Model Matematika Streeter-Phelps dalam Pemurnian Danau = The Streeter-Phelps Mathematical Model in Lake Purification

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Abstrak

Dalam peningkatan kualitas perairan seperti danau, diperlukan pengamatan dan analisis mengenai polutan yang mencemari perairan. Pada penelitian ini dibahas konstruksi model matematika StreeterPhelps yang menggambarkan proses pemurnian pada danau yang terjadi secara mandiri atau disebut self purification. Model tersebut merepresentasikan konsentrasi oksigen dalam danau dan konsentrasi biochemical oxygen demand (BOD), yang didefinisikan sebagai jumlah oksigen maksimum yang dapat dikonsumsi polutanper satuan volume. Sebelum dilakukan konstruksi model StreeterPhelps dilakukan pemodelan matematika pemurnian danau untuk kasus yang sederhana, yaitu danau dengan konsentrasi polutan homogen, konsentrasi polutan nonhomogen, dan pemurnian danau yang terjadi secara difusi. Konstruksi model dilakukan menggunakan persamaan diferensial biasa, persamaan diferensial parsial, dan sistem dinamik. Model StreeterPhelps yang telah didapat dibagi menjadi dua kasus untuk danau yang tercemar ringan dan tercemar berat. Interpretasi model diberikan melalui solusi analitik, grafik solusi, dan bidang fase antara konsentrasi oksigen dan konsentrasi BOD.

.....In order to improve water quality in lakes, it is necessary to observe and analyze the pollutant that contaminate the water. This research discusses the construction of the StreeterPhelps mathematical model which describes the purification process in the lake that occurs naturally in the lake itself or is called self purification. This model describes the oxygen concentration in the lake and the concentration of biochemical oxygen demand (BOD), defined as the maximum amount of oxygen that pollutants can consume per unit volume. Before constructing the StreeterPhelps model, mathematical modeling of lake purification is carried out for several simple cases, namely lakes with homogeneous pollutant concentrations, nonhomogeneous pollutant concentrations, and lake purification that occurs by diffusion. The model construction is carried out using ordinary differential equations, partial differential equations, and dynamical systems. The StreeterPhelps model is divided into two cases which are lightly polluted and heavily polluted lakes. The interpretation of the model is given by an analytical solution, the graph of the solution, and the phase plane depicting the relationship between oxygen concentration and BOD concentration.