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HASIL PENILAIAN SEJAWAT SEBIDANG ATAU *PEER REVIEW*

KARYA ILMIAH : JURNAL ILMIAH*

Judul Jurnal Ilmiah (Artikel)	: Geopolymer From Metakaolin And Biomass Ash For Cu(Ii) Ions Adsorption From Aqueous Solutions: Kinetics And Isotherm Studies		
Nama Penulis	: Aprilina Purbasari, Istadi Istadi, Andri Cahyo Kumoro, **Indro Sumantri**, Silviana Silviana		
Jumlah Penulis	: 5 orang		
Status Pengusul	: **Penulis ke empat**		
Identitas Jurnal Ilmiah	: a. Nama Jurnal	:	Journal of Chemical Technology and Metallurgy
	b. Nomor ISSN	:	13147471, 13147978
	c. Volume, Nomor, Bulan, Tahun	:	Vol. 56, Issue 6, 2021
	d. Penerbit	:	Universities and Research Institutions in Bulgaria
	e. DOI artikel (jika ada)	:	-
	f. Alamat web Jurnal	:	journal@uctm.edu
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Semarang, 14 Januari 2022

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Prof. Dr. Aji Prasetyaningrum, ST, MT	Prof. Dr. Didi Dwi Anggoro, ST, M Eng
NIP. 19691002 199403 2 003	NIP. 19671114 199303 1 001
(Bidang Ilmu/Unit Kerja : Teknik Kimia Universitas Diponegoro)	(Bidang Ilmu/Unit Kerja : Teknik Kimia Universitas Diponegoro)

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Semarang, 15 Januari 2022
Reviewer 1

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Unit Kerja : Fak. Teknik Universitas Diponegoro
Bidang Ilmu : Teknik Kimia

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d. Kelengkapan unsur dan terbitan/jurnal (30%)	12,0		11,0
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NIP. 19671114 199303 1 001
Unit Kerja : Fak. Teknik Universitas Diponegoro
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GEOPOLYMER FROM METAKAOLIN AND BIOMASS ASH FOR Cu(II) IONS ADSORPTION FROM AQUEOUS SOLUTIONS: KINETICS AND ISOTHERM STUDIES

Purbasari, Aprilina ; Istadi, Istadi; Kumoro, Andri Cahyo; Sumantri, Indro; Silviana, Silviana

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[a] Department of Chemical Engineering, Faculty of Engineering, Diponegoro University, Jl. Prof. Soedarto, Kampus Tembalang, Semarang, 50275, Indonesia

Abstract

The utilizations of geopolymer as adsorbent in the treatment of wastewater containing heavy metal or dyes have shown encouraging results. In this paper, geopolymer synthesized from alkaline activation of metakaolin and biomass ash was utilized as adsorbent for Cu(II) ions from aqueous solutions. Adsorption of Cu(II) ions by geopolymer followed Langmuir isotherm model which adsorption occurred on geopolymer surface by forming monolayer of adsorbate molecule with maximum adsorption capacity of 58.824 mg g^{-1}. Furthermore, pseudo-second order kinetics model was more suitable to describe adsorption of Cu(II) ions by geopolymer. © 2021. All Rights Reserved.

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adsorption; biomass ash; copper; geopolymer; metakaolin

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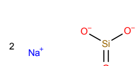

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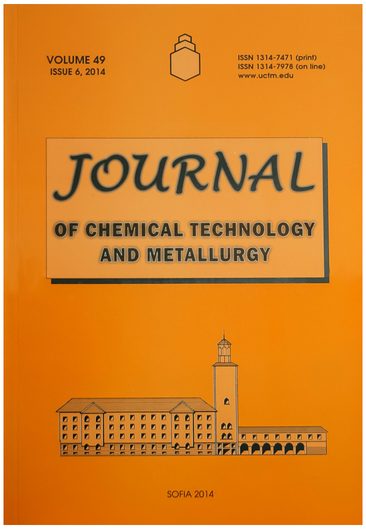

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GEOPOLYMER FROM METAKAOLIN AND BIOMASS ASH FOR Cu(II) IONS ADSORPTION FROM AQUEOUS SOLUTIONS: KINETICS AND ISOTHERM STUDIES

Aprilina Purbasari, Istadi Istadi, Andri Cahyo Kumoro, Indro Sumantri, Silviana Silviana

Department of Chemical Engineering, Faculty of Engineering, Diponegoro University
Jl. Prof. Soedarto, Kampus Tembalang, Semarang 50275, Indonesia
E-mail: aprilina.purbasari@che.undip.ac.id

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ABSTRACT

The utilizations of geopolymer as adsorbent in the treatment of wastewater containing heavy metal or dyes have shown encouraging results. In this paper, geopolymer synthesized from alkaline activation of metakaolin and biomass ash was utilized as adsorbent for Cu(II) ions from aqueous solutions. Adsorption of Cu(II) ions by geopolymer followed Langmuir isotherm model which adsorption occurred on geopolymer surface by forming monolayer of adsorbate molecule with maximum adsorption capacity of 58.824 mg g^{-1}. Furthermore, pseudo-second order kinetics model was more suitable to describe adsorption of Cu(II) ions by geopolymer.

