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Optimizing the Elevated Nitritation for Autotrophic/Heterotrophic Denitritation in CSTR by Treating STP Wastewater

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Abstract : The objective of this study was to optimize and control the highly loaded and efficient nitrite production having suitability for autotrophic and heterotrophic denitritation. A lab scale CSTR for partial and full nitritation was operated to treat the livestock manure digester liquor having an ammonium concentration of ~600 mg-NH4+-N/L and biodegradable contents of ~0.35 g-COD/L. The experiments were performed at 30°C, pH: 8.0, DO: 1.5 mg/L and SRT ranging from 7-20 days. After 125 days operation, >95% nitrite buildup having the ammonium loading rate of ~3.2 kg-NH4+-N/m3-day was seen with almost complete ammonium conversion. On increasing the loading rate further (i-e, from 3.2-6.2 kg-NH4+-N/m3-day), stability of the system remained unaffected. On decreasing the pH from 8 to 7.5 and further 7.2, removal rate can be easily controlled as 95%, 75%, and even 50%. Results demonstrated that nitritation stability and desired removal rates are controlled by a balance of simultaneous inhibition by FA & FNA, pH effect and DO limitation. These parameters proved to be effective even to produce an appropriate influent for anammox. In addition, a mathematical model, identified through the occurring biological reactions, is proposed to optimize the full and partial nitritation process. The proposed model present relationship between pH, ammonium and produced nitrite for full and partial nitritation under the varying concentrations of DO, and simultaneous inhibition by FA and FNA.

Keywords : stable nitritation, high loading, autrophic denitritation, hetrotrophic denitritation
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