

PAPER • OPEN ACCESS

## Preface

To cite this article: 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **926** 011001

View the [article online](#) for updates and enhancements.

You may also like

- [Conference Overview](#)
- [Peer Review Declaration](#)
- [PREFACE](#)



The Electrochemical Society  
Advancing solid state & electrochemical science & technology

243rd Meeting with SOFC-XVIII

Boston, MA • May 28 – June 2, 2023

**Accelerate scientific discovery!**

Learn More & Register



## Preface

The Third International Conference on Green Energy and Environment (The 3<sup>rd</sup> ICoGEE 2021) was organized by the Faculty of Engineering – Universitas Bangka Belitung together with some co-organized members such as the Faculty of Engineering – Universitas Tadulako, Faculty of Engineering – Universitas Bengkulu, Faculty of Engineering – Universitas Maritim Raja Ali Haji, Faculty of Technology and Science – Universitas Jambi, MIPAnet and Asian Federation of Biotechnology (AFOB). We planned The 3<sup>rd</sup> ICoGEE 2021 to held on September 29<sup>th</sup> – 30<sup>th</sup>, 2021, in Pangkalpinang, Indonesia. However, the COVID-19 pandemic that is still engulfing various countries has hampered diverse gathering and traveling activities. Therefore, The 3<sup>rd</sup> ICoGEE 2021 has been held virtually using the Zoom Meeting platform.

The 3<sup>rd</sup> ICoGEE 2021 is a scientific conference involving various disciplines that aims to create innovations related to the development of science and technology to protect energy and the environment. Another goal of ICoGEE is to build a collaborative network between government, practitioners, and academics to solve problems in the energy and environmental sectors. Thus, this year's ICoGEE carries the theme: "Innovation Science and Technology Innovation for Sustainable Development Green Energy and a Cleaner Environment."

Although held online, this conference was attended by about 150 researchers, engineers, and scientists from various institutions. There are more than 60 institutions from nine countries: Indonesia, India, Viet Nam, Japan, Spain, China, Malaysia, Thailand, and Cyprus, participating in The 3<sup>rd</sup> ICoGEE 2021. The conference consists of two parts: keynote presentation and oral presentation. There were 114 papers (after the review process) divided into three topics: Green Energy and Application, Environmental Science and Technology, and Energy and Environmental Management. During the oral presentation session, the participants were divided into academic groups according to the topic.

We are very grateful because, in 2021, The 3<sup>rd</sup> ICoGEE has keynote speakers from different countries and institutions who are experts in energy and environmental aspects. Our great honor is that five experts gave excellent keynote speeches: Prof. Misri Gozan as Vice President of Asian Federation of Biotechnology, Associate Prof. Dr. Oki Muraza from King Fahd University of Petroleum and Minerals, Prof Taufik from Cal. Poly. State University, Prof. Ocky Karna Radjasa as Deputy Chairman of Earth Sciences - LIPI, and Prof. Jatna Supriatna as Vice Chairman of the Belantara Foundation.

Although The 3<sup>rd</sup> ICoGEE was held virtually, the conference can still achieve its primary purpose or benefit. All manuscripts published in the proceeding have been through a rigorous review to meet the requirement of high-quality papers.

The committee wishes to acknowledge speakers and participants who attended this virtual conference. We are beyond glad as this pandemic situation, which has been going on for more than a year, would not let their spirit down to keep participating in this conference. Plenty of thanks are given to all persons who have helped and supported this conference.

Warmest Regards,

**Chairman of Organizing Committee**

Herman Aldila



## Conference Committees

### Steering Committee

1. Dr. Ibrahim, M.Si.
2. Wahri Sunanda, S.T., M.Eng.

**Chairman** : Herman Aldila, S.Pd., M.Si.

**Vice of Chairman** : Robby Gus Mahardika, S.Pd., M.Si.

**Treasurer** : Nelly Gusnita, S.Ak. & Innas Syah Adah, A.Md.

### Secretarial Team :

- Verry Andre Fabiani, S.Si., M.Si. (Coordinator)
- Ririn Amelia, S.T., M.Si.
- Revy Safitri, S.T., M.T.
- Guskarnali, S.T., M.T.
- Izma Fahria, S.E., M.Sc.
- Welly Yandi, S.Pd., M.T.
- Endang S. Hisyam, S.T., M.Eng.
- Yudi Setiawan, S.T., M.T.
- Farid Wajedi, S.E.

### Editorial Team

- Yuant Tiandho, S.Si., M.Si. (Coordinator)
- Eka Sari Wijianti, S.Pd., M.T.
- Delita Ega Andini, S.T., M.T.
- Haslen Oktarianty, S.T., M.T.
- Widodo Budi Kurniawan, S.Pd., M.Sc.
- Fitri Afriani, S.Si., M.Si.
- Anisa Indriwati, S.Si., M.Sc.
- Yekti Widyaningrum, S.Pd., M.Si.
- Tri Kusmita, M.Sc.
- Nurhadini, S.Si., M.Si.
- Fajar Indah Puspita Sari, S.Si., M.Sc.
- Occa Roanisca, S.P., M.Si.
- Adisyahputra, S.Si., M.Sc.
- Ristika O. Asriza, S.Pd., M.Si.
- Fahmi Rizal, S.Si., M.Biomed.
- Ineu Sulistiana, S.E., M.Sc.
- Desy Y. Dalimunthe, S.E., M.Sc.
- Rika Favoria Gusa, S.T., M.Eng.
- M. Yonggi Puriza, S.T., M.T.
- Rudy Kurniawan, S.T., M.T.
- Saparin, S.T., M.Si.
- Desy Yofianti, S.T., M.T.
- Boy Dian Anugra Sandy, S.Pd., M.T.
- Adriyansyah, S.T., M.Si.

**Scientific Committee** :

- |                                      |   |
|--------------------------------------|---|
| 1. Prof. Misri Gozan                 | Universitas Indonesia                       |
| 2. Prof. Djoko Legono                | Universitas Gadjah Mada                     |
| 3. Prof. Aldes Lesbani               | Universitas Sriwijaya                       |
| 4. Prof. Orawan Siriratpiriya        | Chulalongkorn University                    |
| 5. Prof. Buhani                      | Universitas Lampung                         |
| 6. Prof. Rudy Sayoga                 | Institut Teknologi Bandung                  |
| 7. Prof. Posman Manurung             | Universitas Lampung                         |
| 8. Prof. Ambar Pertiwinigrum         | Universitas Gadjah Mada                     |
| 9. Bhakti Yudho Suprpto, M.T.        | Universitas Sriwijaya                       |
| 10. Dr. Eng. Beta Paramita           | Universitas Pendidikan Indonesia            |
| 11. Dr. Julie Waldron                | University of Nottingham                    |
| 12. Dr. Eng. M. Donny Koerniawan     | Institut Teknologi Bandung                  |
| 13. Dr.Eng. Deni Shidqi Khaerudini   | Indonesian Institute of Science             |
| 14. Ihwan Ghazali, Ph.D              | UTEM Malaka                                 |
| 15. Dr. Yayu Arifin                  | Universitas Negeri Gorontalo                |
| 16. Dr. Yuli Asmi Rahman             | Universitas Tadulako                        |
| 17. R. Priyoko Prayitnoadi, Ph.D.    | Universitas Bangka Belitung                 |
| 18. Dr. Eddy Nurtjahya               | Universitas Bangka Belitung                 |
| 19. Dr. Rizal Munadi                 | Universitas Syiah Kuala                     |
| 20. Nugroho Adi Sasongko, Ph.D       | BPPT  |
| 21. Lesnanto Multa Putranto, Ph.D    | Universitas Gadjah Mada                     |
| 22. Dr. Yuszda Salimi                | Universitas Negeri Gorontalo                |
| 23. Dr.RR. Kurnia Novita Sari, M.Si  | Institut Teknologi Bandung                  |
| 24. Assoc.Prof. Ali Awaludin, Ph.D   | Universitas Gadjah Mada                     |
| 25. Ir.R.Sony Sulaksono Wibowo, Ph.D | Institut Teknologi Bandung                  |
| 26. Dr. Peni Indrayudha              | Universitas Muhammadiyah Surakarta          |
| 27. Prof. Agus Ismail Hasan, Ph.D    | University of Southern Denmark              |
| 28. Dr. Eko Agus Suyono              | Universitas Gadjah Mada                     |
| 29. Dr. Abdul Rahman                 | Universitas Bengkulu                        |
| 30. Dr. M. Ali Muhammad Yuzir        | Universiti Teknologi Malaysia               |
| 31. Dr. Adisti P. Putri              | IPB University                              |
| 32. Suci Permata Sari, M.Si.         | Ghent University                            |
| 33. Dr. Diana V. Weilia              | Universitas Andalas                         |
| 34. Dr. Oman Zuas                    | National Standarization Agency of Indonesia |
| 35. Apriadi Salim Adam, Ph.D.        | Indonesian Institute of Science             |
| 36. David F. Silalahi, Ph.D.         | Australia National University               |
| 37. Ahmad R. Firdaus, Ph.D.          | Politenik Negeri Batam                      |
| 38. Dr. Roby Hambali                 | Universitas Bangka Belitung                 |
| 39. Dr. Winda Rahmalia               | Universitas Tanjung Pura                    |
| 40. Dr. Muhamad Salma Fareza         | Universitas Soedirman                       |
| 41. Rizmahardian A. Kurniawan, M.Si. | National Central University Taiwan          |

