J. T. K. L.
JURNAL TEKNIK KIMIA DAN LINGKUNGAN
p-ISSN : 2579-8537
e-ISSN : 2579-9746
Jurnal Teknik Kimia dan Lingkungan

HOME ABOUT USER HOME SEARCH CURRENT ARCHIVES ANNOUNCEMENTS EDITORIAL BOARD PUBLICATION ETHICS

Home > User > Author > Submissions > #151 > **Review**

#151 Review

SUMMARY REVIEW EDITING

Submission

Authors	Siti Jamilatun, Ilham Mufandi
Title	The Effectiveness of Activated Charcoal from Coconut Shell as The Adsorbent of Water Purification in The Laboratory Process of Chemical Engineering Universitas Ahmad Dahlan Yogyakarta
Section	Articles
Editor	Dyah Wulan

Peer Review

Round 1

Review Version	151-614-2-RV.DOCX 2020-03-18
Initiated	2020-03-26
Last modified	2020-03-29
Uploaded file	None

Editor Decision

Decision	Accept Submission 2020-08-30
Notify Editor	Editor/Author Email Record 2020-08-30
Editor Version	151-631-2-ED.DOCX 2020-03-30 151-631-3-ED.DOCX 2020-06-01 151-631-4-ED.DOCX 2020-08-05 151-631-5-ED.DOCX 2020-08-06 151-631-6-ED.DOCX 2020-08-30
Author Version	151-636-1-ED.DOCX 2020-03-21 DELETE 151-636-2-ED.DOCX 2020-04-06 DELETE 151-636-3-ED.DOCX 2020-06-06 DELETE 151-636-4-ED.DOCX 2020-08-05 DELETE 151-636-5-ED.DOCX 2020-08-06 DELETE
Upload Author Version	Choose File No file chosen Upload

FONT SIZE

KEYWORDS

Phanerochaete chrysosporium SSF absorption activated carbon activated sludge adsorbent adsorption banana peel biogas calcium silicate carbonization catalyst cellulose corrosion esterification extraction fermentation glycerol hydrolysis microwave response surface methodology

Gmail

JTKL

Tulis

Email

Kotak Masuk 9.571
Berbintang
Ditunda
Penting
Terkirim
Draf 198
Kategori
Unwanted 1

Chat

Rachma Tia Evitasari
maryudi maryudi
Melia Dian
Heni Anggorowati
Shinta Amelia
Agus Aktawan

Ruang

Meeting Prodi Teknik Ki...

Rapat

[JTKL] Submission Acknowledgement

Eksi

Prayitno <jtkl@polinema.ac.id>
kepada saya

Dear Siti Jamilatun:

Thank you for submitting the manuscript, "The Effectiveness of activatec charcoal from Coconut Shell as the absorber of Water Treatment in The Laboratorium Process of Chemical Engineering Universitas Ahmad Dah Yogyakarta" to Jurnal Teknik Kimia dan Lingkungan. With the online jour management system that we are using, you will be able to track its prog through the editorial process by logging in to the journal web site:

Manuscript URL:
http://jtkl.polinema.ac.id/index.php/jtkl/author/submission/151
Username: sitijamilatun

If you have any questions, please contact me. Thank you for considering journal as a venue for your work.

Prayitno
Jurnal Teknik Kimia dan Lingkungan

Jurnal Teknik Kimia dan Lingkungan
http://jtkl.polinema.ac.id/index.php/jtkl

Noted with thanks. Thanks a lot. Thank you for y

Balas Teruskan

Gmail

JTKL

Tulis

Email

Kotak Masuk 9.571
Berbintang
Ditunda
Penting
Terkirim
Draf 198
Kategori
Unwanted 1

Chat

Rachma Tia Evitasari
maryudi maryudi
Melia Dian
Heni Anggorowati
Shinta Amelia
Agus Aktawan

Ruang

Meeting Prodi Teknik Ki...

Rapat

[JTKL] The Effectiveness of activated char of Chemical Engineering Universitas Ahma

Dyah Ratna Wulan <jtkl@polinema.ac.id>
kepada saya, Ilham

Dear authors,

This letter is to acknowledge the receipt of your manuscript in jtkl online journal management system. Before continuing to reviewers, please rev manuscript format as commented in the text, and return revised manusc the online journal management before 25 Maret 2020.

With the online journal management system that we are using, you will b able to track its progress through the editorial process by logging in to the journal web site.

with best wishes,
Editor,
Dyah Ratna Wulan

Jurnal Teknik Kimia dan Lingkungan
http://jtkl.polinema.ac.id/index.php/jtkl

J. T. K. L.

The Effectiveness of activated charcoal from Coconut Shell as the absorber of Water Treatment in The Laboratorium Process of Chemical Engineering Universitas Ahmad Dahlan Yogyakarta

ABSTRAK

151-613-1-SM.docx

J. T. K. L.
JURNAL TEKNIK KIMIA DAN LINGKUNGAN

J. Tek. Kim. Ling. ...., *XX (X), X-X*
p-ISSN : ...., e-ISSN :..................
www.jtkl.polinema.ac.id

The Effectiveness of activated charcoal from Coconut Shell as the absorber of Water Treatment in The Laboratorium Process of Chemical Engineering Universitas Ahmad Dahlan Yogyakarta

Siti Jamilatun[1*] and Ilham Mufandi[2]
[1]Program Studi Teknik Kimia, FakultasTeknologiIndustri, Universitas Ahmad Dahlan,
Jl. Prof, Dr, Soepomo, Janturan, Yogyakarta, Telp. (0274)379418/381523, Fax (0274) 381523
[2]Department of Mechanical Engineering, Faculty of Engineering, Khon Kaen Univeristy, Thailand.
*E-mail:sitijamilatun@che.uad.ac.id

ABSTRAK

Kualitas air di Laboratorium Proses Teknik Kimia di Kampus 3, Universitas Ahmad Dahlan, Yogyakarta (UAD), perlu dianalisis sebelum diolah menjadi air minum. Arang aktif adala─h senyawa karbon amorf, yang diproduksi dari bahan yang mengandung karbon atau arang yang diolah dengan cara yang unik untuk mendapatkan permukaan penuh. Arang aktif dapat menyerap gas dan senyawa kimia tertentu. Sifat selektif arang aktif tergantung pada ukuran atau volume pori-pori dan luas permukaan. Penelitian ini bertujuan untuk mengetahui kualitas air, penerapan arang aktif, dan air murni di Laboratorium Proses Rekayasa Kimia UAD. Tahapan proses penelitian adalah sebagai berikut: Pertama, menganalisis kadar air di laboratorium pengolahan dengan menganalisis pH , kandungan logam, kekerasan, sulfat, fluoro, mineral, dan bakteri. Kedua, menyiapkan arang aktif tempurung kelapa dan melakukan proses klarifikasi skala laboratorium dengan dua cara, yaitu mencampurkan arang aktif dan air dengan variasi waktu kontak dan mengalirkan air ke dalam kolom arang aktif. Ketiga, analisis hasil klarifikasi seperti analisis pH, kadar logam, kekerasan, kadar sulfat, kadar fluoro, dan mineral. Hasil pemurnian air dapat melihat bahwa kolom arang aktif dapat mengurangi kekerasan $CaCO_3$ hingga 15,33%, kadar SO_4 hingga 98,21%, kadar Flouro hingga 93,35% pada ketebalan kolom aktif 15 cm. Arang aktif yang kurang bersih dalam pencucian akan menambah warna, kekeruhan, tingkat padatan terlarut, kadar besi, kandungan air mangan yang melewati kolom arang aktif. Pengadukan selama 30 menit pada kontak antara arang aktif dan air dapat mengurangi tingkat kekerasan 26,81%, mengurangi tingkat sulfat 98,23%, dan mengurangi tingkat fluoride 93,35%.

