

Editorial Board

EDITOR-IN-CHIEF:

Gabriel Borowski – Lublin University of Technology, Faculty of Environmental Engineering, Poland
e-mail: g.borowski@pollub.pl (<mailto:g.borowski@pollub.pl>)

SCIENTIFIC BOARD MEMBERS:

Maria de Fátima Nunes de Carvalho – Polytechnic Institute of Beja, Portugal

Myroslav S. Malovanyy – Lviv Polytechnic National University, Ukraine

Maria Cristina Lavagnolo – University of Padova, Italy

Antonio Joao Carvalho de Albuquerque – University of Beira Interior, Covilhã, Portugal

Sameh Alsaqoor – Tafila Technical University, Jordan

Süer Anaç – Ege University, Izmir, Turkey

Rune Bakke – University College of Southeast Norway, Norway

Nelson Barros – University of Fernando Pessoa, Porto, Portugal

Zhihong Cao – Institute of Soil Sciences, Chinese Academy of Sciences, Nanjing, China

Aneta Czechowska-Kosacka – Lublin University of Technology, Poland

Magdalena Gajewska – Gdańsk University of Technology, Poland

Joan Garcia – Polytechnic University of Catalonia, Barcelona, Spain

Hassimi Abu Hasan – National University of Malaysia

Faruque Hossain – New York University, New York, USA

Katarzyna Ignatowicz – Białystok University of Technology, Poland

Krzysztof Józwiakowski – University of Life Sciences in Lublin, Poland

Aleksander Kiryluk – Białystok University of Technology, Poland

Michał Kopeć – University of Agriculture in Kraków, Poland

Joanna Kostecka – University of Rzeszów, Poland

Jana Kotovicová – Mendel University in Brno, Czech Republic

Peter Kováčik – Slovak University of Agriculture (SUA) in Nitra, Slovak Republic

Grzegorz Kusza – Opole University, Poland

Fabio Masi – IRIDRA S.r.l., Florence, Italy

Yurij A. Mazhaysky – Ryazan State Agricultural Academy, Ryazan, Russia

Álvaro Monteiro – University of Fernando Pessoa, Porto, Portugal

Adam M. Paruch – Norwegian Institute for Agricultural and Environmental Research – Bioforsk, Norway

Lucjan Pawłowski – Lublin University of Technology, Poland

Ryszard Pokładek – Wrocław University of Environmental and Life Sciences, Poland

Katerina Pozachenyuk – Taurida National V.I. Vernadsky University, Ukraine

Harsha Ratnaweera – Norwegian Institute for Water Research – NIVA, Oslo, Norway
Czesława Rosik-Dulewska – Opole University, Poland



Hynek Roubík – Czech University of Life Sciences Prague, Czech Republic

Pavel Ryant – Mendel University in Brno, Czech Republic

Herald Schöne – Neubrandenburg University of Applied Sciences, Germany

László Simon – University College of Nyíregyháza, Hungary

Elżbieta Skorbiłowicz – Białystok University of Technology, Poland

Vladimir Soldatov – National Academy of Sciences of Belarus, Minsk, Belarus

Jung-Jeng Su – National Taiwan University, Taipei, Taiwan

Agata Szymańska-Pulikowska – Wrocław University of Environmental and Life Sciences, Poland

Alexander Tsyganov – Belarusian State Agricultural Academy, Gorki, Belarus

Tomasz Tymiński – Wrocław University of Environmental and Life Sciences, Poland

Sylvia Waara – Halmstad University, Sweden

Andrzej Wac-Włodarczyk – Lublin University of Technology, Poland

Raoul Weiler – University of Leuven, Belgium

Józefa Wiater – Białystok University of Technology, Poland

Barbara Wiśniowska-Kielian – University of Agriculture in Kraków, Poland

Xiaoping Zhu – Hunter College of The City University of New York, USA

CONSULTING EDITORS:

Izolda Gorgol – Department of Applied Mathematics, Lublin University of Technology, Poland

Szymon Obrusiewicz – Faculty of Environmental Engineering, Lublin University of Technology, Poland

Submit your paper (<https://www.editorialsystem.com/jeeng>)



Instructions for Authors (<http://www.jeeng.net/Instructions-for-Authors,25.html>)



All issues (<http://www.jeeng.net/Archive>)



Articles in press (<http://www.jeeng.net/Online-first>)



Most read



Month Year

Impact of Municipal Solid Waste Landfill on Environment – a Case Study

(<http://www.jeeng.net/Impact-of-Municipal-Solid-Waste-Landfill-on-Environment-a-Case-Study,89664,0,2.html>)

Wastewater Treatment Methods for Effluents from the Confectionery Industry – an Overview
(<http://www.jeeng.net/Wastewater-Treatment-Methods-for-Effluents-from-the-Confectionery-Industry-an-Overview,112557,0,2.html>)

Assessment of Comprehensive Environmental Pollution Index of Kurichi Industrial Cluster, Coimbatore District, Tamil Nadu, India - a Case Study (<http://www.jeeng.net/Assessment-of-Comprehensive-Environmental-Pollution-Index-of-Kurichi-Industrial-Cluster,78747,0,2.html>)

[EN \(http://www.jeeng.net/\)](http://www.jeeng.net/)

[PL \(http://www.jeeng.net/pl\)](http://www.jeeng.net/pl)



Indexes

[Keywords index \(http://www.jeeng.net/Keywords\)](http://www.jeeng.net/Keywords)

[Authors index \(http://www.jeeng.net/Authors\)](http://www.jeeng.net/Authors)



Copyright © 2006-2020 Bentus (<http://www.bentus.com>) All rights reserved.

All issues

< (<http://www.jeeng.net/Issue-7-2019,7471>)

> (<http://www.jeeng.net/Issue-9-2019,7473>)

Volume 20, Issue 8, 2019

Variability of the Water Quality Characterizing High Andean Lagoons for Tourist Use Evaluated Through Multivariate Statistical Methods, Junín, Peru

(<http://www.jeeng.net/Variability-of-the-Water-Quality-Characterizing-High-Andean-Lagoons-for-Tourist-Use,109800,0,2.html>)

María Custodio (<http://www.jeeng.net/Author-María-Custodio/92490>), Gloria Miranda (<http://www.jeeng.net/Author-Gloria-Miranda/121759>), Richard Peñaloza (<http://www.jeeng.net/Author-Richard-Peñaloza/92491>), Heidi De la Cruz (<http://www.jeeng.net/Author-Heidi-De-la-Cruz/121760>), Fernán Chanmé (<http://www.jeeng.net/Author-Fernán-Chanmé/121761>)


J. Ecol. Eng. 2019; 20(8):1–11

DOI: <https://doi.org/10.12911/22998993/109800> (<https://doi.org/10.12911/22998993/109800>)

 Abstract

 Stats

(<http://www.jeeng.net/Variability-of-the-Water-Quality-Characterizing-High-Andean-Lagoons-for-Tourist-Use,109800,0,2.html>)

 Article (PDF) ([http://www.jeeng.net/pdf-109800-41895?filename=Variability of the Water.pdf](http://www.jeeng.net/pdf-109800-41895?filename=Variability%20of%20the%20Water.pdf))

Modification of Natural Clays for Use in the Processes of Sewage Treatment

(<http://www.jeeng.net/Modification-of-Natural-Clays-for-Use-in-the-Processes-of-Sewage-Treatment,111152,0,2.html>)

Lyudmila Pimneva (<http://www.jeeng.net/Author-Lyudmila-Pimneva/84360>), Alla Zagorskaya (<http://www.jeeng.net/Author-Alla-Zagorskaya/84359>)

J. Ecol. Eng. 2019; 20(8):12–17

DOI: <https://doi.org/10.12911/22998993/111152> (<https://doi.org/10.12911/22998993/111152>)


 Stats

 Abstract

(<http://www.jeeng.net/Modification-of-Natural-Clays-for-Use-in-the-Processes-of-Sewage-Treatment,111152,0,2.html>)

PL (<http://www.jeeng.net/pl>)



 Article (PDF) ([http://www.jeeng.net/pdf-111152-44355?filename=Modification of Natural.pdf](http://www.jeeng.net/pdf-111152-44355?filename=Modification%20of%20Natural.pdf))

Transforming Brownfields from Deteriorated to Revitalized Space – The Role of Local Urban Community


(<http://www.jeeng.net/Transforming-Brownfields-from-Deteriorated-to-Revitalized-Space-The-Role-of-Local,110961,0,2.html>)

Aseel Essam Abuzayed (<http://www.jeeng.net/Author-Aseel-Abuzayed/124012>), Nabeel Al-Kurdi (<http://www.jeeng.net/Author-Nabeel-Al-Kurdi/124013>)