**Logistics** : Ardiansyah, S.IP. & Rheny Biantari, S.T.

# Table of contents

Volume 926

**2021**

◀ Previous issue    Next issue ▶

**3rd International Conference on Green Energy and Environment 2021 (The 3rd ICoGEE 2021) 29th-30th September, Bangka Belitung, Indonesia**

Accepted papers received: 05 November 2021

Published online: 03 December 2021

Open all abstracts

---

## Preface

---

**OPEN ACCESS**

011001

Preface

+ Open abstract



View article



PDF

---

**OPEN ACCESS**

011002

Peer Review Declaration

+ Open abstract



View article



PDF

---

## Papers

---

**OPEN ACCESS**

012001

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our Privacy and Cookies policy.  
Inhibition of the  $\alpha$ -glucosidase enzyme from Pelawan stem extract (*Iristaniopsis merguensis* Griff)



R G Mahardika, G P Kusuma, O Roanisca and Henri

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012002

Farmer exchange rate category: A Prediction analysis using ANN back propagation

Syahrudin, Z Azis, S Panggabean, S W Dachi, Nurhayati, Suwati, M Apriyanto and R R Utami

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012003

Indonesian hydro energy potential map with run-off river system

B Pranoto, H Soekarno, D G Cendrawati, I F Akrom, M I A Irsyad, N W Hesty, Aminuddin, I Adilla, L Putriyana, A F Ladiba *et al*

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012004

The effect of flood on slope stability along downstream riverbank of MuaraBangkahulu River, Bengkulu City, Indonesia

L Z Mase, K Amri, M Frisky, P W Anggraini, M N Fikri and S Agustina

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012005

Design of floating photovoltaic system for fish pond lighting

G S H Arimufti, W Sunanda and R F Gusa

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012006

Collaborative approach for coastal and marine spatial planning in Bangka Belitung Island Province

B Murtasidin and S Sujadmi

[+ Open abstract](#) [View article](#) [PDF](#)

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our [Privacy and Cookies policy](#).



---

OPEN ACCESS

012007

Quantifying the perceptions of the 2018 Palu earthquake survivors on the use of light bricks as a wall material of simple house

I G Tunas, Asrafil and N M S Parwati

[+ Open abstract](#)

[View article](#)

[PDF](#)

---

OPEN ACCESS

012008

The perception level on the impact of integrated livestock-fish production systems towards the environmental pollution

S Adibrata, N I Bahtera, R P Astuti and F Arkan

[+ Open abstract](#)

[View article](#)

[PDF](#)

---

OPEN ACCESS

012009

Potential And Characteristics Of Eichhornia Crassipes Biomass And Municipal Solid Waste As Raw Materials For RDF In Co-Firing Coal Power Plants

S A C R Darmawan, A L Sihombing and D G Cendrawati

[+ Open abstract](#)

[View article](#)

[PDF](#)

---

OPEN ACCESS

012010

Fabrication Of Lithium-Carbon Composite Material From Pepper Peel Waste As Battery Electrodes

M Jumnahdi, W B Kurniawan, R G Mahardika, Ipi and M E Saputra

[+ Open abstract](#)

[View article](#)

[PDF](#)

---

OPEN ACCESS

012011

Analysis of linkage type sea wave power plant design through motion study and 3D printed modelling

R P Prayitnoadi, B S Wibowo, A Pamungkas, A Islamiyah, M Lestari, R Putri, R F Ridwan and F Rosa

[+ Open abstract](#)

[View article](#)

[PDF](#)

---

OPEN ACCESS

012012

The Potential of Renewable Energy Generations at Barrang Caddi Island

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our Privacy and Cookies policy.



I Kitta, S Manjang, I Rachmaniar, Riskawati, C Y R Pebakirang and Hardiansyah

[+](#) Open abstract [View article](#) [PDF](#)

---

**OPEN ACCESS**

012013

Experimental investigation of Archimedes Screw Hydro Turbine rotation with and without deflector

Y Setiawan, E S Wijianti, B S Wibowo, S Saparin and P Prayitnodi

[+](#) Open abstract [View article](#) [PDF](#)

---

**OPEN ACCESS**

012014

A floating photovoltaic system for fishery aeration

E G Pratama, W Sunanda and R F Gusa

[+](#) Open abstract [View article](#) [PDF](#)

---

**OPEN ACCESS**

012015

The air quality index based on measurements of mobile air quality monitoring station at the waste-to-energy incineration plant PLT Sa Bantargebang

I P A Kristyawan, Wiharja, A Shoiful, P A Hendrayanto, A D Santoso and N Suwedi

[+](#) Open abstract [View article](#) [PDF](#)

---

**OPEN ACCESS**

012016

Synthesis and antibacterial activity of chitosan membrane from shrimp shell waste

H Aldila, M K Swandi and D Y Dalimunthe

[+](#) Open abstract [View article](#) [PDF](#)

---

**OPEN ACCESS**

012017

Cointegration Test and Projection of Total Rubber and Tin Production and Their Effect on The Environment in Province of Bangka Belitung Island

D Y Dalimunthe and H Aldila

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our Privacy and Cookies policy.





[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012018

Forecasting East Belitung Regency Rainfall Data by Reviewing Heteroscedasticity

E Kustiawan and Adriyansyah

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012019

The planning rain water harvesting integrated wells in public facilities in the village of Kayu Besi

W Puspitasari, E S Hisyam and I Gunawan

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012020

Empowering Society in Waste Management System with the Reduce Reuse and Recycle Approach in Pagarawan Bangka

Sujadmi, L Hayati and R A Saputri

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012021

Distillation-Adsorption of Bioethanol Using Natural Kaolin

F I P Sari, B S Wibowo, R Irwanto and S Sarfita

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012022

Advanced Yield Trial of F7 Upland Rice Lines with Lodging Resistance in Bangka Regency, Bangka Belitung Islands Province, Indonesia

E D Mustikarini, G I Prayoga, R Santi and N P E Sari

[+ Open abstract](#) [View article](#) [PDF](#)

---

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our [Privacy and Cookies policy](#).



