Subject: [IJTech-02-53] Please Revised Based on Reviewer Comment
Date: 2015-12-30 13:48
From: IJTech <ijtech@eng.ui.ac.id>
To: subriyer@unsri.ac.id
Cc: sisnayati_faizal@yahoo.com

Dear Mr./Mrs. Subriyer Nasir,

The editorial board is pleased to inform you that your paper entitled "A LOW-COST CERAMIC FILTERS AND ITS APPLICATION FOR CADMIUM REMOVAL OF PULP INDUSTRY EFFLUENT" has been reviewed by referee.

Please find in the attachment referee's comments, and please make a necessary revision based on the comments. Also please read the submission guidelines.
Any revision of the paper should be submitted to ijtech@eng.ui.ac.id no later than **January 4, 2016.**

It is compulsory to return the revise paper with response comment as attached.
Please state clearly the revision based on reviewer's comment.

We look forward to receiving your revised paper at your earliest convenience.
--
Kind regards,
Secretariat IJTech
International Journal of Technology (IJTech)
ISSN : 2086-9614
http://www.ijtech.eng.ui.ac.id

PART A: Editorial Office Only

SECTION I

Reviewer's Name:

E-Mail:

Manuscript Number: IJTech-02-53

Title: A LOW-COST CERAMIC FILTERS AND ITS APPLICATION FOR CADMIUM REMOVAL OF PULP NDUSTRY EFFLUENT

PART B: Reviewer Only

SECTION II: Comments per Section of Manuscript

General comment:

Overall, this is an interesting paper with some potential utility of the ceramic filters for removal of Cadmium. There are some issues that should be addressed prior to further consideration for publication.

What are the rror values on the flux, water quality parameter, and removal levels of Cadmium reported herein. There is no routine characterization of the ceramic filter (IR, TGA, elemental analysis, nitrogen adsorption, PXRD, etc. The source of the clay was not specified so it is difficult for anyone to reproduce this work in some reasonable fashion. Some chemical analyses of the clay composition would be needed as part of the experimental section; i.e. Table of clay properties. A pH study was not carried out but it likely important.

Please comment.

Can the ceramic filters be regenerated?

What is the advantage of this technology over other ceramic filters?

Some discussion of the key contributions of this work and how it relates to the current state of the art in this field. The authors comment on the disadvantage of this technology due to its cost and potential fouling. It does not appear that the issue was solved in this study. In summary, this paper should be considered for publication after addressing the above comments. Some major revisions are suggested

above and submitting a revised version with consideration for publication should be made after a 2nd round of peer review.

Introduction:

INTERNATIONAL JOURNAL OF TECHNOLOGY

ISSN: 2086-9614

Reviewer's Guide

Methodology:

Results:

Discussion:

Bibliography/References:

Others:

SECTION III - Please rate the following: (1 = Poor) (2 = Fair) (3 = Average) (4 = Above Average)

(5 = Excellent)

Originality:

Technical Quality:

Methodology :

Readability :

Practicability:

Organization:

Importance:

SECTION IV - Recommendation: (Kindly Mark with an X)

Accept As Is:

Requires Moderate Revision: X

Reject On Grounds of (Please Be Specific):

SECTION V: Additional Comments

Please add additional comments, if any:

RETURN OF COMMENTS

Thank you for contributing to International Journal of Technology by completing this review. Please return your comments to:

Dr. Nyoman Suwartha

Managing Editor

International Journal of Technology (IJTech)

Faculty of Engineering

Universitas Indonesia,

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E: ijtech@eng.ui.ac.id atau ijtech.eng.ui@gmail.com

PART A: Editorial Office Only

SECTION I

Reviewer's Name:

E-Mail:

Manuscript Number: IJTech-02-53

Title: A LOW-COST CERAMIC FILTERS AND ITS APPLICATION FOR CADMIUM REMOVAL OF PULP INDUSTRY EFFLUENT

PART B: Reviewer Only

SECTION II: Comments per Section of Manuscript

General comment: I think the paper is interesting, but the paper needs major revisions for representation of entire manuscript

Introduction:

- Revised for the two paragraphs. No need to mention :...According to the Indonesian ministry of environment regulation cadmium in the wastewater excess of 0.1 mg.L -1 is not allowed to be discharged into water bodies. Meanwhile, World Health Organization (WHO) restricts the largest concentration of cadmium (II) in drinking water as 0.003 mg.L -1 ... two times in the introduction.

 Please make it sample and more interesting sentence.

 What is have done,

 what is the new,

 what is the novelty from your work?

 What is the research gap compare the previous result!

Methodology:

Please explain the composition the adsorbent prepared according to ? or this is a new from your study? Then, why you choosen this composition? Any other explanation? Please add it in the introduction!

....Ceramic filter designed as porous tube made of a mixture of 77.5% natural clay, 20% rice bran, and 2.5% iron powder for Filter A and 87.5%: 10%:

2.5% of Filter B on a weight basis. ....

Fig. 1 shows the experimental setup of the present work. This is interesting, but confusing for the scheme? Why did you used no. 4 – 7, they are columns or what? Improve your scheme 1 for clarity of the reactor for adsorption process.

Figures 4 and 5 are not clear, please provide all the figures with high

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Reviewer's Guide

Results: resolution.

