



BCREC

ISSN 1978-2993

Bulletin of Chemical Reaction Engineering & Catalysis

Volume 9, Issue 3, Year 2014, December 2014

An International Journal. Available online at: <http://bcrec.undip.ac.id/>

Bull. Chem. React. Eng. Catal.	Vol. 9	No. 3	Pages: 156 - 269	Semarang October 2014	ISSN 1978 -2993
-----------------------------------	--------	-------	---------------------	--------------------------	--------------------



Published by:

Department of Chemical Engineering, Diponegoro University

Masyarakat Katalis Indonesia – Indonesian Catalyst Society (MKICS)



EDITORIAL BOARD

EDITOR-IN-CHIEF:

Dr. I. Istadi, Department of Chemical Engineering, Diponegoro University, Indonesia 50275; E-mail: istadi@undip.ac.id ; (SCOPUS h-index: 9)

REGIONAL MANAGING EDITOR FOR ASIA-PACIFIC:

Prof. Dr. Y. H. Taufiq-Yap, Centre of Excellence for Catalysis Science and Technology, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia, Malaysia; (SCOPUS h-index: 14)

REGIONAL MANAGING EDITOR FOR EUROPE:

Prof. Dr. Dmitry Yu. Murzin, Laboratory of Industrial Chemistry and Reaction Engineering, Abo Akademi University; Biskopsgatan 8 20500, Turku/Åbo, Finland, ph: + 358 2 215 4985 fax: + 358 2 215 4479, Finland ; (SCOPUS h-index: 42)

ASSOCIATE EDITOR:

Prof. Dr. Heru Susanto, Department of Chemical Engineering, Diponegoro University, Indonesia, (SCOPUS h-index: 12)

Dr. Didi Dwi Anggoro, Department of Chemical Engineering, Diponegoro University, Indonesia 50275, (SCOPUS h-index: 4)

Dr. Mohammad Djaeni, Department of Chemical Engineering, Diponegoro University, Indonesia 50275, (SCOPUS h-index: 5)

Dr. Andri C. Kumoro, Department of Chemical Engineering, Diponegoro University, Indonesia 50275, (SCOPUS h-index: 4)

INTERNATIONAL ADVISORY EDITORIAL BOARDS

Prof. Dr. Jose E. Castanheiro, Dept. of Chemistry, Universidade of Evora, CQE, Evora, Portugal (Scopus h-index= 13)

Prof. Dr. Rafael Molina, Estado Sólido y Catálisis Ambiental, Departamento de Química, Facultad de Ciencias, Universidad Nacional de Colombia, Carrera 30 45-03, Bogotá, D.C., Colombia (Scopus h-index = 21)

Dr. Kalama Jalama, Dept. of Chemical Engineering, University of Johannesburg, P.O. Box 17011, Doornfontein 2028, Johannesburg,, South Africa (SCOPUS h-index=4)

Prof. Dr. Ho-Shing Wu, Dept. of Chemical Engineering & Material Science, Yuan-Ze University, 135 Yuan Tung Road, Chung Li, Taoyuan, 32003, Taiwan, Province of China, (SCOPUS h-index: 11)

Prof. Dr. Toru Wakihara, Yokohama National University, Graduate School of Environment and Information Sciences, Yokohama, Japan, (SCOPUS h-index=12)

Prof. Dr. Xian-ji Guo
Dept. of Chemistry, Zhengzhou University, Zhengzhou 450052, China, (SCOPUS h-index: 4)

Prof. Dr. Mostafa Barigou
School of Chemical Engineering, University of Birmingham, Edgbaston, Birmingham B15 2TT, United Kingdom, (SCOPUS h-index: 17)

Prof. Dr. Raghunath V. Chaudhari
Center for Environmental Beneficial Catalysis, Dept. of Chemical and Petroleum Engineering, The University of Kansas, 1501 Wakarusa Dr., Building B-Room 112B, Lawrence, KS 66047-1803, USA, (SCOPUS h-index: 29)