---

OPEN ACCESS

012023

Fabrication of supercapacitor electrode based on pepper peel activated carbon

W B Kurniawan, K Kurniawan and Ipi

+ Open abstract

 View article

 PDF

---

OPEN ACCESS

012024

Isolation and Identification Cellulolytic Bacteria from Termite Gut Obtained from Indralaya Peatland area

D Oktiarni, Hermansyah, Hasanudin, Miksusanti, E Nofyan and G Kasmiarti

+ Open abstract

 View article

 PDF

---

OPEN ACCESS

012025

Thingsboard-based prototype design for measuring depth and pH of kulong waters

T F Ilyas, F Arkan, R Kurniawan, T H Budianto and G B Putra

+ Open abstract

 View article

 PDF

---

OPEN ACCESS

012026

Vocational high school as a part of Indonesian photovoltaics supply chain

R Budiarto, N Effendy, F Aliyah, D Novitasari, I A Mubarak, R K Arruzi, Z A Fikriyadi, T P Handayani and H H Adudu

+ Open abstract

 View article

 PDF

---

OPEN ACCESS

012027

Heavy metal distribution in sediments around the offshore tin mining area of Central Bangka Regency, Indonesia

Irvani, S Adibrata, M Yusuf, M Hudatwi and A Pamungkas

+ Open abstract

 View article

 PDF

---

OPEN ACCESS

012028

Study of power flow in electricity system using extreme learning machine

This site uses Cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our Privacy and Cookies policy.



[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012029

Tradition *lubuk larangan* as a local wisdom for ecocultural tourism river management through landscape anthropolinguistic approach in Mandailingnese

T Lubis, Dardanila, T Nasution, Zulkarnain, S Hasrul, Ramlan and A F Abus

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012030

Dynamic stability improvement with integrated power plant scheduling method based on moment of inertia

Fitriani, I C Gunadin, A Suyuti and A Siswanto

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012031

Real-time voltage stability monitoring model of wind power plant penetration in electrical power system networks

A M Ilyas, A Suyuti, I C Gunadin and S M Said

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012032

Chlorophyll a concentration of Phytoplankton in Estuary Mangrove Kurau, Bangka Tengah, Indonesia

E Utami, R G Mahardika, Anggraeni and D. Rosalina

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012033

Diversity of Benthic Organisms on Artificial Reef Structure

M Hudatwi, I A Syari, E Utami, M A Nugraha, I Akhrianti and A Pamungkas

[+ Open abstract](#) [View article](#) [PDF](#)

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our [Privacy and Cookies policy](#).



---

OPEN ACCESS

012034

ARIMAX model for rainfall forecasting in Pangkalpinang, Indonesia

R Amelia, D Y Dalimunthe, E Kustiawan and I Sulistiana

[+ Open abstract](#)

[View article](#)

[PDF](#)

---

OPEN ACCESS

012035

The effect of bioethanol mixture of raw coconut roomie (*Cocos nucifera*) with Pertamina (RON 92) and Peralite (RON 90) fuels on the performance of a gasoline motor

A Puspawan, N I Supardi, A Suandi, H R Samosir and Indarto

[+ Open abstract](#)

[View article](#)

[PDF](#)

---

OPEN ACCESS

012036

Design a bee calling tool using a caller voice and honey scent based on arduino and the blynk application

A Thoib, R Kurniawan and T H Budianto

[+ Open abstract](#)

[View article](#)

[PDF](#)

---

OPEN ACCESS

012037

Environmental management and the implications to the plant varieties protection in Bangka Belitung Islands

D Darwance, R Sari and M S Anwar

[+ Open abstract](#)

[View article](#)

[PDF](#)

---

OPEN ACCESS

012038

Optimization of the Belinyu solar power plant to reduce emissions of waste gas in diesel power plant

E M Siregar

[+ Open abstract](#)

[View article](#)

[PDF](#)

---

OPEN ACCESS

012039

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our [Privacy and Cookies policy](#).



# Review of the distribution of granite using geomagnetic methods at Bukit Nunggal Air Mesu Village, Pangkalan Baru Sub-District, Bangka Tengah District

T B Verkoyan, D E Andini and Guskarnali

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS** 012040

## The effect of shape toward characteristics of cerium-iron-boron thin layer

A Indriawati, R Sari and Sulanjari

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS** 012041

## Marine debris: Sources, characteristics, and environmental impact on Baturusa River, Bangka Belitung

I A Syari, J D N Manik, I Akhrianti and A Pamungkas

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS** 012042

## The effectiveness of filtration and phytoremediation with combination of aquatic plants in wastewater treatment of *Sasirangan* industry

A G Ilmannafian, M Kiptiah and M I Darmawan

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS** 012043

## Risk Reduction of Marine Oil Spill using Clusters of Fruit Peel Pellets

G Saha and D Majumdar


[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS** 012044

## Synthesis of 3D-porous scaffold from cockle shells waste-based hydroxyapatite with addition silica from tin tailings

Flasari, Jesvic, Rias R, Bismillah, R, Amelia, M, Hidayat, and Y. Triandha

This site uses cookies to enhance your browsing experience. To find out more, see our Privacy and Cookies policy. 

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012045

Design and testing of 1 phase semi-controlled rectifier circuit (experiment scale): a part of green laboratory project

Yusran and A D Armanda

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012046

2D electrical resistivity imaging to determine depth of andesite spreading at Tanjung Batu, Jambi as eco-friendly exploration of minerals method

T Kusmita and Iwalzi

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012047

Groundwater vulnerability assessment and mapping in shallow groundwater

K Aribowo, W Wilopo and D H Barianto

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012048

The application of artificial neural network for quality prediction of industrial standard water

Y Muharni, Kulsum, A Denisa and Hartono

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012049

Analysis of the use bioethanol-pertalite mixtures in motorcycles on fuel consumption efficiency

B S Wibowo, F I P Sari, Y Setiawan, P Prayitnoadi and M D Adha

[+ Open abstract](#) [View article](#) [PDF](#)

---

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our [Privacy and Cookies policy](#).



<b>OPEN ACCESS</b>	012050
Solution combustion method to synthesize magnetic Fe <sub>3</sub> O <sub>4</sub> as photocatalytic of Congo red dye and antibacterial activity	
Salni, M Said, P L Hariani and I Apriani	
<a href="#">+ Open abstract</a> <a href="#">View article</a> <a href="#">PDF</a>	
<b>OPEN ACCESS</b>	012051
Removal of Congo Red and Procion Red Using Zn/Fe Pillared Bentonite	
Desnelli, W R Asri, Hasanudin, M Said and P L Hariani	
<a href="#">+ Open abstract</a> <a href="#">View article</a> <a href="#">PDF</a>	
<b>OPEN ACCESS</b>	012052
Liquid smoke application in latex as an environment-friendly natural coagulant	
Evahelda, R F Astuti, S N Aini and Nurhadini	
<a href="#">+ Open abstract</a> <a href="#">View article</a> <a href="#">PDF</a>	
<b>OPEN ACCESS</b>	012053
Comparative study of electrical energy conversion on monocrystalline and polycrystalline solar panel types in fixed position with various weather conditions in mountain area	
W Yandi, M Y Puriza and K Jumaida	
<a href="#">+ Open abstract</a> <a href="#">View article</a> <a href="#">PDF</a>	
<b>OPEN ACCESS</b>	012054
Risk analysis and solution of using graphene: Material, synthesis, and application (Mini review)	
L Destiarti, I Kartini, Riyanto, Roto and Mudasir	
<a href="#">+ Open abstract</a> <a href="#">View article</a> <a href="#">PDF</a>	
<b>OPEN ACCESS</b>	012055
Forecasting travel patterns during COVID-19 period using Community Mobility Report Case study: Bangka Belitung Province	



R Safitri and R Amelia

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012056

Visualisation of Naturally Ventilated House in Tropical Hilly Area of Indonesia, Case Study: Vatutela Village, Tondo Hills, Palu

P Fitriaty, A J R Bassaleng, N R Burhany, R Mardin, A Setiawan and S Alam

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012057

Improved the quantity of DMM calibration services by speeding up the quality of the measurement method

H Sardjono, S Wijonarko and D R Wahono

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012058

Research on Contamination of Foods with Mercury Mining: A Ten-Year (2011-2020) Bibliometric Analysis

O Zuas, C Elishian, N T E Darmayanti, H Budiman and U K Yaumidin

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012059

The Diversity of Fruit Fly (Diptera: Tephritidae) on Combination of Attractant and Different Trap Height in Cucumber Field (*Cucumis sativus* L.)