J. Ecol. Eng. 2019; 20(8):18–34

DOI: <https://doi.org/10.12911/22998993/110961> (<https://doi.org/10.12911/22998993/110961>)

 Abstract

 Stats

(<http://www.jeeng.net/Transforming-Brownfields-from-Deteriorated-to-Revitalized-Space-The-Role-of-Local,110961,0,2.html>)

 Article (PDF) ([http://www.jeeng.net/pdf-110961-41893?filename=Transforming Brownfields.pdf](http://www.jeeng.net/pdf-110961-41893?filename=Transforming%20Brownfields.pdf))

Economic Valuation and Effectiveness of Utilizing Electrocoagulation System in Reducing Chemical Oxygen Demand of Textile Industry Wastewater


(<http://www.jeeng.net/Economic-Valuation-and-Effectiveness-of-Utilizing-Electrocoagulation-System-in-Reducing,110960,0,2.html>)

Elanda Fikri (<http://www.jeeng.net/Author-Elanda-Fikri/64655>), Nita Shinta Wati (<http://www.jeeng.net/Author-Nita-Wati/124010>), Tati Ruhmawati (<http://www.jeeng.net/Author-Tati-Ruhmawati/124011>)


J. Ecol. Eng. 2019; 20(8):35–43

DOI: <https://doi.org/10.12911/22998993/110960> (<https://doi.org/10.12911/22998993/110960>)

 Abstract

 Stats

(<http://www.jeeng.net/Economic-Valuation-and-Effectiveness-of-Utilizing-Electrocoagulation-System-in-Reducing,110960,0,2.html>)

 Article (PDF) ([http://www.jeeng.net/pdf-110960-41892?filename=Economic Valuation and.pdf](http://www.jeeng.net/pdf-110960-41892?filename=Economic%20Valuation%20and.pdf))

Utilization of Sewage Sludge after the Process of Autothermal Digestion

(<http://www.jeeng.net/Utilization-of-Sewage-Sludge-after-the-Process-of-Autothermal-Digestion,110840,0,2.html>) EN (<http://www.jeeng.net/>) PL (<http://www.jeeng.net/pl>)



Izabela Bartkowska (<http://www.jeeng.net/Author-Izabela-Bartkowska/116>), Lech Dzienis (<http://www.jeeng.net/Author-Lech-Dzienis/29206>)

J. Ecol. Eng. 2019; 20(8):44–49

DOI: <https://doi.org/10.12911/22998993/110840> (<https://doi.org/10.12911/22998993/110840>)

Abstract

Stats

(<http://www.jeeng.net/Utilization-of-Sewage-Sludge-after-the-Process-of-Autothermal-Digestion,110840,0,2.html>)

Article (PDF) ([http://www.jeeng.net/pdf-110840-41891?filename=Utilization of Sewage.pdf](http://www.jeeng.net/pdf-110840-41891?filename=Utilization%20of%20Sewage.pdf))

Reagent Removal of Heavy Metals from Waters of Coal Mines and Spoil Tips of the Lviv-Volyn Industrial Mine Region

(<http://www.jeeng.net/Reagent-Removal-of-Heavy-Metals-from-Waters-of-Coal-Mines-and-Spoil-Tips-of-the-Lviv,110829,0,2.html>)

Oksana Tymofiyivna Mazurak (<http://www.jeeng.net/Author-Oksana-Mazurak/123847>), Irina Solovodzinska (<http://www.jeeng.net/Author-Irina-Solovodzinska/123848>), Andriy Mazurak (<http://www.jeeng.net/Author-Andriy-Mazurak/123849>), Natalia Grynychshyn (<http://www.jeeng.net/Author-Natalia-Grynychshyn/123852>)

J. Ecol. Eng. 2019; 20(8):50–59

DOI: <https://doi.org/10.12911/22998993/110829> (<https://doi.org/10.12911/22998993/110829>)

Abstract

Stats

(<http://www.jeeng.net/Reagent-Removal-of-Heavy-Metals-from-Waters-of-Coal-Mines-and-Spoil-Tips-of-the-Lviv,110829,0,2.html>)

Article (PDF) ([http://www.jeeng.net/pdf-110829-41890?filename=Reagent Removal of Heavy.pdf](http://www.jeeng.net/pdf-110829-41890?filename=Reagent%20Removal%20of%20Heavy.pdf))

Isolation and Identification of Native Bacteria from Total Petroleum Hydrocarbon Polluted Soil in Wonocolo Public Oilfields, Indonesia

(<http://www.jeeng.net/Isolation-and-Identification-of-Native-Bacteria-from-Total-Petroleum-Hydrocarbon,110816,0,2.html>)

Gina Lova Sari (<http://www.jeeng.net/Author-Gina-Sari/78465>), Yulinah Trihadiningrum (<http://www.jeeng.net/Author-Yulinah-Trihadiningrum/78466>), Ni'matuzahroh Ni'matuzahroh (<http://www.jeeng.net/Author-Ni'matuzahroh-Ni'matuzahroh/78467>)

J. Ecol. Eng. 2019; 20(8):60–64

DOI: <https://doi.org/10.12911/22998993/110816> (<https://doi.org/10.12911/22998993/110816>)

Abstract

Stats

(<http://www.jeeng.net/Isolation-and-Identification-of-Native-Bacteria-from-Total-Petroleum-Hydrocarbon,110816,0,2.html>)

Content and Uptake of Selected Microelements with Potato Tuber Yield Treated with Biostimulators

(http://www.jeeng.net/Content-and-Uptake-of-Selected-Microelements-with-Potato-Tuber-Yield-Treated-with,110815,0,2.html)

Iwona Teresa Mystkowska (http://www.jeeng.net/Author-Iwona-Mystkowska/1017), Anna Rogóż -Matyszczyk (http://www.jeeng.net/Author-Anna-Rogóż -Matyszczyk/123833)

J. Ecol. Eng. 2019; 20(8):65–70

DOI: https://doi.org/10.12911/22998993/110815 (https://doi.org/10.12911/22998993/110815)

Abstract

Stats

(http://www.jeeng.net/Content-and-Uptake-of-Selected-Microelements-with-Potato-Tuber-Yield-Treated-with,110815,0,2.html)

Article (PDF) (http://www.jeeng.net/pdf-110815-41881?filename=Content and Uptake of.pdf)

Characterization of the Zellidja Lead Smelter Slag (Eastern Morocco) in order to their Valorization in Civil Engineering

(http://www.jeeng.net/Characterization-of-the-Zellidja-Lead-Smelter-Slag-Eastern-Morocco-in-order-to-their,110812,0,2.html)

Raja Moussaoui (http://www.jeeng.net/Author-Raja-Moussaoui/123826), Souad EL Moudni EL Alami (http://www.jeeng.net/Author-Souad-EL Moudni EL Alami/123827), Hassan Aouraghe (http://www.jeeng.net/Author-Hassan-Aouraghe/123828)

J. Ecol. Eng. 2019; 20(8):71–81

DOI: https://doi.org/10.12911/22998993/110812 (https://doi.org/10.12911/22998993/110812)

Abstract

Stats

(http://www.jeeng.net/Characterization-of-the-Zellidja-Lead-Smelter-Slag-Eastern-Morocco-in-order-to-their,110812,0,2.html)

Article (PDF) (http://www.jeeng.net/pdf-110812-41880?filename=Characterization_of_the_Z.pdf)

The Effect of Maintenance Works on Ichthyofauna in the Context of Hydrochemical Conditions of Small Watercourses of Central and North-Western Poland

(http://www.jeeng.net/The-Effect-of-Maintenance-Works-on-Ichthyofauna-in-the-Context-of-Hydrochemical-Conditions,110814,0,2.html)



J. Ecol. Eng. 2019; 20(8):82–89

DOI: <https://doi.org/10.12911/22998993/110814> (<https://doi.org/10.12911/22998993/110814>)

Abstract

Stats

(<http://www.jeeng.net/The-Effect-of-Maintenance-Works-on-Ichthyofauna-in-the-Context-of-Hydrochemical-Conditions,110814,0,2.html>)

Article (PDF) ([http://www.jeeng.net/pdf-110814-41877?filename=The Effect of Maintenance.pdf](http://www.jeeng.net/pdf-110814-41877?filename=The%20Effect%20of%20Maintenance.pdf))

β-glucan-mediated Alleviation of NaCl Stress in *Ocimum basilicum* L. in Relation to the Response of Antioxidant Enzymes and Assessment DNA Marker

(<http://www.jeeng.net/-glucan-mediated-Alleviation-of-NaCl-Stress-in-Ocimum-basilicum-L-in-Relation-to,110790,0,2.html>)

Arshad Naji Alhasnawi (<http://www.jeeng.net/Author-Arshad-Alhasnawi/124771>)