Discussion:

 All of the data for representation, but the discussion is very short and no good references provided to support your discussion. Please elaborate your discussion, make it in detail and add new references to support your discussion!

Bibliography/References: ok

Others:

1. Revise the title, I am surprised with the title< ...A LOW-COST CERAMIC .....? Any economical calculation and data to support this title?

2. Improve and make clear for the last sentence in the end of abstract. ..... The results will give insight into the low-cost ceramic filter application for wastewater contains cadmium"..

3. for conclusion is hanging, no special as for conclusion. Please revise this text for the potential result from your data!

Dear reviewer

Thank you for your comments on the paper entitled " A LOW COST OF **CERAMIC FILTERS AND ITS APPLICATION FOR CADMIUM REMOVAL OF PULP INDUSTRY EFFLUENT has been revised as the attachments below.**
My apologize for the late of revision. Thank you.

Best regard,

Subriyer Nasir

List of Changes

Manuscript: A LOW-COST CERAMIC FILTERS AND ITS APPLICATION FOR CADMIUM REMOVAL OF PULP INDUSTRY EFFLUENT

Response and Revision made by Author(s)

Reviewer #1:

No	Comments	Revision/Changes
1	What are the rror values on the flux, water quality parameter, and removal levels of Cadmium reported herein. There is no routine characterization of the ceramic filter (IR, TGA, elemental analysis, nitrogen adsorption, PXRD, etc. The source of the clay was not specified so it is difficult for anyone to reproduce this work in some reasonable fashion. Some chemical analyses of the clay composition would be needed as part of the experimental section; i.e. Table of clay properties.	Flux, water quality parameter and removal levels of Cd was taken at three times of measurements. In addition, all of flux and Cd removal were measured after 15 minutes of operation. South Sumatra natural clay properties were added as shown in Table 1.
2	Revised for the two paragraphs. No need to mention :	The paragraph mentioned was deleted.

	...According to the Indonesian ministry of environment regulation cadmium in the wastewater excess of 0.1 mg.L-1 is not allowed to be discharged into water bodies. Meanwhile, World Health Organization (WHO) restricts the largest concentration of cadmium (II) in drinking water as 0.003 mg.L-1 ... two times in the introduction.	
3	What is have done, what is the new, what is the novelty from your work? What is the research gap compare the previous result! Can the ceramic filters be regenerated? What is the advantage of this technology over other ceramic filters?	The current work has several advantages such as a cheap raw materials (clay and rice bran) were abundant in South Sumatra region. Other ceramic filter or ceramic membrane were made using metals i.e aluminium oxide and titanium oxide. The natural clay based ceramic filters also easy to clean using a weak acid (citric acid).
4	Some discussion of the key contributions of this work and how it relates to the current state of the art in this field. The authors comment on the disadvantage of this technology due to its cost and potential fouling. It does not appear that the issue was solved in this study.	Yes, fouling is the common phenomenon in membrane and ceramic filter operation. Thats way we applied the low operating pressure in the experiments.
5		
6		

Reviewer #2:

No	Comments	Revision/Changes

1	I think the paper is interesting, but the paper needs major revisions for representation of entire manuscript -Revised for the two paragraphs. No need to mention : ...According to the Indonesian ministry of environment regulation cadmium in the wastewater excess of 0.1 mg.L-1 is not allowed to be discharged into water bodies. Meanwhile, World Health Organization (WHO) restricts the largest concentration of cadmium (II) in drinking water as 0.003 mg.L-1 ... two times in the introduction. • Please make it sample and more interesting sentence. • What is have done, • what is the new, • what is the novelty from your work? • What is the research gap compare the previous result!	Yes, thank you. The paragraph has been deleted. Some improvements in the introduction were made.
2	Please explain the composition the adsorbent prepared according to ? or this is a new from your study? Then, why you choosen this composition? Any other explanation? Please add it in the introduction!	We made various ceramic filter compositions, but only two type of filter showed good mechanical strength and crack free as we mentioned in Methodology.
3	Fig. 1 shows the experimental setup of the present work. This is interesting, but confusing for the scheme? Why did you used no. 4 – 7, they are columns or what? Improve your scheme 1 for clarity of the reactor for adsorption process.	Figure 1 experimental set-up notation has been corrected.
4	Figures 4 and 5 are not clear, please provide all the figures with high resolution.	Yes, we made some corrections to the figures.

5	All of the data for representation, but the discussion is very short and no good references provided to support your discussion. Please elaborate your discussion, make it in detail and add new references to support your discussion!	Yes, thank you for your suggestion. We provide the new references and more detail discussion.
6	. Revise the title, I am surprised with the title< ...A LOW-COST CERAMIC .....? Any economical calculation and data to support this title? 2. Improve and make clear for the last sentence in the end of abstract. ..... The results will give insight into the low-cost ceramic filter application for wastewater contains cadmium".. 3. for conclusion is hanging, no special as for conclusion. Please revise this text for the potential result from your data!	Yes, there is no technoeconomical analysis in the study. The abstract was coreccted as your suggestion.
7		

Dear Subriyer Nasir,

We confirmed that the editorial board has received your first revised paper. We appreciate your effort to refine your paper to meet the quality of IJTech publication standard. We will contact you again to inform the status of your manuscript. Thank you.

