BUKTI KORESPONDENSI

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NIP	: 198903112015031002
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Jabatan	: Lektor Kepala
Unit Kerja	: Poltekkes Kemenkes Bandung

Jurnal internasional bereputasi (terindeks pada database internasional bereputasi dan berfaktor dampak) Penulis pertama : (60%x40=24)	Neutralization of Acidity (pH) and Reduction of Total Suspended Solids (TSS) by Solar-Powered Electrocoagulation System	Civil Engineering Journal, Volume 9, No. 5, 2023, Pages 1160-1172, Penulis pertama, ISSN: 26766957, 24763055, Publisher: Salehan Institute of Higher Education, SCOPUS Q1 **(Elanda Fikri**, , Irfan A. Sulistiawan, Agus Riyanto, Aditiyana Eka Saputra). DOI: https://doi.org/10.28991/CEJ-2023-09-05-09 Link WEB : https://civilejournal.org/index.php/cej/article/view/4005 URL DOKUMEN : https://civilejournal.org/index.php/cej/article/view/4005/pdf URL H-INDEKS/SJR: https://www.scimagojr.com/journalsearch.php?q=21101033903&tip=sid&clean=0 URL SIMILARITY https://repo.poltekkesbandung.ac.id/7060/

SUBMIT (23 DESEMBER 2022)

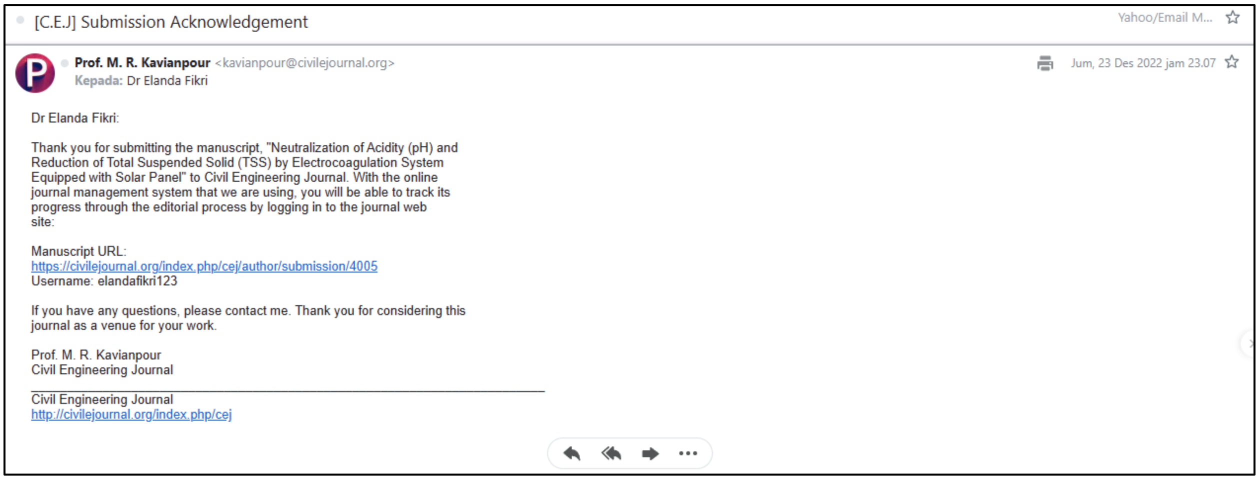
#4005 Summary

Summary | Review | Editing

Submission

Authors Elanda Fikri, Irfan A. Sulistiawan, Agus Riyanto, Aditiyana Eka Saputra
Title Neutralization of Acidity (pH) and Reduction of Total Suspended Solids (TSS) by Solar-Powered Electrocoagulation System
Original file 4005-10265-3-SM.docx 2022-12-23
Supp. files None
Submitter Dr Elanda Fikri
Date submitted December 23, 2022 - 04:07 PM
Section Research Articles
Editor Omid Aminoroayaie Yamini
Abstract Views 66

SUBMIT



[C.E.J] Submission Acknowledgement

Prof. M. R. Kavianpour <kavianpour@civilejournal.org>
Kepada: Dr Elanda Fikri
Jum, 23 Des 2022 jam 23.07

Dr Elanda Fikri:

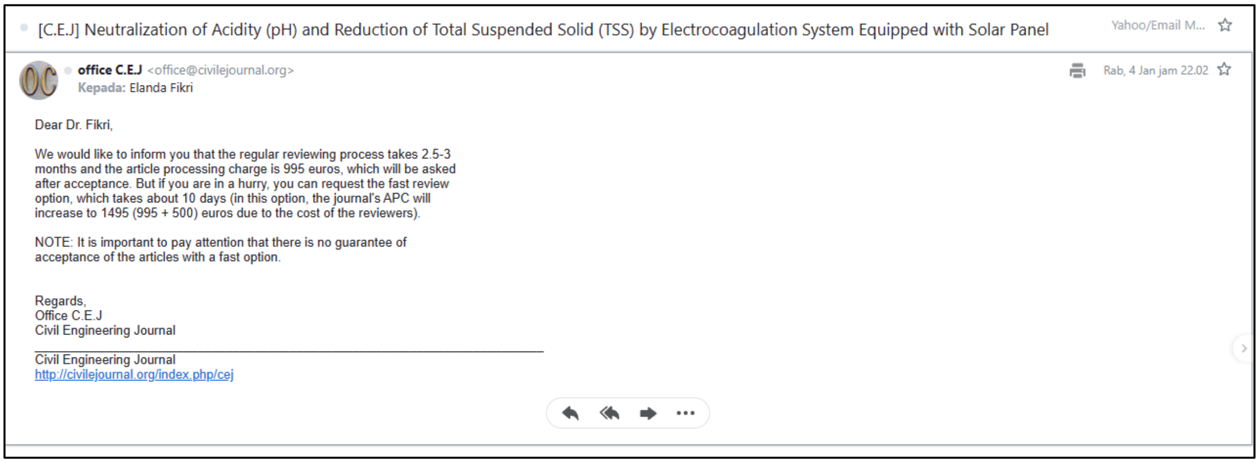
Thank you for submitting the manuscript, "Neutralization of Acidity (pH) and Reduction of Total Suspended Solid (TSS) by Electrocoagulation System Equipped with Solar Panel" to Civil Engineering Journal. With the online journal management system that we are using, you will be able to track its progress through the editorial process by logging in to the journal web site:

Manuscript URL:
https://civilejournal.org/index.php/cej/author/submission/4005
Username: elandafikri123

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

Prof. M. R. Kavianpour
Civil Engineering Journal

Civil Engineering Journal
http://civilejournal.org/index.php/cej



[C.E.J] Neutralization of Acidity (pH) and Reduction of Total Suspended Solid (TSS) by Electrocoagulation System Equipped with Solar Panel

office C.E.J <office@civilejournal.org>
Kepada: Elanda Fikri
Rab, 4 Jan jam 22.02

Dear Dr. Fikri,

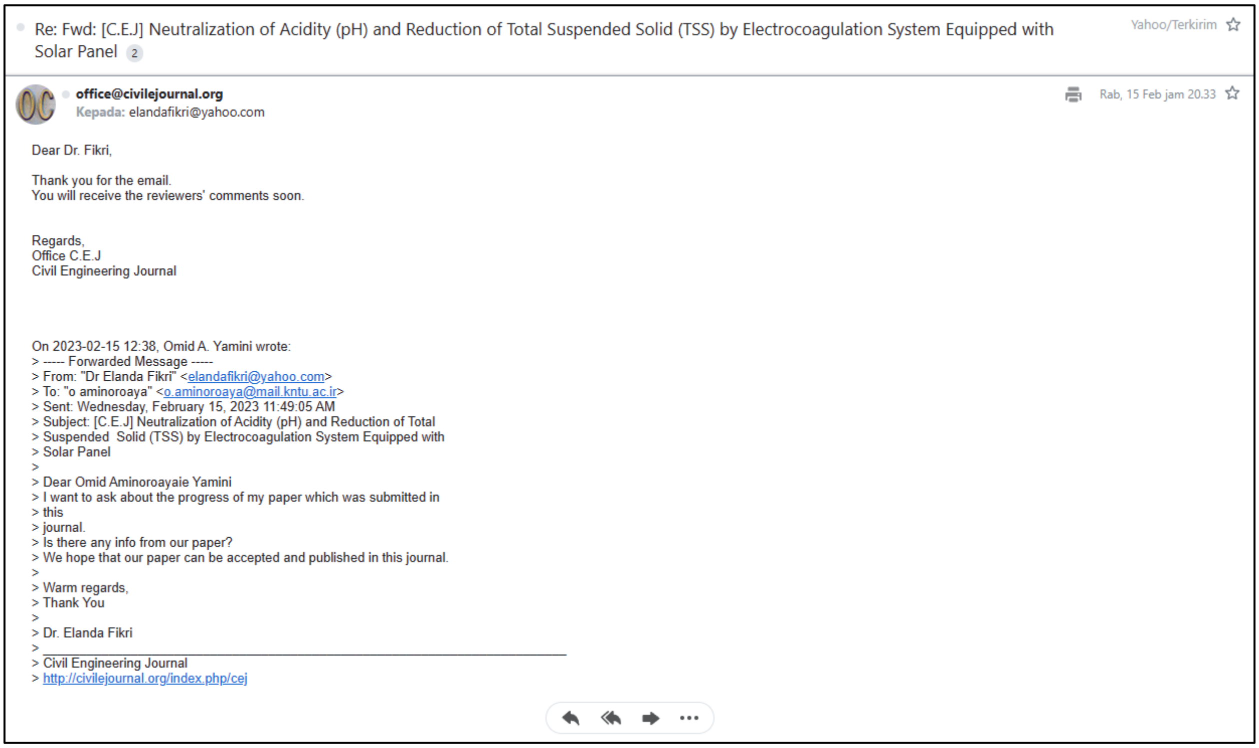
We would like to inform you that the regular reviewing process takes 2.5-3 months and the article processing charge is 995 euros, which will be asked after acceptance. But if you are in a hurry, you can request the fast review option, which takes about 10 days (in this option, the journal's APC will increase to 1495 (995 + 500) euros due to the cost of the reviewers).

NOTE: It is important to pay attention that there is no guarantee of acceptance of the articles with a fast option.