J. Ecol. Eng. 2019; 20(8):90–99

DOI: <https://doi.org/10.12911/22998993/110790> (<https://doi.org/10.12911/22998993/110790>)

Abstract

Stats

(<http://www.jeeng.net/-glucan-mediated-Alleviation-of-NaCl-Stress-in-Ocimum-basilicum-L-in-Relation-to,110790,0,2.html>)

Article (PDF) (http://www.jeeng.net/pdf-110790-41876?filename=_glucan_mediated.pdf)

Analysis of the Energetic Use of Fuel Fractions Made of Plastic Waste

(<http://www.jeeng.net/Analysis-of-the-Energetic-Use-of-Fuel-Fractions-Made-of-Plastic-Waste,110766,0,2.html>)

Halina Marczak (<http://www.jeeng.net/Author-Halina-Marczak/172>)

J. Ecol. Eng. 2019; 20(8):100–106

DOI: <https://doi.org/10.12911/22998993/110766> (<https://doi.org/10.12911/22998993/110766>)

Abstract

Stats

(<http://www.jeeng.net/Analysis-of-the-Energetic-Use-of-Fuel-Fractions-Made-of-Plastic-Waste,110766,0,2.html>)

Article (PDF) ([http://www.jeeng.net/pdf-110766-41875?filename=Analysis of the Energetic.pdf](http://www.jeeng.net/pdf-110766-41875?filename=Analysis%20of%20the%20Energetic.pdf))



(<http://www.jeeng.net/Innovative-Approach-in-Creation-of-Integrated-Technology-of-Desalination-of-Mineralized,110767,0,2.html>)

Inna Trus (<http://www.jeeng.net/Author-Inna-Trus/123744>), Iaroslav Radovenchyk (<http://www.jeeng.net/Author-Iaroslav-Radovenchyk/114275>), Vita Halysh (<http://www.jeeng.net/Author-Vita-Halysh/114277>), Margarita Skiba (<http://www.jeeng.net/Author-Margarita-Skiba/123745>), Inna Vasylenko (<http://www.jeeng.net/Author-Inna-Vasylenko/123746>), Victoria Vorobyova (<http://www.jeeng.net/Author-Victoria-Vorobyova/123747>), Olena Hlushko (<http://www.jeeng.net/Author-Olena-Hlushko/123748>), Ludmila Sirenko (<http://www.jeeng.net/Author-Ludmila-Sirenko/123749>)

J. Ecol. Eng. 2019; 20(8):107–113

DOI: <https://doi.org/10.12911/22998993/110767> (<https://doi.org/10.12911/22998993/110767>)

Abstract

Stats

(<http://www.jeeng.net/Innovative-Approach-in-Creation-of-Integrated-Technology-of-Desalination-of-Mineralized,110767,0,2.html>)

Article (PDF) ([http://www.jeeng.net/pdf-110767-41874?filename=Innovative Approach in.pdf](http://www.jeeng.net/pdf-110767-41874?filename=Innovative+Approach+in.pdf))

Histological Damage at Gonad of Faunus ater (Gastropod Mollusk) Obtained from Heavy Metal Contaminated River

(<http://www.jeeng.net/Histological-Damage-at-Gonad-of-Faunus-ater-Gastropod-Mollusk-Obtained-from-Heavy,110787,0,2.html>)

Rahmi Agustina (<http://www.jeeng.net/Author-Rahmi-Agustina/123783>), M Ali Sarong (<http://www.jeeng.net/Author-M-Sarong/123784>), Fredinan Yulianda (<http://www.jeeng.net/Author-Fredinan-Yulianda/123785>), Suhendrayatna Suhendrayatna (<http://www.jeeng.net/Author-Suhendrayatna-Suhendrayatna/123786>), Ervina Dewi (<http://www.jeeng.net/Author-Ervina-Dewi/123787>)

J. Ecol. Eng. 2019; 20(8):114–119

DOI: <https://doi.org/10.12911/22998993/110787> (<https://doi.org/10.12911/22998993/110787>)

Abstract

Stats

(<http://www.jeeng.net/Histological-Damage-at-Gonad-of-Faunus-ater-Gastropod-Mollusk-Obtained-from-Heavy,110787,0,2.html>)

Article (PDF) ([http://www.jeeng.net/pdf-110787-41873?filename=Histological Damage at.pdf](http://www.jeeng.net/pdf-110787-41873?filename=Histological+Damage+at.pdf))

The Influence of Drainage Devices and Post-Bog Soil Changes on Water Retention in Drained Lower Supraśl River


(<http://www.jeeng.net/The-Influence-of-Drainage-Devices-and-Post-Bog-Soil-Changes-on-Water-Retention-in,110788,0,2.html>)


Aleksander Kiryluk (<http://www.jeeng.net/Author-Aleksander-Kiryluk/498>)

J. Ecol. Eng. 2019; 20(8):120–128

DOI: <https://doi.org/10.12911/22998993/110788> (<https://doi.org/10.12911/22998993/110788>)
EN (<http://www.jeeng.net/>) PL (<http://www.jeeng.net/pl>)



 Abstract
(<http://www.jeeng.net/The-Influence-of-Drainage-Devices-and-Post-Bog-Soil-Changes-on-Water-Retention-in,110788,0,2.html>)

 Article (PDF) ([http://www.jeeng.net/pdf-110788-41872?filename=The Influence of Drainage.pdf](http://www.jeeng.net/pdf-110788-41872?filename=The%20Influence%20of%20Drainage.pdf))


Particularities of Forming Desert Pastures Near Settlements of Southern Balkhash (Kazakhstan)

(<http://www.jeeng.net/Particularities-of-Forming-Desert-Pastures-Near-Settlements-of-Southern-Balkhash,110768,0,2.html>)


Kanaibek Kubenkulov (<http://www.jeeng.net/Author-Kanaibek-Kubenkulov/123750>), Ashat Naushabaev (<http://www.jeeng.net/Author-Ashat-Naushabaev/123751>), Niet Abdirahymov (<http://www.jeeng.net/Author-Niet-Abdirahymov/123752>), Bagdat Rustemov (<http://www.jeeng.net/Author-Bagdat-Rustemov/123753>), Samat Bazarbaev (<http://www.jeeng.net/Author-Samat-Bazarbaev/123754>)

J. Ecol. Eng. 2019; 20(8):129–134

DOI: <https://doi.org/10.12911/22998993/110768> (<https://doi.org/10.12911/22998993/110768>)

 Abstract
(<http://www.jeeng.net/Particularities-of-Forming-Desert-Pastures-Near-Settlements-of-Southern-Balkhash,110768,0,2.html>)

 Stats

 Article (PDF) ([http://www.jeeng.net/pdf-110768-41871?filename=Particularities of.pdf](http://www.jeeng.net/pdf-110768-41871?filename=Particularities%20of.pdf))


The Analysis of the Amount of Pollutants in Wastewater after Mechanical Treatment in the Aspect of their Susceptibility to Biodegradation in the Treatment Plant in Nowy Targ

(<http://www.jeeng.net/The-Analysis-of-the-Amount-of-Pollutants-in-Wastewater-after-Mechanical-Treatment,110393,0,2.html>)

Elwira Nowobilaska-Majewska (<http://www.jeeng.net/Author-Elwira-Nowobilaska-Majewska/62049>), Piotr Michał Bugajski (<http://www.jeeng.net/Author-Piotr-Bugajski/8265>)

J. Ecol. Eng. 2019; 20(8):135–143

DOI: <https://doi.org/10.12911/22998993/110393> (<https://doi.org/10.12911/22998993/110393>)

 Abstract
(<http://www.jeeng.net/The-Analysis-of-the-Amount-of-Pollutants-in-Wastewater-after-Mechanical-Treatment,110393,0,2.html>)

 Stats

Cytotoxic Test of Octopus cyanea Ink Extract

(<http://www.jeeng.net/Cytotoxic-Test-of-Octopus-cyanea-Ink-Extract,111153,0,2.html>)

John Dominggus Kalor (<http://www.jeeng.net/Author-John-Kalor/97395>), Eva Susanty Simaremare (<http://www.jeeng.net/Author-Eva-Simaremare/124236>), Gloria Wabiser (<http://www.jeeng.net/Author-Gloria-Wabiser/124237>), Allowisya Futwembun (<http://www.jeeng.net/Author-Allowisya-Futwembun/124238>), Elsy Gunawan (<http://www.jeeng.net/Author-Elsye-Gunawan/124239>), Yuliana Rut Yabansabra (<http://www.jeeng.net/Author-Yuliana-Yabansabra/124240>)


J. Ecol. Eng. 2019; 20(8):144–152

DOI: <https://doi.org/10.12911/22998993/111153> (<https://doi.org/10.12911/22998993/111153>)