Kata kunci: Arang aktif tempurung kelapa, Penjernian Air, Kesadahan

ABSTRACT

The water quality in the Chemical Engineering Process Laboratory at Campus 3, Universitas Ahmad Dahlan, Yogyakarta (UAD), needs to be analyzed before it processed into drinking water. Activated charcoal is a carbon amorph compound, which is produced from carbon-containing materials or from charcoal that treated in a unique way to get a full surface. Activated charcoal can adsorb certain gases and chemical compounds. The selective nature of activated charcoal depends on the size or volume of the pores and surface area. This study aims to determine the quality of water, the implementation of activated charcoal, and purify water at UAD Chemical Engineering Process Laboratory.The stages of the research process are as follows: Firstly, analyze the water content in the processing laboratory by analyzing the pH, metal content, hardness, sulfate, fluoro, minerals, and bacteria. Secondly, prepare coconut shell active charcoal and conduct a laboratory-scale clarification process in two ways, namely mixing activated charcoal and water with variations in contact time and passing water into the activated charcoal column. Thirdly, analysis of the results of clarification such as analysis of pH, metal content, hardness, sulfate content, fluoro content, and minerals. The results of water purification can see that the activated charcoal column can reduce $CaCO_3$ hardness up to 15.33%, SO_4 levels up to 98.21%, Flouro levels up to 93.35% at 15 cm active column thickness. Activated charcoal that is less clean in washing will add color, turbidity, levels of Dissolved Solids, Iron content, Manganese content of water that passed in the activated charcoal column. Stirring for 30 minutes on contact between activated charcoal and water can reduce hardness levels of 26.81%, reduce sulfate levels of 98.23%, and reduce fluoride levels of 93.35%.

Keywords: coconut shell active charcoal, water purification, hardness

Corresponding author: sitijamilatun@che.uad.ac.id
Jurusan Teknik Kimia, Politeknik Negeri Malang
Jl. Soekarno Hatta No. 9, Malang 65141, Indonesia
E-mail: xxxx@polinema.ac.id

Diterima: xx Oktober 2018
Disetujui: xx Januari 2019

Commented [RI1]: identitas penulis dihapus untuk proses blind review

Commented [RI2]: abstrak ditulis sebanyak 100-200 kata

Commented [RI3]: kata kunci disusun urut abjad menggunakan huruf kecil

Commented [RI4]: tambahkan (SO4) setelah kata sulfate

Commented [RI5]: tambahkan (F) setelah kata flouro

Commented [RI6]: Ganti dengan F

Commented [RI7]: tambahkan (Fe) setelah kata iron

Commented [RI8]: tambahkan (Mn) setelah kata manganese

Commented [RI9]: mohon di cek ulang, flouro, fluoride atau fluorine dan disesuaikan penulisan dalam satu artikel sebaiknya ajeg dalam penulisan

Commented [RI10]: abstrak ditulis sebanyak 100-200 kata

Commented [RI11]: kata kunci disusun urut abjad

1. INTRODUCTION

Charcoal is a porous solid containing 85% ─ 95% carbon, produced from materials containing carbon by heating at high temperatures. Besides being used as fuel, it can also use as an adsorbent. The surface area of the particles determines absorption, and this ability can be higher if the charcoal is activated by active factors of chemicals or by heating at high temperatures. Thus, the charcoal will experience changes in physical and chemical properties called active charcoal.

Based on Franco Cataldo, 2012 [1] explains that the use of activated charcoal with a pore area of 120 m^2/g can reduce Fe levels to near 0 mg/L from 12.60 mg/L. NO_3 from 23.90 mg/L to 0 mg/L, metals and other compounds such as Mn, NH_4, NO_2, SO_4, Cl not detected after active charcoal passed. Activated charcoal with the larger surface area can decreases the COD from 3.14 mg/L to 2.24 mg/L. For example, activated charcoal with a pore area of 1000 m^2/g can reduce COD from 5.15 mg/L to 546 mg/L. While metals and other compounds after absorption not detect. One of the functions of water for health is to push out toxins from the body, so the Department of Health recommends that the pH of water consumed is 6.5 ─8.5.

Active charcoal production can be cunducted through the process of pyrolysis of biomass as the raw materials that has reported by [2] conducting research on the development of activated charcoal from coconut shells. In addition, the experiment from (Jamilatun, S.et all. 2015; Jamilatunet al., 2017) [3,4] was performed that the increased of yield of activated charcoal by activating with H_2SO_4, variations in temperature and times.

Based on previous research, the use of activated carbon as an abrorben has been carried out by [5] reporting that the effectiveness of activated charcoal by thermal method and in-situ regulation. The research [6] conducted research on activated carbon from banana peel as a methyl blue absorber. Other uses of activated charcoal can be used as an increase in the quality of liquid smoke [7,8]. Once the importance of activated charcoal. Futhemore, in this study we took the objective of using activated charcoal for laboratory water purification.

Analyzing water in the Laboratory of Chemical Engineering Process Campus 3 Universitas Ahmad Dahlan, Yogyakarta (UAD) can find out the levels of metals, minerals, pH, and bacteria so that it can determine how to improve its quality. One way to enhance the quality of water is to use adsorbents in the form of activated charcoal. There is a finding to find out the effect of activated charcoal on water quality in two ways. The first is to pass water in the active column. The second way is to contact between water and activated charcoal accompanied by stirring with variations in the length of time of mixing. With these two ways, we will get water with better quality and can treat for research and other purposes.

Literatur Review

Groundwater

Groundwater is water that contained in layers of soil or rocks below the surface of the land. Groundwater is one of the water resources. In addition to river water and rainwater, groundwater also has a significant role, especially in maintaining the balance and availability of raw water supplies for domestic (domestic) and industrial purposes. In some areas, dependence on clean water and groundwater supplies has reached ±70%. Groundwater, especially for household and industrial use, in urban and lowland areas tends to contain high levels of iron or organic acids. This condition can be caused by Indonesia's geological conditions, which naturally have high Fe deposits, especially on mountain slopes or caused by human activities. While water with high organic acid content can cause by peatlands or mangroves that are rich in organic compounds [9].

Commented [RI12]: Hapus tahun. selingkung jurnal untuk merujuk sitasi di depan kalimat contoh: Franco Cataldo [1] explain dan selanjutnya.

Commented [RI13]: iron (Fe)

Commented [RI14]: nitrate (NO_3)

Commented [RI15]: manganese (Mn)

Commented [RI16]: sesuaikan penulisan menjadi: senyawa (simbol)

Commented [RI17]: tambahkan kepanjangannya dulu kemudian singkatan (COD) karena text sebelumnya belum menyebutkan kepanjangan COD. Hal ini dilakukan untuk memudahkan khalayak umum memahami artikel.

Commented [RI21]: introduction tidak perlu memuat beberapa subtitle introduction yang mengsegmentasisubbab per subbab. Sebaiknya deskripsi mengenai literatur review menjadi satu kesatuan cerita yang padu dalam introduction.

Commented [RI18]: tahun dihlangkan menjadi: from Jamilatun, S. et al.; Jamilatun et al. [3,4]

Commented [RI19]: by Suprianti et al. [5]

Commented [RI20]: perbaiki pola kalimat dan cara penulisan sitasinya

Charcoal and activated charcoal

Charcoal obtained by heating wood (pyrolysis carbonization), which only leaves carbon and inorganic ash. Semi-industrial production by burning woodpiles that have covered in mud or bricks. The lower the ash content, water, and substances that evaporate, the higher the level of fixed carbon so that the quality of the shell charcoal is higher [10,11]. The raw material is carbonized at temperatures of 400°C─500°C to eliminate volatile substances. Then it is oxidized with gas at 800°C─1000°C to develop pores and surface area [12].

The activation process is a process to remove hydrocarbons that line the surface of charcoal to increase carbon porosity [13,14]. Activation of activated charcoal can do in two ways, namely the physical activation process and the chemical activation process. The principle of physical activation is the provision of water vapor or CO_2 gas to the charcoal that has heat. The law of chemical activation is the immersion of charcoal in a chemical compound before it is heated. It expected that the activating agent enters between the hexagonal layers of activated charcoal and then opens a closed surface. Chemicals that can use include H_3PO_4, $ZnCl_2$, NH_4Cl, $AlCl_3$, HNO_3, KOH, NaOH, H_3BO_3, $KMnO_4$, SO_2, H_2SO_4, K_2S, $CaCl_2$, and $MgCl_2$ [15].

Absorption of activated charcoal is enormous, which is 25%─1000% of the weight of activated charcoal. Activated charcoal divided into two types, namely activated charcoal as a pale and as an absorbent of steam. Activated charcoal usually in the form of a fine powder, pore diameter reaches 1000 A° and use in the liquid phase. The benefit serves to remove the irritating substances that cause unexpected colors and odors, freeing solvents from the disruptive materials and other uses, namely on the chemical industry and new industries [16]

2. Materials dan Methods

2.1 Materials

The main ingredients used in this study were activated coconut shell charcoal, aquadest, I_2, and $KMnO_4$. Water samples get at the Ahmad Dahlan University Chemical Engineering laboratory. **Figure 1** shows a series of activated charcoal activation devices for water purification in the chemical engineering laboratory of Ahmad Dahlan University.