--
Kind regards,
Secretariat IJTech
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Dear Mr./Mrs. Subriyer Nasir,

The editorial board is pleased to inform you that your paper entitled "A LOW-COST CERAMIC FILTERS AND ITS APPLICATION FOR CADMIUM REMOVAL OF PULP INDUSTRY EFFLUENT" has been reviewed by referee.

Please find in the attachment referee's comments, and please make a necessary revision based on the comments. Also please read the submission guidelines.
Any revision of the paper should be submitted to ijtech@eng.ui.ac.id no later than **February 19, 2016**.

It is compulsory to return the revise paper with response comment as attached.
Please state clearly the revision based on reviewer's comment.

We look forward to receiving your revised paper at your earliest convenience.
--
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PART A: Editorial Office Only

SECTION I

Reviewer's Name:

E-Mail:

Manuscript Number: IJTech-02-53

Title: A LOW-COST CERAMIC FILTERS AND ITS APPLICATION

FOR CADMIUM REMOVAL OF PULP INDUSTRY

EFFLUENT

PART B: Reviewer Only

SECTION II: Comments per Section of Manuscript

General comment:

The paper has improved since the 1 st version. A key issue that has not been discussed in this paper is the role of swelling with regard to flux. Clays are known to undergo tremendous swelling and this issue should be commented upon in the revised version of the manuscript.

Introduction:

A comparison of other studies employing ceramic filters would have been helpful to position the current study within the literature relating to such materials.

Methodology:

A Table of compositions should be included for the reader to evaluate the combinations of components used for the filter preparation.

Results: It would be helpful to the reader to see error estimates in Tables 2-5.

Discussion:

As mentioned herein, it would be beneficial to discuss results in the context of available literature. This has been done to a limited extent.

Bibliography/References: The authors should attempt to relate their results to the exisiting literature pertinent to this field.

Others:

The paper needs to be revised for grammar, syntax, and clarity. There remain some awkward statements and incorrect grammar throughout the manuscript. The role of clay swelling in permeate flux

(Fig. 2 and 3) should be discussed. The SEM results in Fig.l4 and 5 are presumably carried out on dried samples; it would be of greater interest to examine swollen clay materials as a comparison.

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Reviewer's Guide

SECTION III - Please rate the following: (1 = Poor) (2 = Fair) (3 = Average) (4 = Above Average)

(5 = Excellent)

Originality: 3

Technical Quality: 2

Methodology : 3

Readability : 2

Practicability: 3

Organization: 3

Importance: 3

SECTION IV - Recommendation: (Kindly Mark with an X)

Accept As Is:

Requires Moderate Revision: x x

Reject On Grounds of (Please Be Specific):

SECTION V: Additional Comments

Please add additional comments, if any: The low-cost aspect of this work has not been fully supported and this phrase should be removed from the title of the manuscript. The role of swelling on textural properties and relationship to permeate flux should be discussed. The characterization of the clay materials is carried out on dried samples which may present a limited picture due to likely role of swelling in water.

RETURN OF COMMENTS

Thank you for contributing to International Journal of Technology by completing this review. Please

return your comments to:

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Managing Editor

International Journal of Technology (IJTech)

Faculty of Engineering

Universitas Indonesia,

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PART A: Editorial Office Only

SECTION I

Reviewer's Name:

E-Mail:

Manuscript Number: IJTech-02-53

Title: A LOW-COST CERAMIC FILTERS AND ITS APPLICATION

FOR CADMIUM REMOVAL OF PULP INDUSTRY

EFFLUENT

PART B: Reviewer Only

SECTION II: Comments per Section of Manuscript

General comment:

Introduction:

Methodology:

Results:

Discussion:

Bibliography/References:

Others:

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SECTION III - Please rate the following: (1 = Poor) (2 = Fair) (3 = Average) (4 = Above Average)

(5 = Excellent)

Originality:

Technical Quality:

Methodology :

Readability :

Practicability:

Organization:

Importance:

SECTION IV - Recommendation: (Kindly Mark with an X)

Accept As Is:

Requires Moderate Revision:

Reject On Grounds of (Please Be Specific):

SECTION V: Additional Comments

Please add additional comments, if any:

The every comment from reviewer, you answered well. But, I did not know, what is part that you changed it. So, please highlights what did you change in the revised paper with different colours? I dont see anything change, except the title.

RETURN OF COMMENTS

Thank you for contributing to International Journal of Technology by completing this review. Please return your comments to:

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Managing Editor

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Faculty of Engineering

Universitas Indonesia,

Kampus UI Depok 16424

T: +62 (0) 21 78849052

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E: ijtech@eng.ui.ac.id atau ijtech.eng.ui@gmail.com

Dear Subriyer Nasir,

We confirmed that the editorial board has received your third revised paper. We appreciate your effort to refine your paper to meet the quality of IJTech publication standard. We will contact you again to inform the status of your manuscript. Thank you.

--
Kind regards,
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International Journal of Technology (IJTech)
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http://www.ijtech.eng.ui.ac.id

On 2016-04-25 15:21, subriyer unsri wrote:

Dear Editor,

We made some corrections as suggested by reviewers. Please find the attachment below. Thank you for your attention and help.