Dr. Satish Lakhapatri
University of Toledo, Dept. of Chemical and Environmental Engineering, Toledo, United States, (SCOPUS h-index: 3)

Dr. Sibudjing Kawi
Dept. of Chemical and Biochemical Engineering, National University of Singapore, Singapore, (SCOPUS h-index: 30)

Prof. Dr. Ram Prasad
Dept. of Chemical Engineering and Technology, Institute of Technology, Banaras Hindu University, India (SCOPUS h-

index:3)

Dr. S. Subagio

Dept. of Chemical Engineering, Institut Teknologi Bandung, Jl. Ganesha 10, Bandung, Indonesia

Prof. Dr. Liu Yan

School of Chemical Engineering, Qinghai University, Xining, China, Email: liuyan_qhu@163.com

Prof. Dr. Nor Aishah Saidina Amin

Faculty of Chemical and Natural Resources Engineering, Universiti Teknologi Malaysia, 81310 UTM Skudai, Johor, Malaysia, (SCOPUS h-index: 14)

Prof. Dr. Hadi Nur

Ibnu Sina Institute for Fundamental Science Studies, Universiti Teknologi Malaysia , 81310 UTM Skudai, Johor, Malaysia, (SCOPUS h-index: 14)

Prof. Dr. Abdul Rahman Mohamed

School of Chemical Engineering, Universiti Sains Malaysia, 14300 Nibong Tebal, Pulau Penang, Malaysia, SCOPUS h-index: 32)

Dr. Hery Haerudin

Research Center for Chemistry, Indonesian Institute of Sciences (PP Kimia – LIPI), Kawasan PUSPIPTEK, Tangerang, Banten, Indonesia (SCOPUS h-index: 1)

Dr. Oki Muraza

CENT & Dept. of Chemical Engineering, King Fahd University of Petroleum and Minerals, PO Box 5040 Dhahran 31261 KSA, Saudi Arabia , (SCOPUS h-index: 4)

Dr. K. Kusmiyati

Dept. of Chemical Engineering, Muhammadiyah University of Surakarta, Pabelan, Surakarta, Indonesia, Telp/Fax: +62-271-717417, Indonesia (SCOPUS h-index: 2)

Prof. Dr. P. Purwanto, Dept. of Chemical Engineering, Diponegoro University, Jln. Prof. Soedarto, Kampus Undip Tembalang, Semarang, Indonesia 50275

Dr. Rino R. Mukti

Division of Inorganic and Physical Chemistry Faculty of Mathematics and Natural Sciences Institut Teknologi Bandung, Jl. Ganesha no.10 Bandung 40132, Indonesia, (SCOPUS h-index:7)



AIMS AND SCOPE

Bulletin of Chemical Reaction Engineering & Catalysis (ISSN 1978-2993), an international journal, provides a forum for publishing the novel technologies related to chemical reaction engineering and catalysis. Scientific articles dealing with the following topics in chemical reaction engineering, catalysis engineering, catalyst preparation method and characterization, novel innovation of chemical reactor, etc. are particularly welcome.

This journal encompasses original research articles, review articles, and short communications, including: fundamental of catalysis; fundamental of chemical reaction engineering; chemistry of catalyst and catalysis; applied chemical reaction engineering; applied catalysis; applied bio-catalysis; applied bio-reactor; membrane bio-reactor; chemical reactor design; catalyst regeneration; surface chemistry of catalyst; bio-catalysis; enzymatic catalytic reaction; industrial practice of catalyst; industrial practice of chemical reactor engineering; and application of plasma technology in catalysis and chemical reactor.

The manuscript articles should be submitted electronically in MS Word / Open Office / PDF file to Editorial Office through **Online Submission interface at:** <http://ejournal.undip.ac.id/index.php/bcrec>. Author must read the author guidelines before submitting manuscript.

PUBLICATION INFORMATION

Bulletin of Chemical Reaction Engineering & Catalysis (ISSN 1978-2993)

Short journal title: ***Bull. Chem. React. Eng. Catal.***

Year 2015, 3 issues (Volume 10, Issue 1 (April), Issue 2 (August), and Issue 3 (December)) are scheduled for publication.