R Apriyadi, H M Saputra, S Sintia and D E Andini

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012060

Characterization of cellulose acetate functional groups synthesized from corn husk (*Zea mays*)

R O Asriza, Ropalia, D Humaira, G O Ryaldi and Zomi

[+ Open abstract](#) [View article](#) [PDF](#) This site uses cookies. By continuing to use this site, you agree to our use of cookies. To find out more, see our Privacy and Cookies policy.





---

OPEN ACCESS

012061

Biosynthesis and characterization of zinc ferrite ( $ZnFe_2O_4$ ) via *Antidesma bunius* L. fruit extract

V A Fabiani, F I P Sari, Nur'aini and S A Putri

+ Open abstract

 View article

 PDF

---

OPEN ACCESS

012062

Analysis of ocean wave power plant buoy system at Kelong

T Suhendra, R A Putra, S Nugraha, H A Kusuma, A H Yunianto, E Prayetno and D Nusyirwan

+ Open abstract

 View article

 PDF

---

OPEN ACCESS

012063

Smart system using programmable logic controller for seabin prototype

A H Yunianto, E Prayetno, F I Susanto and T Suhendra

+ Open abstract

 View article

 PDF

---

OPEN ACCESS

012064

Techno-economic evaluation of integrated levulinic acid-bioethanol plant design based on oil palm empty fruit bunches

Muryanto, K L Putri, P Srinophakun and M Gozan

+ Open abstract

 View article

 PDF

---

OPEN ACCESS

012065

Review of digital PCR potential for surveillance of emerging disease from wastewater

A Dewantoro, W C Anggundari, B Prasetya and Yopi

+ Open abstract

 View article

 PDF

---

OPEN ACCESS

012066

Vector error correction model to analyze energy uses, environmental quality and economic growth during Covid-19 Pandemic

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our Privacy and Cookies policy.



[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012067

Analysis of granitoid type of Bukit Nunggal Village, Air Mesu, Central Bangka Regency

Franto, Mardiah and J Pitulima

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012068

Aquifer Susceptibility to Groundwater Pumping in Kediri City, East Java Province, Indonesia

T Widodo, W Wilopo and A Setianto

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012069

Influence of Deacetylation Process in Chitosan Extract From Shrimp Shell Waste

Nurhadini, W Yandi, M A Nugraha, M A Putri and N Riyani

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012070

Techno-economic analysis of recombinant Endo- $\beta$ -1,4-Glucanase production from *Escherichia coli* Eg-RK2 culture using oil palm empty fruit bunch

S Z Amraini, E A Surya, S Limoes, S Setyahadi, S Abd-Aziz and M Gozan

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012071

Application of the APLIS Method for Groundwater Vulnerability Assessment in Rote Island Karst Areas

H Syafarini, H Hendrayana and S Winardi

[+ Open abstract](#) [View article](#) [PDF](#)



---

**OPEN ACCESS**

012072

The potential for land erosion due to primary tin mining in Bangka Island

R Hambali and S Wahyuni

**+** [Open abstract](#)

 [View article](#)

 [PDF](#)

---

**OPEN ACCESS**

012073

The Potential of Conversion of Sea Wave Energy to Electric Energy: The Performance of Central Sulawesi West Sea using Oscillating Water Column Technology

Y A Rahman and Setiyawan

**+** [Open abstract](#)

 [View article](#)

 [PDF](#)

---

**OPEN ACCESS**

012074

Relationship of plant types to noise pollution absorption level to improve the quality of the road environment

D Yofianti and K Usman

**+** [Open abstract](#)

 [View article](#)

 [PDF](#)

---

**OPEN ACCESS**

012075

Geopark Belitong : Environment Based Tourism Branding in Belitung Island

N Zuhri, E Rosalina and C Christianingrum

**+** [Open abstract](#)

 [View article](#)

 [PDF](#)

---

**OPEN ACCESS**

012076

Flood Vulnerability Study of Pangkalpinang City, Bangka Belitung Archipelago Province

Guskarnali, Irvani and E.P.S.B. Taman Tono

**+** [Open abstract](#)

 [View article](#)

 [PDF](#)

---

**OPEN ACCESS**

012077

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our [Privacy and Cookies policy](#).



The role of Energy Management System based on ISO 50001 for Energy-Cost Saving and Reduction of CO<sub>2</sub>-Emission: A review of implementation, benefits, and challenges

B Prasetya, D R Wahono, A Dewantoro, W C Anggundari and Yopi

[+](#) Open abstract [View article](#) [PDF](#)

---

**OPEN ACCESS**

012078

Hydrogeological Conceptual Model in the Middle of Randublatung Groundwater Basin

D L Setyaningsih, K D Setyawan, D P E Putra and Salahuddin

[+](#) Open abstract [View article](#) [PDF](#)

---

**OPEN ACCESS**

012079

Nitrate contamination level in groundwater of the randublatung basin and its surroundings

E E Tantama, M A Kumara, D P E Putra and G I Marliyani

[+](#) Open abstract [View article](#) [PDF](#)

---

**OPEN ACCESS**

012080

Current research in development of polycaprolactone filament for 3D bioprinting: a review

C Amni, Marwan, S Aprilia and E Indarti

[+](#) Open abstract [View article](#) [PDF](#)

---

**OPEN ACCESS**

012081

Nitrate in groundwater of the west side Magelang Regency, Central Java, Indonesia

D Erlinawati, D P E Putra and A D Titisari

[+](#) Open abstract [View article](#) [PDF](#)

---

**OPEN ACCESS**

012082

Adsorption Capacity of Ca<sup>2+</sup> by Hydrochloric Acid Activated Kaolin



[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012083

Production of biodiesel over ZnO-TiO<sub>2</sub> bifunctional oxide catalyst supported on natural zeolite

M Al Muttaqii, M Amin, E Prasetyo, R Alvianny and L Marlinda

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012084

Forecasting model of power generated by wind power plants

A M Ilyas, A Suyuti, I C Gunadin and S M Said

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012085

Biogas efficiency from cow dung waste in strengthening energy security during the covid-19 pandemic through a dynamic modeling system

L Lusiana, N A Sasongko, Y D Kuntjoro, M Fakhruddin, A F Widrian, A M Siregar and A Vidura

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012086

Identification of groundwater potential zones in the Southern Mountains, Yogyakarta Special Region

H Hasibuan, A H Rafsanjani, D P E Putra and S S Surjono

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012087

Bamboo fiber-PLA composite materials for disposable food and beverages packaging tools: a brief review

S Darwin, G Prajna and T A Tamba

[+ Open abstract](#) [View article](#) [PDF](#)