Figure 1. Experiment equipment of activated charcoal

2.2 Methods

Figure 2 shows water purification phases of chemical engineering laboratory using activated coconut shells. The first step is to analyze the pH content, metal content, hardness, sulfate, fluoro, minerals, and bacteria contained in chemical engineering laboratory water. Next, prepare the coconut shell active charcoal and conduct laboratory-scale clarification processes. There are two ways in which the activated charcoal purified As follows: 1) Mixing the activated charcoal and water by varying the contact time and 2) passing water into the activated charcoal column. The third stage is the analysis of clarification results such as analysis of pH, metal content, hardness, sulfate content, fluoro content, and minerals.

Figure 2.The stages of water purification using activated charcoal

Commented [RI23]: were obtained

Commented [RI24]: tidak bold

Commented [RI25]: akan lebih baik jika ada keterangan gambar yang lebih advance. semisal gambar yang dikiri atau gambar (a) itu gambar apa yang ditengah gambar apa yang paling kanan gambar apa , agar pembaca umum dengan lebih paham

Commented [RI26]: tidak bold

Commented [RI22]: ditinjau ulang apa benar hingga 1000%?

Commented [RI27]: diperbaiki gambar agar dapat terlihat dengan jelas oleh pembaca

Commented [RI28]: tidak bold

3. Results and Discussions

3.1 Analysis of water quality before treatment using activated charcoal.

The water quality of the UAD Campus 3 Chemical Engineering Laboratory before active charcoal treatment can see in **Table 1**, wherein general the test results are following the Clean Water Quality Standards allowed with No. 416 / MENKES / PER / IX / 1990. [16]

Tabel 1. Water analysis result in laboratory Campus 3, UAD before treatment using activated charcoal

No	Parameters	Units	Results	492/IV/2010
1.	Color	TCU Scale	10	15
2.	Turbidity	NTU Scale	0.45	5
3.	Dissolved Solids (TDS)	mg/L	948	500
4.	pH	-	6.87	6.5-8.5
5.	Chloride	mg/L	33.98	250
6.	Hardness ($CaCO_3$)	mg/L	183,08	500
7.	Organic Substances($KMnO_4$)	mg/L	3.160	10
8.	Sulfate (SO_4^{2-})	mg/L	67.69	250
9.	Flourida (F^-)	mg/L	0.40	1.50
10.	Nitrite (NO_2^--N)	mg/L	0.002	300
11.	Nitrate (NO_3^--N)	mg/L	7.31	50
12.	Iron (Fe)	mg/L	<0.003	0.30
13.	Mangan (Mn)	mg/L	<0.002	0.40
14.	Cyanide (CN^-)	mg/L	<0.006	0.07

Yogyakarta Health Laboratory Testing Laboratory: Maximum allowable level according to Clean Water Quality Standards No: 416 / MENKES / PER / IX? 1990 (Request Parameters) [16]

3.2 Purification of water by filtering activated charcoal

After the water has undergone a filtering treatment on the activated charcoal column and stirring the activated charcoal together with water. Table 3 shows the results of research on the screening treatment using activated charcoal columns with a thickness of 5, 10, and 15 cm can reduce hardness, sulfate, and fluoride levels.

Table 2. Test data with active charcoal column thickness of 5 cm, 10 cm, and 15 cm

No	Parameters	Units	Early	5 cm	10 cm	15 cm
1.	Color	mg/L	10	500	600	2000
2.	Turbidity	mg/L	0.450	133	227	135
3.	Dissolved Solids (TDS)	mg/L	948	1218	1304	1604
4.	pH	mg/L	6.87	6.500	6.5	6.50
5.	Chloride	mg/L	33.98	58.34	63.88	77.10
6.	Hardness ($CaCO_3$)	mg/L	183.08	168	165	155
7.	Organic Substances($KMnO_4$)	mg/L	3.16	-	-	-
8.	Sulfate (SO_4^{2-})	mg/L	67.69	16.87	2.81	1.21
9.	Flourida (F^-)	mg/L	0.40	0.06	0.03	<0.02
10.	Nitrite (NO_2^--N)	mg/L	0.002		-	-
11.	Nitrate (NO_3^--N)	mg/L	7.31		-	-

No	Parameters	Units	Early	5 cm	10 cm	15 cm
12.	Iron (Fe)	mg/L	<0.003	1.22	0.96	0.49
13.	Mangan (Mn)	mg/L	<0.002	0.02	0.13	0.29
14.	Cyanide (CN^-)	mg/L	<0.006	-	-	-

From Table 2, it can see that three parameters have decreased, namely hardness, sulfate levels, and fluoride. This decrease factor influenced by the thickness of the activated charcoal bed in the column.

Other parameters such as color, turbidity, solute solids, chloride, iron, manganese have increased very significantly. The dirtiness of activated charcoal causes an increase in brightness, turbidity, and dissolved solids after washing.

The increased Fe, chloride, and Manganese content is caused by the metal content that is involved by the activated charcoal dissolving when water passed into the activated charcoal column. The existence of Iron, Chloride and Manganese is also caused by the washing of activated charcoal which is less than the maximum so that it pollutes the water.

Water treatment in the metal removal industry and the other is carried out further processes after being passed by a sand filter whose piles are activated charcoal. To reduce hardness and metals to zero is given in the ion exchanger. So for the use of activated charcoal is less suitable for water purification that is already appropriate based on Clean Water Quality Standards. Activated charcoal is beneficial in the cleaning of waste (solution), which is colored and reduces odor. The result is very significant in the processing of batik waste.

3.3. Water purification by stirring activated charcoal Together with water

Table 3 illustrates that the longer the stirring time will further reduce hardness, sulfate levels, and flour levels. But in the 30th minute the water becomes turbid and requires sedimentation to separate the clear water.

Commented [RI29]: tidak bold

Table 3. Data of test results with stirring for 5 minutes, 10 minutes, 20 minutes and 30 minutes

No	Parameters	Units	Early	5 minutes	10 minutes	15 minutes	30 Minutes
1.	Color	TCU Scale	10	-	-	-	turbid
2.	Turbidity	NTU Scale	0.45	-	-	-	-
3.	Dissolved Solids (TDS)	mg/L	948	-	-	-	-
4.	pH	mg/L	6.87	6.48	6.48	6.48	6.48
5.	Chloride	mg/L	33.98	-	-	-	-
6.	Hardness ($CaCO_3$)	mg/L	183.08	150	145	135	134
7.	Organic Substances ($KMnO_4$)	mg/L	3,16	-	-	-	-
8.	Sulfate ($SO4^{2-}$)	mg/L	67.69	15.80	1.81	1.25	1,20
9.	Flourida (F-)	mg/L	0.40	0.06	0.04	0.03	0.03
10.	Nitrite(NO_2^--N)	mg/L	0,002	-	-	-	-

No	Parameters	Units	Early	5 minutes	10 minutes	15 minutes	30 Minutes
11.	Nitrate (NO_3^--N)	mg/L	7.31	-	-	-	-
12.	Iron (Fe)	mg/L	<0.003	-	-	-	-
13.	Mangan (Mn)	mg/L	<0.002	-	-	-	-
14.	Cyanide (CN^-)	mg/L	<0.006	-	-	-	-

Conclusions

Water treatment in Laboratorium of Chemical Engineering Universitas Ahmad Dahlan, Yogyakarta analyzed with two steps as follows Purification of water by filtering activated charcoal and Water purification by stirringactivated charcoal together with water. Active charcoal column can reduce $CaCO_3$ hardness up to 15.33%, SO_4 levels up to 98.21%, Fluorine content up to 93.35% at 15 cm active column thickness.

Activated charcoal that is less clean in washing will add color, turbidity, levels of Dissolved Solids, Iron content, Manganese content of water that passed in the activated charcoal column.Stirring for 30 minutes on contact between activated charcoal and water will cause a decrease in hardness of 26.81%, a reduction in sulfate levels of 98.23%, and a reduction in Flouro content of 93.35%.

Acknowledgments

Researchers would like to thank research funding assistance through the Internal Grant Compete Research Scheme through the Research and Community Service Institute of Universitas Ahmad Dahlan, Yogyakarta

References

[1] Paten Franco Cataldo, 2012, Process For The Purification Of Landfill Leachate Wastewater By Active Charcoal And Photo Ozonolysis.

