Modelling Diurnal Variation of Dissolved Oxygen in Waste Stabilization Ponds

Author(s)

S Kayomboa, T.S.A Mbwette, A.W Mayo, J.H.Y Katima, S.E Jorgensen

Abstract

The dissolved oxygen sub model was developed in order to depict the combined influence of light, pH, temperature and carbon dioxide on the processes of dissolved oxygen (DO) production and utilization in secondary facultative waste stabilization ponds (SFWSP). The model was formulated based on Chen and Orlob (Chen, C.W., Orlob, G.T., 1975. In: Patten, B.C. (Ed.), Systems Analysis in Ecology, Vol. 3. Academic Press, New York, pp. 476–588.), and was modified to include the influence of pH and carbon dioxide. The forcing functions to the DO model were light intensity, carbon dioxide, temperature and pH. It was found that temperature, light and pH influence the process of photosynthesis based on the multiplicative formulation of forcing functions. The model was calibrated and validated by using the average daily data from SFWSP1 and 11. The model yielded a linear regression coefficient of 0.87 during calibration and 0.78 during validation. Based on the model results the rate of production of DO with relation to dry algal biomass was 1.599 mg DO/mg dry weight, which is equivalent to 35.905 mg DO/mg chlorophyll-a. Such correlation between the observed data and model prediction indicates that the assumption inherent in the mathematical model formulation of the processes is valid for the description of DO production and usage in the ponds.

Keywords

Diurnal cycle;
Facultative ponds;
Photosynthesis;
Oxygen production rate;
Oxygen utilization rate