Regards,
Office C.E.J
Civil Engineering Journal

Civil Engineering Journal
http://civilejournal.org/index.php/cej

MENANYAKAN PROGRESS MANUSKRIP (15 Februari 2023)



Re: Fwd: [C.E.J] Neutralization of Acidity (pH) and Reduction of Total Suspended Solid (TSS) by Electrocoagulation System Equipped with Solar Panel

office@civilejournal.org
Kepada: elandafikri@yahoo.com

Rab, 15 Feb jam 20.33

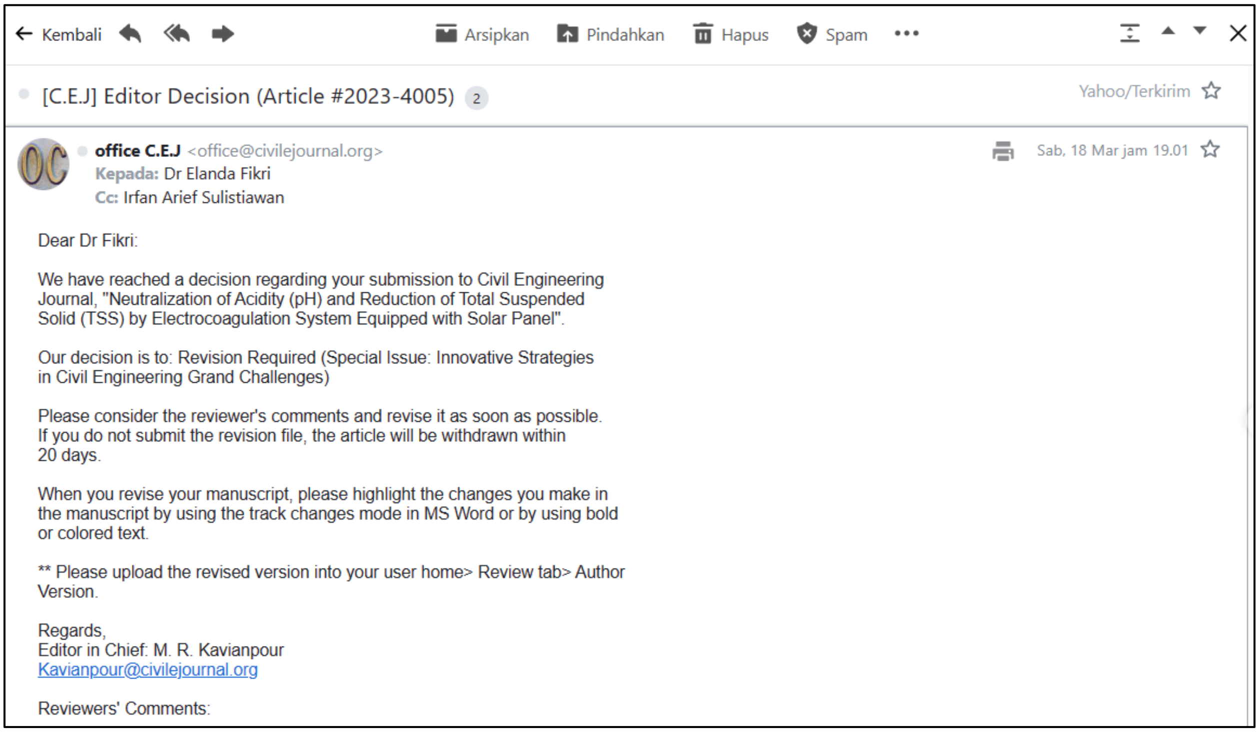
Dear Dr. Fikri,

Thank you for the email.
You will receive the reviewers' comments soon.

Regards,
Office C.E.J
Civil Engineering Journal

On 2023-02-15 12:38, Omid A. Yamini wrote:
> ----- Forwarded Message -----
> From: "Dr Elanda Fikri" <elandafikri@yahoo.com>
> To: "o aminoroaya" <o.aminoroaya@mail.kntu.ac.ir>
> Sent: Wednesday, February 15, 2023 11:49:05 AM
> Subject: [C.E.J] Neutralization of Acidity (pH) and Reduction of Total
> Suspended Solid (TSS) by Electrocoagulation System Equipped with
> Solar Panel
>
> Dear Omid Aminoroayaie Yamini
> I want to ask about the progress of my paper which was submitted in
> this
> journal.
> Is there any info from our paper?
> We hope that our paper can be accepted and published in this journal.
>
> Warm regards,
> Thank You
>
> Dr. Elanda Fikri
> ____
> Civil Engineering Journal
> http://civilejournal.org/index.php/cej

MENDAPAT KOMENTAR DARI REVIEWER (18 Maret 2023)



[C.E.J] Editor Decision (Article #2023-4005)

office C.E.J <office@civilejournal.org>
Kepada: Dr Elanda Fikri
Cc: Irfan Arief Sulistiawan

Sab, 18 Mar jam 19.01

Dear Dr Fikri:

We have reached a decision regarding your submission to Civil Engineering Journal, "Neutralization of Acidity (pH) and Reduction of Total Suspended Solid (TSS) by Electrocoagulation System Equipped with Solar Panel".

Our decision is to: Revision Required (Special Issue: Innovative Strategies in Civil Engineering Grand Challenges)

Please consider the reviewer's comments and revise it as soon as possible.
If you do not submit the revision file, the article will be withdrawn within 20 days.

When you revise your manuscript, please highlight the changes you make in the manuscript by using the track changes mode in MS Word or by using bold or colored text.

** Please upload the revised version into your user home> Review tab> Author Version.

Regards,
Editor in Chief: M. R. Kavianpour
Kavianpour@civilejournal.org

Reviewers' Comments:

Reviewer #1:

The topic is interesting and important. However, there are several key areas that need more work prior to publication. I have summarized the required changes in the hope that the feedback will be useful to you as you update the paper.

1- The authors should ask the help of native English speaking proof reader, because there are too many typo and linguistic mistakes that should be fixed.
2- Abstract to modify: the abstract should contain Objectives, Methods/Analysis, Findings, and Novelty /Improvement. It is suggested to present the abstract in one 200 words paragraph.
3- The introduction is poorly written and it does not properly refer to previously published studies. The authors need to carefully review the published literature, identify the gaps in the literature, and propose their approach to fill the gap.
4- It is important to add some recent work (2021-2023) to the literature review. At least 5 new references should be added to article.
5- Unit for all dimensions of the figure 1 should be presented.
6- Draw a flowchart from your workflow that briefly shows the process of the methodology.
7- This system should be compared and discussed with similar examples in other countries.
8- It is suggested to present some of the results of the study as charts and graphs.
9- Please avoid reference overkill/run-on, i.e. do not use more than 3 references per sentence.
10- Some of the tables in the appendix file can be added to the text of the article and discussed.
11- The authors used some invalid references. It is important to replace them with prestigious journals (e.g. [2], [4], and [8]).
12- Much more explanations and interpretations should be added for the result, which are not enough.
13- It is suggested to compare the results of the present study with previous studies and analyze their results completely.

Reviewer #4:

- At this stage, the manuscript English language must not bear any error.
- The abstract could become much better if re-written to state clearly the contribution of this study to the field as well as the gap this study intends to address in the field.
- Methods section determines the results. Kindly focus on three basic elements of the methods section.
a. How the study was designed?
b. How the study was carried out?
c. How the data were analyzed?
- Some key parameters are not mentioned. The rationale on the choice of the particular set of parameters should be explained with more details. Have the authors experimented with other sets of values? What are the sensitivities of these parameters on the results?
- Conclusion:
•The conclusion section is currently a repeat or rehash of the preceding sections, and needs to be re-written to improve it, keeping in mind the following suggestions.
•Update the conclusion to include the newly formulated theoretical contributions
•Summarize the key results in a compact form and re-emphasize their significance.
•Summarize how the article contributes to new knowledge in the domain.
•This conclusion could be worded in a manner as to emphatically motivate the academic community to get down to actionable, practical engaged scholarship.

Technical Editor Comments:

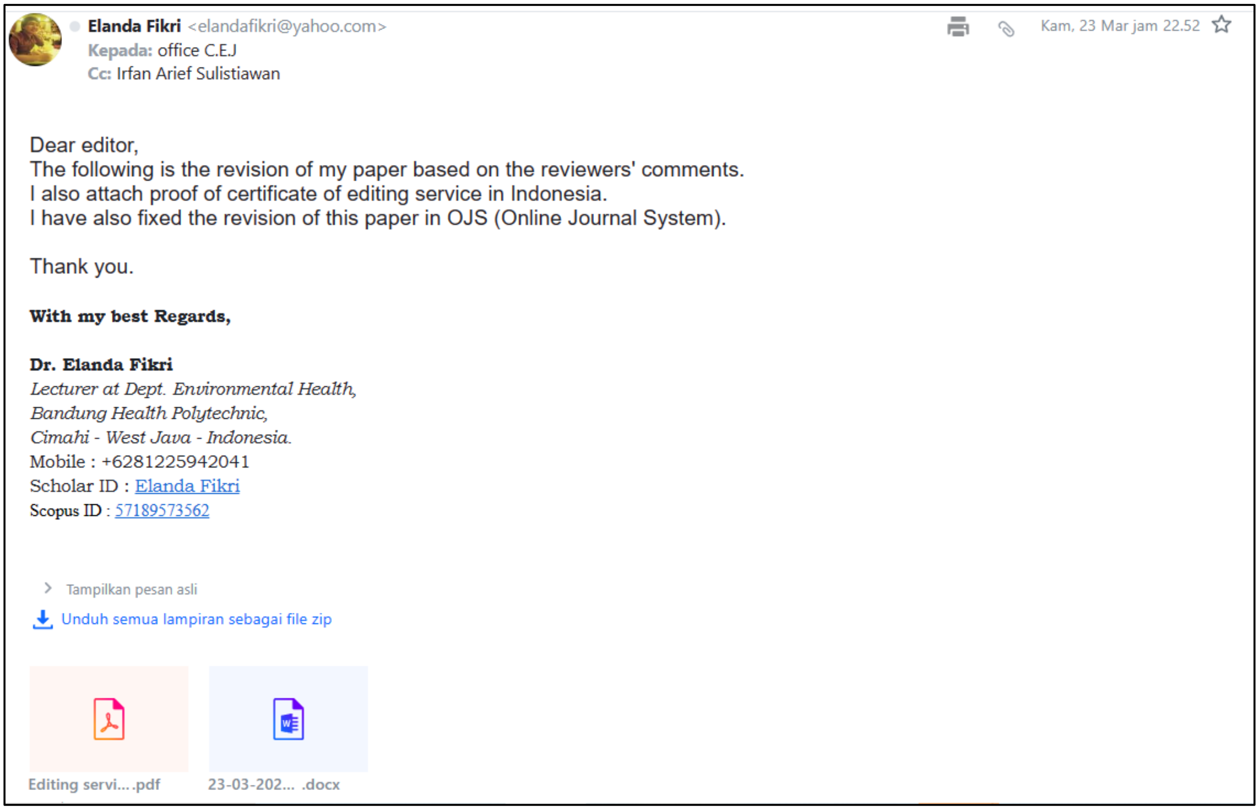
- Please add an ORCID for at least one author.

- Please pay attention that this manuscript can ONLY be published in the "Special Issue "Innovative Strategies in Civil Engineering Grand Challenges"".

- If one of the referees has suggested that your manuscript should undergo English revisions, please address this issue during revision. We propose that you use one of the editing services listed at https://www.euhera.org/language-editing-services/ or have your manuscript checked by a native English-speaking colleague.