[2] Jamilatun, S., Kusuma,D., Shakti ASS, dan Ferdiant, F., 2010, Pembuatan Biocoal Sebagai Bahan Bakar Alternatif dari Batubara dengan Campuran ArangS erbuk Gergaji KayuJati, Glugu dan SekamPadi, Prosiding Seminar Nasional Teknik Kimia "Kejuangan" , PengembanganTeknologi Kimia untukPengolahanSumberDayaAlam Indonesia , ISSN 1693 – 4393,

[3] Jamilatun, S. dan Salamah, S., 2015, Peningkatan Kualitas Asap Cairdengan Menggunakan Arang Aktif, SNTT FGDT 2015, Universitas Muhammadiyah Surakarta.

[4] Jamilatun, S. and Salamah, S., 2017, Pemanfaatan Asap Cair Food Grade yang Dimurnikan dengan Arang Aktif sebagai Pengawet Ikan Nila, Eksergi, 14 (2), 29-34.

[5] Suprianti, Y., Syafitri Kurniasetyawati, A., Regenerasi In-Situ Adsorben Karbon Aktif Tipe Granul dengan Metode Termal, J. Tek. Kim. Ling. 2019, 3 (1), 1-9

[6] Kurniati,Y., Putri Prastuti, O., Lutfi Septiani, E., Studi Kinetika Adsorpsi Metil Biru Menggunakan Karbon Aktif Limbah Kulit Pisang, *J. Tek. Kim. Ling*. 2019, 3 (1), 34-38

[7] Jamilatun, S., Aslihati, L. dan Suminar, E.W., 2016, Pengaruh perendaman ikan nila dengan asap cair (liquid smoke) terhadap daya simpan, Prosiding Semnastek 2016.

[8] Jamilatun, S., Budhijanto, Rochmadi, Yuliestyan, A. and Budiman, A., 2019, Valuable Chemicals Derived from Pyrolysis Liquid Products of Spirulina platensis Residue, Indones. J. Chem., 19 (3), 703 – 711.

[9] Ince, Margaret and Guy Howard. 1999. Developing Realistic Drinking-Water Quality Standards, 25th WEDC Conference Integrated Development

Commented [RI34]: Jamilatun, S. and Salamah, S., Pemanfaatan Asap Cair Food Grade yang Dimurnikan dengan Arang Aktif sebagai Pengawet Ikan Nila, *Eksergi*, vol. 14, no. 2, hal. 29-34, 2017.

Commented [RI30]: semua reference disesuaikan dengan JTKL templat yang menggunakan IEEE Referencing style. tahun ditulis paling akhir.
contoh sitasi artikel berbahasa inggris:
T. Kaczorek, Minimum energy control of fractional positive electrical circuits, *Archives of Electrical Engineering*, vol. 65, no. 2, pp.191–201, 2016.

Commented [RI31]: ditambah reference dari penulis lainnya selain Jamilatun agar lebih memperkuat artikel sehingga tidak terlalu banyak self-citation

Commented [RI32]: sebagai contoh:
[1] Paten Franco Cataldo, Process For The Purification Of Landfill Leachate Wastewater By Active Charcoal And Photo Ozonolysis, 2012.

Commented [RI33]: 1.Khusus untuk Prosiding mohon diperhatikan tata cara penulisan sebagai berikut :
Author(s) Initial(s). Surname(s), Title of paper, **in *Abbrev. Name of Conf.***, [location of conference is optional], [vol., no. if available], tahun, hal. xxx–xxx
contoh:
S. R. Ayyubi, Y. Miao, dan H. Shi, Automating standalone smoke alarms for early remote notifications, in: ICARCV, (13th Intern. Conf. on Cont. Automa. Robotics & Vision), Marina Bay Sands Singapore, Dec. 2014.

for Water Supply and Sanitation, Addis Ababa, Ethiopia

[10] Jamilatun, S., IntanDwi, I., Elza Novita, P., 2014, Karakteristik Arang Aktif dari Tempurung Kelapa dengan Pengaktivasi H_2SO_4 Variasi Suhu dan Waktu, Simposium Nasional Teknologi Terapan (SNTT) II 2014, Universitas Muhammadiyah Surakarta, ISSN: 2339-028X.

[11] Jamilatun, S., Setyawan, S., Salamah, S., Ayu Purnama, D.A., Melani Putri, R., Pembuatan ArangAktif Dari Tempurung Kelapa Dengan Aktivasi Sebelum dan SusudahPirolisis, Seminar Nasional Sains dan Teknologi2015, FakultasUniversitas Muhammadiyah Jakarta, 2407-1846 (Print) 2460-8416 (Online).

[12]Ami Cobb,2012, *Low-Tech Coconut Shell Activated Charcoal Production*, International Journal for Service Learning in Engineering Vol. 7, No. 1, pp. 93-104, Spring 2012 ISSN 1555-9033.

[13]Cooney DO. 1980. Activated Charcoal, Antidotal, and Other Medical Uses. New York: Marcel Dekker, Ann Arbor,Michigan

[14] Kienle HV. 1986. Carbon. Di dalam Campbell, PT Prefferkorn R., dan Roundsaville JF. Ullman's Encyclopedia of Industrial Chemistry, 5th Completely Revised Ed. Vol A5: Cancer Chemotherapy to Ceramics Colorants. Weinheim: VHC

[15]Oyo KB, Igbokwe PK (2001). Production of activated carbon from coconut-shell. J. Chem. Soc. Nig., 26(1): 91-94

[16]Keputusan Menteri KesehatanNomor 907 Tahun 2002

Gmail

JTKL

Tulis

Email

Kotak Masuk 9.571
Berbintang
Ditunda
Penting
Terkirim
Draf 198
Kategori
Unwanted 1

Chat

Rachma Tia Evitasari
maryudi maryudi
Melia Dian
Heni Anggorowati
Shinta Amelia
Agus Aktawan

Ruang

Meeting Prodi Teknik Ki...

Rapat

[JTKL] Editor Decision

Eksternal Kotak Masuk

Dyah Ratna Wulan <jtkl@polinema.ac.id>
kepada saya

Dear Siti Jamilatun:

Thank you for being submitted revised manuscript. For future improvem the manuscript, we have reached a decision regarding your submission Jurnal Teknik Kimia dan Lingkungan, "The Effectiveness of activated cha from Coconut Shell as the absorber of Water Treatment in The Laborato Process of Chemical Engineering Universitas Ahmad Dahlan Yogyakart

Our decision is: Revisions Required

If you are able to correct the manuscript taking into account all of the points raised in the referees' report, I would be willing to arrange for the manuscript to be reviewed again. Revisions should be submitted within days.

Besides the referees' report as attached in this email, see also the "Reviewer Uploaded Files" in journal's website to read the additional comments from reviewers (if any).

If you choose to revise your manuscript it will be due into the Editorial Office by XX XXXX XXXX.

Revised article should be submitted on JTKL's online system under Rev Tab, click on "Upload Author Version".

Submission URL: http://jtkl.polinema.ac.id/index.php/jtkl

If you does not know or forget your username and password for the jour web site, you can use this link to reset your password (which will then be emailed to you along with your username).
http://jtkl.polinema.ac.id/index.php/jtkl/login/lostPassword

Gmail

JTKL

Tulis

Email

Kotak Masuk 9.571
Berbintang
Ditunda
Penting
Terkirim
Draf 198
Kategori
Unwanted 1

Chat

Rachma Tia Evitasari
maryudi maryudi
Melia Dian
Heni Anggorowati
Shinta Amelia
Agus Aktawan

Ruang

Meeting Prodi Teknik Ki...

Rapat

[JTKL] Editor Decision

Kotak Masuk ×

Dyah Ratna Wulan <jtkl@polinema.ac.id>
kepada saya

Dear Siti Jamilatun:

We have reached a decision regarding your submission to Jurnal Teknik dan Lingkungan, "The Effectiveness of activated charcoal from Coconut as the absorber of Water Treatment in The Laboratorium Process of Ch Engineering Universitas Ahmad Dahlan Yogyakarta".

Our decision is: Revisions Required.

If you are able to correct the manuscript taking into account all of the points raised in the referees' report, I would be willing to arrange for the manuscript to be reviewed again. Revisions should be submitted within days.

Besides the referees' report as attached in this email, see also the "Reviewer Uploaded Files" in journal's website to read the additional comments from reviewers (if any).

If you choose to revise your manuscript it will be due into the Editorial Office by XX XXXX XXXX.

Revised article should be submitted on JTKL's online system under Rev Tab, click on "Upload Author Version".