 Abstract

 Stats

(<http://www.jeeng.net/Cytotoxic-Test-of-Octopus-cyanea-Ink-Extract,111153,0,2.html>)

 Article (PDF) (<http://www.jeeng.net/pdf-111153-41869?filename=Cytotoxic Test of Octopus.pdf>)

The Agriculture and Forestry Lands Level of Changes in Planning Process as a Sustainable Development Measure of Municipalities Located within National Parks Impact Areas


(<http://www.jeeng.net/The-Agriculture-and-Forestry-Lands-Level-of-Changes-in-Planning-Process-as-a-Sustainable,110791,0,2.html>)

Konrad Podawca (<http://www.jeeng.net/Author-Konrad-Podawca/44121>), Agata Pawłat-Zawrzykraj (<http://www.jeeng.net/Author-Agata-Pawłat-Zawrzykraj/44122>)


J. Ecol. Eng. 2019; 20(8):153–164

DOI: <https://doi.org/10.12911/22998993/110791> (<https://doi.org/10.12911/22998993/110791>)

 Abstract

 Stats

(<http://www.jeeng.net/The-Agriculture-and-Forestry-Lands-Level-of-Changes-in-Planning-Process-as-a-Sustainable,110791,0,2.html>)

 Article (PDF) (<http://www.jeeng.net/pdf-110791-41868?filename=The Agriculture and.pdf>)

Diversity in Anthropogenic Environment – Permanent Puddle as a Place for Development of Diatoms


(<http://www.jeeng.net/Diversity-in-Anthropogenic-Environment-Permanent-Puddle-as-a-Place-for-Development,111463,0,2.html>)


Mateusz Rybak (<http://www.jeeng.net/Author-Mateusz-Rybak/33180>), Teresa Noga (<http://www.jeeng.net/Author-Teresa-Noga/34>), Anita Poradowska (<http://www.jeeng.net/Author-Anita-Poradowska/66043>)

J. Ecol. Eng. 2019; 20(8):165–174

DOI: <https://doi.org/10.12911/22998993/111463> (<https://doi.org/10.12911/22998993/111463>)

 Abstract

 Stats

 Article (PDF) ([http://www.jeeng.net/pdf-111463-421452?filename=Life-Cycle-Assessment-of-the-Mixed-Municipal-Waste-Management-System-Based-on-Mechanical,111463,0,2.html](http://www.jeeng.net/pdf-111463-421452?filename=Life-Cycle-Assessment-of-the-Mixed-Municipal-Waste-Management-System-Based-on-Mechanical-Biological-Treatment,111463,0,2.html)) Diversity in.pdf
in-Anthropogenic-
Environment-
Permanent-Puddle-
as-a-Place-for-
Development,111463,0,2.html)

Life Cycle Assessment of the Mixed Municipal Waste Management System Based on Mechanical-Biological Treatment

(<http://www.jeeng.net/Life-Cycle-Assessment-of-the-Mixed-Municipal-Waste-Management-System-Based-on-Mechanical,111323,0,2.html>)

Karolina Joanna Kossakowska (<http://www.jeeng.net/Author-Karolina-Kossakowska/59117>), Katarzyna Grzesik (<http://www.jeeng.net/Author-Katarzyna-Grzesik/47163>)


J. Ecol. Eng. 2019; 20(8):175–183

DOI: <https://doi.org/10.12911/22998993/111323> (<https://doi.org/10.12911/22998993/111323>)

 Abstract

 Stats

(<http://www.jeeng.net/Life-Cycle-Assessment-of-the-Mixed-Municipal-Waste-Management-System-Based-on-Mechanical,111323,0,2.html>)

 Article (PDF) (<http://www.jeeng.net/pdf-111323-41900?filename=Life Cycle Assessment of.pdf>)

Morphological Effects of Stymjod Foliar Application on Medicago x varia T. Martyn


(<http://www.jeeng.net/Morphological-Effects-of-Stymjod-Foliar-Application-on-Medicago-x-varia-T-Martyn,111151,0,2.html>)

Jacek Sosnowski (<http://www.jeeng.net/Author-Jacek-Sosnowski/81>), Ewelina Toczyska (<http://www.jeeng.net/Author-Ewelina-Toczyska/124235>), Milena Truba (<http://www.jeeng.net/Author-Milena-Truba/44139>)


J. Ecol. Eng. 2019; 20(8):184–191

DOI: <https://doi.org/10.12911/22998993/111151> (<https://doi.org/10.12911/22998993/111151>)

 Abstract

 Stats

(<http://www.jeeng.net/Morphological-Effects-of-Stymjod-Foliar-Application-on-Medicago-x-varia-T-Martyn,111151,0,2.html>)

 Article (PDF) (<http://www.jeeng.net/pdf-111151-41901?filename=Morphological Effects of.pdf>)

Geomodelling of Destruction of Soils of Ukrainian Steppe Due to Water Erosion


(<http://www.jeeng.net/Geomodelling-of-Destruction-of-Soils-of-Ukrainian-Steppe-Due-to-Water-Erosion,110789,0,2.html>)

Nataliia Vasylyvna Dudiak (<http://www.jeeng.net/Author-Nataliia-Dudiak/123788>), Vitalii Ivanovich Pichura (<http://www.jeeng.net/Author-Vitalii-Pichura/123789>), Larisa Aleksandrovna Potravka (<http://www.jeeng.net/Author-Larisa-Potravka/123790>), Natalia Vladimirovna Strachuk (<http://www.jeeng.net/Author-Natalia-Strachuk/123791>)

 Abstract

 Stats

(<http://www.jeeng.net/Geomodelling-of-Destruction-of-Soils-of-Ukrainian-Steppe-Due-to-Water-Erosion,110789,0,2.html>)

 Article (PDF) ([http://www.jeeng.net/pdf-110789-41902?filename=Geomodelling of.pdf](http://www.jeeng.net/pdf-110789-41902?filename=Geomodelling%20of.pdf))

Length-Weight Relationship and Condition Factor of Mudskipper *Boleophthalmus pectinirostris* from Maro Estuary, Merauke Regency, Papua

(<http://www.jeeng.net/Length-Weight-Relationship-and-Condition-Factor-of-Mudskipper-Boleophthalmus-pectinirostris,110841,0,2.html>)

Sunarni Sunarni (<http://www.jeeng.net/Author-Sunarni-Sunarni/123867>), Eddy H.P Melmambessy (<http://www.jeeng.net/Author-Eddy-Melmambessy/123868>), Norce Mote (<http://www.jeeng.net/Author-Norce-Mote/123869>), Rahmatia Rahmatia (<http://www.jeeng.net/Author-Rahmatia-Rahmatia/123870>), Baigo Hamuna (<http://www.jeeng.net/Author-Baigo-Hamuna/96371>)


J. Ecol. Eng. 2019; 20(8):199–204

DOI: <https://doi.org/10.12911/22998993/110841> (<https://doi.org/10.12911/22998993/110841>)

 Abstract

 Stats

(<http://www.jeeng.net/Length-Weight-Relationship-and-Condition-Factor-of-Mudskipper-Boleophthalmus-pectinirostris,110841,0,2.html>)

 Article (PDF) (http://www.jeeng.net/pdf-110841-42320?filename=Length_Weight.pdf)

Quality of Leachate from Landfill with Reverse Osmosis Concentrate Recirculation

(<http://www.jeeng.net/Quality-of-Leachate-from-Landfill-with-Reverse-Osmosis-Concentrate-Recirculation,111711,0,2.html>)

Izabela Anna Tałałaj (<http://www.jeeng.net/Author-Izabela-Taalaaj/36152>)


J. Ecol. Eng. 2019; 20(8):205–211

DOI: <https://doi.org/10.12911/22998993/111711> (<https://doi.org/10.12911/22998993/111711>)

 Abstract

 Stats

(<http://www.jeeng.net/Quality-of-Leachate-from-Landfill-with-Reverse-Osmosis-Concentrate-Recirculation,111711,0,2.html>)

 Article (PDF) ([http://www.jeeng.net/pdf-111711-41904?filename=Quality of Leachate from.pdf](http://www.jeeng.net/pdf-111711-41904?filename=Quality%20of%20Leachate%20from.pdf))

Evaluation of the Utility of Using Classification Algorithms when Designing New Polymer Composites

EN (<http://www.jeeng.net/>)

PL (<http://www.jeeng.net/pl>)



(<http://www.jeeng.net/Evaluation-of-the-Utility-of-Using-Classification-Algorithms-when-Designing-New-Polymer,111712,0,2.html>)

Bernardeta Dębska (<http://www.jeeng.net/Author-Bernardeta-Dębska/41967>), Barbara Dębska (<http://www.jeeng.net/Author-Barbara-Dębska/125233>), Lech Lichołai (<http://www.jeeng.net/Author-Lech-Lichołai/41968>)

