Effects of Seed Culture and Attached Growth System on the Performance of Anammox Hybrid Reactor Treating Nitrogenous Wastewater

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***Abstract*—The start-up of anammox (anaerobic ammonium oxidation) process in hybrid reactor delineated four distinct phases i.e. cell lysis, lag phase, activity elevation and stationary phase. Cell lysis phase was marked by death and decay of heterotrophic denitrifiers resulting in breakdown of organic nitrogen into ammonium. Lag phase showed initiation of anammox activity with turnover of heterotrophic denitrifiers, which is evident from appearance of NO_3-N in the effluent. In activity elevation phase, anammox became the dominant reaction, which can be attributed to consequent reduction of NH_4-N into N_2 with increased NO_3-N in the effluent. Proper selection of mixed seed culture at influent NO_2^-/NH_4^+ ratio (1:1) and hydraulic retention time (HRT) of 1 day led to early start up of anammox within 70 days. Pseudo steady state removal efficiencies of NH_4^+ and NO_2^- were found as 94.3% and 96.4% respectively, at nitrogen loading rate (NLR) of 0.35 kg N/m^3d at an HRT of 1 day. Analysis of the data indicated that attached growth system contributes an additional 11% increase in the ammonium removal and results an average of 29% reduction in sludge washout rate. Mass balance study of nitrogen indicated that 74.1% of total input nitrogen is converted into N_2 gas followed by 11.2% being utilized in biomass development. Scanning electron microscope (SEM) observation of the granular sludge clearly showed the presence of cocci and rod shaped microorganisms intermingled on the external surface of the granules.**

***Keywords*— Anammox, hybrid reactor, startup, granulation, nitrogen removal, mixed seed culture.**