Subriyer Nasir

2016-04-12 14:37 GMT+07:00 IJTech <ijtech@eng.ui.ac.id>:

Dear Mr./Mrs. Subriyer Nasir,

The editorial board is pleased to inform you that your paper entitled "A LOW-COST CERAMIC FILTERS AND ITS APPLICATION FOR CADMIUM REMOVAL OF PULP INDUSTRY EFFLUENT" has been reviewed by referee.

Please find in the attachment referee's comments, and please make a necessary revision based on the comments. Also please read the submission guidelines.
Any revision of the paper should be submitted to ijtech@eng.ui.ac.id no later than **April 7, 2016**.

It is compulsory to return the revise paper with response comment as attached.
Please state clearly the revision based on reviewer's comment.

We look forward to receiving your revised paper at your earliest convenience.

--
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Dear Subriyer Nasir,

We confirmed that the editorial board has received your third revised paper. We appreciate your effort to refine your paper to meet the quality of IJTech publication standard. We will contact you again to inform the status of your manuscript. Thank you.

--
Kind regards,
Secretariat IJTech
International Journal of Technology (IJTech)
ISSN : 2086-9614
http://www.ijtech.eng.ui.ac.id

Dear Mr./Mrs. Subriyer Nasir,

On behalf of the Editorial Board, I am pleased to inform you that your revised paper entitled: "A LOW-COST CERAMIC FILTERS AND ITS APPLICATION FOR CADMIUM REMOVAL OF PULP INDUSTRY EFFLUENT" has been accepted to be published in International Journal of Technology (IJTech).
We will notify you again for the next process required toward publication. Thank you for your contribution to IJTech and looking forward to a good collaboration in the next future.

With warm regards,

Dr. Mohammed Ali Berawi
Editor-in-Chief
International Journal of Technology
ISSN : 2086-9614

International Journal of Technology
ISSN 2086-9614

June 9, 2016

Re: **Acceptance Letter**

Dear Subriyer Nasir

Greetings from Depok,

The editorial board is delighted to inform you that your paper entitled "A LOW-COST CERAMIC FILTERS AND ITS APPLICATION FOR CADMIUM REMOVAL OF PULP INDUSTRY EFFLUENT" has been accepted to be published in the next issue of IJTech. At the present, we are conducting further necessary action to complete the publication process.

On behalf of IJTech, we appreciate your intention and willingness to publish your work with IJTech.

Warmest regards,

Dr. Mohammed Ali Berawi
Editor in Chief
International Journal of Technology (IJTech)
ISSN : 2086-9614
http://www.ijtech.eng.ui.ac.id.

Dear Mr./Mrs. Subriyer Nasir,

We have conducted line editing to your paper as part of the publication process in IJTech. Enclosed, please find the comments from the line editor indicated by character in color beside black. We would like to ask you to complete the following:

Please make necessary revise of the paper accordingly to the line editor comments.

Please complete detail information for: name of author(s), and affiliation of each author(s). Please refer to Guideline for Author to write the affiliation section

After the revision complete, please send it back to ijtech@eng.ui.ac.id or by reply this email, no later than **June 15, 2016**. We will proceed to the next step (Layouting, Final proof & Copyright) of the revised paper before printing.

We look forward to receiving your revised paper soon.

--
Kind regards,
Secretariat IJTech
International Journal of Technology (IJTech)
ISSN : 2086-9614
http://www.ijtech.eng.ui.ac.id

CERAMIC FILTERS AND THEIR APPLICATION FOR CADMIUM REMOVAL FROM PULP INDUSTRY EFFLUENT

IJTech-02-53

ABSTRACT

The purpose of this paper was to investigate the performance of ceramic filters made from a mixture of natural clay, rice bran, and iron powder in removing cadmium from pulp industry effluent. Some parameters were examined such as acidity, total dissolved solid (TDS), total suspended solid (TSS), electrical conductivity (EC), and cadmium concentration. Results showed that the composition percentage of the ceramic filter, which in this case amounted to 87.5% natural clay, 10% rice bran, and 2.5% iron powder, may decrease cadmium concentration in pulp industry effluent by up to 99.0%. Furthermore, the permeate flux decreased after 30 minutes of filtration time, and subsequently became constant at one hour of contact time. In addition, Scanning Electron Microscope (SEM) micrographs of the ceramic filter surfaces indicate that ceramic filters have a random pore structure and can be categorized as microfiltration filters.

Keywords: Cadmium, ceramic filters, permeate flux, pulp industry

1. INTRODUCTION

Wastewater from the Kraft pulp industry process (Kamali and Khodaparast, 2014) may contain heavy metal contaminants such as lead and cadmium. Cadmium in pulp industry wastewater needs to be treated prior to being released into the water. In low concentrations, cadmium is a non-essential extremely toxic trace element in rivers, lakes and, ponds (Guner, 2010). However, cadmium can be dispersed into the environment through industrial processes such as metal plating, alloy manufacturing, nickel-cadmium batteries, plant foods, pesticides, and paint pigments. Pulp industry wastewater may contain heavy metal contaminants such as lead and cadmium, which are derived from the pulping process. Therefore, cadmium has been reported to be a potent carcinogen and teratogen (Sharma, 2008).

