

PHOTO-FENTON TREATMENT OF SAGO WASTEWATER: RSM OPTIMIZATION AND TOXICITY EVALUATION

Article history

Received

3 April 2017

Received in revised form

23 August 2017

Accepted

1 November 2017

Devagi Kanakaraju^{a*}, Wong Soon Pang^a, Wan Azelee Wan Abu Bakar^b

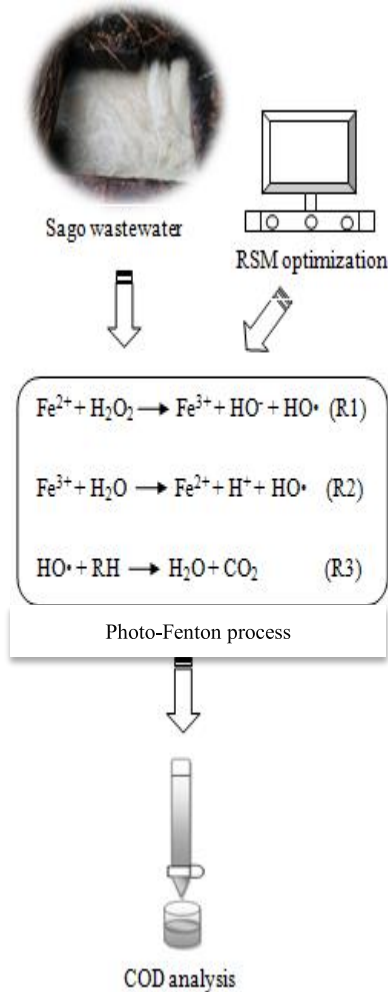
*Corresponding author

kdevagi@unimas.my

^aFaculty of Resource Science and Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia

^bDepartment of Chemistry, Faculty of Science, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia

Graphical abstract



Abstract

Due to the fact that organic matter in sago wastewater is not effectively removed by current traditional methods, this study was designed to systematically investigate the performance of photo-Fenton treatment. Despite being ratified for its high efficiency in improving wastewater quality, there remains a paucity of evidence on its performance on sago wastewater. Thus, the objective of this study was to optimize the conditions of the photo-Fenton process by employing the response surface methodology (RSM) using the chemical oxygen demand (COD) removal as the target parameter. Fenton's reagent (Fe^{2+} and H_2O_2 concentration) and pH were used as the independent variables to be optimized. Under optimum conditions, 90.0% of COD removal efficiency was obtained when the wastewater sample was treated at pH 2.66 in the presence of 4.01 g/L of H_2O_2 and 5.07 g/L Fe^{2+} ion. Despite the high COD removal, the total organic carbon (TOC) removal under the same optimized condition was lower, only 48.0% indicating incomplete mineralization of stable intermediates present in the solution. Toxicity evaluation revealed that the mortality of *Artemia salina* was less than 50%, which means that the treated sago wastewater can be considered as non-toxic. The regression value ($R^2 > 0.99$) of the models indicates a high degree of correlation between the parameters evaluated. The results obtained indicate the feasibility of photo-Fenton treatment to the sago wastewater as an appealing alternative approach.

Keywords: Chemical oxygen demand, degradation, Box-Behnken design, wastewater, Fenton

Abstrak

Disebabkan oleh kandungan bahan organik dalam sisa air sago yang tidak dapat dirawat secara berkesan oleh kaedah rawatan tradisional, kajian ini telah dijalankan untuk menyiasat prestasi rawatan foto-Fenton secara sistematik. Walaupun kaedah foto-Fenton telah diperakui tahap keefisienannya untuk memperbaiki tahap kualiti air sisa, masih terdapat kekurangan bukti atau data yang kukuh bagi sisa air sago. Oleh itu, objektif kajian ini adalah untuk mengoptimumkan kondisi proses foto-Fenton dengan menggunakan kaedah gerak balas permukaan (GBP) dan penyingkiran permintaan oksigen kimia (POK) sebagai parameter sasaran. Reagen Fenton (kepekatan Fe^{2+} dan H_2O_2) dan pH telah digunakan sebagai pemboleh ubah tak bersandar untuk dioptimumkan. Dalam keadaan yang optimum, sebanyak 90.0% kecekapan penyingkiran POK telah diperolehi apabila sampel air sisa sago yang pada pH 2.66 dan 4.01 g/L H_2O_2 and 5.07 g/L Fe^{2+} ion. Walaupun penyingkiran POK yang diperolehi adalah tinggi, jumlah karbon organik yang diperolehi pada keadaan yang optimum didapati rendah iaitu hanya 48% menunjukkan mineralisasi yang tidak sempurna bagi bahan perantaraan stabil yang hadir dalam larutan. Ujian ketoksikan menunjukkan tahap kematian *Artemia salina*