- 
- OPEN ACCESS** 012088  
*In vitro* study of *Cratoxylum glaucum* Stem ethyl acetate extract as antidiabetic  
O Roanisca, R G Mahardika and Y Widyaningrum  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012089  
Ecological design ideas of large-scale public buildings: review of Russian Botanical Garden greenhouses ecological design  
A Budilovskaia and S Yu  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012090  
The effectiveness of a mini photovoltaic cell by using light LED bulbs as a source of photon energy  
Mustofa, Iskandar, Muchsin, S Suluh and T M Kamaludin  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012091  
Fabrication of Norbixin-Sensitized Solar Cell and The Effect of Light Intensity on Its Performance and Reusability  
W Rahmalia, E Crespo and T Usman  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012092  
Performance investigation of grid-connected photovoltaic systems for family household: A case study in Amman, Jordan  
Y Kassem, H Çamur, A A Othman, L Alshrouf, M Yasin and Y Abu-Aysheh  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012093  
Evaluation of wind energy potential for different regions in Lebanon based on NASA wind speed database  
Y Kassem, H Çamur, A A Othman, L Alshrouf, M Yasin and Y Abu-Aysheh



[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012094

Utilization of electric vehicles as an energy alternative to reduce carbon emissions

C Sudjoko, N A Sasongko, I Utami and A Maghfuri

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012095

Analysis of Indonesia and New Zealand geothermal regulation

B Bramantio, S H Sumantri, S Thamrin and N A Sasongko

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012096

Heavy metal (As, Cd, Cr, Hg, Pb) analysis and identification of heavy metal resistant bacteria in sediments from Manado Bay

B J Kepel, W Bodhi, Fatimawali and T E Tallei

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012097

Application of the anaerobic co-digestion method to sewage sludge treatment toward recover green energy and utilize nutrients for agriculture

T Tran, L T A Hong and L V Tan

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012098

Green technologies for air pollution treatment by microalgae in tubular photobioreactor

T T Minh, N H Tien, L V Giang, H H Loc, V T D Hien and T Tran

[+ Open abstract](#) [View article](#) [PDF](#)



- 
- OPEN ACCESS** 012099  
Coral reef monitoring in Panjang Island, Central Bangka  
W Adi, I Akhrianti and M Hudatwi  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012100  
Coral reef condition at the Putri Island, Bangka Regency  
I Akhrianti, I A Syari and A Gustomi  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012101  
Improvement of bearing capacity of clay that is stabilized with bamboo charcoal powder  
S Alam, F Fahriani and Y Apriyanti  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012102  
The Effect of Addition of Bagasse Ash and Eggshell Powder on CBR Value of Clay Soil  
M Carlina, Y Apriyanti and F Fahriani  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012103  
Kinetic evaluation of methylene blue decolorization by CuO as a Fenton-like catalyst  
Y Tiandho, F Afriani, J Evi, R Lingga and Handoyo  
[+](#) Open abstract [View article](#) [PDF](#)
- 
- OPEN ACCESS** 012104  
Water ecosystem services of Merawu Watershed, Banjarnegara, Central Java, Indonesia





[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012105

Solubility of metals content Bangka tin tailings sand using inorganic acids

Adisyahputra, F I P Sari, R G Mahardika and G Afriza

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012106

Optimization of ilmenite ore processing using induced roll magnetic separator

M R Virgiawan and J Pitulima

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012107

Phosphorus desorption and recovery from aqueous solution using amorphous zirconium hydroxide/MgFe layered double hydroxides composite

A Nuryadin and T Imai

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012108

Dynamic optimal power flow calculates intermittent wind turbine using ant colony method

R P Siwi, IC Gunadin, SM Said, A Siswanto and S Humena

[+ Open abstract](#) [View article](#) [PDF](#)

---

**OPEN ACCESS**

012109

Seawater Intrusion Assessment based on Hydrochemical Data in Gapura Sub-district of Sumenep Regency, East Java, Indonesia

R K Warist, W Wilopo and N I Setiawan


[+ Open abstract](#) [View article](#) [PDF](#)



Techno-Economic Analysis of Municipal Solid Waste Gasification System for Electric Generation, Case Study: City at Central Java

A Feisal and A Surjosatyo

**+** Open abstract

 View article

 PDF

**JOURNAL LINKS**

---

Journal home

---

Journal scope

---

Information for organizers

---

Information for authors

---

Contact us

---

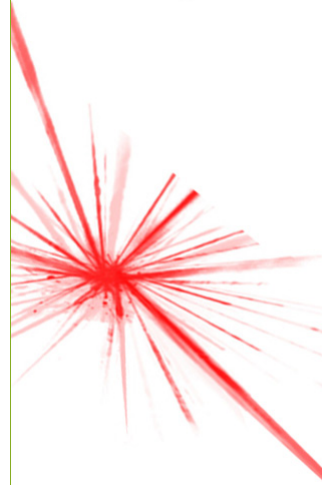
Reprint services from Curran Associates



**physicsworld**  
WEBINAR

**A micro-to-nano  
zoom through  
a real-world  
battery with  
X-ray vision**

Live webinar  
at 6 p.m. BST/  
1 p.m. EDT  
on 17 May 2023



[Click to register](#)



PAPER • OPEN ACCESS

## Removal of Congo Red and Procion Red Using Zn/Fe Pillared Bentonite

To cite this article: Desnelli *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **926** 012051

View the [article online](#) for updates and enhancements.

You may also like

- [Synthesis of CuO/rGO nanocomposites for carcinogenic Congo red photodegradation](#)  
Do Quang Dat, Vo Thi Lan Phuong, Lam Van Nang et al.
- [Chitosan nanoparticles on a natural zeolite as an efficient adsorbent for Congo red](#)  
Y Yulizar, T Utari, D O B Apriandanu et al.
- [Adsorption using chitosan and nano zerovalent iron composite material for sustainable water treatment](#)  
S R Sowmya, G M Madhu, Ravi Sankannavar et al.



The Electrochemical Society  
Advancing solid state & electrochemical science & technology

243rd Meeting with SOFC-XVIII

Boston, MA • May 28 – June 2, 2023

Accelerate scientific discovery!

Learn More & Register



# Removal of Congo Red and Procion Red Using Zn/Fe Pillared Bentonite

Desnelli<sup>1,2</sup>, W R Asri<sup>1,2</sup>, Hasanudin<sup>1,2</sup>, M Said<sup>1,2,\*</sup> and P L Hariani<sup>1,2</sup>

<sup>1</sup> Department of Chemistry, Faculty of Mathematics and Natural Science, Universitas Sriwijaya, Jalan Palembang-Prabumulih Km32 Indralaya, Indonesia

<sup>2</sup> Reseach Centre of Advanced Material and Nanocomposite, Faculty of Mathematics and Natural Science, Universitas Sriwijaya, Jalan Palembang-Prabumulih Km32 Indralaya, Indonesia

\*Email: msaidusman@unsri.ac.id

**Abstract.** The process of pillarization of metal oxide Zn/Fe compounds in bentonite has been carried out. The study of adsorbent weight, pH, adsorption time, and initial concentration were investigated to get the optimum reduction of Congo red and Procion red concentration. In addition, the pseudo kinetic also determined to investigate the rate and type of adsorption. From the experiment, the optimum conditions for removal of Congo red for the adsorbent weight, pH, and adsorption time were 0.02 g, 2, 20 minutes, respectively, while for the removal of Procion red was 0.04 g, 2, 20 minutes, respectively and both of adsorbent followed the pseudo-second-order model kinetics with chemisorption mechanism. Although the optimum conditions for removal of the two dyes were similar, in fact the percentage removal of the Congo red dye was greater. In conclusion, the Zn/Fe pillared bentonite was more suitable for the removal of the Congo red than Procion red.