Keywords: adsorption, biomass ash, copper, geopolymer, metakaolin.

INTRODUCTION

Geopolymer is inorganic polymer with Si-O-Al bonds synthesized from alkaline activation of alumino-silicate materials at low temperature, generally below 100°C [1]. Metakaolin (Si_2O_5,Al_2O_2), obtained from calcination of kaolin ($Al_2O_3.2SiO_2.2H_2O$), is alumino-silicate material that has been widely used as geopolymer raw material [2]. Another source of alumino-silicate materials is solid waste from combustion such as fly ash and biomass ash. Biomass ash containing high silica, e.g. bamboo ash, can be used as geopolymer raw material [3].

Geopolymer having three dimensional porous structure has been applied for wastewater treatment as adsorbent of heavy metals [4, 5]. Adsorption has been widely used for heavy metal removal from wastewater because the process is simple, economical, and efficient [6, 7]. Applications of geopolymer from metakaolin as heavy metal adsorbent had been conducted on Cd, Cr, Cu, Pb [8]; Cs, Pb [9]; Zn, Ni [10]; and Pb [11]. Meanwhile, geopolymer from metakaolin and biomass ash had been applied as Pb adsorbent [12]. The use of geopolymer from biomass ash along with metakaolin as heavy metals adsorbent is interesting to study because it is one of the efforts to utilize solid waste to treat wastewater.

In this research, geopolymer was synthesized from alkaline activation of metakaolin and biomass ash and then applied as Cu(II) ions adsorbent. Copper is one of common heavy metals in industrial wastewater such as from electroplating, metal surface finishing, and fertilizer production, that are very toxic even at low concentration [13, 14]. Factors affecting adsorption process, namely adsorbent dosage, pH, initial concentrations, contact time, were studied in addition to kinetics and isotherm adsorption studies.

EXPERIMENTAL

Materials

Materials used in this study were metakaolin, biomass ash, commercial sodium hydroxide flakes (purity of 98 %), and commercial sodium silicate solution (SiO_2 = 30 %, Na_2O = 9 %, H_2O = 61 %). Metakaolin was obtained from calcination of commercial kaolin powder in electric furnace at 550ºC for 3 hours, while biomass ash was obtained from combustion of bamboo (*Gigantochloa apus*). Metakaolin contained SiO_2 = 53.9 % and Al_2O_3 = 42.4 %, whereas the biomass ash contained SiO_2 = 58.6 % and Al_2O_3 = 0.7 %.

Preparation of geopolymer

Geopolymer powder for Cu(II) ions adsorption was obtained from geopolymer paste preparing from metakaolin, biomass ash, and alkaline activator. The weight ratio of metakaolin to biomass ash was 4:1. Alkaline activator used was mixture of 10 N sodium hydroxide

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BIOLOGICAL APPROACHES IN WASTEWATER TREATMENT (REVIEW)

Evgenia Vasileva, Tsvetomila Parvanova-Mancheva, Venko Beschkov

Institute of Chemical Engineering, Bulgarian Academy of Sciences
Acad. G. Bonchev Str. Block 103,
1113 Sofia, Bulgaria
E-mail: jenivasileva96@gmail.com

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ABSTRACT

The need of clean water is a major goal of humanity. Therefore, many studies have focused on selecting an appropriate method for wastewater treatment (WWT). WWT is applied extensively in many industries. Some of them are: removal of pesticides, pharmaceutical industry, petroleum refinery, textile industry, alcohol distillery; olive removal; heavy metal removal, cyanide removal, mining industry and phosphorus removal. The classical biological processes are with suspended activated sludge and processes with naturally attached biofilms. Biological methods are the best option compared to other methods, because they are more eco-friendly and require low expenditures. The classical methods are useful but there are more effective new methods, such as algal and enzymatic treatment; microbial fuel cell; immobilization techniques; nanoparticles in bioremediation; membrane bioreactor, etc.

Keywords: municipal and industrial wastewater, contaminants, wastewater treatment, classical and new biological methods.