Submission URL: http://jtkl.polinema.ac.id/index.php/jtkl

If you does not know or forget your username and password for the jour web site, you can use this link to reset your password (which will then be emailed to you along with your username).
http://jtkl.polinema.ac.id/index.php/jtkl/login/lostPassword

Gmail

JTKL

Tulis

Email

Kotak Masuk 9.571
Berbintang
Ditunda
Penting
Terkirim
Draf 198
Kategori
Unwanted 1

Chat

Rachma Tia Evitasari
maryudi maryudi
Melia Dian
Heni Anggorowati
Shinta Amelia
Agus Aktawan

Ruang

Meeting Prodi Teknik Ki...

Rapat

[JTKL] Editor Decision

Kotak Masuk ×

Dyah Ratna Wulan <jtkl@polinema.ac.id>
kepada saya

Dear Siti Jamilatun:

We have reached a decision regarding your submission to Jurnal Teknik dan Lingkungan, "The Effectiveness of activated charcoal from Coconut as the absorber of Water Treatment in The Laboratorium Process of Ch Engineering Universitas Ahmad Dahlan Yogyakarta".

Our decision is to: Accept Submission
Your manuscript will be publish in Jurnal Teknik Kimia dan Lingkungan V No.2 in October 2020. (After this stage there will be a copyedit and proo reading stage).

Best regards,
Dyah Ratna Wulan
Department of Chemical Engineering, Politeknik Negeri Malang
ratnawln@polinema.ac.id

Jurnal Teknik Kimia dan Lingkungan
http://jtkl.polinema.ac.id/index.php/jtkl

Balas Teruskan

Gmail

JTKL

Tulis

Email

Kotak Masuk 9.571
Berbintang
Ditunda
Penting
Terkirim
Draf 198
Kategori
Unwanted 1

Chat

Rachma Tia Evitasari
maryudi maryudi
Melia Dian
Heni Anggorowati
Shinta Amelia
Agus Aktawan

Ruang

Meeting Prodi Teknik Ki...

Rapat

1. Click on the Submission URL below.
2. Log into the journal and click on the File that appears in Step 1.
3. Open the downloaded submission.
4. Review the text, including copyediting proposals and Author Queries.
5. Make any copyediting changes that would further improve the text.
6. When completed, upload the file in Step 2.
7. Click on METADATA to check indexing information for completeness a accuracy.
8. Send the COMPLETE email to the editor and copyeditor.
note: please click "complete" button after upload the manuscript

Submission URL:
http://jtkl.polinema.ac.id/index.php/jtkl/author/submissionEditing/151
Username: sitijamilatun

This is the last opportunity to make substantial copyediting changes to tl submission. The proofreading stage, that follows the preparation of the galleys, is restricted to correcting typographical and layout errors.

If you are unable to undertake this work at this time or have any questio please contact me. Thank you for your contribution to this journal.

Dyah Ratna Wulan
[SCOPUS ID: 56960460700] Department of Chemical Engineering, Polit Negeri Malang
ratnawln@polinema.ac.id

Jurnal Teknik Kimia dan Lingkungan
http://jtkl.polinema.ac.id/index.php/jtkl

Balas Teruskan

Gmail

JTKL

Tulis

Email

Kotak Masuk 9.571
Berbintang
Ditunda
Penting
Terkirim
Draf 198
Kategori
Unwanted 1

Chat

Rachma Tia Evitasari
maryudi maryudi
Melia Dian
Heni Anggorowati
Shinta Amelia
Agus Aktawan

Ruang

Meeting Prodi Teknik Ki...

Rapat

[JTKL] Copyediting Review Acknowledger

Dyah Ratna Wulan <jtkl@polinema.ac.id>
kepada saya

Siti Jamilatun:

Thank you for reviewing the copyediting of your manuscript, "The Effectiveness of activated charcoal from Coconut Shell as the absorber Water Treatment in The Laboratorium Process of Chemical Engineering Universitas Ahmad Dahlan Yogyakarta," for Jurnal Teknik Kimia dan Lingkungan. We look forward to publishing this work.

Dyah Ratna Wulan
Department of Chemical Engineering, Politeknik Negeri Malang
ratnawln@polinema.ac.id

Jurnal Teknik Kimia dan Lingkungan
http://jtkl.polinema.ac.id/index.php/jtkl

Balas Teruskan

Gmail

JTKL

Tulis

Email

Kotak Masuk 9.571
Berbintang
Ditunda
Penting
Terkirim
Draf 198
Kategori
Unwanted 1

Chat

Rachma Tia Evitasari
maryudi maryudi
Melia Dian
Heni Anggorowati
Shinta Amelia
Agus Aktawan

Ruang

Meeting Prodi Teknik Ki...

Rapat

[JTKL] Proofreading Request (Author)

Dyah Ratna Wulan <jtkl@polinema.ac.id>
kepada saya

Siti Jamilatun:

Your submission "The Effectiveness of activated charcoal from Coconut as the absorber of Water Treatment in The Laboratorium Process of Che Engineering Universitas Ahmad Dahlan Yogyakarta" to Jurnal Teknik Kir Lingkungan now needs to be proofread by folllowing these steps.
1. Click on the Submission URL below.
2. Log into the journal and view PROOFING INSTRUCTIONS
3. Click on VIEW PROOF in Layout and proof the galley in the one or m formats used.
4. Enter corrections (typographical and format) in Proofreading Correctic
5. Save and email corrections to Layout Editor and Proofreader.
6. Send the COMPLETE email to the editor.

Submission URL:
http://jtkl.polinema.ac.id/index.php/jtkl/author/submissionEditing/151
Username: sitijamilatun

Dyah Ratna Wulan
[SCOPUS ID: 56960460700] Department of Chemical Engineering, Poli Negeri Malang
ratnawln@polinema.ac.id

Jurnal Teknik Kimia dan Lingkungan
http://jtkl.polinema.ac.id/index.php/jtkl

Balas Teruskan

[JTKL] Proofreading Acknowledgement ar

Dyah Ratna Wulan <jtkl@polinema.ac.id>
kepada saya

Siti Jamilatun:

Thank you for proofreading the galleys for your manuscript, "The Effectiveness of activated charcoal from Coconut Shell as the absorber Water Treatment in The Laboratorium Process of Chemical Engineering Universitas Ahmad Dahlan Yogyakarta," in Jurnal Teknik Kimia dan Ling We are looking forward to publishing your work in October 2020.

If you subscribe to our notification service, you will receive an email of the Table of Contents as soon as it is published.

We would like to inform you that JTKL starts in the April 2020 issue will require a publication fee of IDR 350,000 for articles already received an will be published. This fee is entirely for financing DOI usage in the article and annual fees for using DOI. Therefore, please make payments the following account:

Mandiri 1440017415875 (Asalil Mustain)

Please send the invoice or transfer evidence to us. If you have any questions, please contact me.

Dyah Ratna Wulan (089615983630)
Department of Chemical Engineering, Politeknik Negeri Malang
ratnawln@polinema.ac.id

Jurnal Teknik Kimia dan Lingkungan
http://jtkl.polinema.ac.id/index.php/jtkl

J. T. K. L.
JURNAL TEKNIK KIMIA DAN LINGKUNGAN

J. Tek. Kim. Ling. 2020, 4 (2), 113-120
p-ISSN : 2579-8537, e-ISSN : 2579-9746
www.jtkl.polinema.ac.id

The Effectiveness of Activated Charcoal from Coconut Shell as The Adsorbent of Water Purification in The Laboratory Process of Chemical Engineering Universitas Ahmad Dahlan Yogyakarta

Siti Jamilatun[1,*], Ilham Mufandi[2]

[1]Department of Chemical Engineering, Faculty of Industrial Technology, Universitas Ahmad Dahlan, Kampus 4, Jl. Ringroad Selatan, Kragilan, Yogyakarta, Indonesia
[2]Department of Mechanical Engineering, Faculty of Engineering, Khon Kaen Univeristy, Thailand.