## 1. Introduction

Dyes can harmfully affect waters and can restrain the action of living organic entities due to their nature. The Congo red and Procion red, as well known dyes, additionally have a significant degree of poisonousness and are difficult to remove naturally. Based on the character, it is really needed to use a suitable method to reduce the pollutant. Among the methods, adsorption is still the best and cheap method to treat the dyes in waste water [1]. A few past investigations have consistently utilized activated carbon as an adsorbent, though enacted carbon has the hindrance that it required high energy of activation method and costly [2]. Along these lines, we need another kind of adsorbent that is cheap, simple to get and reusable.

Bentonite is one of famous natural adsorbent. Bentonite has a layered structur and exchangeable inorganic cations that make it suitable for adsorption process [3]. Since bentonite has a small distance between layers, it needed an addition action to increase the basal spacing. To overcome this, the researcher has been investigated the use of large molecules to increase the distance between layers [4].

Bentonite modification is done by inserting and intercalation material on the surface and inside bentonite as known as doping and pillarization [5]. Metal ions such as  $Al^{+3}$ ,  $Co^{2+}$ ,  $Cu^{+2}$ ,  $Al^{3+}$ ,  $Fe^{+3}$ ,  $Cr^{3+}$ , and so on have been used to increase the adsorption capacity of bentonite via pillarization [6]. Furthermore, the use of a combination of two metal ions, such as Zr/Al [7], Cr/Al [8] and so on, is fascinating because it provides an increased adsorption capacity compared to the single metal [9]. The combination of Zn/Fe metals is getting more attention because these metals are reported to have a high



surface area to volume ratio, high density of reactive surface sites and are environmentally friendly [10-11].

The combination of Zn/Fe metal oxide may have a synergic effect on increasing the ability of bentonite to adsorb dyes. Adsorption studies of Congo red and Procion red dyes using Zn/Fe pillared bentonite have not yet been reported. Therefore, this research will focus on studying the effect of adsorbent weight, pH, adsorption time, and pseudo kinetic parameters of Zn/Fe pillared bentonite on the percentage removal of Congo red and Procion red dyes also will compare to natural bentonite as a control.

## 2. Materials and method

### 2.1. Materials

Bentonite clay was supplied from bentonite deposit located in Lampung Province, Indonesia. The Congo red and Procion red dye were obtained from the local market in Palembang, Indonesia. Materials used in research these are: ZnCl<sub>2</sub>, FeCl<sub>2</sub>, NaOH, and HCl that purchased from Merck Millipore and used as received without further purification.

### 2.2. Pillarization of Bentonite with Metal Oxides Zn/Fe

Pillarization of Zn/Fe was synthesized by adding 12 g of bentonite to 120 mL of distilled water and stirred for 2 hours. The prepared suspension was then added with the Zn/Fe solution. The mixture was stirred and distilled for 24 hours. After 24 hours, the solution was filtered and the solid was dried at 100°C and followed calcined for 2 hours at 400°C.

### 2.3. Effects of Adsorbent Weight

50 mL of Congo red and Procion dye solution with concentration of 100 mg/L in interaction with bentonite polarized Zn/Fe metal oxide and natural bentonite (control) with variation of weight of adsorbent 0.01; 0.02; 0.03; 0.04 and 0.05 g. The mixture was stirred using a horizontal shaker for 60 minutes, then the dyestuff solution having been centrifuged and measured using UV-Vis Spectrophotometer at  $\lambda$  max of 498 nm and 537 nm for Congo red and Procion red, respectively.

### 2.4. Effect of pH

The effect of pH was studied by interaction of 0.05 g bentonite which had been polarized by Zn/Fe metal oxide and natural bentonite (control) and then added to 50 mL of Congo red and Procion dye with concentration of 100 mg/L while stirring in a horizontally using shaker within 1 hour. pH was adjusted by 0.01 M HCl or 0.01 M. NaOH. The pH variations used were 1, 2, 3, 4, 5 and 6. Then we observed the stability using UV-Vis spectrophotometer.

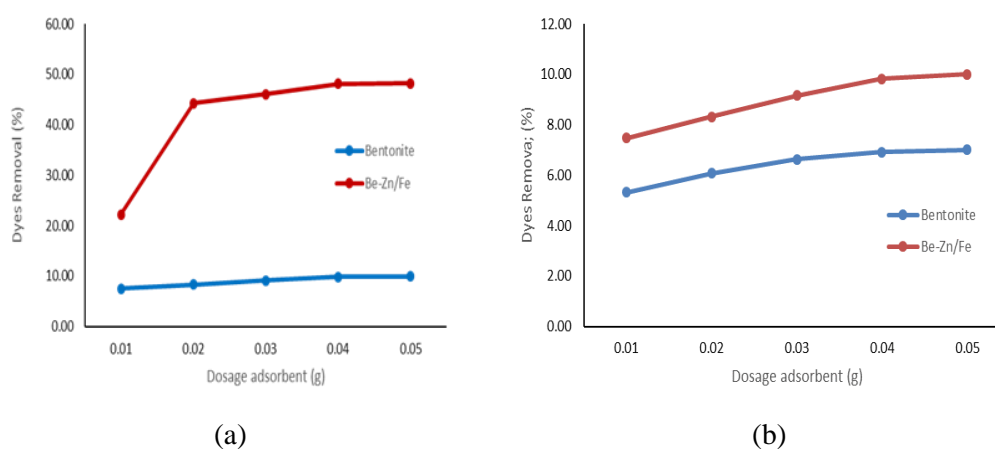
### 2.5. Effect of Adsorption Time and Kinetic Parameters

A total of 0.05 g of natural bentonite (control) was added to 5 mL of dye with a concentration of 100 mg/L. The mixture is stirred with a horizontal shaker at predetermined intervals. Adsorption time variation starts from 20, 30, 40, 50, 60, 70, 80, 90, and 100 minutes. Pigment, which has gone through the adsorption process, is separated and measured its absorbance using a UV-Vis spectrophotometer. The same procedure is performed for the pillarized bentonite adsorbent. The amount of residual concentration (C<sub>e</sub>) and the amount of adsorbed dye (C<sub>0</sub>-C<sub>e</sub>) was calculated using the standard solution calibration curve equation, while the kinetic model can be calculated using pseudo first order and second order pseudo equation.

## 3. Results and Discussion

### 3.1. Effect of Adsorbent weight

Variation of adsorbent dosage was conducted in order to know the influence of adsorption weight between natural and pillarized bentonite on the percentage of dye removal that can be seen in Figure 1.



**Figure 1.** Effect of adsorbent weight on: (a) Congo red and (b) Procyon red

Figure 1 shows that the percentage of dye removal increased with increasing adsorbent dosage. Along with the increase in the adsorbent dosage, the number of active sites also increases. Therefore the adsorption process is more facilitated, leading to an increase in the percentage of dye removal [12]. This trend consistent with similar adsorption studies of Procion Red MX-5B and Crystal Violet using activated carbon from corn cobs reported by Nazifa et al. [13].

