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**A Simplified Mathematical Model to Determine the Degradation Coefficient and Order of Decay for Activated Sludge Process****Dharmadasa K.H.S.M.<sup>1\*</sup>, Chairuangri S.<sup>2</sup>, Muthukudaarachchi K.H.<sup>1</sup>**<sup>1</sup>*Central Environmental Authority, Sri Lanka*<sup>2</sup>*Environmental Science Research Center, Chiang Mai University, Thailand**\*sameeracea@yahoo.com***Abstract**

The Activated Sludge Process (ASP) is the largely used biological treatment of wastewater, fundamentally because it is a cheap technology, which can be adapted to vast range of wastewater. In the ASP, a bacterial biomass suspension (the activated sludge) is responsible for the removal of pollutants. Biodegradation of organic matter plays a key role in ASP to treat the wastewater. A mathematical model was developed in order to describe the degradation coefficient and order of decay in organic matter and nutrients. Experiments were conducted in pilot-scale activated sludge reactor under steady-state conditions and varying Hydraulic Retention Time (HRT) (6, 12 and 18h). Peristaltic pump was used to automatically supply wastewater to the reactor from the feed tank and sludge was approximately 100% recycled. Biochemical Oxygen Demand (BOD) was measured to carry out the mathematical modeling for ASP. Average temperature during the experiment was maintained between 27.2-28.2° C. stating from mass balance equation and derive differential equation for calculate the BOD degradation coefficient and order of the decay. Derived equation cannot solve analytically and 4<sup>th</sup> Order Runge-Kutta equation used to performed the mathematical model. The model was run under different  $\Delta t$  values in order to determine the suitable  $\Delta t$  value for each HRT.  $\Delta t=1$  take long time to run the process and  $\Delta t=8$  take short time to run the process. Then  $\Delta t=3$  chose as best  $\Delta t$  value for this ASP. Order of decay and degradation coefficient of BOD at  $\Delta t=3$  ware (0.9 $\approx$ 1.0)  $\text{mgL}^{-1}\text{d}^{-1}$  and 0.1  $\text{d}^{-1}$  respectively under HRT 6h whereas (0.7 $\approx$ 1.0)  $\text{mgL}^{-1}\text{d}^{-1}$  and 0.1 $\text{d}^{-1}$  respectively under HRT 12h. In HRT 18h, order of decay was (0.1 $\approx$ 0.0)  $\text{mgL}^{-1}\text{d}^{-1}$  and degradation coefficient was 16.0  $\text{mgL}^{-1}\text{d}^{-1}$ . Results showed that first order process take place at HRT 06 and zero order process take place at HRT 18. Process does not depend on the number of microorganism cell at first order reaction and process depends on the number of cells at zero order reaction. It can concluded that BOD degradation at HRT 18 depend on microbial cell number and BOD degradation at HRT 6 independent from microbial cell number. Experimental data and model data plot at  $\Delta t=3$  clearly showed that 6 and 18h HRT experimental data remarkably fit with mathematical model and 12h HRT experimental data fit with the model data at start and deviate in end. It was expected that BOD degradation at 12h HRT was mix order reaction. It clearly indicates that BOD concentration was rapidly decreased at 18h HRT. Because microorganism had sufficient time to degrade the organic matter contain in the wastewater at 18h HRT than 06 and 12h HRTs. Rapid BOD removal caused to higher BOD rate constant at 18h HRT.

**Keywords:** Mathematical modeling, Activated sludge process, Degradation coefficient, Order of decay