The Ministry of Environment of the Republic of Indonesia Regulation Number 03/2010 stipulates that cadmium concentration in excess of 0.1 $mg.L^{-1}$ is not allowed to be discharged into bodies of water. In addition, the World Health Organization (WHO) restricts the maximum concentration of cadmium (II) in drinking water to 0.003 $mg.L^{-1}$. At present, available options for pulp effluent treatment include chemical oxidation, adsorption, sedimentation, and membrane filtration. (Pokhrel and Viraraghavan 2004).

Ceramic membranes have several advantages such as good mechanical, chemical, and thermal properties (Yang et al. 2008, Jana et al. 2010). Therefore, ceramic membranes are used for nutrient processing, biotechnology, and pharmaceutical products (Yang et al. 2008). Nevertheless, some disadvantages of ceramic membranes are their high production cost, high membrane weight, and the fact that they are difficult to clean due to the fouling susceptibility. Numerous methods have been proposed for cadmium removal from wastewaters such as ion exchange resins, solvent extraction, membrane technologies, precipitation, adsorption, electrochemical treatment, chemical precipitation, and biosorption (Yilmaz et al. 2012, Jhia et al. 2012). Heavy metal reduction may also be performed using microorganisms (bioremediation) (Boopathy 2008), or plants (phytoremediation) (Ali et al. 2013) to mitigate the effects of heavy metal ions in the environment. However, such techniques are relatively expensive because of intensive energy consumption.

Filtration studies using porous tubular filter supports performed for the treatment of solutions containing dye and cadmium were investigated by Ezziane et al. (2010). The 99.99% rejection rate of cadmium ions was obtained in a treatment time of two hours. In another study, Vasudepan and Lakshmi (2011) used the electrolysis method to study cadmium removal from the wastewater. They found that cadmium concentration could be decreased by approximately 97.8% and 96.9%, respectively, using alternating current and direct current for electrocoagulation. In another study, Boparai et al. (2011) concludes that nano zero valent iron (nZVI) can be used as an efficient adsorbent for removing cadmium from contaminated water sources. Cadmium adsorption was also investigated by Hydari et al. using activated carbon, chitosan biosorbent, and mixed (composite) as an adsorbent. The results obtained at optimum operating conditions brings about 100% removal of cadmium. Further, Saljoughi and Mousavi (2012) use polysulfone-based nanofiltration for cadmium removal, and reduced cadmium concentration from wastewater by 98%.

The application of low-cost ceramic filters in wastewater treatment continues to interest researchers. For instance, Han et al. (2009) show that ceramic filters made of sludge and fly ash ceramic particles are safe for wastewater treatment. Hasan et al. (2004) further report that ceramic filters made of 80% clay soil and 20% rice bran would be applicable for use in membrane bioreactor facilities without clogging after one year of operation. Another study using local clays impregnated with silver compounds shows that clays that contain traces of crystalline albite or

Commented [.1]: Please don't leave extra spaces between words and sentences.

Commented [.2]: The serial comma is required in US English.

Commented [.3]: Please use the present tense when referring to published studies.

crystalline pyroxene have better sorption of silver species, and the mineralogy of the source materials was found to have the most significant influence on the strength of ceramic filters (Craver et al. 2014). The low-cost and locally produced tubular composite membranes from natural aluminosilicates (clay, bentonite, feldspar, quartz, alumina) were studied by Almandoz et al. (2015). The results show that such composite membranes were suitable for microfiltration process and able to remove 100% insoluble residue and 87–99% of bacteria.

The use of ceramic membrane in wastewater treatment is actually limited because of the higher cost of such membranes (Saffaja et al., 2004). In addition, the cost of ceramic membranes is ten times greater than the cost of polymer membranes (Jana et.al, 2010). For that reason, it is necessary to find a low-cost material for ceramic membranes. The present work aims to investigate an alternative treatment of pulp industry wastewater using ceramic filters. The materials used for ceramic filter fabrication in the current work are natural clay and rice bran, which are easily available and inexpensive. Fabricated ceramic filters can be used to improve the quality of effluent from pulp and paper processing, mainly in neutralizing the pH and lowering levels of cadmium in the effluent. The research was focused on the development of ceramic filters, characterization of the porosity and surface area, and performance evaluation of the ceramic filters for cadmium pulp industrial wastewater treatment.

Commented [.4]: Place the period after the in-text citation as the citation is part of the sentence.

2. METHODOLOGY/ EXPERIMENTAL

2.1. Ceramic filters

Ceramic filters used in this study were designed as porous tubes made of a mixture of natural clay, rice bran, and iron powder. The average weight of each ceramic filter is about 300g. Two types of ceramic filter were fabricated for the current work. Ceramic filters with a composition of 77.5% natural clay, 20% rice bran, and 2.5% iron powder are stated as Filter A. Meanwhile, ceramic filters with a composition of 87.5% natural clay, 10% rice bran, and 2.5% iron powder are reffered to as Filter B. Two filter compositions were chosen due to their better mechanical strength and crack-free properties. Natural clay, rice bran (particle size of 500 µm), and iron powder (particle size of 500 µm) were homogenized with 30% clean water, molded, dried at room temperature. and sintered at 900^{o}C for 12 hours at a local ceramic manufacture. The composition of natural clay from South Sumatra, Indonesia, was shown in Table 1 (South Sumatra Energy and Mineral Resource, 2005).

