Studies on heterotrophic biomass conversion (HBC) process were carried out for the removal of N–NH₃ and organic carbon from wastewater. Ammonium sulfate and glucose were used as nitrogen and organic sources, respectively. A range of parameters were studied such as time, concentration variations of N–NH₃, and organic nutrients keeping the biomass (total volatile suspended solids, TVSS) concentration invariant in all the cases. The kinetics followed dual rates, i.e. an initial faster phase, followed by the slower one. The rates of N–NH₃, and chemical oxygen demand (COD) removal depended on their initial concentrations. The consumption of N–NH₃ and COD followed first order kinetics. The unified rate equation was also established. Two other kinetic models, such as Monod and diffusion, were studied. The pH during the HBC process showed a decreasing trend. Other parameters studied were: N–NO₃⁻, N₂O, N–NO₂⁻, and DO. A part of N–NH₃ utilized for emission of N₂O may be due to heterotrophic nitrification (HN). Statistical studies were carried out such as analyses of variance (ANOVA), multi linear regression analysis and principal component analysis (MLRA), and principal component analysis (PCA). Optimization studies were carried out using response surface modeling (RSM) to maximize the removal efficiency of N–NH₃ and COD, minimizing the N–N₂O emissions, along with maximizing the TVSS production simultaneously.

**Keywords:** Heterotrophic biomass conversion; Kinetics; Monod; Diffusion; Wastewater treatment; Optimization; Statistical technique