*E-mail:sitijamilatun@che.uad.ac.id

ABSTRAK

Penelitian ini bertujuan untuk menguji efektivitas arang aktif dari tempurung kelapa untuk pemurnian air di Laboratorium Proses Teknik Kimia, Universitas Ahmad Dahlan, Yogyakarta. Penelitian terdiri dari tiga tahapan: Tahapan pertama, menganalisis kandungan air Laboratorium Teknik Kimia UAD, Tahapan kedua, pengujian efektivitas arang aktif untuk penjernihan air dengan dua (2) cara: (1) filter kolom arang aktif dan (2) pencampuran arang aktif dan air sampel, kemudian dilakukan pengadukan. Tahapan ketiga, menganalisa hasil pemurnian air seperti analisis pH, kadar logam, kesadahan (*hardness*), kadar sulfat (SO_4), kadar fluoride, dan mineral. Parameter pemurnian air merujuk pada *Clean Water Quality Standards* Kementrian Kesehatan. Hasil penelitian yang diperoleh menunjukkan bahwa pemurnian air menggunakan metode kolom filter dapat mengurangi kesadahan kalsium karbonat ($CaCO_3$) hingga 15,33%, kadar asam sulfat (SO_4) hingga 98,21%, kadar Flourida (F) hingga 93,35% pada ketebalan kolom arang aktif 15 cm. Sedangkan pemurnian air dengan pencampuran arang aktif dan pengadukan selama 30 menit dengan kecepatan 1000 rpm dapat mengurangi tingkat kekesadahan $CaCO_3$ hingga 26,81%, kadar asam sulfat (SO_4) hingga 98,23%, dan fluorida (F) hingga 93,35%. Pemurnian air melalui pencampuran arang aktif dan air dengan pengadukan lebih baik daripada penggunaan kolom arang aktif, karena klorida, bahan organik, nitrit, nitrat, Fe, Mn, CN^- tidak ditemukan dalam air setelah pemurnian.

***Kata kunci*:** Arang aktif, kesadahan, kolom filter

ABSTRACT

This study aims to examine the effectiveness of activated charcoal from coconut shells for water purification at the Chemical Engineering Process Laboratory, Ahmad Dahlan University, Yogyakarta. The first stage, analyzing the water content of the UAD Chemical Engineering Laboratory, Second, testing the effectiveness of activated charcoal for water purification in two (2) ways: (1) activated charcoal column filter and (2) mixing the activated charcoal and water samples, then stirring. The third, analyzing the results of water purification such as analysis of pH, metal content, hardness (hardness), sulfate levels (SO_4), fluoride levels, and minerals. Water purification parameters refer to the Ministry of Health's Clean Water Quality Standards. The results optimum obtained using the column filter in thickness activated charcoal column 15 cm could reduce hardness ($CaCO_3$) by 15.33%, sulfuric acid (SO_4) levels up to 98.21%, Fluoride (F) levels up to 93.35%. While by mixing activated charcoal (15 gram) and water (500 ml) with stirring for 30 minutes at a speed of 1000 rpm could reduce hardness levels by 26.81%, sulfuric acid (SO_4) levels up to 98.23%, and fluoride (F) up to 93.35%. Purification of water through the mixing of activated charcoal and water with stirring is better than using an activated charcoal column because it is better than the chloride, organic matter, nitrite, nitrate, Fe, Mn, CN^- are not found in the water after purification.

***Keywords*:** Activated charcoal, column filter, hardness

1. INTRODUCTION

Water becomes a primary requirement in life. The kinds of water consist of groundwater, river water, and rainwater. Application water in society has to qualify, for instance, chemical character, physical character, and

Corresponding author: Siti Jamilatun
Department of Chemical Engineering, Universitas Ahmad Dahlan
Jl. Ringroad Selatan, Kragilan, Yogyakarta, Indonesia
E-mail: sitijamilatun@che.uad.ac.id

Diterima: 28 Februari 2020
Disetujui: 30 Agustus 2020

bacterial nature, which is not dangerous for the environment and health [1].

Water quality control was required carefully and effectively to avoid environmental problems caused by household wastewater, industrial wastewater, and laboratory wastewater [2]. The water purification was conducted with filter technology through activated charcoal to catch chemical compound.

According to Irmanto and Suyato [3], activated charcoal was able to reduce Biochemical Oxygen Demand (BOD) level up to 33.51%, Chemical Oxygen Demand (COD) level up to 78.92%, and Total Suspended Solids (TSS) level up to 61.05% on the liquid waste of industry. Activated charcoal applications can use to filter the magnesium oxide (MgO) [4]. Riyani [5] reported that the use of activated charcoal could reduce the photodegradation of textile dyes on the liquid waste of textiles. The capability of activated charcoal can reduce 64.69% of ammonia content, 52.35% of nitrite and 86.40% of nitrate has researched by I. Suyata [6]. Other benefits of activated charcoal are improving bio-oil and liquid smoke quality as alternative fuels [7] and food preservatives [8,9].

Based on Franco Cataldo [10] was explained that the benefit of activated charcoal with a pore area of 120 m^2/g could reduce Iron (Fe) level to near 0 mg/L from 12.60 mg/L, Nitrate (NO_3) level from 23.90 mg/L to 0 mg/L, metals and other compounds such as manganese (Mn), ammonium (NH_4), nitrogen dioxide (NO_2), sulfate (SO_4), and chloride (Cl).

The activation process is a process to remove hydrocarbons that line the surface of charcoal to increase carbon porosity [11,12]. The activation of charcoal conducted in two ways: (i) the physical activation process and (ii) the chemical activation process. The material activation is the distribution of water vapor or carbon dioxide (CO_2) gas to the charcoal. While the chemical activation is the immersion of charcoal in a chemical compound before it is heated, it expected that the activating agent enters between the hexagonal layers of activated charcoal and then opens a closed surface [13-15].

Absorption of activated charcoal is enormous, which is 25%-100% of the weight of activated charcoal. Activated charcoal is divided into activated charcoal as the pale and activated charcoal as the absorbent of steam. Activated charcoal usually in the form of a fine powder, pore diameter reaches 1000A^o and use in the liquid phase. The benefit serves to remove the irritating substances that cause unexpected colors and odors, freeing solvents from the disruptive materials and other uses, namely on the chemical industry and new industries [14-16]

Activated charcoal production can conduct through the process of pyrolysis of biomass as the raw materials. According to Jamilatun et al. [17] have done that activated charcoal from coconut shells. Besides, the experiment from Jamilatun, et al. [17,18] performed that the increased yield of activated charcoal by activating with sulfuric acid (H_2SO_4) with a variation on temperatures and times.

Based on previous research, the use of activated charcoal as the adsorbent has been carried out by [19], reporting that the effectiveness of activated charcoal by the thermal method and in-situ regulation. According to [20] has researched activated charcoal from the banana peel as a methyl blue absorbent. Another benefit of activated charcoal was the increase in liquid smoke [21,22].

Furthermore, in this study, we conducted the application of activated charcoal to water purification in the laboratory process of Chemical Engineering, Universitas Ahmad Dahlan. Analyzing water in the Laboratory of Chemical Engineering Process, Universitas Ahmad Dahlan, Yogyakarta (UAD) found the level of metal, mineral, pH, and bacteria so that it was determined how to improve its quality. One way to enhance water quality is to use absorbent in the form of activated charcoal.

2. METHODS

2.1 Materials

The primary raw material in this study included: activated charcoal from coconut shell, water, Iodine (I_2), and potassium permanganate ($KMnO_4$). The activated charcoal used has a size of 80 mesh with an Iod number of 580 mg I_2/gram of charcoal.
Water samples obtained from the laboratory process of Universitas Ahmad Dahlan with flow velocity is 33.33 ml/hour.

2.2. Water test equipment

The tools used to test water include the Atomic Absorption Spectrophotometer (AAS) 700 Perkin Elmer Analyst, UV-Vis Winlab Perkin Elmer Spectrophotometer, Turbidimeter, Salinometer, and water quality checker.
Other analytical tools are Erlenmeyer, pH meter, burette, measuring flask, goblet, thermometer, goiter pipette, analytical balance, hot plate, spray flask, dropper, and magnetic stirrer.

2.3. Water purification methods

Figure 1 shows the water purification phases of the laboratory of UAD by using activated charcoal from coconut shells by three steps.
1) The first step is to analyze the Chemical Engineering laboratory's water content based on Clean Water Quality Standards. Furthermore, preparing the coconut shell activated charcoal and conduct laboratory-scale.
2) The second stage, there are two ways the purification water as follows:
a) Water purification through activated charcoal filter column uses bottled drinking water with a diameter of 6 cm, a height of 20 cm. Height of activated charcoal pile with variations of 5, 10, and 15 cm.
b) Water purification by stirring activated charcoal together with water waste. The use of 15 grams of activated charcoal to purify 500 ml of water, with a stirring speed of 500 rpm with time varied 5, 10, 15, and 30 minutes.
3) The third stage is the analysis of water purification results such as pH, metal content, hardness, sulfate content, fluoride content, and minerals.