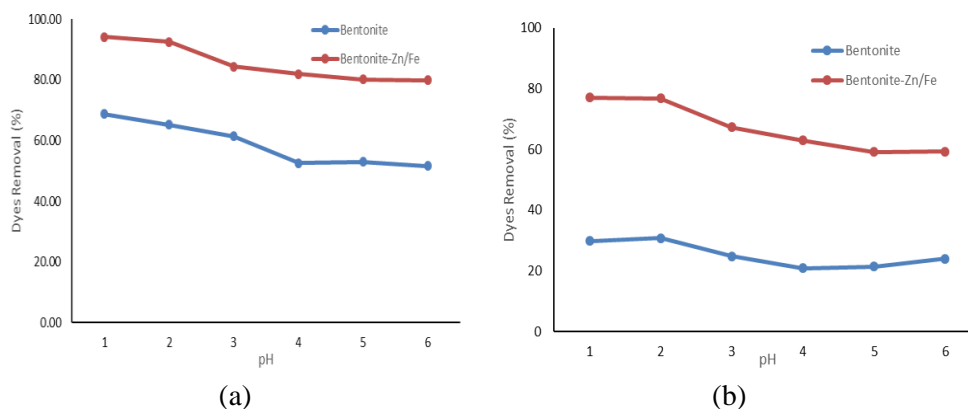
Figure 1 also shows that The percentage of dye removal over Zn/Fe pillared bentonite is greater than natural bentonite, indicating that the pillarization is positively correlated with the increasing ability of bentonite as an adsorbent; this is probably due to the availability of Zn/Fe active sites on the bentonite surface, thus making the percentage of dye removal more effective [6-7]. Similar conditions have been reported by Issaoui et al. [5] using Al pillared bentonite. Furthermore, the increase in the percentage of dye removal in bentonite is relatively insignificant compared to Zn/Fe pillared bentonite. This is probably due to the agglomeration of adsorbent particles and saturation of the active site, thus giving a relatively constant dye removal percentage [16].

The adsorbent dosage effect on the percentage removal of dyes has been reported using other adsorbents. Jumadi et al. [17] using chitosan,  $\text{Fe}_3\text{O}_4$ , and magnetic chitosan nanocomposite (MCN) reported that almost 100 % of dyes removed with an optimum dosage of 50 mg. Stjepanovi et al. [18] using waste wood biomass Euroamerican Poplar with an adsorbent dosage range of 1-10  $\text{mg dm}^{-3}$ , reported that the optimum dosage for Congo red dye removal was 8  $\text{mg dm}^{-3}$  with a dye removal percentage of 69.4 %. Ghorai et al. [19] used polyacrylamide grafted xanthan gum/silica nanocomposite, reported that the optimum dosage for congo red dye removal was 50 mg with a dye removal percentage of 96.37 %. Georgin et al. [20] using avocado shells- $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ , reported that the optimum adsorbent dosage for Procyon red dye removal was 0.3  $\text{g L}^{-1}$  with a dye removal percentage of 96%. Nazifa et al. [13] using activated charcoal from corn cobs, reported that the optimum dosage for Procyon red dye removal was 0.5 g/50 mL with dye removal percentage of 98.9 %. Generally, it can be concluded that Zn/Al pillared bentonite is quite effective in increasing the percentage of dye removal compare to bentonite because of its active site that plays a role in adsorption of dyes.

### 3.2. Effect of Initial pH

Effect of pH on natural and pillared bentonite to Congo red and Procyon red removal are presented in Figure 2 and show that the percentage of dye removal decreased as the pH value increased. This is due to the electrostatic attraction between the anionic dye Congo red which has a negatively charged sulfonate group ( $\text{SO}_3^- \text{Na}^+$ ), and the surface of the adsorbent, which has a positively charged Xylanol group. When the pH is close to neutral, the percentage of dyes removal relatively constant. This is caused by the interaction only involve the physical forces. Furthermore, as the pH increases from neutral to

basic, the amount of negative charge on the surface of the adsorbent increased due to deprotonation leading to electrostatic repulsion with the anionic dye, thus decreasing the percentage of dye removal [10-11]. Similar results have been reported by Etemadinia et al. [23] using  $\text{ZnFe}_2\text{O}_4/\text{SiO}_2/\text{Tragacanth}$  gum magnetic nanocomposite with a pH interval study of 5-11.

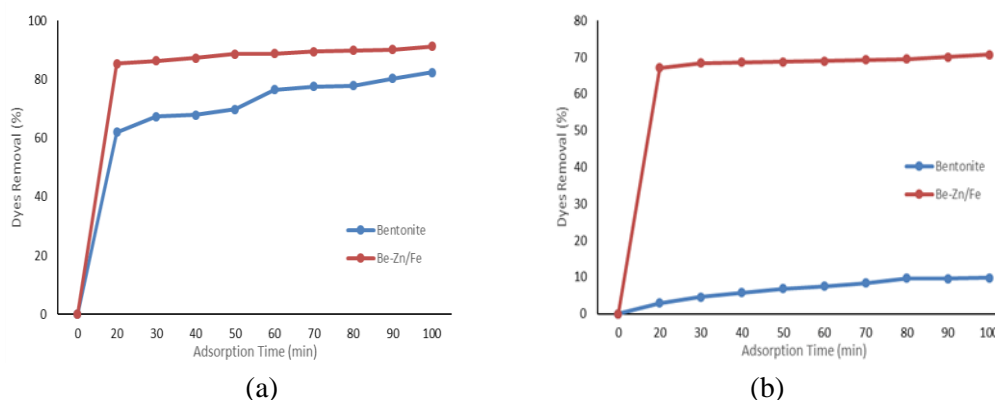


**Figure 2.** Effect of pH on: (a) Congo red and (b) Procyon red

Ribas et al. [24] reported that the maximum dye removal percentage of Procyon Red MX-5B obtained at pH 2 was 84 % using activated carbon from peaches, and this is consistent with the data obtained using bentonite and Zn/Fe pillared bentonite. The percentage affinity for the removal of Congo red and Procyon red relatively different. This difference in affinity is because specific dyes have different electrostatic and physical forces according to their structure, size, and functional groups [15].

### 3.3. Effect of Adsorption Time

The effect of adsorption on the removal of Congo red and Procyon using natural and pillared bentonite are shown in Figure 3.



**Figure 3.** Effect of adsorption time on: (a) the Congo red and (b) Procyon red

From Figure 3, it can be seen that the dye removal process in bentonite and Zn/Fe pillared bentonite is relatively fast in the initial time interval. However, with increasing contact time, the percentage of dye removal increases slowly and gradually reaches equilibrium. A similar condition has been reported by Huang et al. [25] in the study of the adsorption of Rhodamine B and Acid red 1 using CTAB-bentonite with an interval time of 10-130 minutes. The high percentage of dye removal in the early stages was due to the availability of adsorption sites on the surface of the adsorbent. After rapid adsorption, a phase transition occurs where the percentage rate of dye removal is slow and reaches a constant value [15].



The rapid adsorption in the early stages can be attributed to external surface adsorption. While at a slower stage, it occurs through internal surface adsorption [26].

Yulizar et al. [6] reported that the optimum adsorption time occurred at 45 minutes with the percentage of sodium dodecyl benzene-sulfonate adsorption of 99.30% using Al-pillared bentonite/PDDA. Ayati et al. [27] reported that the adsorption of Congo red was achieved in 30 minutes with Na-bentonite and more quickly using Ti, HDTMA, and Al/Fe modified clay, which was less than 20 minutes.

The adsorption kinetics study is an important factor to evaluate the rate of dye removed by the adsorbent. The adsorption process generally occurs through a process that starts from the external mass transfer of adsorbate molecules from the solution to the external adsorbent surface, followed by the transfer of the adsorbed molecules to the adsorption site and finally, the absorption itself [28]. Experimental data can be described by pseudo-first-order and pseudo-second-order and can be seen in equations 1 and 2, respectively.

$$\log (q_e - q_t) = \log q_e \frac{k_1}{2.303} t \quad (1)$$

$$\frac{1}{q_t} = \frac{1}{k_2 q_e^2} + \frac{1}{q_e} t \quad (2)$$

Where  $q_e$  and  $q_t$  are adsorption capacity (mg/g) at equilibrium and any time  $t$  (min), also  $k_1$  ( $\text{min}^{-1}$ ) and  $k_2$  ( $\text{g/mg}\cdot\text{min}$ ) are pseudo-first order and pseudo-second order constant, respectively.

