FE-KUALA KANGSAR CLAY AS HETEROGENEOUS CATALYST FOR FENTON-LIKE DECOLORIZATION OF DYEING WASTEWATER

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NOVEMBER 2012

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UNIVERSITI TEKNOLOGI MARA

PEMENANG Anugerah Kualiti Perdana Menteri 2008

Surat Kami : 600-RMI/ST/DANA 5/3/Dst (121/2011)
Tarikh : 18 Mei 2011

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Y. Brs. Profesor/Tuan/Puan

KELULUSAN PERMOHONAN DANA KECEMERLANGAN 05/2011

Tajuk Projek	:	Fe-Kuala Kangsar Clay as Heterogeneous Catalyst for Fenton-Like Decolorization of Dyeing Wastewater
Kod Projek	:	600-RMI/ST/DANA 5/3/Dst (121/2011)
Kategori Projek	:	Kategori F (2011)
Tempoh	:	1 Jun 2011 – 31 Mei 2012 (12 bulan)
Jumlah Peruntukan	:	RM 10,000.00
Ketua Projek	:	Puan Hamizura Hassan

Dengan hormatnya perkara di atas adalah dirujuk.

2. Sukacita dimaklumkan pihak Universiti telah meluluskan cadangan penyelidikan Y. Brs Profesor/tuan/puan untuk membiayai projek penyelidikan di bawah Dana Kecemerlangan UiTM.

3. Bagi pihak Universiti kami mengucapkan tahniah kepada Y. Brs. Profesor/tuan/puan kerana kejayaan ini dan seterusnya diharapkan berjaya menyiapkan projek ini dengan cemerlang.

4. Peruntukan kewangan akan disalurkan melalui tiga (3) peringkat berdasarkan kepada laporan kemajuan serta kewangan yang mencapai perbelanjaan lebih kurang 50% dari peruntukan yang diterima.

Peringkat Pertama	20%
Peringkat Kedua	40%
Peringkat Ketiga	40%

5. Untuk tujuan mengemaskini, pihak Y. Brs. Profesor/tuan/puan adalah diminta untuk melengkapkan semula kertas cadangan penyelidikan berdasarkan borang penilaian yang dilampirkan, mengisi borang setuju terima projek penyelidikan dan menyusun perancangan semula bajet yang baru seperti yang diluluskan. Sila lihat lampiran bagi tatacara tambahan untuk pengurusan projek.

Sekian, harap maklum.

"SELAMAT MENJALANKAN PENYELIDIKAN DENGAN JAYANYA"

Yang benar

MUSTAFAR KAMAL HAMZAH
Ketua Penyelidikan (Sains dan Teknologi)

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5. Report

5.1 Proposed Executive Summary

Dyes in wastewater can create aesthetic problems, limit the possible use of water and obstruct the light penetration and oxygen transfer into water bodies, hence affecting the aquatic life. The Fenton process has long-established credibility in the field of environmental remediation for non-biodegradable pollutants. However, the overall efficiency of homogeneous Fenton is limited with significant disadvantages like generated iron hydroxide sludge and tight range of pH. Heterogeneous Fenton emerged as an interesting ways to overcome these limitations by the usage of Fenton-like heterogeneous catalyst. In heterogeneous solid catalyst, the iron species is "immobilized" on the solid supports or within the structure and in the pore/interlayer of the catalyst. Being inexpensive and widely available, clays represents an attractive supports for iron immobilization. Therefore this study focuses on the development of heterogeneous catalysts from the low cost material, which is Kuala Kangsar clay. The efficiency of this heterogeneous catalyst will be tested on decolorization of model real textile wastewater that is Reactive Black 5 (RB5) by making use of a Fenton-like process. This catalyst (Fe-Kuala Kangsar clay) will be prepared by impregnation method in which iron ion act as catalyst is attached on the supported catalyst (Kuala Kangsar clay). The prepared catalyst is characterized by using Scanning Electron Microscope (SEM), Brunauer Emmett-Teller (BET), Fourier Transform Infrared (FTIR), Elemental chemical analysis (EDX), and X-Ray diffraction (XRD). The effect of different reaction parameters such as different ion loading on supported catalyst, catalyst dosage, initial pH, and initial concentration of hydrogen peroxide and dye on the decolorization of RB5 will be assessed. It is expected that Fe-Kuala Kangsar clay catalyst possess a potential to treat RB 5 solution and this could give an added value since it is natural, abundant, low cost and environmentally friendly.

5.2 Enhanced Executive Summary

Decolorization of azo dye Reactive Black 5(RB5) in an aqueous solution was investigated by using Fe-Kuala Kangsar clay (Fe-KKC) as heterogeneous catalyst. Fe-KKC was successfully prepared via impregnation method. The prepared catalyst was characterized by Scanning Electron Microscope (SEM), Fourier Transform Infrared Spectroscopy (FTIR), X-ray powder diffraction (XRD) and Energy Dispersive X-ray (EDX). The effectiveness of this catalyst in the decolorization of RB5 as well as the influence of reaction parameters like effect of iron ions loading on the supported catalyst, catalyst dosage, pH, initial concentration of hydrogen peroxide and dye and reaction temperature were assessed.

The SEM result showed that the morphology of the catalyst become more porous and fluffy after undergo impregnation process. From the EDX analyses, the main elements of the prepared catalyst indicate that the presence of iron, silica, oxide and alumina with different percentage of concentrations. FTIR result revealed that the structure of the catalyst has been modified with some bands were shifted, disappeared and/or new peaks emerged as a results of immobilization of iron ions into the support. The XRD result showed that the Fe-KKC was in crystalline form with small peak of iron oxide were formed after calcinations process.

The best reacting conditions were found to be 1.0 wt.% of iron ions loading on Kuala Kangsar clay (KKC) when the dosage of the catalyst is 2.5 g/L with initial pH of 4.0, 8 mM of initial concentration of hydrogen peroxide and initial concentration of RB5 of 50 mgL^{-1}at temperature 30 °C. Under these conditions, 99% decolorization efficiency of RB5 was achieved within 180 min reaction time. The results indicated that Fe-AKKC has proven to be a superior heterogeneous catalyst for decolorization of RB5 in an aqueous solution.