INTRODUCTION

Water is one of the most important natural resources on our planet. However, in addition to an inadequate clean water supply in many developing countries, water quality in industrialized nations has reached a worrying state [1, 2]. The pollution of municipal, agricultural, and industrial wastewater with a huge number of organic and inorganic contaminants, such as microplastics [3], xenobiotics [1], heavy metals [4], and high concentrations of nitrates [5], phosphates [6], and carbon (C) compounds [2], puts a stress on the food chain and thus on the basis of life.

According to Wollmann et al. [7] wastewater treatment (WWT) is a global issue that cannot be managed by a single technology because of the extremely variable scales, types of contaminants, and regional conditions involved (Fig. 1).

The conventional WWT plants focus on the removal of suspended solids (mostly mechanically) and the reduction of biochemical oxygen demand (BOD) by activated sludge [8]. This biodegradation involves the breakdown of organic molecules and inorganic constituents (nitrogen [N] and phosphorous [P] compounds), which is of great importance to prevent the eutrophication of natural ponds such as rivers and lakes. The degradation capacity of these conventional technologies is limited, especially with regard to heavy metals, extremely high nutrient loads, and xenobiotics, leading to an increasing accumulation of these substances in groundwater [1 - 6]. Because of the metabolic flexibility of microalgae, i.e. their ability to perform photoautotrophic, mixotrophic, or heterotrophic metabolism [9, 10], they represent promising biological systems for treating a variety of sources of wastewater.

The main purpose of the study by Gogate et al. [11] is to demonstrate the improvement in conventional biological oxidation process for the two different effluents both municipal and industrial. The different strategies investigated are based on the pretreatment

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COMPARISON OF PARALLEL FLOW MIXING IN STRUCTURED PACKED BED REACTORS USING PARTICLE RESOLVED MODEL AND POROUS MEDIA MODEL WITH VALIDATION

Ali Alkhalaf[1, 2], Kamyar Mohammadpour[2], Eckehard Specht[2]

[1] *Mechanical Engineering Department*
University of Technology, Baghdad, Iraq
E-mail: 20079@uotechnology.edu.iq
[2] *Institute of Fluid Dynamics and Thermodynamics*
Otto von Guericke University
Universitätsplatz 2 D-39106, Magdeburg, Germany

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ABSTRACT

Packed beds of large reactors, such as shaft kilns and cupola furnaces, have to be approximated as a porous media. The particles and the gas space between them are in mm range and therewith much larger as the pores of a typical porous medium. This study researches the quality of this approximation for the mixing of an injected fuel in air. The mixing flow and concentration are calculated with the Porous Media Model (PMM) and with the Particle Resolved Model (PRM), which is the real flow. For validation, nitrogen was injected in parallel in an air flow using a shaft, with spheres of 52 mm in simple cubic and body centred cubic structure. The distribution of the oxygen concentration was measured at different position. The experimental results match very well with the PRM. The PMM does not match for the Simple cubic (SC) structure. The Body Centred Cubic (BCC) structure can be approximated with the PMM, only peak value differs a little bit.

Keywords: CFD, parallel flow mixing, structured packed bed, porous media.

INTRODUCTION

In a lot of packed bed reactors two or more gas flows have to be mixed. One flow is air and the other flows are gaseous fuels. For example, in shaft kilns for the calcination of limestone, dolomite and magnesite, such as for the sintering of aluminium oxides, refractory, etc., a gaseous fuel is injected into the main air flow through lances in the packed bed of the materials. In cupola furnaces for the melting of scrap and the reduction of iron ore, air and fuel are injected from a circumferential position. Between the bed and the gas heat is exchanged. The non-reactive heat transfer and the pressure drop have been experimentally researched for decades [1 - 4]. Little research has been done on the mixing behaviour. Measurements of concentrations in the real kilns are difficult. On the one hand, it is difficult to place measuring devices in the moving bed of shafts with diameters up to 6 m. On the other hand, because of the high temperatures, all metallic measuring equipment would be damaged. Consequently, the mixing behaviour in kilns can only be theoretically researched. The CFD calculation of the real flow between the particles in a kiln fails because of high computational time. The reason is the large dimension of the kiln and the fine grid required in the contact area of the particles. Therefore, some researchers [5 - 8] approximated the packed bed as a porous medium. However, no information exists regarding the accuracy of this approximation. There are various designs to inject gaseous fuel into a packed bed. In parallel flow regenerative (PFR) shaft kilns for lime burning, the fuel is injected using lances, which are placed axially in the packed bed. Fig. 1 shows a scheme of a parallel-flow regenerative shaft kiln. It consists of two parallel shafts and a connecting crossover channel. Up to 25 lances are distributed in the cross-section. In the left shaft, fuel is injected vertically down in the bed. From the top of this shaft, air for the combustion