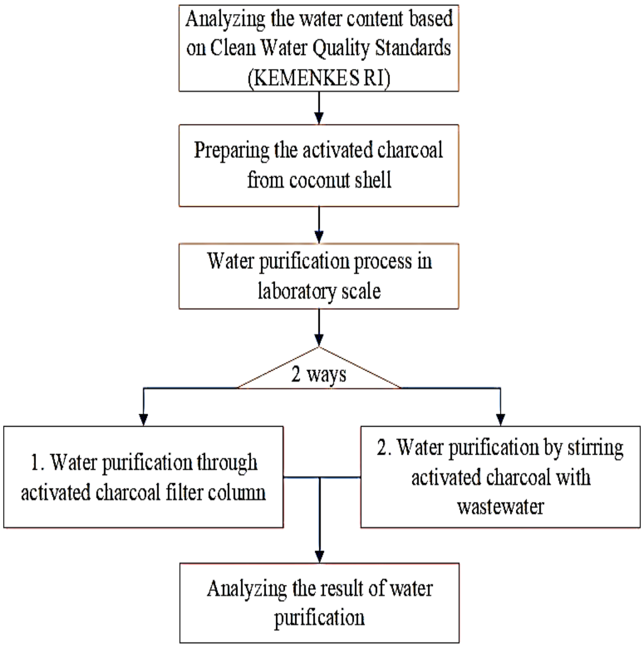

Fig. 1.The stages of water purification

Figure 2 shows the purification water by activated charcoal in the laboratory process of Ahmad Dahlan University.

(a) (b)

Fig. 2. The purification water by activated charcoal in the laboratory process of UAD: (a) filter column and (b) mixing and stirring

3. RESULTS AND DISCUSSION

3.1. Characteristics of activated charcoal

Activated charcoal has a water content of 1.3%, the ash content of 0.60% meets the SNI (Standard Nasional Indonesia) 0258-79 standard. It has an absorbency of the iodine content of 580.0 mg/g that meets the SNI 06-3730 standard and granular size of 80 mesh.

3.2. Analysis of water content based on Clean Water Quality Standards

This analysis as the baseline to compare the water content in the laboratory of UAD before going to the experiment by using activated charcoal. The Clean Water Quality Standards have followed as the baseline in this parameter. Table 1 shows the test results of water content in the laboratory of UAD. It uses a set of the Clean Water Quality Standards allowed with Regulation of the Minister of Health of the Republic of Indonesia No. 416/MENKES/PER/IX/1990 [23].

Table 1. Water analysis results in the laboratory process of UAD before treatment using activated charcoal

No	Parameters	Units	Results	Maximum Allowable Level
1.	Color	TCU Scale	10	15
2.	Turbidity	NTU Scale	0.45	5
3.	Dissolved Solids (TDS)	mg/L	948	500
4.	pH	-	6.87	6.5-8.5
5.	Chloride	mg/L	33.98	250
6.	Hardness ($CaCO_3$)	mg/L	183.08	500
7.	Organic Substances($KMnO_4$)	mg/L	3.16	10
8.	Sulfate ($SO_4^{2-)}$	mg/L	67.69	250
9.	Florida (F^-)	mg/L	0.40	1.50
10.	Nitrite (NO_2^--N)	mg/L	0.002	300
11.	Nitrate (NO_3^--N)	mg/L	7.31	50
12.	Iron (Fe)	mg/L	<0.003	0.30
13.	Mangan (Mn)	mg/L	<0.002	0.40
14.	Cyanide (CN^-)	mg/L	<0.006	0.07

*Yogyakarta Health Laboratory Testing Laboratory: Maximum allowable level according to Clean Water Quality Standards No: 416/MENKES/PER/IX/1990 (Request Parameters) [23]

3.3. Water purification through an activated charcoal filter column

Table 2 shows the effect of the activated charcoal column (5, 10, and 15 cm) on the characteristics of the purified water. From this table, it can seem that the most optimal clarification results obtained at a column thickness of 15 cm, there are three parameters decreased, namely hardness (from 183.03 to 155 mg/L), sulfate levels (from 67.69 to 1.21 mg/L) and fluoride (from 0.4 to 0.002 mg/L). This reduction factor influenced by the thickness of the activated charcoal layer in the column. Whereas organic matter, nitrite, nitrate, and CN^- were not found in the product water. As for other parameters such as color, turbidity, dissolved solids, chloride, iron, and manganese, have increased significantly. Activated charcoal impurities cause increased turbidity and suspended solids-the increase in Fe, chloride, and Manganese content generated by the metal in the activated charcoal. The metal dissolves when the water sample flows into the column. It caused by the washing of activated charcoal, which is less than the maximum, so it pollutes the water.

Industrial water treatment for removal of metals and other contents passed through sand filters and activated charcoal piles so that the hardness and metal content become zero flowed in the ion exchanger. So, for the use of activated charcoal, it is not suitable for water purification that has appropriate characteristics based on Clean Water Quality Standards. Activated charcoal is beneficial in cleaning colored wastes (solutions) and reducing odors. The result is very significant in processing batik waste [5,24].

Purifying water with an active column still leaves a large number of impurities in the product water. This phenomenon is due to less optimal absorption of metals and contaminants; the sample water only flows on the surface of activated charcoal, unable to reach the inside of the pores. The results will be more effective if mixed water samples and activated charcoal are accompanied by stirring [5,24].

Table 2. Test data with active carbon filter column with a thickness of 5, 10 and 15 cm

No	Parameters	Units	Early	5 cm	10 cm	15 cm
1.	Color	mg/L	10	500	600	2,000
2.	Turbidity	mg/L	0.450	133	227	135
3.	Dissolved Solids (TDS)	mg/L	948	1,218	1,304	1,604
4.	pH	mg/L	6.87	6.50	6.50	6.50
5.	Chloride	mg/L	33.98	58.34	63.88	77.10
6.	Hardness ($CaCO_3$)	mg/L	183.08	168	165	155
7.	Organic Substances ($KMnO_4$)	mg/L	3.16	-	-	-
8.	Sulfate (SO_4^{2-})	mg/L	67.69	16.87	2.81	1.21
9.	Flourida (F^-)	mg/L	0.40	0.06	0.03	<0.02
10.	Nitrite (NO_2^--N)	mg/L	0.002		-	-
11.	Nitrate (NO_3^--N)	mg/L	7.31		-	-
12.	Iron (Fe)	mg/L	<0.003	1.22	0.96	0.49
13.	Mangan (Mn)	mg/L	<0.002	0.02	0.13	0.29
14.	Cyanide (CN^-)	mg/L	<0.006	-	-	-

3.4. Water purification by stirring activated charcoal together with water

The effect of stirring time (with a rotating speed of 500 rpm) on water purification by mixing activated charcoal (15 grams) and sample water (500 ml) shown in Table 3. From the table it can be seen that the longer the stirring time can reduce the level of hardness (from 183.03 to 134 mg/L), sulfate levels (from 67.69 to 1.2 mg/L), and fluoride levels (from 0.4 to 0.03 mg/L). Whereas chloride, organic matter, nitrite, nitrate, Fe, Mn, CN^- were not found in the water after purification with 5, 10, 15, and 30 minutes of stirring. The turbid water can be clarified again by sedimentation.

The overall results of the experiment showed that the purification of water through the mixing of activated charcoal and water with stirring (method 2) was better than flowing water in the column (first method). The first method still found turbidity, TDS, chloride, Fe, Mn, while in the second way chloride, organic matter, nitrite, nitrate, Fe, Mn, CN^- were not found in the water after purification.

Mixing with stirring gives better results because the contact between the activated charcoal and the water sample to be extracted by the metal or impurity component is more effective. Metal or impurity components are absorbed more in the pores of activated charcoal. Stirring turn makes water to wet all parts from activated charcoal, so metals also contaminants incorporated into pores' holes.