Civil Engineering Journal
http://civilejournal.org/index.php/cej

MENGIRIM REVISI MANUSKRIP (23 Maret 2023)



Elanda Fikri <elandafikri@yahoo.com>
Kepada: office C.E.J
Cc: Irfan Arief Sulistiawan
Kam, 23 Mar jam 22.52

Dear editor,
The following is the revision of my paper based on the reviewers' comments.
I also attach proof of certificate of editing service in Indonesia.
I have also fixed the revision of this paper in OJS (Online Journal System).

Thank you.

With my best Regards,

Dr. Elanda Fikri
Lecturer at Dept. Environmental Health,
Bandung Health Polytechnic,
Cimahi - West Java - Indonesia.
Mobile : +6281225942041
Scholar ID : Elanda Fikri
Scopus ID : 57189573562

PROOF READING (23 Maret 2023)

SASTRA LINGUA INDONESIA
Certified Professional Translation and Language Services
Decision Letter of Indonesian Ministry of Law and Human Rights
No. AHU-0011945.AH.01.07.YEAR 2022

Statement Letter

No.: 09.016/SLI/II/2023

Hereby I stated that this article entitled:

Neutralization of Acidity (pH) and Reduction of Total Suspended Solids (TSS) by Solar-Powered Electrocoagulation System

Authors: Elanda Fikri, Irfan Arief Sulistiawan, Agus Riyanto, Aditiyana Eka Saputra

was in English, and the content had deeply been edited by an expert linguist in Sastra Lingua Indonesia. All amendments were tracked using Microsoft Word's "Track Changes" features. Thus, authors can accept or reject each comment or suggestion individually if necessary. With this certificate, authors can proceed the manuscript/texts for academic/business/legal purposes.

Sumenep, March 23, 2023

Imamatul Khair, S.Hum

Director

Available online at www.CivileJournal.org

Civil Engineering Journal

(E-ISSN: 2476-3055; ISSN: 2676-6957)

Vol. x, No. x, xxxxx, 20xx

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Neutralization of Acidity (pH) and Reduction of Total Suspended Solids (TSS) by Solar-Powered Electrocoagulation System ~~Equipped with Solar Panel~~

Elanda Fikri[1,2*], Irfan Arief Sulistiawan[3], Agus Riyanto[4], Aditiyana Eka Saputra[4]

[1]*Department of Environmental Health, Bandung Health Polytechnic, North Cimahi, West Java, Indonesia, 40514*

[2] *Center of Excellence on Utilization of Local Material for Health Improvement, Bandung Health Polytechnic, 40171*

[3] *Environmental Health Installation, West Java Province Mental Hospital, Cisarua, Indonesia, 40551*

[4]*Faculty of Health Sciences and Technology, Jenderal Achmad Yani, West Java, Indonesia. 40633*

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Abstract

This study investigates~~d~~ the effect of electrocoagulation contact time on pH and TSS of wastewater discharged from the ~~West Java Province Mental Hospital's W~~wastewater ~~T~~treatment ~~P~~plant (WWTP) of the Psychiatric Hospital of West Java Province. ~~Using a~~The experiment followed the pretest-posttest ~~experimental~~control group design ~~with a control group,~~. ~~There werea~~This study involved testing of ~~sample of~~ 56 wastewater samples ~~was used, with which were tested~~ six times ~~6 treatments~~ before and after treatment.~~, 4~~ Each treatment was repeated four times~~titions~~, and ~~controls per repetition~~there was one control group for each repetition. The electrocoagulation ~~device~~ tool used in this study ~~had a distance between~~consisted of 6 1-mm electrode plates which were~~of~~ 8 cm apart, a current strength of 5A, a voltage of 12V~~, and 6 electrode plates, each 1 mm thick~~, ~~with~~and a 50-Watt solar panel ~~50 watt peak~~. The data were analyzed~~sis consisted of~~ using descriptive and inferential statistics. The results showed that all electrocoagulation contact time treatments had a significant effect on increasing the pH and the TSS ~~before and after treatment~~. Additionally, the electrocoagulation ~~device~~ tool was found to be effective, stable, portable, and environmentally friendly, with a self-cleaning system that reduced operational costs and saved electricity through the use of solar panels. Thise study contributes to the development of an effective electrocoagulation ~~device~~ toll for wastewater treatment and the determination of optimal contact time for the ~~device~~tool, providing a practical solution to overcome the problems of pH and TSS in wastewater. These findings can be applied to other wastewater treatment plants, thus improving the quality of discharged wastewater.

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* Corresponding author:

http://dx.doi.org/10.28991/cej-202X-XXXXXXXX

Keywords: ~~W~~wastewater; ~~E~~electrocoagulation ~~C~~contact ~~T~~time; pH; TSS; ~~S~~solar ~~P~~panel

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1. Introduction

Hospital waste is all waste generated from hospital activities in solid, liquid, and gas forms. Wastewater is all wastewater including feces originating from hospital activities which may contain pathogenic microorganisms and toxic and radioactive chemicals that are harmful to the health. Therefore, every hospital must treat its wastewater ~~until~~so that it meets the standard requirements and does not have a direct effect on ~~that have the potential to impact~~the health [1].

There are 334 hospitals in West Java Province ~~has 334 hospitals recorded in having~~that are making efforts to secure waste from Indonesian health-care facilities. Based on the recapitulation of ~~the~~ wastewater discharge ~~reporting data~~, the daily average of hospital wastewater discharge ~~produced~~ is 0.35 m3/bed~~/day~~. Of the 334 hospitals, only 39 hospitals have reported their wastewater discharge, including the Psychiatric Hospital of West Java Province ~~Mental Hospital~~**[2]**.

The ~~Mental~~ Psychiatric Hospital of West Java Province is a ~~H~~healthcare ~~F~~facility located in ~~the~~ West Bandung Regency ~~area which~~ that has a ~~W~~waste ~~W~~water ~~T~~treatment ~~P~~plant (WWTP) ~~with~~ using an aerobic ~~and~~ -anaerobic biofilter system. The basic principle of the system is to utilize aerobic and anaerobic bacteria in the filter to decompose pollutants in water~~, where pollutants in water~~ that occur in the process of releasing nitrogen ions that ~~were~~are previously bound ~~in~~to ammonia (NH_3) into nitrates and nitrites. ~~The process of releasing these ions causes~~As a result, the degree of acidity (pH) in water ~~to reduced~~decreases and tends to be acidic and increases the ~~number of~~total suspended solids (TSS) which can be harmful to the environment [3,4].

pH is ~~the~~a degree ~~of acidity used to~~which indicates the ~~level of~~ acidity or alkalinity ~~on~~in a solution. pH is defined as the cologarithm of the activity of dissolved hydrogen ions (H^+) [5]. The standard for pH ~~standard~~ of wastewater is 6-9, which is in accordance with the wastewater quality standards ~~based on~~set by ~~T~~the Minister of Environment and Forestry of the Republic of Indonesia under the Regulation Number P.68/Menlhk-Setjen/2016 concerning Domestic Wastewater Quality Standards ~~ranging from 6 – 9~~. ~~Whereas Conditions of w~~Wastewater whose~~with a~~ pH ~~that~~ does not meet the ~~S~~standards, ~~moreover~~especially if it ~~that~~ is continuously discharged into the environment, can cause the ~~the death of~~ aquatic organisms to die and disrupt ~~environmental~~ the ecosystems **[6]**.

T~~TSS (Total Suspended Solid) or t~~otal suspended solids (TSS) are all ~~kinds~~types of solids that comes from total solids that are retained on a ~~sieve~~ filter with a maximum particle size of 2.0 µm ~~and can settle~~[7,8]. The standard for ~~Total Suspended Solid (~~TSS~~)~~ in wastewater is 30 mg/L, which is in accordance with the wastewater quality standards ~~based on~~set by the Minister of Environment and Forestry of the Republic of Indonesia under the Regulation Number P.68/Menlhk-Setjen/2016 concerning Domestic Wastewater Quality Standards~~, which is 30 mg/L~~. ~~Whereas~~The ~~H~~high level of TSS ~~levels~~ in wastewater that ~~enter~~is contained in water bodies ~~continuously will~~ can cause the high turbidity of the water bodies. As a result,~~ so that it will disable~~ ~~the~~ sunlight, which~~-~~ is needed by autotrophs to carry out natural remediation (photosynthesis) in the river, will be hampered from entering the riverbed ~~where sunlight is needed by autotrophic in carrying out natural remediation (photosynthesis) in the river~~[9].

According to the preliminary study of routine wastewater testing conducted by the authors, the pH value of ~~obtained information that secondary data from routine wastewater monitoring checks at the outlet of~~ the Wastewater Treatment Plant of the Pyschiatric Hospital of West Java Province ~~Mental Hospital, shows an average pH that ranges from~~was 4-6 and the TSS level ~~ranges from~~was 35-45 mg/L [10]~~,~~ ~~and~~On the other hand, ~~the data on~~ the wastewater ~~examination~~testing conducted by the environmental laboratory ~~with a result of~~showed that the pH value of the wastewater treatment plant was 4.5 and the TSS level was 45 mg/L ~~TSS~~. The previous studies showed that ~~T~~the pH value and the TSS ~~values~~level ~~still do~~ has not meet the quality standards. Treatments ~~that~~ can be ~~carried out~~done ~~based on~~ using the ~~current developed~~latest technology~~, can be~~ that involves ~~done by~~ either physical, chemical, and biological systems or a combination of the three ~~systems~~[11]. One of the combinations of~~ed~~ physical and chemical systems is electrocoagulation [12,13].

Electrocoagulation is the process of coagulation and deposition of fine particles contained in wastewater using electrical energy. Electrocoagulation is a more advanced technology and has more advantages compared to ~~the~~ chemical coagulation ~~method which still uses chemical coagulants~~ that can damage the environment [14–18~~,15~~], one of which is that ~~. The electrocoagulation process has advantages compared to the coagulation process[16–18].~~

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~~E~~electrocoagulation can ~~improve~~increase the pH value and ~~reduce~~decrease the TSS level in wastewater [18–20]. Vari~~ations of~~ous treatments ~~given~~were done to the wastewater using aluminum electrodes, with different contact times~~,~~ and voltages. The ~~test~~ treatment results using aluminum electrodes at 12V for 60 minutes showed positive results, that is, ~~in~~ an increas~~ing~~e in the degree of acidity ~~with a percentage of~~by 16%.~~ at 12 V voltage treatment and 60 minutes with aluminum electrodes.~~

Amri et al.~~'s~~ [21] also ~~research in 2020 stated~~suggested that electrocoagulation using aluminum electrodes can ~~also improve~~increase the pH value of wastewater~~ with aluminum electrodes~~. Vari~~ations of~~ous treatments ~~are given~~were done~~ by using~~ with different voltages and flow rates [21]. The treatment results at a voltage of 12V and a flow rate of 0.087 L/m ~~of these trials~~ also showed positive results, that is, ~~in~~ an increas~~ing~~e in the degree of acidity ~~with an increase~~ from 3.6 to 6.7 and a decrease in the level of TSS ~~of~~ by 90.90% from 1100 mg/L to 100 mg/L~~ at a voltage treatment of 12 V and a flow rate of 0.087 L/m~~ [21]. ~~The two previous~~Other researchers ~~used variations in~~gave different treatments in terms of contact time, w~~ in their research.~~hich~~ Contact time~~ is a factor ~~that affects the process of~~in the electrocoagulation process [22]. The results showed that ~~I~~increasing the contact time of electrocoagulation can increase the efficiency of ~~removing~~ pollutant~~s~~ removal [23–25].