Table 1 South Sumatra Natural Clay Properties

No	Compound	Concentration (wt%)
1.	SiO_2	65.35
2.	Fe_2O_3	6.65
3.	NH_2CO_3	14.13
4.	CaO	3.13
5.	MgO	0.29
6.	Na_2O	6.52
7.	K_2O	2.69
8.	TiO	0.30
9	H_2O	0.94

Commented [WL5]: The cadmium adsorption properties of this clay materials should be reported.

This will make the filtration results seem more reasonable.

See the following ref:
Environ Sci Pollut Res (2013) 20:925–938
The uptake capacity of cadmium here is ~ 49 mg/g of chitosan/clay composite

Whereas Na-bentonite has a maximum sorption capacity of 26.2 mg g^{-1} Cd

These results are important for interpretation of Fig. 2

2.2. Sample and Analysis

The pulp mill effluent sample used in experiment was collected from one of pulp mill in South Sumatra. The samples were analyzed according to the Indonesian standards of wastewater. Some parameters examined are pH, TSS, TDS, EC, and cadmium content. Process variables studied were pressure differences (ΔP), filter composition, and feed flow rate. In addition, a Scanning Electron Microscope (JEOL 330 Japan) was used to determine ceramic filter surface. The Quantachrom Nova A-600 porosimeter used for pores distribution examination and Atomic Absorption Spectrophotometer (AAS) (Shimadzu AA-6800) for cadmium determination. Ceramic filters design: inner diameter of 5 cm, the outer diameter is 7 cm, and 25 cm length. It is placed in a polyethylene filter cartridge with an inner diameter of 8.5 cm, outer diameter of 9 cm, and 25 cm length.

Commented [WL6]: What are the limits of detection for this method; the cadmium concentration levels are approximately ppb levels and it is unclear that the AA will provide the required accuracy. Please comment.

2.3. Experimental set-up

The equipment used in the experiment include a polyethylene tank with a capacity of 250L, stirrer, centrifugal pumps, pressure gauge, and flow-meter. The system was also equipped with a sand filter, spoons filter (5 µm of pore size), and activated carbon filters. Wastewater samples were coagulated using 200 $mg.L^{-1}$ of Poly Aluminum Chloride. They were stirred at 100 RPM for one minute and then 60 RPM for 10 minutes before they were fed into a storage tank. The filtrate was collected in a storage tank with a capacity of 250L and pumped into sand filter, sediment filter, activated carbon filter, and ceramic filter, respectively. The permeate was collected in a 1000 mL beaker glass and measured after 15, 30, 45, and 60 minutes of filtration time. Permeate flux was calculated as follows:

$$Jv = V/A \times t \quad (1)$$

where V is the permeate volume, A is area of ceramic filter and t is the filtration period.

Figure 1 shows the experimental setup of the present work.

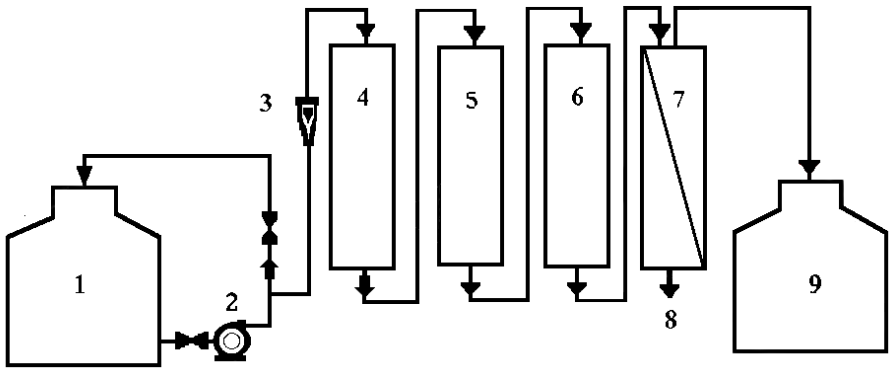

Figure 1 Experimental set-up
(1. Feed tank 2. Centrifugal Pump 3. Flowmeter 4. Spoons filter column 5. Sand filter column 6. Activated carbon filter 7. Ceramic Filter 8. Retentate 9. Permeate Tank)

3. RESULTS AND DISCUSSION

Table 2 displays the sample analysis. It is seen that cadmium, COD, TSS, and pH were above the Indonesian standard for pulp industry wastewater.

Table 2 Sample Analysis

Parameters	Values	Indonesian Standard
Cd ($mg.L^{-1}$)	0.65	0.1
Fe ($mg.L^{-1}$)	0.64	10
Pb ($mg.L^{-1}$)	0.21	1
COD ($mg.L^{-1}$)	215	100
TDS ($mg.L^{-1}$)	567	-
EC ($\mu S.cm^{-1}$)	1107	-
TSS ($mg.L^{-1}$)	162	150
pH	9.84	6-9
Turbidity (NTU)	135	-

3.1. Effect of Contact Time on Permeate Flux

The influence of contact time on the flux at different pressures (ΔP) is shown in Figure 2. All ceramic filters showed a flux decline after 30 minutes of filtration time and remained constant for one hour. The permeate flux declined due to the build-up of solute on the filter surface, which was caused by several factors such as concentration polarization, adsorption, and plugging of the pores. The concentration polarization will affect the flux of microfiltration and ultrafiltration membranes mainly for high operating pressure. The filter fouling may be caused by higher values of TDS and TSS in feed with prolonged operating time together with adsorption of cadmium on filter pores. As a consequence, the permeate flux of the microfiltration process decreases with time, which will significantly reduce the filtration performance (Zhang et al 2014). Cadmium ion adsorption by clay, which depends on the ceramic filter characteristics, concentration of solute, and pH, reduce the cadmium in the feed solution.