J. Ecol. Eng. 2019; 20(8):212–225

DOI: <https://doi.org/10.12911/22998993/111712> (<https://doi.org/10.12911/22998993/111712>)

Abstract

Stats

(<http://www.jeeng.net/Evaluation-of-the-Utility-of-Using-Classification-Algorithms-when-Designing-New-Polymer,111712,0,2.html>)

Article (PDF) ([http://www.jeeng.net/pdf-111712-41945?filename=Evaluation of the Utility.pdf](http://www.jeeng.net/pdf-111712-41945?filename=Evaluation%20of%20the%20Utility.pdf))

Reliability Evaluation of Wastewater Treatment Plant Impact on the Receiving Waters

(<http://www.jeeng.net/Reliability-Evaluation-of-Wastewater-Treatment-Plant-Impact-on-the-Receiving-Waters,111713,0,2.html>)

Dariusz Andraka (<http://www.jeeng.net/Author-Dariusz-Andraka/31099>)

J. Ecol. Eng. 2019; 20(8):226–231

DOI: <https://doi.org/10.12911/22998993/111713> (<https://doi.org/10.12911/22998993/111713>)

Abstract

Stats

(<http://www.jeeng.net/Reliability-Evaluation-of-Wastewater-Treatment-Plant-Impact-on-the-Receiving-Waters,111713,0,2.html>)

Article (PDF) ([http://www.jeeng.net/pdf-111713-41906?filename=Reliability Evaluation of.pdf](http://www.jeeng.net/pdf-111713-41906?filename=Reliability%20Evaluation%20of.pdf))

The Opoka-Rock from the Mesozoic/Neogene Contact Zone in the Bełchatów Lignite Deposit – Characteristics of a Petrographic Nature and as a Raw Material

(<http://www.jeeng.net/The-Opoka-Rock-from-the-Mesozoic-Neogene-Contact-Zone-in-the-Belchatow-Lignite-Deposit,111714,0,2.html>)

Agnieszka Pękala (<http://www.jeeng.net/Author-Agnieszka-Pękala/95197>)

J. Ecol. Eng. 2019; 20(8):232–237

DOI: <https://doi.org/10.12911/22998993/111714> (<https://doi.org/10.12911/22998993/111714>)

Abstract

Stats

(<http://www.jeeng.net/The-Opoka-Rock-from->

Lead in Agricultural Soils and Cultivated Pastures Irrigated with River Water Contaminated by Mining Activity

(<http://www.jeeng.net/Lead-in-Agricultural-Soils-and-Cultivated-Pastures-Irrigated-with-River-Water-Contaminated,111715,0,2.html>)

Edith Pilar Orellana (<http://www.jeeng.net/Author-Edith-Orellana/125234>), Maria Custodio (<http://www.jeeng.net/Author-Maria-Custodio/92490>), María Carolina Bastos (<http://www.jeeng.net/Author-María-Bastos/125235>), Walter Cuadrado (<http://www.jeeng.net/Author-Walter-Cuadrado/125236>)

J. Ecol. Eng. 2019; 20(8):238–244

DOI: <https://doi.org/10.12911/22998993/111715> (<https://doi.org/10.12911/22998993/111715>)

📄 Abstract

📊 Stats

(<http://www.jeeng.net/Lead-in-Agricultural-Soils-and-Cultivated-Pastures-Irrigated-with-River-Water-Contaminated,111715,0,2.html>)

📄 Article (PDF) ([http://www.jeeng.net/pdf-111715-41908?filename=Lead in Agricultural.pdf](http://www.jeeng.net/pdf-111715-41908?filename=Lead%20in%20Agricultural.pdf))

Non-Uniformity of Water Demands in a Rural Water Supply System

(<http://www.jeeng.net/Non-Uniformity-of-Water-Demands-in-a-Rural-Water-Supply-System,111716,0,2.html>)

Joanna Gwoździej-Mazur (<http://www.jeeng.net/Author-Joanna-Gwoździej-Mazur/37560>), Kamil Świętochowski (<http://www.jeeng.net/Author-Kamil-Świętochowski/125237>)

J. Ecol. Eng. 2019; 20(8):245–251

DOI: <https://doi.org/10.12911/22998993/111716> (<https://doi.org/10.12911/22998993/111716>)

📄 Abstract

📊 Stats

(<http://www.jeeng.net/Non-Uniformity-of-Water-Demands-in-a-Rural-Water-Supply-System,111716,0,2.html>)

📄 Article (PDF) ([http://www.jeeng.net/pdf-111716-41909?filename=Non_Uniformity of Water.pdf](http://www.jeeng.net/pdf-111716-41909?filename=Non_Uniformity%20of%20Water.pdf))

Solving the Beach Wrack Problems by On Site Treatment with Reed Beds Towards Fertilizer Amendments

(<http://www.jeeng.net/Solving-the-Beach-Wrack-Problems-by-On-Site-Treatment-with-Reed-Beds-Towards-Fertilizer,111717,0,2.html>)

Alicja Kupczyk (<http://www.jeeng.net/Author-Alicja-Kupczyk/125238>), Katarzyna Kołeczka (<http://www.jeeng.net/Author-Katarzyna-Kołeczka/38106>), Magdalena Hanna Gajewska (<http://www.jeeng.net/Author->)



DOI: <https://doi.org/10.12911/22998993/111717> (<https://doi.org/10.12911/22998993/111717>)

Abstract

Stats

<http://www.jeeng.net/Solving-the-Beach-Wrack-Problems-by-On-Site-Treatment-with-Reed-Beds-Towards-Fertilizer,111717,0,2.html>

Article (PDF) ([http://www.jeeng.net/pdf-111717-41910?filename=Solving the Beach Wrack.pdf](http://www.jeeng.net/pdf-111717-41910?filename=Solving%20the%20Beach%20Wrack.pdf))

Monitoring of Groundwater in the Area of a Reclaimed Municipal Waste Landfill

<http://www.jeeng.net/Monitoring-of-Groundwater-in-the-Area-of-a-Reclaimed-Municipal-Waste-Landfill,111718,0,2.html>

Janina Piekutin (<http://www.jeeng.net/Author-Janina-Piekutin/1032>)

J. Ecol. Eng. 2019; 20(8):262-268

DOI: <https://doi.org/10.12911/22998993/111718> (<https://doi.org/10.12911/22998993/111718>)

Abstract

Stats

<http://www.jeeng.net/Monitoring-of-Groundwater-in-the-Area-of-a-Reclaimed-Municipal-Waste-Landfill,111718,0,2.html>

Article (PDF) ([http://www.jeeng.net/pdf-111718-41911?filename=Monitoring of Groundwater.pdf](http://www.jeeng.net/pdf-111718-41911?filename=Monitoring%20of%20Groundwater.pdf))

[Submit your paper \(https://www.editorialsystem.com/jeeng\)](https://www.editorialsystem.com/jeeng)

[Instructions for Authors \(http://www.jeeng.net/Instructions-for-Authors,25.html\)](http://www.jeeng.net/Instructions-for-Authors,25.html)

[All issues \(http://www.jeeng.net/Archive\)](http://www.jeeng.net/Archive)

[Articles in press \(http://www.jeeng.net/Online-first\)](http://www.jeeng.net/Online-first)

Most read

Month Year

Impact of Municipal Solid Waste Landfill on Environment – a Case Study

<http://www.jeeng.net/Impact-of-Municipal-Solid-Waste-Landfill-on-Environment-a-Case-Study,89664,0,2.html>

Wastewater Treatment Methods for Effluents from the Confectionery Industry – an Overview
(<http://www.jeeng.net/Wastewater-Treatment-Methods-for-Effluents-from-the-Confectionery-Industry-an-Overview,112557,0,2.html>)



Assessment of Comprehensive Environmental Pollution Index of Kurichi Industrial Cluster, Coimbatore District, Tamil Nadu, India - a Case Study (<http://www.jeeng.net/Assessment-of-Comprehensive-Environmental-Pollution-Index-of-Kurichi-Industrial-Cluster,78747,0,2.html>)

Indexes



Keywords index (<http://www.jeeng.net/Keywords>)

Authors index (<http://www.jeeng.net/Authors>)






Human Behaviour and Brain

HumanBaB is a peer-reviewed, open access, interdisciplinary and international journal.