~~The e~~Electrocoagulation~~ technique~~ is quite effective in reducing the values of turbidity, color, free ammonia, TSS, and heavy metal~~s~~ as well as improving the pH value in wastewater treatment of non-fishery~~ing~~ industry~~ial wastewater treatment~~ [26–28]. However, ~~it~~electrocoagulation has not been widely applied ~~in~~to~~ the~~ hospital ~~management of~~ wastewater management~~ from hospital activities~~. Hospital wastewater has ~~characteristics of a pollutant load that is~~ relatively the same characteristics of pollutant load as domestic wastewater~~ in general~~.

Previous studies have reported ~~on~~ the use of electrocoagulation for wastewater ~~the~~ treatment~~ of wastewater~~ from various sources~~, including the removal of suspended solids and the neutralization of pH~~. For example, Raju et al. [29]~~(2008)~~ investigated~~d~~ the use of electrocoagulation for the removal of suspended solids from textile wastewater~~, generated in the textile industry[29]. Similarly,~~ while Omwene et al. ~~(2018)~~[30] ~~studied~~investigated the effect of electrocoagulation on the removal of suspended solids and chemical oxygen demand (COD) from municipal wastewater~~[30]~~. ~~Recent research has focused on the use of electrocoagulation to treat wastewater. For example, a study by~~ Meanwhile, Rookesh et al. [31] ~~(2022)~~ investigated~~d~~ the removal of COD and TSS from landfill leachate using electrocoagulation~~[31]~~. ~~Another study by~~Lastly, Kobya et al. ~~(2007)~~[32] ~~evaluated~~investigated the removal of pollutants from textile wastewater using ~~an~~ electrocoagulation ~~process[32]~~.

While the abovementioned~~se~~ studies have provided valuable insights into the use of electrocoagulation for wastewater treatment, there is still a gap in the literature regarding the use of solar~~ panels to ~~-powered electrocoagulation ~~systems~~ for ~~the~~wastewater treatment~~ of wastewater~~. This is ~~an~~ important~~ gap to fill, as~~ because the use of solar panels ~~could~~ may provide a sustainable and cost-effective solution for wastewater treatment in areas with limited access to electricity.

To address this gap, th~~e present~~is study aims to investigate the use of ~~an~~solar-powered electrocoagulation ~~system powered by a solar panel~~ ~~for the~~to neutraliz~~ation of~~e the pH and reduc~~tion of~~e the TSS in wastewater. Thise study ~~will~~ evaluates the effectiveness of the system in treating the wastewater ~~generated by~~from the wastewater treatment plant of the Psychiatric Hospital of West Java Province~~ Mental Hospital WWTP~~. The findings of this study ~~could~~ may contribute to the development of sustainable and cost-effective solutions for wastewater treatment, particularly in areas with limited access to electricity.

2. Methods

This ~~type of research~~study is a pretest-posttest true experimental control group design~~ with a control group~~. ~~In this research design~~Before the treatment, randomization was carried out in each experimental ~~group~~ and control groups so that both groups had the same characteristics~~ before treatment~~. ~~Then~~Subsequently a pretest was carried out in all experimental groups, ~~then after some time~~followed by a posttest. ~~was carried out and t~~The post-test results of~~in~~ all ~~these~~ groups ~~could be~~were referred to as the effect of treatment [33]. ~~The purpose of this study was to determine the effect of electrocoagulation contact time on the degree of acidity (pH) and total suspended solids (TSS) of the wastewater from the WWTP of West Java Province Mental Hospital wastewater outlet with a given treatment of electrocoagulation contact time as 10, 20, 30, 40, 50 and 60 minutes.~~ Thise study was conducted between~~in~~ May and~~-~~ June 2022.

The population ~~in this study~~ was ~~the entire~~all wastewater ~~at the outlet of~~from the ~~W~~wastewater ~~T~~treatment p~~P~~lant (WWTP) of the Psychiatric Hospital of~~at~~ West Java Province~~ Mental Hospital~~. The sampl~~ing technique used in this research~~e was chosen using ~~is S~~simple ~~R~~random ~~S~~sampling by means of chemical deoxygenation. ~~The sample in this study was part of the wastewater at the WWTP outlet of West Java Province Mental Hospital.~~ The sample size ~~in this study~~ was determined ~~completely~~ randomly because the sample ~~in this study~~ was relatively homogeneous and the entire population had the same opportunity to become the chosen.

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The experiments were done six times for 10, 20, 30, 40, 50, and 60 minutes. Each experiment was repeated four times. ~~The number of repetitions in this study was 4 repetitions. In this study, the authors used 6 treatments, namely 10, 20, 30, 40, 50, and 60 minutes of contact time.~~ Therefore, there were 24 samples ~~total number of samples~~ in the experimental group. In addition, ~~there was~~ one sample was in the control group for each repetition,~~was 24 samples plus 1 control in each repetition, so the number of samples was~~there were resulting in 28 samples in total. ~~The number of samples in 1 repetition is~~Moreover, there were ~~7~~seven samples for each repetition.~~,~~ ~~for 1~~Each sample ~~it takes~~consisted of 3,000 ml of wastewater, and thus ~~and for 1~~so each repetition ~~it takes~~consisted of 21,000 ml of wastewater. ~~So~~ In other words, ~~for 4 repetitions,~~ the sample size was~~is~~ 84,000 ml of wastewater for four repetitions.

T~~he tool in t~~his study ~~consisted of~~used a tool, that is, an electrocoagulation bath with a configuration of six~~6~~ aluminum plates equipped with~~:~~ (1) an integrated total solids spectrophotometer, which was used to measure TSS in wastewater; (2)~~,~~ a stopwatch which was used to measure the contact time ~~between wastewater~~ in the electrocoagulation process; (3)~~,~~ a multitester, which was used to measure the electrical voltage ~~that entered~~in the electrocoagulation process~~. electrocoagulation process,~~; (4) ~~the~~a stabilizer, which was ~~is~~ used to stabilize the electrical voltage ~~that enters~~in the electrocoagulation process; (5)~~,~~ a 12V and 5A transformer; and (6) ~~that has a voltage of 12 volts and a current of 5 amperes, and this tool is also equipped with~~ a mini generator as a power backup ~~power~~.

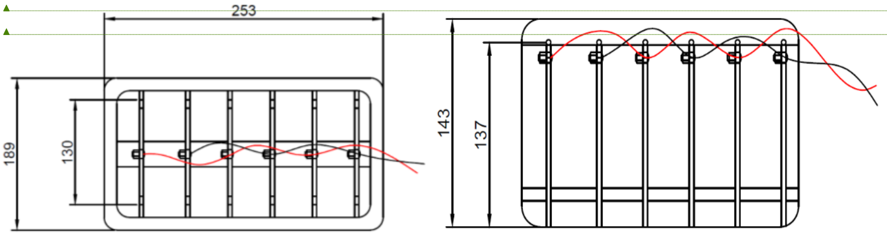
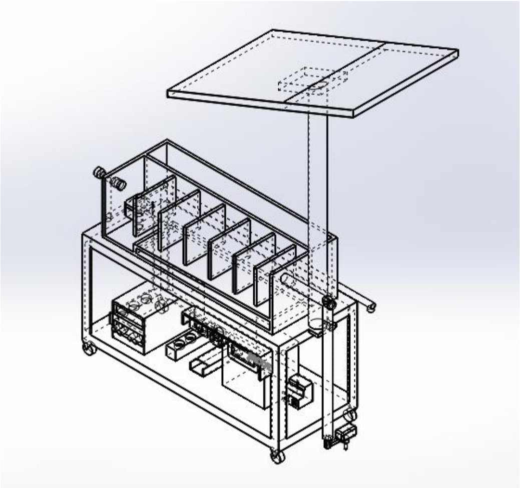


Figure 1. Electrocoagulation ~~T~~bath~~ub~~ ~~D~~design in cm (left to right: ~~T~~top ~~V~~view, ~~and L~~lateral ~~V~~view)~~ (unit in cm)~~



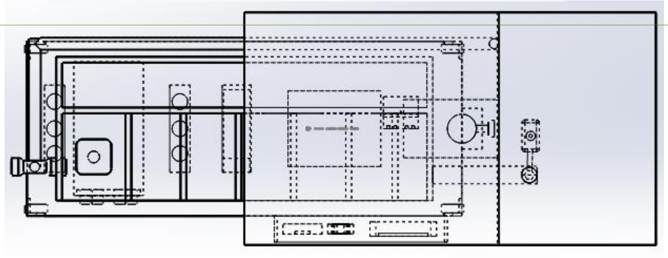


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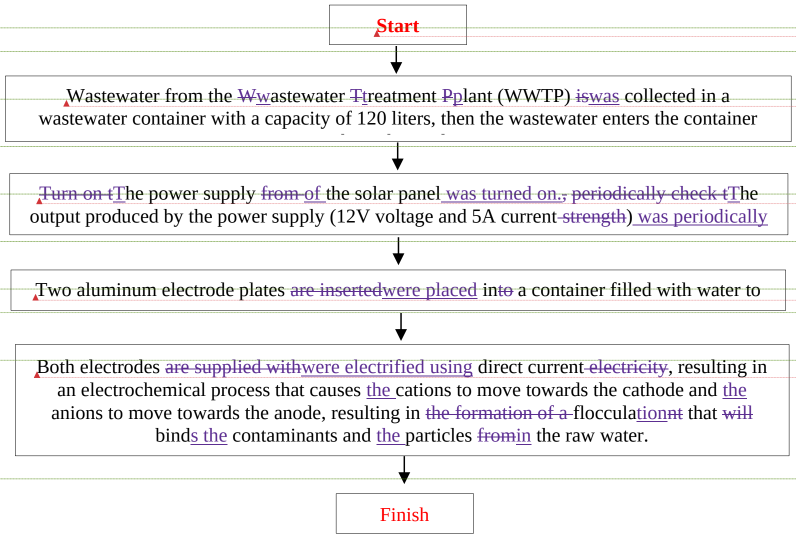
Figure 2. Solar-powered e~~E~~lectrocoagulation~~ Equipped with Solar Panel~~

~~W~~The wastewater ~~will be~~was ~~in ~~contacted with six~~6~~ aluminum plates in the electrocoagulation bath for 10, 20, 30, 40, 50, and 60 minutes ~~as a process ~~to ~~see ~~determine the effect of contact time on the degree of acidity (pH) and the level total suspended solids (TSS). ~~Examination of~~The pH was determined using a pH meter ~~based on~~with the Indonesian National Standard number 06-6989.11-2004, while ~~and~~the TSS was determined using ~~the~~a gravimetric ~~method ~~analysis with an balance ~~based on~~with the Indonesian National Standard number 06-6989.3-2004. **The following Figure 3 shows the research flowchart**~~ can be seen in Figure 3 below~~:


Start

Wastewater from the ~~W~~wastewater ~~T~~treatment ~~P~~plant (WWTP) ~~is~~was collected in a wastewater container with a capacity of 120 liters, then the wastewater enters the container

~~Turn on t~~The power supply ~~from ~~of the solar panel was turned on.~~,~~ ~~periodically check t~~The output produced by the power supply (12V voltage and 5A current~~ strength~~) was periodically

Two aluminum electrode plates ~~are inserted~~were placed into~~o~~ a container filled with water to

Both electrodes ~~are supplied with~~were electrified using direct current~~ electricity~~, resulting in an electrochemical process that causes the cations to move towards the cathode and the anions to move towards the anode, resulting in ~~the formation of a ~~flocculation~~nt~~ that ~~will~~ binds the contaminants and the particles ~~from~~in the raw water.