Clays consist of negatively charged aluminosilicate layers kept together by cations and they have the ability to adsorb water between the layers, resulting in strong repulsive forces and clay expansion. Clay swelling depends on the molecular packing of intercalated water, charge locus, charge density, and the type of counterion (Hensen & Smit, 2002). Adsorption of cadmium may occur at different sites on the aluminosilicate structure of clay over a wide range of concentrations (Bergaya et al,, 2006) or by electrostatic attraction. In addition, increases in temperatures will reduce the water retention capacity, and thus decrease the clay swelling capacity (Anderson et al., 2010). However, the effect of clay swelling of the flux needs further investigation since the contact time is too short. Increasing the contact time will increase the fouling risk of ceramic filters caused by high suspended solid particle from the raw water. As shown in Table 4, increases in the contact time does not affect the removal of cadmium since the cadmium concentration is constant after one hour of contact time.

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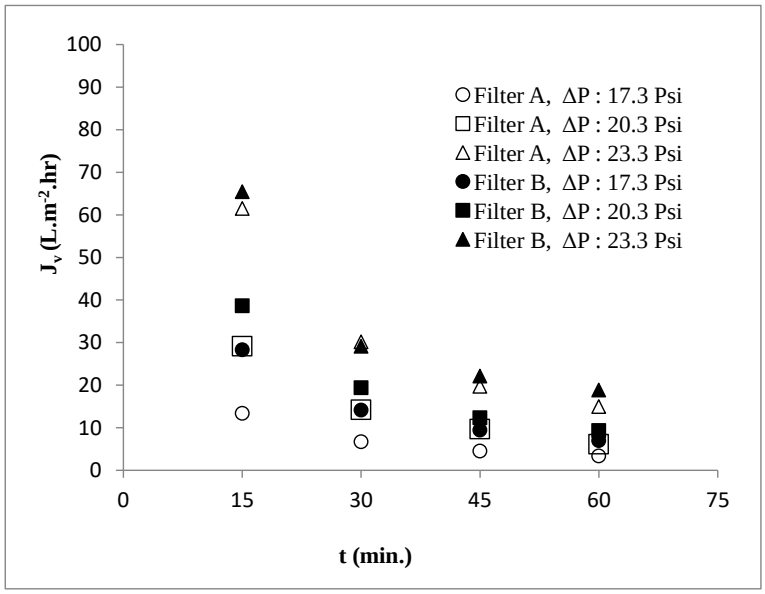
100
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J_v (L.m^{-2}.hr)
t (min.)
Filter A, ΔP : 17.3 Psi
Filter A, ΔP : 20.3 Psi
Filter A, ΔP : 23.3 Psi
Filter B, ΔP : 17.3 Psi
Filter B, ΔP : 20.3 Psi
Filter B, ΔP : 23.3 Psi

Figure 2 Permeate fluxes

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See the following ref. where timeframes of 300 hours or more are monitored.
Please explain why the time interval is so short and the implication on the utility of this filter.

3.2. Permeate Analysis

Permeate analysis can be seen in Table 3. It is shown that TDS, EC, pH, and cadmium concentrations of permeate meet the Indonesian standard for pulp industrial wastewater. Filter A was able to reduce the cadmium concentration by up to 99.53%, and Filter B by up to 99.90%. All permeates also showed good turbidity with pH in the range of 6.59 and 7.46. This means the effluent is safe to discharge into the environment. It also indicates effective absorption of cadmium on the ceramic filter surfaces.

Table 3 Permeate Analysis

ΔP (psi)	Time (min.)	Filter A				Filter B			
		TDS ($mg.L^{-1}$)	EC ($\mu S.cm^{-1}$)	Cd ($mg.L^{-1}$)	pH	TDS ($mg.L^{-1}$)	EC ($\mu S.cm^{-1}$)	Cd ($mg.L^{-1}$)	pH
17.3	15	490	982	0.005	6.72	472	945	0.003	7.46
	30	494	988	0.005	6.84	469	943	< 0.0015	6.62
	45	494	989	0.003	6.83	468	943	< 0.0015	6.62
	60	492	986	0.002	7.46	469	949	< 0.0015	6.62
20.3	15	490	980	0.005	7.32	477	954	0.002	6.60
	30	490	981	0.005	7.42	478	958	< 0.0015	6.59
	45	490	981	0.003	7.20	477	949	< 0.0015	7.32
	60	491	982	0.002	6.60	477	955	< 0.0015	7.20
23.3	15	488	970	0.005	6.59	462	925	< 0.0015	6.93
	30	489	977	0.002	7.32	475	950	< 0.0015	6.74
	45	489	979	< 0.0015	7.20	479	959	< 0.0015	6.74
	60	488	977	< 0.0015	6.93	478	957	< 0.0015	6.95

Table 4 illustrates the cadmium removal efficiency of Filter A and Filter B. Filter A was able to reduce the cadmium concentration by up to 99.53%, and Filter B by up to 99.90%. It has shown that Filter B is more effective in the removal of cadmium from pulp industry effluent at a pressure difference of 20.3 Psi and one hour of filtration time. This is due to characteristics of the filter such as the porosity and surface area of Filter B, which is larger than Filter A. Filter B is also able to

reduce the levels of TDS and TSS in feed, making a good permeate in terms of turbidity. Besides, these two types of ceramic filters can neutralize the pH of permeate.