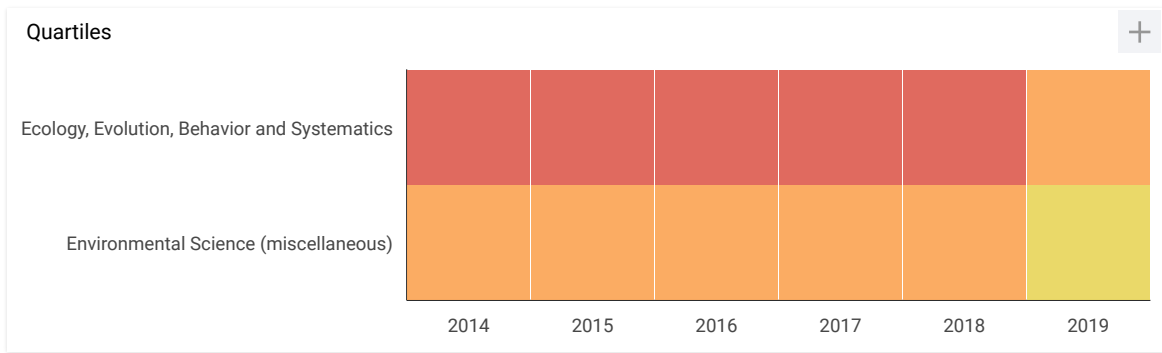
Human Behaviour and Brain OPEN

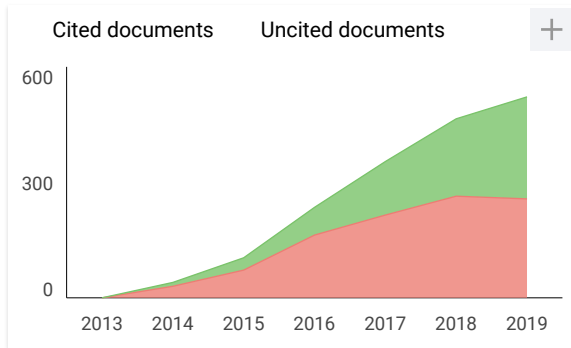
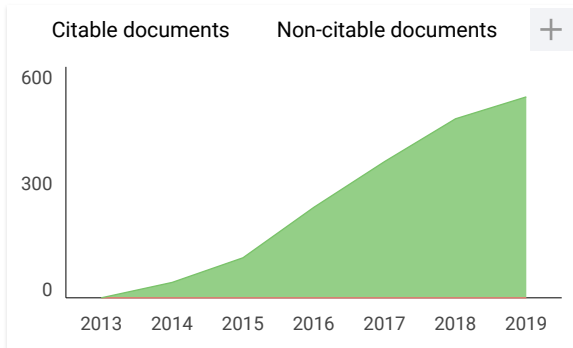
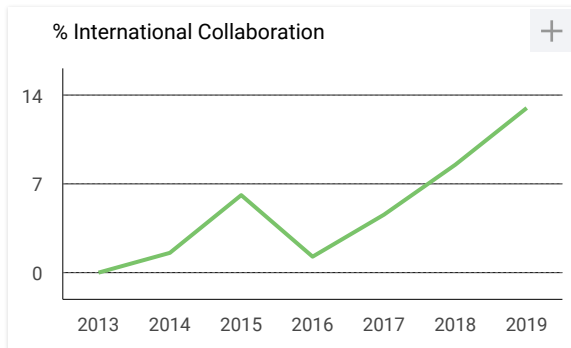
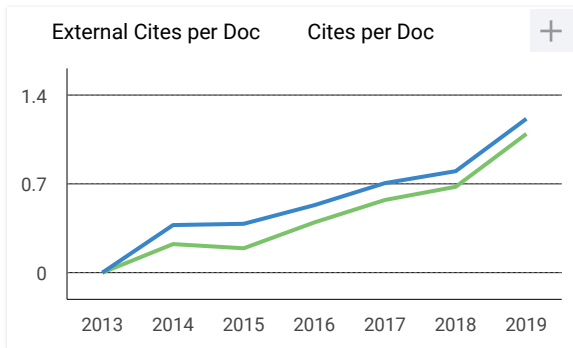
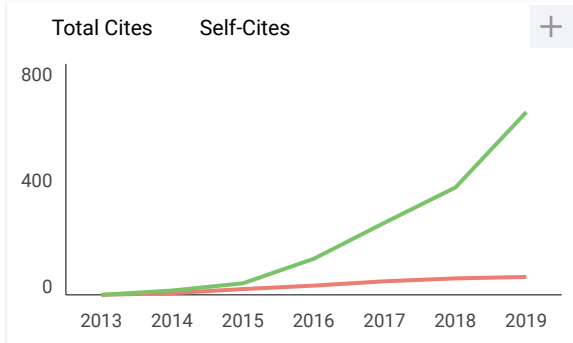
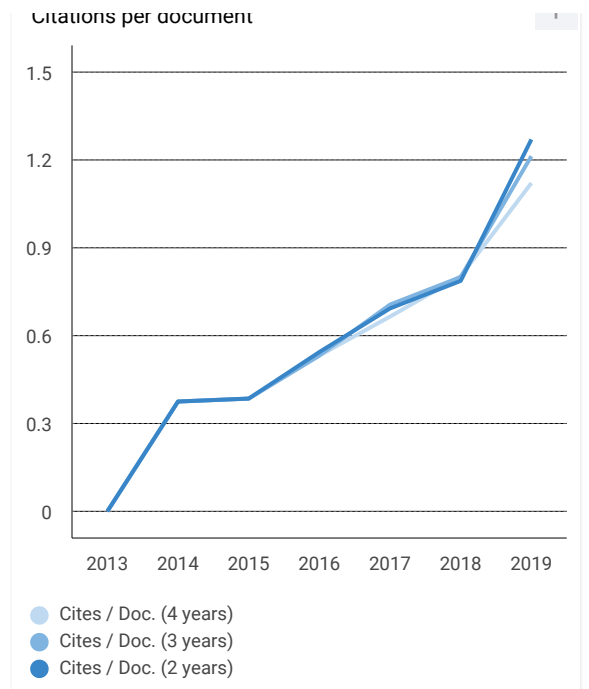
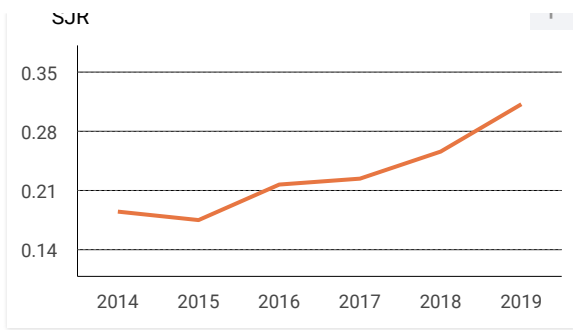
Journal of Ecological Engineering

Country	Poland -  SJR Ranking of Poland
Subject Area and Category	Agricultural and Biological Sciences Ecology, Evolution, Behavior and Systematics Environmental Science Environmental Science (miscellaneous)
Publisher	Polskie Towarzystwo Inżynierii Ekologicznej
Publication type	Journals
ISSN	22998993, 2081139X
Coverage	2013-2020
Scope	- Industrial and municipal waste management - Pro-ecological technologies and products - Energy-saving technologies - Environmental landscaping - Environmental monitoring - Climate change in the environment - Sustainable development - Processing and usage of mineral resources - Recovery of valuable materials and fuels - Surface water and groundwater management - Water and wastewater treatment - Smog and air pollution prevention - Protection and reclamation of soils - Reclamation and revitalization of degraded areas - Heavy metals in the environment - Renewable energy technologies - Environmental protection of rural areas - Restoration and protection of urban environment - Prevention of noise in the environment - Environmental life-cycle assessment (LCA) - Simulations and computer modeling for the environment
	Homepage How to publish in this journal Contact  Join the conversation about this journal

14

H Index





Journal of Ecological Engineering

Q2 Environmental Science (miscellaneous) best quartile

SJR 2019 0.31

powered by scimagojr.com

← Show this widget in your own website

Just copy the code below and paste within your html code:

```
<a href="https://www.scimagojr.com" style="color: blue; text-decoration: underline;">https://www.scimagojr.com
```

Isolation and Identification of Native Bacteria from Total Petroleum Hydrocarbon Polluted Soil in Wonocolo Public Oilfields, Indonesia

Gina Lova Sari^{1*}, Yulinah Trihadiningrum², Ni'matuzahroh³

¹ Faculty of Engineering, Universitas Singaperbangsa Karawang, Teluk Jambe Timur, Karawang 41361, Indonesia

² Department of Environmental Engineering, Faculty of Civil Engineering, Environment, and Geoscience, Institut Teknologi Sepuluh Nopember, Surabaya 60111, Indonesia

³ Department of Biology, Faculty of Science and Technology, Airlangga University, Surabaya 60115, Indonesia

* Corresponding author's e-mail: ginalovasari@gmail.com

ABSTRACT

The presented study concerns on isolation and identification of indigenous bacteria in total petroleum hydrocarbon (TPH) polluted soil. The composite TPH polluted soil was collected from Wonocolo public oilfields, Indonesia. Pour plate and plate count techniques were used to bacterial population analysis and enumeration, respectively. Two dominant bacterial colonies were isolated from 4.06×10^7 CFU/g population in polluted soil, then morphologically and biochemically were characterized using Microbact Identification Kits (Microbact™ GNB12A and 12B). The identification of isolated bacteria was performed using Bergey's Manual of Determinative Bacteriology. The results showed that the strains of bacteria are *Bacillus sp.* and *B. cereus* with probability of 72.00 and 77.00%, respectively. These strains potentially acted as biosurfactant producers and hydrocarbon degraders. Thus, biostimulation could be implemented to reduce the TPH levels in polluted soil at Wonocolo public oilfields.