Finish

Based on the results of the ~~t-test treatment~~experiment,~~ of 10 minutes to 60 minutes,~~ a p-value ~~obtained is~~of 0.0001 < 0.005 was obtained, which means that all treatments had~~there is~~ an effect ~~of all electrocoagulation contact time treatments ~~on the increase in pH and ~~a reduction~~the decrease in TSS.~~ before and after treatment,~~ In addition, the ~~ANOVA test results obtained ~~a p-value of 0.0001 < 0.005 was obtained from the results of the ANOVA test, which means there ~~is~~was a significant difference ~~between ~~among the six treatments.

3. Results

Electrocoagulation is the process of ~~clumping ~~coagulation and deposition of fine particles in wastewater using electrical energy. The ~~electrocoagulation ~~process is carried out in an electrolysis ~~vessel ~~container in which there are two direct current conductors known as electrodes [34].

Electrocoagulation ~~introduces ~~produces metal cations in situ~~,~~ electrochemically using an~~the~~ anode~~ used~~ (usually aluminum or iron). The cations are hydrolyzed in water to form hydroxides ~~with the main~~whose species is determined by the pH of the solution. The highly charged cations destabilize ~~each ~~colloidal particles ~~with the~~by forming~~ation of a~~ polyvalent polyhydroxide~~s~~ complexes. These complexes have high absorption properties~~, which~~ and form aggregates with pollutants [35,36].

~~Contact time is o~~One of the important parameters in the electrocoagulation process is contact time. ~~The c~~Contact time is also ~~related to~~associated with~~ the~~ reaction rate, which is expressed as ~~the~~a change in concentration ~~with ~~over time. The longer the electrocoagulation process, the more H_2, and OH^- are formed.~~ therefore~~ As a result, the number ~~more~~ of complexes that bind pollutants and the amount of hydrogen gas increases [37–39]. The electrocoagulation process is ~~the~~a development of the electrolysis process, that is,~~ uses electrodes as the fulcrum to control the working principle of this system. Electrolysis is~~ the decomposition of electrolytes by direct ~~electric ~~current using two ~~kinds of~~ electrodes, namely~~. The electrodes used are in the form of a~~ cathode and anode [40–42].

In the process of electrolysis and electrocoagulation, the cathode acts as the negative pole. At the cathode, a reduction reaction occurs~~, namely when~~ because cations (positive ions) are attracted ~~by~~to the cathode, thus~~ and will~~ receiving~~e~~ additional electrons which reduce~~d~~ the oxidation number. The cathode will produce hydrogen ions which ~~lift ~~remove~~various~~ the flocculants formed ~~during ~~in the electrocoagulation process~~,~~. ~~therefore when ~~After the

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electrocoagulation process is ~~completed~~finished, white spots will ~~be seen on~~stick to the cathode~~,~~ as a sign of the release of hydrogen ions there ~~in that spot~~[43].
In contrast to the cathode, ~~in the process of electrolysis and electrocoagulation,~~ the anode acts as the positive pole. At the anode, an oxidation reaction ~~will~~ occurs~~, namely~~ because anions (negative ions) ~~is~~ are attracted ~~by~~to the anode, thus releasing ~~and the number of~~ electrons ~~will reduce so that the~~ which increase the oxidation ~~increases~~number. ~~So this is what causes that during the electrocoagulation process~~ As a result, the flocculants formed in the electrocoagulation process will stick to the anode as a coagulant ~~agent~~ [44,45].

Aluminum is a silvery-white metal and is the thirteenth~~13th~~ element in the periodic table. ~~In general, p~~Pure aluminum is not found in nature because of its~~the~~ tendency to easily bond with other elements [46]. Aluminum is the most common electrode material used in the electrocoagulation process. The aluminum electrode is oxidized as Al^{3+}. The resistivity of aluminum ~~itself~~ is 2.65 x 10^{-8} ~~Ohm meter~~ohms. In many cases, aluminum electrodes ~~have advantages in terms of~~are more effective in terms of removal ~~efficiency~~ ~~when~~ compared to other electrodes [47].

~~The electrocoagulation process using aluminum is a process that is often carried out~~Aluminum has been widely used in the electrocoagulation process. When aluminum is used as ~~an~~the anode ~~material~~, metal ions are released from the anode and ~~many~~ hydrolyzed ~~species of~~ ionic monomers are formed, depending on the pH of the solution. The reactions that occur at the electrodes according to Khandegar and Saroha~~, 2013~~ [48] are as follows~~[48]~~s:

Oxidation reaction at the anode:

$$Al_{(s)} \rightarrow Al^{3+}_{(aq)} + 3e^-$$

Reduction reaction at the cathode:

$$3H_2O + 3e^- \rightarrow (3/2-)H_2 + 3OH^-$$

All reactions during the electrolysis-:

$$Al^{3+} \rightarrow Al(OH)_n^{(3-n)} \rightarrow Al_2(OH)_2^{4+} \rightarrow Al_3(OH)_4^{5+} \rightarrow Al_{13} \rightarrow complex \rightarrow Al\ (OH)_3$$

The use of electrocoagulation (EC) ~~technology~~ for wastewater treatment has gained increasing attention in recent years due to its advantages, such as high efficiency, low energy consumption, and environmentally friendly operation. Several studies have been conducted to investigate the effectiveness of EC in removing various pollutants from wastewater, including pH and TSS. For example, Khandegar [49]~~(2013)~~ used EC to remove TSS from textile ~~the~~ wastewater ~~of a textile industry[49]~~, while Li et al. ~~(2011)~~[50] used EC ~~investigated the~~ to remo~~v~~eval ~~of~~ pH from landfill leachate ~~using EC[50]~~. ~~While many studies have been conducted on the use of EC technology for wastewater treatment~~However, ~~there is still a need to compare and discuss~~ the effectiveness of ~~this technology~~EC in different countries still needs to be investigated. In Iran, Nouri et al. [51]~~(2021)~~ investigated~~studied~~ the use of EC to ~~the~~ removeal ~~of~~ zinc and copper from ~~from~~ aqueous solutions ~~using EC[51]~~. In Turkey, Koyuncu et al. ~~(2020)~~[52] investigated the use of EC for ~~the~~ domestic wastewater treatment ~~of domestic wastewater[52]~~. In Indonesia, Alam et al. ~~(2022)~~[53] ~~examined~~ investigated the use of EC to removeal ~~of~~ Fe from ~~a~~ mining wastewater ~~using EC[53]~~. ~~In India,~~ Lakshmi and Sivashanmugam ~~et al. (2013)~~[54] in India ~~studied~~investigated the use of EC for ~~the treatment of~~ oil tanning~~[54]~~, while Tak et al. ~~(2014)~~[55] in Korea~~,~~ investigated the use of EC to~~the~~ removeal ~~of C~~color and COD from livestock wastewater ~~using EC[55]~~. In Jordan, Al-Shannag et al. ~~(2011)~~[56] investigated the use of~~the~~ EC to removeal ~~of~~ TSS and COD from paper mill wastewater ~~using EC[56]~~. In China, Sia et al. ~~(2020)~~[57] investigated the use of EC ~~the~~to removeal ~~of~~ TSS, COD and color from ~~oil~~ palm oil mill effluent ~~using EC[57]~~. In Saudi Arabia, Al-Othman et al. ~~(2022)~~[58] examined the use of EC for ~~the~~municipal wastewater treatment ~~of municipal wastewater[58]~~. Lastly, ~~I~~in Brazil, Valente et al. ~~(2012)~~[59] ~~studied~~investigated the use of EC ~~the~~ to removal~~e~~ ~~of~~ TSS from dairy industry wastewater ~~using EC[59]~~.

Overall, while there are many studies on the use of EC ~~technology~~ for wastewater treatment, few studies have ~~compared and discussed~~focused on the effectiveness of ~~this technology~~EC in different countries. Therefore, this study aims to investigate the effectiveness of EC for the removal of pH and TSS from wastewater ~~at a mental~~from a psychiatric hospital in West Java, Indonesia~~,~~ and to compare ~~and discuss~~ the results with similar studies conducted in other countries. The findings of this study will contribute to a better understanding of the effectiveness of EC ~~technology~~ in wastewater treatment and provide insights for future research and application of this technology in different countries.

The results of the pH examination in this study are presented in the following table ~~below:~~s.

Table 1. ~~Overview of~~ pH values of the ~~C~~control group ~~Before and After W~~ without any ~~Given T~~treatment (60 ~~M~~minutes)

Repetition	pH Values				Quality Standard
	Before	Description	After	Description	
1	3.63	Does not meet the requirements	3.63	Does not meet the requirements	6--9
2	3.71		3.71		
3	3.69		3.69		
4	3.7		3.7		

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~~In table 1 above, it can be seen~~Table 1 above shows that the pH value before and after each repetition did not change and was ~~included in the category of not~~considered not meeting the standard requirements ~~according to quality standards~~ of wastewater set by the Minister of Environment and Forestry.

The WWTP ~~outlet wastewater at~~of the Psychiatric Hospital of West Java Province~~'s Mental Hospital~~ ha~~s~~d a low or acidic pH value~~. This is~~ due to the ~~activity of~~ decomposi~~ng~~tion of nitrogen ions that were previously bound ~~in~~to ammonia (NH_3) into nitrates and nitrites. The ~~H~~hy~~y~~drogen i~~I~~ons released from the nitrogen ions beca~~o~~me free, ~~therefore~~ causing the pH of the wastewater to become acidic.