Table 4 Pulp Industry wastewater treatment using ceramic filters

Parameters	**Ceramic Filter A**	**Removal (%)**	**Ceramic Filter B**	**Removal (%)**
Cd ($mg.L^{-1}$)	0.003	99.53	0.0015	99.00
TDS ($mg.L^{-1}$)	498	12.17	472	16.75
EC ($\mu S.cm^{-1}$)	986	10.93	970	12.38
TSS ($mg.L^{-1}$)	21.4	86.79	17.8	89.01
pH	7.14	27.44	6.98	29.07
Turbidity (NTU)	7.12	94.65	2.56	98.08

The filter characteristics are presented in Table 5. The amount of rice bran affects the porosity of the filters. An increase in the rice bran percentage of the filter composition will increase the filter's porosity. Average pore diameters for both filters range from between 1 and 10 μm. It is suggested that rice bran should be oxidized at high a temperature to realize a random pore in the ceramic filters. This will lead to an increase of the pore formation in the ceramic filters.

Table 5 Filter Characteristics

Ceramic Filter	Rice bran (%)	Average Pore Diameter (μm)	Surface area (m^2g)	Porosity (%)
A	20	7.84	12.01	41.96
B	10	1.09	14.63	43.95

Pores play an important role in the heavy metal adsorption of membranes or filter surfaces. Increasing the addition of rice bran as a pore forming agent in the ceramic filter composition results in lower mechanical strength since the porosity obtained is higher (Yang, 2008). Consequently, it can decrease the heavy metal concentration from wastewater using the adsorption mechanism. A simple and rapid method to determine the filter surface is to use a Scanning Electron Microscope as shown in Figures 3 and 4.

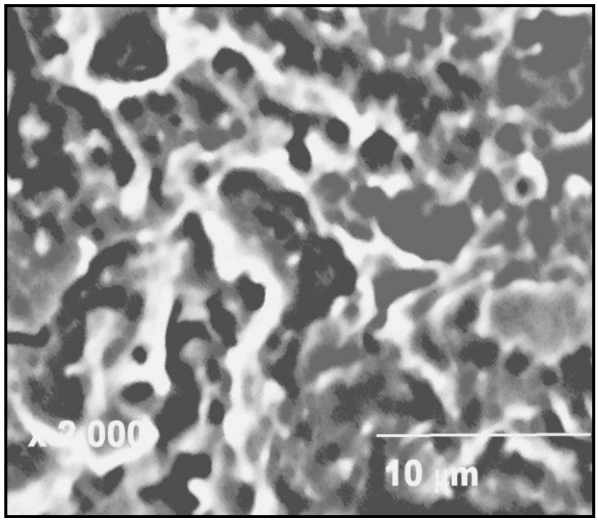

Figure 3 SEM micrograph of Filter A

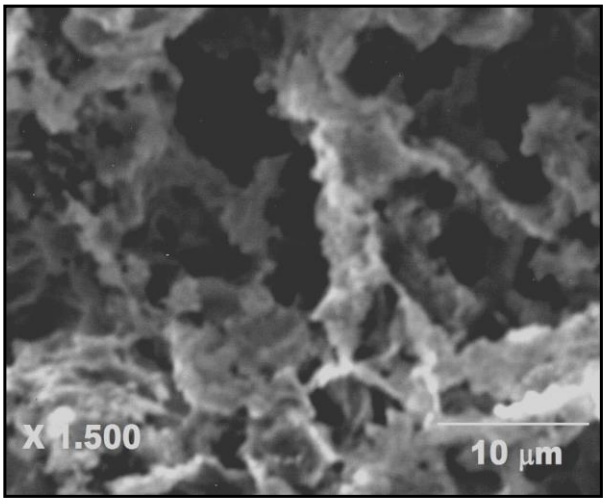

Figure 4 SEM micrograph of Filter B

Figures 3 and 4 depict the filter pores with the addition of rice bran. It has been described that the size of the rice bran particles have an influence on the permeability of the filters. Fine particles expose a more extensive surface area and increases the permeability of the filters. SEM images of

filters at various magnifications show a random filter structure with pore sizes ranging from 1 to 10 µm. Therefore, the ceramic filters can be classified as microfiltration filters. This is similar to those reported by Yang and Tsai (2008), which use starch as a filter material and found that the pore size is around 8 µm. The results obtained could be used for natural clay applications for the treatment of cadmium from the pulp and paper industry.

4. CONCLUSION

Ceramic filters made from 87.5% natural clay, 10% of rice bran, and 2.5% iron powder may reduce cadmium from pulp industry effluent by up to 99.0%. The permeate flux declined after 30 minutes of contact time and remained constant for one hour. The ceramic filters can be categorized as a microfiltration filter, and they can be used in the treatment of wastewater containing cadmium.

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Hasan et al. (2004) or (2011)?
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