{ day}^{-1}$) along with SCN^- (100 mg L^{-1}) and $\text{NH}_4^+\text{-N}$ (100 mg L^{-1}) on the stability and performance of AGS. R2 granules were stable at an organic loading rate (OLR) of $5.71 \text{ kg COD m}^{-3} \text{ day}^{-1}$, whereas the granules of R1 started to disintegrate at an OLR of more than $3.32 \text{ kg COD m}^{-3} \text{ day}^{-1}$.

Afterwards, the potential of AGS for simultaneous biodegradation of two nitrogenous heterocyclic compounds (NHCs), i.e., pyridine and indole, and $\text{NH}_4^+\text{-N}$ along with phenol and SCN^- was investigated in three SBRs. R1 and R2 were operated with pyridine and indole, respectively, whereas R3 was operated with a mixture of equimolar concentrations of pyridine and indole. Pyridine did not show any inhibitory effect on characteristics of aerobic granules up to a concentration of 5.0 mM . However, Indole was having a profound adverse impact on the granular characteristics and other pollutants removal with a concentration of more than 1.0 mM (R2 and R3).