Table 2. ~~Overview of~~ pH value ~~Before and After Treatment~~ with ~~V~~various ~~E~~electrocoagulation c~~C~~ontact ~~T~~times

Repetition	pH Value				Quality Standard
	Before	Description	After	Description	
		10 Minutes Treatment			
1	3.79	Does not meet the requirements	5.94	Does not meet the requirements	6-~~—~~9
2	3.73		5.99		
3	3.77		5.95		
4	3.78		5.94		
		20 Minutes Treatment			
1	3.72	Does not meet the requirements	6.44	Meets the requirements	
2	3.75		6.41		
3	3.74		6.44		
4	3.72		6.47		
		30 Minutes Treatment			
1	3.76	Does not meet the requirements	6.65	Meets the requirements	
2	3.77		6.69		
3	3.73		6.71		
4	3.77		6.68		
		40 Minutes Treatment			
1	3.75	Does not meet the requirements	7.09	Meets the requirements	
2	3.76		7.15		
3	3.73		7.18		
4	3.78		7.16		
		50 Minutes Treatment			
1	3.76	Does not meet the requirements	7.38	Meets the requirements	
2	3.76		7.41		
3	3 ,75		7.39		
4	3.77		7.38		
		60 Minutes Treatment			
1	3.75	Does not meet the requirements	7.76	Meets the requirements	
2	3.76		7.81		
3	3.77		7.77		
4	3.75		7.79		

~~In table 2 above, it can be seen~~Table 2 above shows that the pH value before treatment did not meet the standard ~~overall~~ requirements ~~according to the quality standard~~ of wastewater set by the Minister of Environment and Forestry. A~~t the pH a~~fter 10 minutes of treatment, there was a change in the pH value~~was seen~~, but it ~~still~~ did not meet the ~~quality~~ standard requirements of wastewater yet. However, ~~a pH in a variation~~ after 20 to- 60 minutes of treatment, the pH value finally ~~has~~ met the ~~quality~~ standard requirements of wastewater. ~~At the~~After 60 minutes of treatment, the pH value ~~also~~ increased, approaching the ~~alkaline~~ pH value of alkaline.

The results of the data analysis showed that ~~the~~ 10-minute electrocoagulation contact time ~~of 10 minutes treatment~~ could increase the pH value of the wastewater ~~but~~ although it~~still~~ did not meet the ~~quality~~ standard requirements yet~~s~~. This ~~condition~~ was ~~is caused~~ because ~~the~~ 10-minute contact time ~~of 10 minutes is~~was not sufficient for the ~~electrocoagulation~~ cation reaction ~~in~~ to reduc~~inge~~ water to hydrogen (H_2) and hydroxide (OH^-) which can affect the pH value. The ~~time of 15 – 30 minutes is the~~ ideal contact time ~~for~~ to improv~~inge~~ the quality of wastewater ~~parameters~~is between 15 and 30 minutes, which can increase ~~one of which is~~ the pH value~~, -~~, while the optimum contact time for the electrocoagulation process is within the initial 15 minutes [60]. Meanwhile,

~~T~~the optim~~um~~ ~~contact~~~~ization~~ time ~~of~~ for the electrocoagulation process to improve the quality of wastewater is 30 minutes, ~~in improving the parameters of the wastewater, one of~~ which ~~is~~can increase the pH value [60,61]. On the other hand,~~The~~ 45 minutes is ~~enough~~ sufficient to form ~~a~~ flocculants ~~through~~ via $Al(OH)_3$ as a coagulant, ~~so it~~which can affect the pH value of the wastewater[62]. Considering the fact that ~~T~~the electrocoagulation process consists of ~~the~~ cation~~s~~ and anion~~s~~ reactions~~.~~, ~~T~~the cation reaction of H^+ from the acid will ~~be reduced to~~result in the

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reduction of hydrogen which will be released as gas bubbles. Meanwhile,~~ and ~~ the anion reaction at the anode will produce gas, foam, and $Al(OH)_3$ [63]. At ~~a~~50-minute ~~C~~contact time~~ of 50 minutes~~, there was~~is~~ a considerable change in the pH value [64]. Electrocoagulation contact time can increase the efficiency of pollutant removal [65]. Lastly, ~~T~~the 60~~-~~-minute~~s~~ contact time of electrocoagulation with ~~aluminum~~aluminium electrodes was~~is~~ found to be the most effective in increasing the pH value [66–68].

The changes in pH ~~b~~in the~~y~~ electrocoagulation process we~~a~~re due to the electrolysis process through ~~aluminum~~aluminium consisting of a cathode and an anode~~ process~~. ~~In~~At the cathode~~ process~~, a reduction ~~process~~ reaction occurs ~~where ~~because the negative attracts the positive ions, resulting in the formation of H_2 and OH^-. Meanwhile, ~~in~~at the ~~cathode ~~anode~~process~~, the pH value in the wastewater increases. This is in line with the previous ~~research ~~study by Kobya et al. ~~(2014)~~[69] ~~whereas ~~that the cathode ~~process ~~in the electrocoagulation process will produce H_2 and OH^- which will affect the pH value~~,~~. ~~t~~The longer the contact time and the ~~more ~~higher voltage ~~is ~~used in electrocoagulation, the greater the reduction of wastewater pollutants that occurs [69]. In this sense~~case~~, if the electrocoagulation contact time is extended, there is a possibility that the pH will become very alkaline (~~above~~>~~-~~9), which can also be harmful to the environment [70].

pH is an important parameter in the electrocoagulation process as it can affect the solubility of metal ions and the formation of flocculants, which can ~~impact ~~affect the efficiency of pollutant removal. ~~When t~~The pH value that is too low or too high~~, it can~~ may result in incomplete coagulation or destabilization of flocculants, leading to poor treatment efficiency. Generally, the optimal pH ~~range ~~value for electrocoagulation ranges~~is~~ between 6 and 8.5.

According to ~~the study by ~~Arroyo et al. ~~(2009)~~[71], pH affects the electrocoagulation process due to its ~~influence ~~effect on the electrochemical reactions that occur at the anode and cathode~~[71]~~. At a low pH, the concentration of H+ ions increases, leading to a decrease in the solubility of metal ions and a decrease in the rate of coagulation. On the other hand, at a high pH, the concentration of OH- ions increases, ~~which can result~~resulting in the formation of insoluble metal hydroxides that can reduce the efficiency of pollutant removal.

~~-~~The results of the TSS examination in this study are presented in the following table~~s below:~~.

Table 3. ~~Overview of ~~TSS ~~Control Before and After~~level ~~W~~without ~~Given ~~any ~~T~~treatment (60 ~~M~~minutes)

Repetition	TSS Level~~Values~~				Quality Standard
	Before	Description	After	Description	
1	122	Does not meet the requirements	122	Does not meet the requirements	30
2	123		123		
3	123		123		
4	122		122		

~~In table 3 above, it can be seen~~Table 3 above shows that~~ T~~ the TSS value before and after each repetition ~~shows no reduction~~did not change and was considered~~ included in the category of~~ not meeting the standard requirements set by the Minister of Environment and Forestry ~~according to the quality standard ~~because it exceeded the quality standard of 30 mg/L.

The WWTP ~~outlet wastewater at~~of the Psychiatric Hospital of West Java Province~~'s Mental Hospital~~ has~~d~~ a high TSS level~~. This is~~ ~~due to the condition of~~because the biofilter~~ which is~~ was full of mud. ~~An excess of~~Excess mud in the biofilter causes suspended particles to be carried away~~, which eventually causes~~ resulting in the high TSS ~~values~~ level~~in~~ of the wastewater.

Table 4. ~~Overview of ~~TSS level~~Before and After Treatment~~ with ~~V~~various ~~E~~electrocoagulation ~~C~~contact ~~T~~times

Repetition	TSS Level~~Value~~				Quality Standard
	Before	Description	After	Description	
	10 Minutes Treatment				
1	122	Does not meet the requirements	39	Does not meet the requirements	30
2	124		37		
3	123		36		
4	123		38		
	20 Minutes Treatment				
1	123	Does not meet the requirements	36	Does not meet the requirements	
2	122		34		
3	124		34		
4	122		35		
	30 Minutes Treatment				
1	122	Does not meet the requirements	34	Does not meet the requirements	
2	123		33		
3	123		32		

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Repetition	TSS Level~~Value~~				Quality Standard
	Before	Description	After	Description	
4	124		31		
40 Minutes Treatment					
1	124	Does not meet the requirements	30	Meets the requirements	
2	124		28		
3	123		29		
4	122		28		
50 Minutes Treatment					
1	122	Does not meet the requirements	25	Meets requirements	
2	121		23		
3	123		24		
4	124		24		
60 Minutes Treatment					
1	122	Does not meet the requirements	20	Meets requirements	
2	121		19		
3	124		19		
4	123		18		

~~In table 4 above, it can be seen~~Table 4 above shows that the TSS level before treatment did not meet the standard requirements ~~according to the wastewater quality standard~~of wastewater. At ~~TSS after~~ 10 minutes to 30 minutes of treatment, there was a reduction in the TSS level~~ was seen~~, but it ~~still~~ did not meet the ~~quality~~ standard requirements of wastewater yet. ~~TSS a~~After 40~~-~~ to 60 minutes of treatment, the TSS level ~~has~~finally met the ~~quality~~ standard requirements of wastewater.

~~The TSS a~~After 10 to~~–~~ 30 minutes of treatment, the TSS level ~~is~~was ~~still in the category of~~considered not meeting the requirements because it ~~is still~~was above the ~~quality~~ standard requirements of wastewater, which is 30 mg/L. This ~~condition is~~was because~~d by~~ the electrocoagulation process ~~in the reaction~~ was not maximized ~~within~~between 10 ~~-~~and 30 minutes~~,~~. ~~because~~ As a result,~~the~~ there was not much Al(OH)$_3$ and flocculants ~~has not been~~were not formed~~ much and not many flocs have been formed~~ to precipitate suspended particles.

~~The TSS a~~After 40 ~~–~~to 60 minutes of treatment, the TSS level ~~is already in the category of~~was considered meeting~~ qualifying~~ the standard requirements of wastewater because it is below 30 mg/L~~ according to the regulation~~. This ~~condition is~~was because~~d~~ ~~by~~the ~~ the maximized~~ reaction in the electrocoagulation process was maximized ~~within~~between 40 ~~–~~to 60 minutes. As a result,~~ because during that time~~ there was a lot of Al(OH)$_3$ ~~has been formed~~ and flocculants ~~have been~~were formed which ~~can~~ to precipitate suspended particles.

~~Contact time of 40 – 60 minutes is t~~The ideal contact time ~~for~~to improv~~ing~~e the quality of wastewater ~~parameters~~is between 40 to 60 minutes, ~~one of which is~~which can reduce the TSS level [21], whereas~~. T~~ the optimum contact time to improve the quality of wastewater ~~for~~in the electrocoagulation process is 30 minutes~~ in improving wastewater parameters, one of which is TSS~~[72]. After~~t~~ 45 minutes, ~~numerous~~ flocculants ~~a~~were formed ~~through~~ via Al(OH)$_3$. The formed flocculants ~~has~~ bin~~oun~~d a lot of suspended and ~~settled~~ precipitated substances, ~~therefore~~ so it ~~can~~ may reduce the TSS ~~value~~ level in wastewater [73]. ~~The e~~Electrocoagulation ~~process~~ consists of the ~~reaction of~~ cation~~s~~ and anion reactions~~s~~. The cation reaction of~~ cations~~ H$^+$ from the acid will ~~be reduced to~~result in the reduction of hydrogen which will be released as gas bubbles, while the~~ and~~ anion reaction~~s~~ at the anode will produce gas, foam, and flocculants of Al(OH)$_3$ [74].