Keywords: *Bacillus sp.*, *B. cereus*, TPH polluted soil, Wonocolo public oilfields.

INTRODUCTION

The crude oil exploration activities in Wonocolo public oilfields caused soil and surface water contamination of total petroleum hydrocarbons, TPH (Handrianto et al., 2012; Sari et al., 2018). Our previous study reported that topsoil in Wonocolo public oilfields was highly polluted by TPH in a range of 52,328.14–107,189.63 µg/g (Sari et al., 2018). TPH constitute hydrophobic compound that are toxic, mutagenic, and carcinogenic. The accumulation of TPH in soil may cause plant, animal, and human tissues to be damaged as they transport in biomagnification chain (Xu and Liu, 2010; Kumari et al., 2013). Therefore, the topsoil at Wonocolo public oilfields need bioremediation to avoid the impact on the people and environment in the local area (Sari et al., 2018). Bioremediation is an effective method to reduce the TPH level in polluted soil

with feasibility cost. Several studies reported that the bioremediation effectiveness for TPH degradation reaches up to 80% (Handrianto et al., 2012; Xu and Liu, 2010; Asquith et al., 2012; Darmayanti et al., 2017).

Bioremediation, biostimulation and/or bioaugmentation, is defined as the process that utilizes the metabolic capabilities of microorganisms for TPH uptake and degradation into less toxic substance, or their removal from polluted soil. Biostimulation and bioaugmentation aim at increasing the level of TPH biodegradation by microorganisms. The difference of both techniques is bacteria used, where biostimulation and bioaugmentation use indigenous and specific competent exogenous bacteria introduced to the process, respectively (Xu and Liu, 2010; Asquith et al., 2012). Both bacteria were stimulated through environmental factors (nutrient, oxygen, moisture, pH, and temperature) monitoring

to enhance the effectivity of TPH degradation (Xu and Liu, 2010; Das and Chandran, 2011).

The viability of bacteria has been found to be useful in both bioremediation process. This study aimed at isolating and identifying the bacteria in polluted soil from Wonocolo public oil-fields. It was necessary to determine the required technique for better TPH biodegradation performance. In addition, the potential role of bacteria in bioremediation process was reviewed.

MATERIALS AND METHODS

TPH polluted soil collection

The TPH polluted soil was taken in April 2017 from 0 to 30 cm below the surface of three contaminated sites at Wonocolo public crude oil-fields. The description of the sites, soil sampling procedures, and the preparation were reported in our previous study (Sari et al., 2018).

MICROBIAL ANALYSES

Determination of bacterial population

Pour plate and plate count methods were used for bacteria population analysis and enumeration. One gram of soil was mixed with 50 mL of NaCl (0.8%). 1 mL of the mixture was diluted from 10^{-1} to 10^{-10} or more. 1 mL of dilution liquid was subculture into nutrient agar (NA) and incubated for 24 hours at a room temperature. After 24 hours of incubation, bacteria colonies forms were counted (Cappucino and Sherman, 1983).

Isolation, characterization, and identification of bacterial strain

The dominant bacteria colonies were subcultured on the NA using a streak method following Olukunle (2013). Morphological of selected colony such as color, shape, edge, and size were observed using microscope. The selected colony

was picked for cellular morphological characterization through Gram staining analysis (Balows, 1992). Meanwhile, the biochemical characteristics of selected colony were performed using Microbact Identification Kits (Microbact™ GNB12A and 12B). Furthermore, individual bacterial strain was identified according to Bergey's Manual of Determinative Bacteriology (Holt et al., 1994).

RESULTS AND DISCUSSION

Total population and characterization of bacteria isolated from TPH polluted soil

The population of bacteria in TPH polluted soil amounted to 4.06×10^7 CFU/g with two dominant colonies. This indicates that bacteria are able to adapt with the presence of TPH in the polluted soil (Sari et al., 2016). The morphological characteristics of the colonies are presented in Table 1, and classified as gram-positive bacteria with basic forms of bacilli (Fig. 1).

The biochemical characteristics of bacteria (Table 2) show that colony 1 exhibited motility (using flagella to move). Furthermore, it also produces many enzymes such as oxydase, catalase, nitrate reductase, gelatinase, and voges proskauer. Barely same characteristics showed by Colony 2 are motility and enzyme producers (oxydase, amylase, catalase, nitrate reductase, and voges proskauer). The capabilities show that colony 1 and 2 may play a role in organic matter decomposition. However, both colonies are unable to ferment lactose and sucrose into glucose.

Identification of bacterial strain

On the basis of morphological and biochemical characteristics, two isolate colonies may belong to *Bacillus* genera. Furthermore, the prediction was confirmed that Bergey's Manual of Determinative Bacteriology which identified colony 1 and 2 belong to *Bacillus* sp. (72.00%), and *B. cereus* (77.00%) strains, respectively. Prakash et al. (2014) confirmed that *Bacillus* sp.

Table 1. Morphological characteristics of bacteria isolated

Bacteria	Morphological characteristics				
	Color	Shape	Edge	Size (cm)	Gram Strain
Colony 1	White	Irregular	Undulate	0.30	+
Colony 2	White	Circular	Filiform	0.20	+

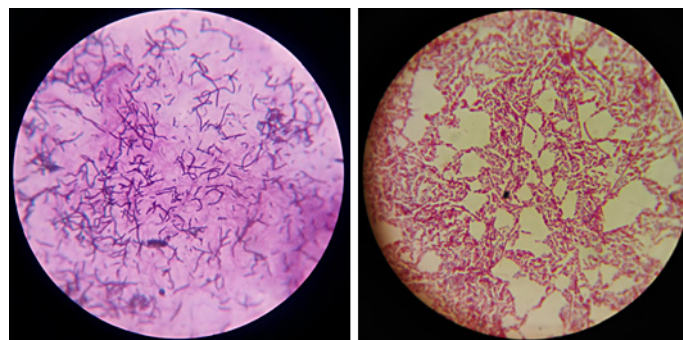


Figure 1. Gram strain colony 1 (left); colony 2 (right)

is one of indigenous bacteria in crude oil contaminated soil. Meanwhile, *B. cereus* is indigenous bacteria in diesel contaminated soil (Bento et al., 2005). Both conditions are in accordance to Wonocolo public oilfields that exploit crude oil and produce heavy diesel.

The presence of both indigenous strains in TPH polluted soil indicates that the bacteria might utilize the hydrocarbon as carbon and energy source to grow (Das and Chandran, 2011). Therefore, the indigenous bacteria in polluted soil could be responsible for TPH removal in bioremediation process (Kumari et al., 2013; Darmayanti et al., 2017; Balows, 1992). Olukunle (2013) stated that the capability of indigenous bacteria showed a possibility of in situ bioremediation which is an economical technique.

Role of *Bacillus* sp. and *B. cereus* in Bioremediation of TPH-Polluted Soil

Several researchers reported that *Bacillus* sp. and *B. cereus* are capable of acting as hydrocarbon degraders (Das and Chandran, 2011; Prakash et al., 2014; Cerqueira et al., 2011). *Bacillus* sp. and *B. cereus* can reduce the concentration of benzene up to 54.80% (Prakash et al., 2014) and 92.59–95.37% (Ole, 2017), respectively. It is due to *Bacillus* strain being able to produce surface active compounds, also known as biosurfactants, which could reduce surface tension and emulsify

hydrocarbon (Cerqueira et al., 2011; Yangejeh et al., 2017).

Several studies reported that the surface tension of *Bacillus* sp. and *B. cereus* are lower than distilled water (73.05 mN/m) of 24.60 (Zhou et al., 2015) and 25.00 mN/m (Tuleva et al., 2005), respectively. Simultaneously, it facilitates hydrocarbon attack and diffusion into bacterial cells (Yangejeh et al., 2017) through affinity improvement in the change of the cell surface hydrophobicity (Kumar et al., 2007). The ability review of *Bacillus* sp. and *B. cereus* is presented in Table 3.

