

WASTEWATER TREATMENT PROCESS: A
MODIFIED MODEL FOR OXIDATION POND

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Rawatan air sisa bertujuan untuk menghilangkan pepejal terampai sebanyak mungkin sehingga sampai ke sisa air, yang dikenali sebagai efluen, sebelum dilepaskan ke persekitaran. Kaedah kolam pengoksidaan telah terbukti berjaya dalam proses rawatan air sisa kerana kos pembinaan dan penyelenggaraannya yang rendah. Matlamat penyelidikan ini adalah untuk mengkaji degradasi bahan pencemar air sisa melalui sistem rawatan kolam pengoksidaan. Tujuan tesis ini adalah untuk memaparkan hubungan antara kepekatan bakteria, iaitu fototrofik dan koliform, permintaan oksigen kimia (COD), dan oksigen terlarut (DO). Selain itu, antara muka pengguna grafik (GUI) yang meramalkan proses rawatan air sisa di kolam pengoksidaan telah dibangunkan dalam kajian ini. Model yang diubahsuai yang terdiri daripada satu set persamaan pembezaan biasa (ODE) dikembangkan dengan memasukkan persamaan Monod untuk COD. Model ini diselesaikan secara berangka dengan menggunakan kaedah Runge-Kutta urutan ke-4 dan teknik pemasangan parameter iaitu algoritma Nelder-Mead simplex yang disertakan dalam perisian MATLAB. Untuk mengesahkan keputusan, perbandingan antara model dan data eksperimen telah dijalankan dan diukur dengan menggunakan ralat kuasa dua min punca (RMSE). Hasilnya, model matematik yang diubah menunjukkan RMSE yang lebih rendah berbanding dengan model yang sedia ada. Oleh kerana nilai RMSE yang lebih rendah menunjukkan kesesuaian yang lebih baik, model yang diubah suai mempunyai penghampiran yang lebih baik daripada model yang sedia ada berdasarkan perubahan jumlah kepekatan di kolam pengoksidaan untuk menghasilkan air yang berkualiti.

ABSTRACT

Wastewater treatment aims to eliminate suspended solids as many as possible before the remaining water, known as effluent, is released into the environment. Oxidation pond methods have practically been proven successful for the wastewater treatment process due to their low construction and maintenance costs. This study aims to investigate the degradation of wastewater pollutants through an oxidation pond treatment system. The purpose of this thesis is to present the relationship between the concentration of bacteria, which are phototrophic and coliform, chemical oxygen demand (COD), and dissolved oxygen (DO) in the form of modified mathematical model. Additionally, a Graphical User Interface (GUI) which predicting the wastewater treatment process in an oxidation pond is developed in this study. A modified model comprising of a set of ordinary differential equations (ODE) is proposed by incorporating Monod equation for COD. The model has been solved numerically by using the 4th order Runge-Kutta method and a parameter fitting technique namely Nelder-Mead simplex algorithm embedded in MATLAB software. To validate the result, a comparison between the model and the experimental data was carried out and measured by using the root mean squared error (RMSE). As a result, the modified mathematical model demonstrated lower RMSE as compared to the existing model. Since a lower RMSE value indicates better fit, the modified model provided a better approximation than an existing model based on the changes of the amount of concentration in the oxidation pond to produce good quality of water.

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