The changes in TSS ~~value~~ level ~~which changes due to~~in the electrocoagulation process ~~is~~ occurred~~ing~~ because of the electrolysis process through ~~aluminum~~aluminium consisting of ~~a~~ a cathode and an anode~~ process~~. In contrast to the cathode, ~~the anode process occurs~~ as an oxidation process of the positive pole occurs at the anode, which releases the coagulant ~~agent~~ (Al^{3+}), which is ~~aluminum~~aluminium,~~ in this case, aluminum~~ into the wastewater. This coagulant will form flocculants which will be precipitated~~, therefore it can~~ ~~in order to~~to reduce the TSS ~~value~~ level and improve the quality of the wastewater~~ quality~~. This is in line with the previous ~~research~~ study by Feng et al ~~(2007)~~[75] in which the anode ~~process~~ in the electrocoagulation process will form a coagulant (Al3$^+$) ~~where this coagulant~~which will attract suspended ~~substances~~ particles to form flocculants that will ~~settle~~ precipitate to the bottom of the ~~tub~~ bath.~~and t~~The longer the contact time and the higher voltage used in electrocoagulation, the greater the pollutants that~~more it~~ will ~~reduce the pollutants parameters in~~be removed from the wastewater[75].

TSS can affect the electrocoagulation process because it can interfere with the coagulation and flocculation of suspended particles in the wastewater. TSS can also lead to fouling on~~of~~ the electrode surfaces, which can reduce the effectiveness of the process. The amount and nature of the suspended solids in the wastewater can also ~~influence~~ affect the performance of electrocoagulation.

A study conducted by Bazrafshan et al. ~~(2013)~~[76] investigated the effect of TSS on the performance of ~~the~~ electrocoagulation ~~process~~ for the dairy industry wastewater treatment ~~of dairy wastewater~~[76]. The results showed that the ~~removal~~ efficiency of chemical oxygen demand (COD) and total suspended solids (TSS) removal decreased with the increasing concentration of initial TSS~~ concentration~~. The study suggested that the presence of TSS in ~~the~~ wastewater can lead to a decrease in the efficiency of electrocoagulation~~ efficiency~~, ~~and~~

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~~thus~~so it should be taken into account when designing and ~~operating~~ performing electrocoagulation systems.

3.1 Suggestions and limitations

Among the contributions of this study are as follows:

- The results of this study can increase the knowledge in wastewater management, especially in relation to increasing the ~~e~~ pH value and reducing the~~e~~ TSS level in wastewater.
- The results become an ~~I~~input for WWTP managers in treating wastewater, especially in increasing the pH value and reducing the TSS level in wastewater.
- It ~~is~~becomes an alternative ~~in~~of wastewater management efforts.~~, especially in increasing pH and reducing TSS in wastewater~~
- Further research is needed ~~on~~ to investigate other chemicals~~ elements~~ in wastewater after the electrocoagulation process is carried out.
- A real field application ~~is required as~~of the results of this study is necessary~~,~~ in order to ~~re~~solve the problem of wastewater quality standard requirements, especially on the pH and TSS parameters.

~~In this study, there are still~~Among the limitations of the study~~, in which there~~ are in relation to the differences ~~between~~ among ~~application and~~ implementations in the field, namely:

- In this study, the electrocoagulation bath ~~was used using~~ used a batch system, while in the field implementation, ~~it was~~ a continuous system was used. In principle, the wastewater ~~residence~~ retention time will be different between batch and continuous systems. Therefore, it is necessary for~~to~~ further research to investigate the effect of contact time electrocoagulation ~~using~~ using a continuous system.
- In this study, the electrocoagulation bath ~~used~~ did not use effluents to remove wastewater. This ~~condition will~~ caused the mixing of solid particles that ~~have settled~~precipitated or floated~~, which will~~ affecting the TSS ~~value~~level when ~~entering~~ moving the sample into the ~~sample~~ bottle. Therefore, it is necessary to measure TSS using ~~T~~the ~~T~~total ~~S~~solids integrated spectrophotometr~~ic methody~~.
- In this study, only one ~~tub~~ bath of electrocoagulation was used. Therefore, the difference in treatment ~~is~~ was not carried out ~~at one time~~simultaneously, ~~causing~~ leading to a possibility of bias in the research.
- In this study, the ~~determination of the sample~~ number of samples required was determined ~~refers~~according to the minimum number of samples required for inspection, but ~~does~~did not~~ refer~~ consider~~ to~~ the amount of wastewater discharge~~ of wastewater debit~~. Therefore, it is necessary to carry out further research ~~with reference to~~by considering the amount of wastewater discharge~~ debit~~.

4. Conclusion

~~The~~ Solar-powered electrocoagulation (SPEC) system ~~with a solar panel~~ has been shown to be an efficient and environmentally friendly technology for the wastewater treatment~~ of wastewater~~, particularly in terms of neutralizing the acidity (pH) and reducing the total suspended solids (TSS). Through a review of previous ~~research~~studies, it is clear that ~~EC~~ electrocoagulation has been widely investigated for its effectiveness in removing various pollutants from wastewater. However, ~~there is still a need to compare and discuss the~~ effectiveness of this technology in different countries still needs to be investigated.

~~The current study adds to the existing knowledge by demonstrating the effectiveness of the EC system with a solar panel in neutralizing pH and reducing TSS in wastewater. The study also contributes to new knowledge by investigating the use of this technology specifically in the context of the reduction of TSS and neutralization of pH in wastewater.~~ The results of this study have practical implications for the development of sustainable and efficient wastewater treatment systems.

This study motivates the academic community to continue researching and developing practical and actionable solutions for wastewater treatment. By exploring the potential of the SPEC system~~ with a solar panel~~, researchers can contribute to the development of sustainable and environmentally friendly technologies for wastewater treatment, which are critical for protecting the environment and ensuring the public health.

5. Declarations

5.1. Author Contributions

Conceptualization, E.F and I.A.S.~~.~~; methodology, I.A.S and A.R.; software, E.F.; validation, E.F and I.A.S.; formal analysis, E.F, I.A.S, A.R, A.E.S,~~,~~; investigation, I.A.S.; resources, E.F.; data curation, E.F.; writing—original draft preparation, E.F and I.A.S.; writing—review and editing, E.F.; visualization, E.F.; supervision, E.F and I.A.S.; project administration, I.A.S.; funding acquisition, E.F and I.A.S. All authors have read and agreed to the published version of the manuscript.

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5.2. Data Availability Statement

The data presented in this study are available upon request from the corresponding author.

5.3. Funding and Acknowledgments~~dgements~~

The authors would like to thank ~~the~~ Tirta Wening for providing laboratory facilities ~~under~~for the study~~research project~~ with the certificate~~contract~~ number ~~(certificate)~~ 02253.22.04025.

5.4. Conflicts of Interest

The authors declare that there is no conflict of interest.

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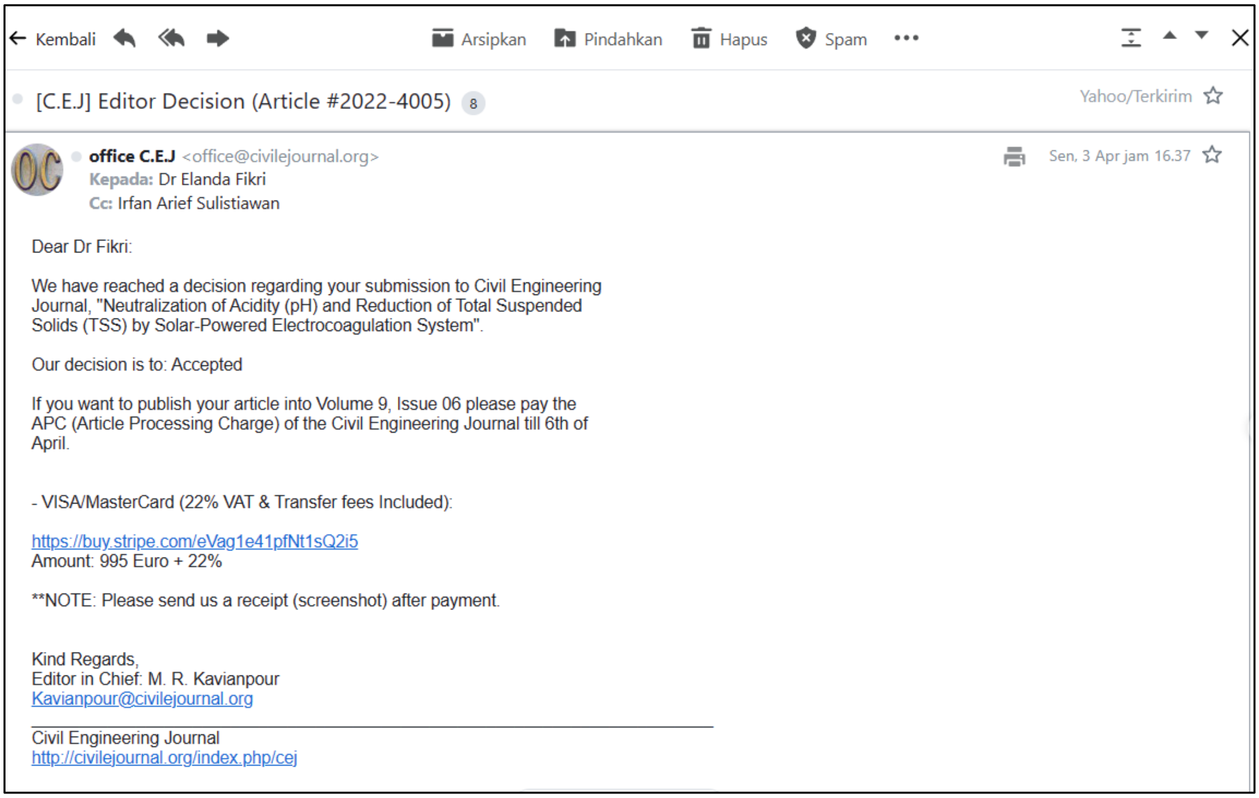
PAPER ACCEPTED (3 April 2023)



[C.E.J] Editor Decision (Article #2022-4005)

office C.E.J <office@civilejournal.org>
Kepada: Dr Elanda Fikri
Cc: Irfan Arief Sulistiawan

Sen, 3 Apr jam 16.37

Dear Dr Fikri:

We have reached a decision regarding your submission to Civil Engineering Journal, "Neutralization of Acidity (pH) and Reduction of Total Suspended Solids (TSS) by Solar-Powered Electrocoagulation System".

Our decision is to: Accepted

If you want to publish your article into Volume 9, Issue 06 please pay the APC (Article Processing Charge) of the Civil Engineering Journal till 6th of April.