Table 3 Data of test results via stirring for 5, 10, 20, and 30 minutes

No	Parameters	Units	Early	5	10	15	30
1.	Color	TCU	10	-	-	-	Turbid
2.	Turbidity	NTU	0.45	-	-	-	-
3.	Dissolved Solids (TDS)	mg/L	948	-	-	-	-
4.	pH	mg/L	6.87	6.48	6.48	6.48	6.48
5.	Chloride	mg/L	33.98	-	-	-	-
6.	Hardness ($CaCO_3$)	mg/L	183.08	150	145	135	134
7.	Organic Substances ($KMnO_4$)	mg/L	3,16	-	-	-	-
8.	Sulfate ($SO4^{2-}$)	mg/L	67.69	15.0	1.81	1.25	1.20
9.	Flourida (F-)	mg/L	0.40	0.06	0.04	0.03	0.03
10.	Nitrite(NO_2^--N)	mg/L	0,002	-	-	-	-
11.	Nitrate (NO_3^--N)	mg/L	7.31	-	-	-	-
12.	Iron (Fe)	mg/L	<0.003	-	-	-	-
13.	Mangan (Mn)	mg/L	<0.002	-	-	-	-
14.	Cyanide (CN^-)	mg/L	<0.006	-	-	-	-

4. CONCLUSION

The water purification through the activated charcoal stirring activated charcoal together with a water sample is better than the filter column. The experiment result shows that activated charcoal filter column can reduce calcium carbonate ($CaCO_3$) hardness up to 15.33%, sulfate (SO_4) levels up to 98.21%, Fluorine (F) content up to 93.35% at 15 cm active filter column thickness. In comparison, the water purification via stirring for 30 minutes on contact between activated charcoal and water can cause a decrease in hardness of 26.81% and a reduction in sulfate (SO_4) levels of 98.23, and a decrease in Flouride (F) content of 93.35%. The overall results of the experiment showed that the purification of water through the mixing of activated charcoal and water with stirring was better than flowing water in the column. The first method still found turbidity, TDS, chloride, Fe, Mn, while in the second way chloride, organic matter, nitrite, nitrate, Fe, Mn, CN- were not found in the water after purification.

ACKNOWLEDGMENTS

Researchers would like to thank research funding assistance through the Internal Grant Compete Research Scheme through the Research and Community Service Institute of Universitas Ahmad Dahlan, Yogyakarta.

REFERENCES

[1] R. Marsidi, Zeolit untuk Mengurangi kesadahan Air, *J. Teknol. Lingkung.*, vol. 2, no. 1, pp. 1–10, 2001.

[2] B. Supriyatno, Pengelolaan Air Limbah yang Berwawasan Lingkungan Suatu Startegi dan Langkah Penangannya, *Jurnal Teknologi Lingkungan*, vol. 1, no. 1, pp. 17–26, Januari 2011.

[3] Irmanto and Suyata, Optimasi Penurunan Nilai BOD, COD, dan TSS Limbah Cair Industri Tapioka Menggunakan Arang Aktif dari Ampas Kopi, *J. Mol.*, vol. 5, no. 1, pp. 22–23, 2010.

[4] H. P. Putra, B. P. Mursanto, A. Handayani, Utilization of Human Urine as Fertilizer with Magnesium Oxide (MgO), Zeolite and Activated carbon as Absorber, vol. 4, no. 3, pp. 49–52, 2014.

[5] K. Riyani, Pengaruh Karbon Aktif Terhadap Aktivitas Fotodegradasi Zat Warna pada Limbah Cair Industri Tekstil Menggunakan Fotokatalis TiO_2, *J. Mol*, vol. 6, no. 2, pp. 113–122, 2011.

[6] I. Suyata, Penurunan Kadar Amonia, Nitirit, dan Nitrat Limbah Cair Industri Tahu Menggunakan Arang Aktif dari Ampas Kopi, *J. Mol*, vol. 4, no. 2, pp. 105–114, 2009.

[7] S. Jamilatun, D. Kusuma, A.S.S., Shakti, F. Ferdiant, Pembuatan Biocoal Sebagai Bahan Bakar Alternatif dari Batubara dengan Campuran Arang Serbuk Gergaji KayuJati, Glugu dan SekamPadi, Prosiding Seminar Nasional Teknik Kimia "Kejuangan" , Pengembangan Teknologi Kimia untuk Pengolahan Sumber Daya Alam Indonesia , 2010.

[8] S. Jamilatun and S. Salamah, Peningkatan Kualitas Asap Cair dengan Menggunakan Arang Aktif, SNTT FGDT, Universitas Muhammadiyah Surakarta, Indonesia, 2015.

[9] S. Jamilatun and S. Salamah, Pemanfaatan Asap Cair Food Grade yang dimurnikan dengan Arang Aktif sebagai Pengawet Ikan Nila, *Eksergi*, vol. 14, no. 2, pp. 29-34, 2017.

[10] F. Cataldo, Process for the purification of landfill leachate wastewater by active charcoal and photo-ozonolysis, US Patent US 20140299549A1, 2012.

[11] S. Elkhalifa, T. Al-Ansari, H. Robert Mackey, G. McKay, Food waste to biochars through pyrolysis: A review, *Resources, Conservation & Recycling,* 144, pp. 310–320, 2019.

[12] H.V. Kienle, Carbon. di dalam Campbell, PT Prefferkorn R., Roundsaville JF. Ullman's Encyclopedia of Industrial Chemistry, 5th Completely Revised Ed. Vol A5: Cancer Chemotherapy to Ceramics Colorants, Weinheim: VHC, 1986.

[13] K.B. Oyo, P.K. Igbokwe, Production of activated charcoal from coconut-shell. *J. Chem. Soc. Nig.*, vol. 26, no.1, pp. 91-94, 2001.

[14] Ruangudomsakul, M., Osakoo, N., Keawkumay, C., Kongmanklang, C., Butburee, T., Kiatphuengporn, S., Faungnawakij, K., Chanlek, N., Wittayakun, J., Khemthong, P., 2020, Influential properties of activated carbon on dispersion of nickel phosphides and catalytic performance in hydrodeoxygenation of palm oil, *Catalysis Today*, https://doi.org/10.1016/j.cattod.2020.04.068

[15] Y. Yin, T. Zhou, H. Luo, J. Geng, W. Yu, Z. Jiang, Adsorption of arsenic by activated charcoal coated zirconium-manganese nano composite: Performance and mechanism, *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 575, pp. 318–328, 2019.

[16] A. Cobb, M. Warms, E.P. Maurer, S. Chiesa, Low-Tech Coconut Shell Activated Charcoal Production, *International Journal for Service Learning in Engineering*, vol. 7, No. 1, pp. 93-104, 2012.

[17] S. Jamilatun, M. Setyawan, S. Salamah, D.A. Ayu Purnama, R. Melani Putri, Pembuatan Arang Aktif dari Tempurung Kelapa Dengan Aktivasi Sebelum dan Susudah Pirolisis, Seminar Nasional Sains dan Teknologi, Fakultas Teknik Universitas Muhammadiyah Jakarta, 2015.

[18] S. Jamilatun, I. Intan Dwi, P. Elza Novita, Karakteristik Arang Aktif dari Tempurung Kelapa dengan Pengaktivasi H_2SO_4 Variasi Suhu dan Waktu, Simposium Nasional Teknologi Terapan (SNTT) II, Universitas Muhammadiyah Surakarta, 2014.

[19] Y. Suprianti and A. Kurniasetyawati, Regenerasi In-Situ Adsorben Karbon Aktif Tipe Granul dengan Metode Termal, *J. Tek. Kim. Ling*, vol.3, no.1, pp. 1-9, 2019.

[20] Y. Kurniati, O. Putri Prastuti, E. Lutfi Septiani, Studi Kinetika Adsorpsi Metil Biru Menggunakan Karbon Aktif Limbah Kulit Pisang, *J. Tek. Kim. Ling*, vol. 3 no. 1, pp. 34-38, 2019.

[21] S. Jamilatun, L. Aslihati, E.W. Suminar, Pengaruh perendaman ikan nila dengan asap cair (liquid smoke) terhadap daya simpan, Prosiding Semnastek, Fakultas Teknik Universitas Muhammadiyah Jakarta, Indonesia, 2016.

[22] S. Jamilatun, Budhijanto, Rochmadi, A. Yuliestyan, A. Budiman, Valuable Chemicals Derived from Pyrolysis Liquid Products of *Spirulina platensis* Residue, *Indones. J. Chem.*, vol.19, no.3, pp. 703 – 711, 2019.

[23] Peraturan Menteri Kesehatan, No. 416/MENKES/PER/IX/1990.

[24] W.P. Utomo, E. Santoso, G. Yuhaneka, A.I. Triantini, M.R. Fatqi, M.F. Huda, N. Nurfitria, Studi adsorpsi zat warna naphthol yellows pada limbah cair menggunakan karbon aktif dari ampas tebu, *Jurnal kimia (journal of chemistry),* 13 (1), pp. 104 – 116, Januari 2019.