

Mathematical Modelling for Bio-nutrient Removal in Sewage Treatment using Acti-zyme as Bio-catalyst

Musaida. M. Manyuchi^{1,2}, Daniel. I. O. Ikhu-Omoregbe²

¹, Oluwaseun. O. Oyekola², Willard Zvarevashe³, Zororo. Makumbe³

¹Department of Chemical and Process Systems Engineering Harare Institute of Technology P O Box BE 277, Belvedere, Harare, Zimbabwe
mmanyuchi@hit.ac.zw

²Department of Chemical Engineering Cape Peninsula University of Technology Bellville, Western Cape, Cape Town 7530, South Africa

³Department of Mathematical Sciences Harare Institute of Technology P O Box BE 277, Belvedere, Harare, Zimbabwe

Keywords: Acti-zyme, bio-nutrients, bio-degradability ratios, de-nitrification, mathematical models.

Alternative biological sewage treatment methods have received attention lately in developing countries. The present study presents the mathematical modeling for bio-nutrient removal in sewage after applying Acti-zyme a biocatalyst at various retention times and loadings. The bio-nutrient removal was measured through the removal of the sewage bio-contaminants i.e. chemical oxygen demand to the biochemical demand ratio (COD/BOD₅), the BOD₅ to the total Kjeldahl nitrogen ratio (BOD₅/TKN), the COD/TKN ratio and the COD to the total phosphates ratio (COD/TP). In addition, all the other sewage physicochemical parameters were measured to determine the quality of the sewage. Experiments were carried out in 250 mL flasks with a 75% working volume anaerobically incubated at 37C and agitation of 60 rpm. The Acti-zyme loading was varied between 35-70 g/m³ whilst the residence time was varied between 0-60 days. The COD/BOD₅, BOD₅/TKN, COD/TKN and COD/TP ratios obtained were greater than 1.2, 4, 8 and 15, respectively. COD/BOD₅, BOD₅/TKN, COD/TKN and COD/TP models with R² > 0.9 in the form: Bionutrient removal ratio = K + X₁ TKN + X₂ BOD + X₃ TP + X₄ COD at a p value of 0.05 were developed. Validation of the models using p-plots indicated that the predicted values and the measured values were correlated. The models are ideal for application in measuring the bio-nutrient removal in sewage treatment using Acti-zyme.