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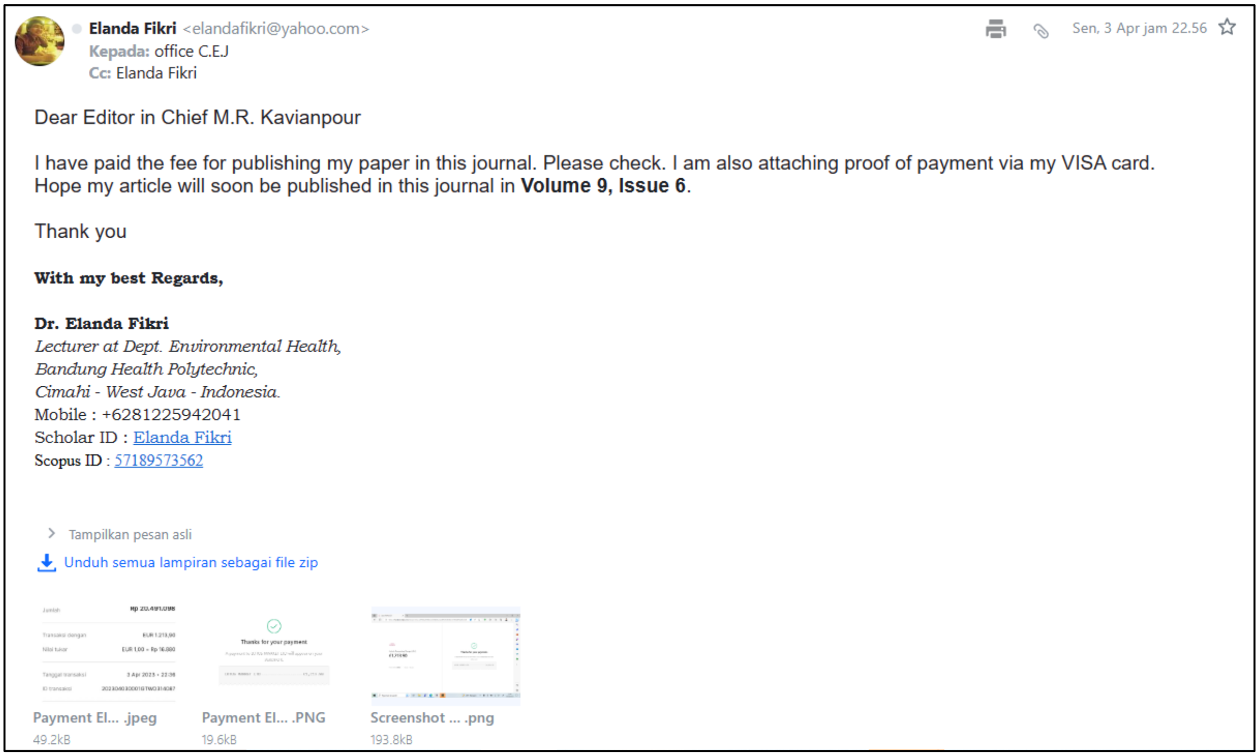

Elanda Fikri <elandafikri@yahoo.com>
Kepada: office C.E.J
Cc: Elanda Fikri

Sen, 3 Apr jam 22.56

Dear Editor in Chief M.R. Kavianpour

I have paid the fee for publishing my paper in this journal. Please check. I am also attaching proof of payment via my VISA card. Hope my article will soon be published in this journal in **Volume 9, Issue 6**.

Thank you

With my best Regards,

Dr. Elanda Fikri
Lecturer at Dept. Environmental Health,
Bandung Health Polytechnic,
Cimahi - West Java - Indonesia.
Mobile : +6281225942041
Scholar ID : Elanda Fikri
Scopus ID : 57189573562

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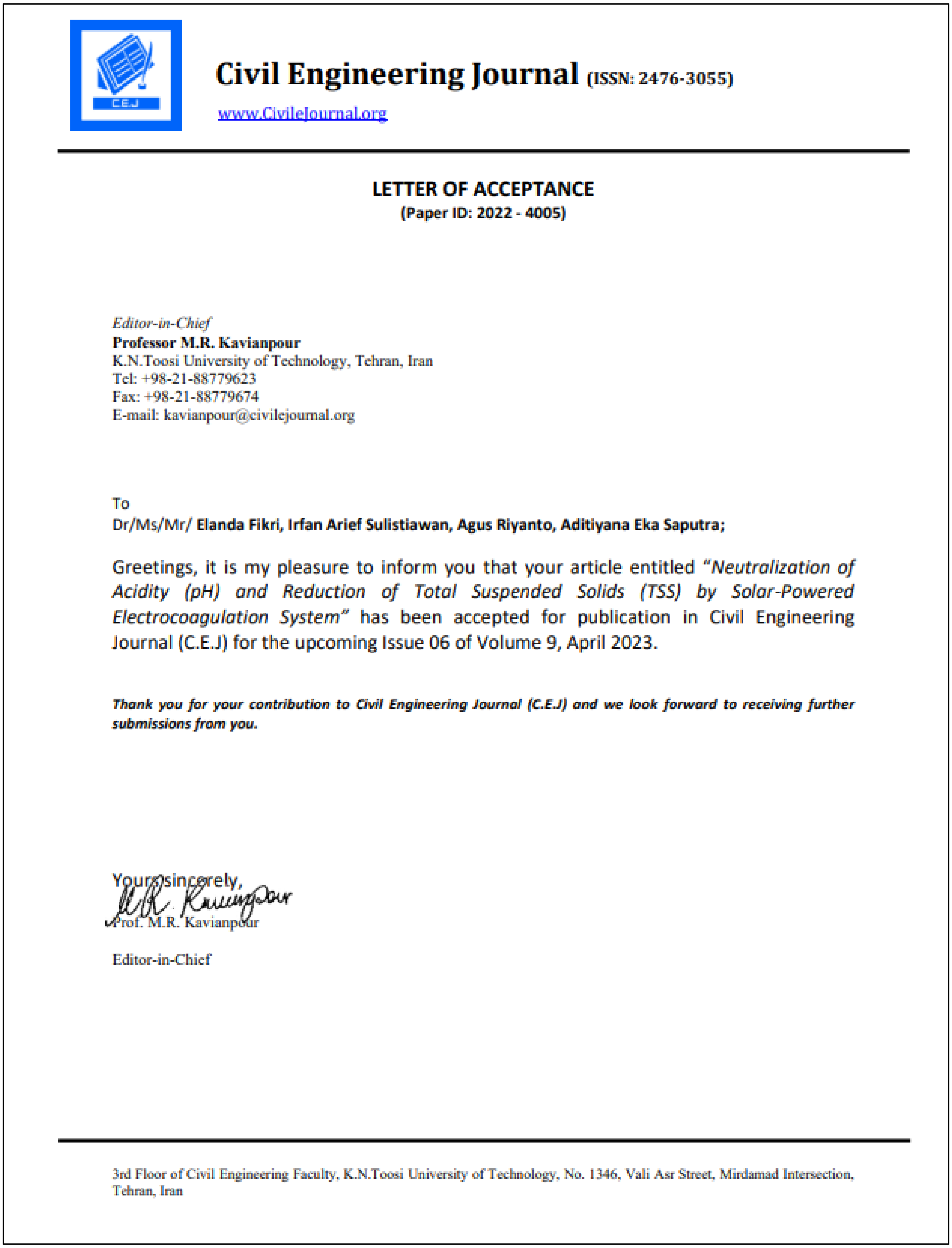

Civil Engineering Journal (ISSN: 2476-3055)
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LETTER OF ACCEPTANCE

(Paper ID: 2022 - 4005)

Editor-in-Chief
Professor M.R. Kavianpour
K.N.Toosi University of Technology, Tehran, Iran
Tel: +98-21-88779623
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E-mail: kavianpour@civilejournal.org

To
Dr/Ms/Mr/ **Elanda Fikri, Irfan Arief Sulistiawan, Agus Riyanto, Aditiyana Eka Saputra;**

Greetings, it is my pleasure to inform you that your article entitled "*Neutralization of Acidity (pH) and Reduction of Total Suspended Solids (TSS) by Solar-Powered Electrocoagulation System*" has been accepted for publication in Civil Engineering Journal (C.E.J) for the upcoming Issue 06 of Volume 9, April 2023.

Thank you for your contribution to Civil Engineering Journal (C.E.J) and we look forward to receiving further submissions from you.

Yours sincerely,
M.R. Kavianpour
Prof. M.R. Kavianpour

Editor-in-Chief

PROOF READING FINAL (27 Mei 2023)

[C.E.J] Proofreading (Article #2022-4005) 2

office@civilejournal.org
Kepada: elandafikri@yahoo.com
Cc: pui@poltekkesbandung.ac.id

Sab, 27 Mei jam 18.07

Dear Dr. Fikri,

I would ask you to check the pre-publication format of your article in Civil Engineering Journal and modify some queries, which have been asked by comments.

You have 24 hours to send back the final version. You should highlight or use track-changes to show the modification.

Regards,
Office C.E.J
Civil Engineering Journal

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Civil Engineering Journal

ISSN (Online): 2476-3055
ISSN (Print): 2676-6957

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Neutralization of Acidity (pH) and Reduction of Total Suspended Solids (TSS) by Solar-Powered Electrocoagulation System

Elanda Fikri, Irfan A. Sulistiawan, Agus Riyanto, Aditiyana Eka Saputra

Abstract

This study investigates the effect of electrocoagulation contact time on the pH and TSS of wastewater discharged from the wastewater treatment plant (WWTP) of the Psychiatric Hospital of West Java Province. The experiment followed the pretest-posttest control group design. This study involved testing 56 wastewater samples six times before and after treatment. Each treatment was repeated four times, and there was one control group for each repetition. The electrocoagulation tool used in this study consisted of six 1-mm electrode plates that were 8 cm apart, a current strength of 5A, a voltage of 12V, and a 50-Watt solar panel. The data were analyzed using descriptive and inferential statistics. The results showed that all electrocoagulation contact time treatments had a significant effect on increasing the pH and the TSS. Additionally, the electrocoagulation tool was found to be effective, stable, portable, and environmentally friendly, with a self-cleaning system that reduced operational costs and saved electricity through the use of solar panels. This study contributes to the development of an effective electrocoagulation toll for wastewater treatment and the determination of the optimal contact time for the tool, providing a practical solution to overcome the problems of pH and TSS in wastewater. These findings can be applied to other wastewater treatment plants, thus improving the quality of discharged wastewater.

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Civil Engineering Journal

(E-ISSN: 2476-3055; ISSN: 2676-6957)

Vol. 9, No. 05, May, 2023

Neutralization of Acidity (pH) and Reduction of Total Suspended Solids (TSS) by Solar-Powered Electrocoagulation System

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Received 23 December 2022; Revised 04 April 2023; Accepted 17 April 2023; Published 01 May 2023

Abstract

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Keywords: Wastewater; Electrocoagulation Contact Time; pH; TSS; Solar Panel.