The natural bentonite has a smaller adsorption rate than pillared. It is caused the Zn/Fe metal oxide give a greater reactive rate as listed in Table 1.

**Table 1.** Constant of kinetic adsorption model of Congo red and Procion red

Type of Adsorbate (Adsorbent)	Experimental $Q_e$	Pseudo-first-order (PFO)		Pseudo-Seconds-order (PSO)	
		$Q_e$	$R^2$	$Q_e$	$R^2$
CR (N)	75.76	77.08	0.966	85.83	0.995
CR (P)	80.14	88.16	0.936	90.61	0.988
PR (N)	24.831	52.461	0.906	60.431	0.904
PR (P)	54.761	65.760	0.905	60.666	0.908

From the Table 1 shows the adsorption of Congo red on bentonite and Zn/Fe pillared bentonite match with the PSO kinetic adsorption model with coefficient of determination ( $R^2$ ) 0.995 and 0.988, respectively which higher than PFO. This result indicates that the adsorption process follows PSO kinetics with the chemisorption mechanism [23]. Similar results have been reported by Kadeche et al. [29] in the Coomassie blue dye adsorption study using Na-bentonite and Fe pillared bentonite, and Huang et al. [25] in the study of the adsorption of Rhodamine B and Acid red 1 using organobentonite.

#### 4. Conclusion

The adsorption capacity of bentonite was successfully enhanced by modification using Zn/Fe metal to pillar the inner layer of bentonite. Congo red and Procion red dye can be adsorbed by natural bentonite and Zn/Fe pillared bentonite. The results showed that the adsorption of Congo red and Procion on raw natural and pillared bentonite followed the pseudo-second-order kinetic with chemisorption mechanism.

## References

- [1] Fosso-Kankeu E, Waanders F and Fourie C L 2016 *Desalin. Water Treat.* **57** 27663-27671
- [2] Idan I J, Abdullah L C, Choong T S and Jamil S N A B 2018 *Adsorpt. Sci. Technol.* **36** 694-712
- [3] Toor M, Jin B, Dai S and Vimonses V 2015 *J. Ind. Eng. Chem.* **21** 653-661
- [4] Azis B K, Salh D M, Kaufhold S and Bertier P 2019 *Molecules* **24** 1-15
- [5] Issaoui O, Amor H B, Ismail M and Jeday 2017 *Int. Conf. Green Energy Convers. Syst GECS 2017* vol 4 (Hammamet: IEEE) pp 9-12
- [6] Yulizar Y, Utari T, Apriandanu D O B and Yolani D 2020 *AIP Conf. Proc.* vol 2242 no 1 (Indonesia : AIP Publishing LCC) p 040048
- [7] Huang W, Chen J, He F, Tang J, Li D, Zhu Y and Zhang Y 2015 *App. Clay Sci.* **104** 252-260
- [8] Said M, Dian A R, Mohadi R and Lesbani A 2020 *Molekul* **15** 140-148
- [9] Elhalil A, Elmoubarki R, Farnane M, Machrouhi A, Sadiq M, Mahjoubi F Z, Qourzal S and Barka N 2018 *Environ. Nanotechnology Monit. Manag.* **10** 63-72
- [10] Zafar M N, Dar Q, Nawaz F, Zafar M N, Iqbal M and Nazar M F 2019 *J. Mater. Res. Technol.* **8(1)** 713-725
- [11] Siddiqui S I and Chaudhry S A 2017 *Process Saf. Environ. Prot.* **111** 592-626
- [12] Djelloula C, Housseineb A and Hamdaouic O 2017 *Desalin. Water Treat.* **78** 313-320
- [13] Nazifa T H, Habba N, Aris A and Hadibarata T 2018 *J. Chinese Chem. Soc.* **65** 259-270
- [14] Ain Q U, Rasheed U, Yaseen M, Zhang H and Tong Z 2020 *J. Hazard. Mater.* **397** 122758
- [15] Anirudhan T S and Ramachandran M 2015 *Process Saf. Environ. Prot* **95** 215-225
- [16] Jain N, Dwivedi M K, Waskle A 2016 *Int. J. Adv. Eng. Res. Sci.* **3** 9-16
- [17] Jumadi J, Kamari A, Rahim N A, Wong S T S, Yusoff S N M, Ishak S, Abdulrasool M M and Kumaran S 2019 *J. Phys. Conf. Ser.* **1397(1)** 012027
- [18] Stjepanović M, Velić N, Galić A, Kosović I, Jakovljević T and Habuda-Stanić M 2021 *Water (Switzerland)* **13(3)** 279
- [19] Ghorai S, Sarkar A K, Panda A B and Pal S 2013 *Bioresour. Technol.* **144** 485-891
- [20] Georgin J, da Silva Marques B, da Silveira Salla J, Folleto E L, Allasia D and Dotto G L 2018 *Environ. Sci. Pollut. Res.* **25(7)** 6429-6442
- [21] Han Z X, Zhu Z, Wu D D, Wu J, Liu Y R 2014 *Synth. React. Inorganic Met. Nano-Metal Chem.* **44(1)** 140-147
- [22] Khelifi S, Ayari F, Choukchou-Braham A and Chehimi D B H 2018 *J. Porous Mater.* **25** 885-896
- [23] Etemadinia T, Barikbin B and Allahresani A 2019 *Surface and Interface* **14** 117-126
- [24] Ribas M C, De Franco M A, Adebayo M A, Lima E C, Parkes G M and Feris L A 2020 *Appl. Water Sci.* **10(6)** 1-13
- [25] Huang Z, Li Y, Chem W, Shi J, Zhang N, Wang X, Li Z, Gao L and Zhang Y 2017 *Mater. Chem. Phys* **202** 266-276
- [26] Huang R, Zhang L, Hu P and Wang J 2016 *Int. J. Biol. Macromol.* **86** 496-504
- [27] Ayari F, Manai G, Khelifi S and Trabelsi-Ayadi M 2019 *Saudi Chem. Soc.* **23** 294-306
- [28] Ullah S, Rahman A U, Ullah F, Rahid A, Arshad T, Vigišová, Galamboš M, Mahmoodi N M and Ullah H 2021 **13** *Water* 965
- [29] Kadeche A, Ramdani, A, Adjdir M, Guendouzi, A, Taleb S, Kaid M and Deratani A 2020 *Res. Chem. Intermed.* **46** 4985-5008

## Acknowledgement

The research of this article was funded by DIPA of Public Service Agency of Universitas Sriwijaya 2021. SP DIPA-023.17.2.677515/2021, On November 23, 2020. In accordance with the Rector's Decree Number : 0010/UN9/SK.LP2M.PT/2021, On April 28, 2021



# CERTIFICATE

No : 088/ICoGEE/IX/2021

This certificate awarded to

**Dr. Muhammad Said, M.T**

as **Presenter** of the paper entitled

**Removal of Congo Red and Procion Red Using Zn/Fe Pillared Bentonite**

in **The 3rd International Conference on Green Energy and Environment (ICoGEE 2021)**

September 29<sup>th</sup>, 2021  
Pangkalpinang, Indonesia

Head of Organizing Committee

**ICoGEE**  
3<sup>rd</sup> INTERNATIONAL CONFERENCE ON  
GREEN ENERGY AND ENVIRONMENT 2021

**Herman Aldila, S.Pd., M.Si.**