CONCLUSIONS

The current study confirms that *Bacillus* sp. and *B. cereus* are dominant indigenous bacteria at Wonocolo public oilfields polluted soil. These bacteria are hydrocarbon degraders and are able to produce biosurfactants. We recommend biostimulation such as composting and landfarming to be used as bioremediation techniques for TPH polluted soil at the site.

Acknowledgements

The authors gratefully acknowledge the Indonesian Ministry of Research, Technology,

Table 2. Biochemical characteristics of bacteria isolated

Bacteria	Biochemical characteristics														
	Motility	Oxidase	Nitrate reduction	Amylase	Catalase	H ₂ S production	Indole production	Gelatinase	Voges proskauer	Urease	Glucose	Mannitol	Xylose	Sucrose	Lactose
Colony 1	+	+	+	-	+	-	-	+	+	-	-	-	-	-	-
Colony 2	+	+	+	+	+	-	-	-	+	-	-	-	-	-	-

Table 3. The ability of *Bacillus* sp., and *B. cereus*

Bacteria	Source of Oil-Contaminated Soil	Degradation of Hydrocarbon	Biosurfactant	Reference
<i>Bacillus</i> sp.	Meerut Region	54.80% of benzene	-	Prakash et al., 2014
	Guanoco Lake, Sucre State	67.00±3.00 up to 69.00±4.00 of Phenanthrene	Surface tension up to 40 mN/m	Kumar et al., 2007
	Oilfield in northwest China	-	Lipopeptide, surface tension of 24.60 mN/m	Zhou et al., 2015
	Automobile workshop in Manipal, India	-	Lipopeptide, surface tension reduction up to 36.10 mN/m	Varadavenkatesan and Murty, 2012
	Not explained	-	Lipopeptide, surface tension up to 27.80 mN/m	Hesty and Putra, 2017
<i>B. cereus</i>	Hongkong, China	-	Surface tension of 50.00 mN/m	Bento et al., 2005
	Petrochemical industry in the city of Triunfo, Rio Grande do Sul State, Brazil	<ul style="list-style-type: none"> • 88.40±0.60% of aliphatic hydrocarbon • 40.30±6.70% of aromatic hydrocarbon 	<ul style="list-style-type: none"> • Surface tension of 41.40±0.30 mN/m • Emulsifying activity of 33.30±0.10% 	Cerqueira et al., 2011
	Artificial	92.59–95.37% of BTX	-	Ole, 2017
	Not explained	72.00±4.00% of Naphthalene	Rhamnolipid, surface tension of 25.00 mN/m	Tuleva et al., 2005
	Cepu, East Java, Indonesia	54.00% of TPH	-	Darmayanti et al., 2017

and Higher Education for the Doctoral Dissertation Research Grant, which made this study to work out. The authors gratefully thank to thank Mrs. Mery M. Soesilo, Mrs. Hurun In, Ms. Kartika Primasari from Soil Waste Laboratory of Institut Teknologi Sepuluh Nopember and Biology Laboratory of Airlangga University for their scientific contribution and assistance in sample analysis.

REFERENCES

- Asquith, E.A., Geary, P.M., Nolan, A.L., Evans, C.A. 2012. Comparative Bioremediation of Petroleum Hydrocarbon-Contaminated Soil by Biostimulation, Bioaugmentation and Surfactant Addition. *J. Env. Sci. Eng.*, A1, 637–650.
- Balows, A. 1992. *The Prokaryotes: A Handbook on the Biology of Bacteria: Ecophysiology, Isolation, Identification, Applications.* Springer-Verlag: Heidelberg, Germany.
- Bento, F.M., Camargo, F.O.A., Okeke, B.C., Frankenberger, W.T. 2005. Diversity of Biosurfactant Producing Microorganisms Isolated from Soil Contaminated with Diesel Oil. *Microbiological Research*, 160(3), 249–255.
- Cappucino, J.G.N., and Sherman, N. 1983. *Microbiology: A Laboratory Manual*, 8th Edition. Addison-Wesley Publishing Company, California.
- Cerqueira, V.S., Hollenbach, E.B., Maboni, F., Vainstein, M.H., Camargo F.A.O., Peralba M.C., Bento F.M. 2011. Biodegradation Potential of Oily Sludge by Pure and Mixed Bacterial Cultures. *Bioresource Technology*, 102, 11003–11010.
- Darmayanti, Y., Sanusi, HS., Prartono, T., Santosa, D.A., Nuchsin, R. 2017. Optimal Bacterial Density and Fertilizer Dosage for Bioremediation of Oil Contaminated Sandy Beach: A Case of Cilacap, Indonesia. *BIOTROPIA*, 24(3), 182–191.
- Das, N., and Chandran, P. 2011. Microbial Degradation of Petroleum Hydrocarbon Contaminants: An Overview. *Biotech. Res. Inter.*: 1–13.
- Handrianto, P., Rahayu, Y.S., Yuliani, Y. 2012. The Bioremediation as Solution of Hydrocarbon Contaminated Soil (In Indonesian). *Proc. Chemical National Conference*, Surabaya: 22–30.
- Hesty, H., and Putra, M.D. 2017. Kinetic Study and Modeling of Biosurfactant Production using *Bacillus* sp. *Electronic J. Biotech.*, 27, 49–54.
- Holt, J.G., Krieger, N.R., Sneath, P.H.A., Staley, J.T. 1994. *Bergey's Manual of: Determinative Bacteriology.* 9th edition. Lippincott Williams and Wilkins: Baltimore, USA.

11. Kumar, M., Leon, V., Materano, A.D.S., Ilzins, O.A. 2007. A Halotolerant and Thermotolerant *Bacillus* sp. Degrades. *World J Microbiol Biotechnol.*, 23, 211–220.
12. Kumari, N., Vashistha, A., Saini, P., Meghani, E. 2013. Isolation, Identification and Characterization of Oil Degrading Bacteria Isolated from the Contaminated Sites of Barmer, Rajasthan. *Int. J. Biotech. Bioeng., Res.*, 4(5), 429–436.
13. Ole, M.A.N. 2017. Bioremediation of Benzene, Toluene and Xylene (BTX) from Petroleum Contaminated Soil by Aerobic Bacteria at Slurry Phase in Bioreactor [In Indonesian]. Thesis: Institut Teknologi Sepuluh Nopember, Surabaya.
14. Olukunle, O.F. 2013. Characterization of Indigenous Microorganisms Associated with Crude Oil-Polluted Soils and Water Using Traditional Techniques. *Microbiology Journal*, 3(1), 1–11.
15. Prakash, A., Bisht, S., Singh, J., Teotia, P., Kela, R., Kumar, V. 2014. Biodegradation Potential of Petroleum Hydrocarbons by Bacteria and Mixed Bacterial Consortium Isolated from Contaminated Sites. *Turkish J. Eng. Env. Sci.*, 38, 41–50.
16. Sari, G.L., Mizwar, A., Trihadiningrum, Y. 2016. Soil pH Effect for Polycyclic Aromatic Hydrocarbon (PAH) Biodegradation Process from Coal Contaminated Soil [In Indonesian]. *Jurnal Teknologi*, 8(1), 31–38.
17. Sari, G.L., Trihadiningrum, Y., Ni'matuzahroh. 2018. Petroleum Hydrocarbon Pollution in Soil and Surface Water by Public Oil Fields in Wonocolo Sub-district, Indonesia [in press]. *J. Ecol. Eng.*
18. Tuleva, B., Christova, N., Jordanov, B., Nikolova-Damyanova, B., Petrov, P. 2005. Naphthalene Degradation and Biosurfactant Activity by *Bacillus Cereus* 28BN. *J. Bioscie.*, 60(7–8), 577–582.
19. Varadavenkatesan, T., and Murty, V.R. 2013. Production of a Lipopeptide Biosurfactant by a Novel *Bacillus* sp. and Its Applicability to Enhanced Oil Recovery. *ISRN Microbiology*: 1–8.
20. Xu, Y., and Liu, M. 2010. Bioremediation of Crude Oil-Contaminated Soil: Comparison of Different Biostimulation and Bioaugmentation Treatments. *J. Hazard. Mater.*, 183, 395–401.
21. Yangejeh, R.J., Pourjafarian, V., Afrous, A., Gholami, A., Maktabi, P., Sharifi, R. 2017. Studying *Bacillus Cereus*'s Ability to Biodegrade Crude Oil in Hot Areas. *Petroleum Sci. Tech.*, 35(3), 287–291.
22. Zhou, H., Chen, J., Yang, Z., Qin, B., Li, Y., Kong, X. 2015. Biosurfactant Production and Characterization of *Bacillus* sp. Zg0427 Isolated from Oil-Contaminated Soil. *Annals of Microbiology*, 65(4), 2255–2264.