Bulletin of Chemical Reaction Engineering & Catalysis, BCREC, has been published via journal website (<http://bcrec.undip.ac.id>). The BCREC journal has been published by Department of Chemical Engineering, Diponegoro University, jointly with *Masyarakat Katalis Indonesia* - Indonesian Catalyst Society (MKICS). Commencement of publication: January 2007

The BCREC journal has been indexed and abstracted by Elsevier products (SCOPUS, Engineering Village / Compendex, EnCompassLit, and EMBASE) since 2011. This journal has been ranked 40th or Q4 level in the world from Scimago Journal Ranking (<http://scimagojr.com>), SJR=0.303, by the subject category of Catalysis, and ranked 20th or Q2 level by the subject category of Process Chemistry and Technology. This journal has also been ranked in Journal Metrics (<http://journalmetrics.com>) with SNIP impact factor of 0.380.

This journal has been distributed by **EBSCO Publishing** started from Volume 4 Number 1 Year 2009 to present. The BCREC journal has been a CrossRef Member since 2012, so that all articles published by this journal have DOI unique numbers.

JOURNAL CITATIONS AND IMPACT FACTOR

* Impact Factor in Scimago Journal Ranking	: SJR = 0.303 (2013)
* Impact Factor in Journal Metrics	: SNIP = 0.380 (2013)
* Impact per Publication (IPP)	: IPP = 0.552 (2013)
* h-index in Scimago Journal Ranking	: 2
* Ranked in Scimago Catalysis category	: 40th or Q4 level
* Ranked in Scimago Process and Chemistry Technology category	: 20th or Q2 level
* SCOPUS ID	: 19900191860
* SCOPUS h-index	: 4
* Total articles published in SCOPUS	: 82 articles (since 2011)
* Total Citations in SCOPUS	: 77 citations (since 2011)
* Google Scholar h-index	: 8
* Google Scholar i10-index	: 6
* Total articles published in Google Scholar	: 101 articles (since 2007)
* Total citations in Google Scholar	: 244 citations (since 2007)
* Impact Factor in Google Scholar	: 2.416



INDEXING AND ABSTRACTING

Bulletin of Chemical Reaction Engineering & Catalysis (ISSN 1978-2993) has been covered by following indexing services:

- CiteSeerX - (2013-.) (<http://citeseer.ist.psu.edu/>)
- CiteULike - (2012-.) (<http://www.citeulike.org/user/bcrec/>)
- Mendeley - (2012-.) (<http://www.mendeley.com/profiles/bcrec-undip/>)
- CrossRef - (2012-.) (<http://www.crossref.org>)
- IPI (Indonesian Publication Index) - (2009 - .) (<http://portalgaruda.org>)
- Index Copernicus - (<http://journals.indexcopernicus.com/masterlist.php?name=Master&litera=B&start=150&skok=30>)
- CABI Direct - (2011-.) (<http://www.cabdirect.org/>)
- SCOPUS - Elsevier (2011-.) (<http://www.info.scopus.com>)
- Compendex - Elsevier (2011-.) (<http://www.ei.org>)
- EnCompassLit - Elsevier (2011-.) (http://www.ei.org/encompasslit_pat)
- EMBASE - Elsevier (2011-.) (<http://www.info.embase.com>)
- Engineering Village - Elsevier (2011-.) (<http://www.ei.org>)
- REAXYS - Elsevier (2011-.) (<http://info.reaxys.com>)
- SCIRUS - for scientific information (2010-.) (<http://www.scirus.com/>)
- Chemical Abstract Services - (2010-.) (<http://www.cas.org>), a division of American Chemical Society (ACS).
- EBSCOHOST - TOC Premier (2009-.) (<http://search.ebscohost.com>)
- EBSCOHOST - Energy & Power Source (2009-.) (<http://search.ebscohost.com>)
- EBSCOHOST - Academic Search Premier (2009-.) (<http://search.ebscohost.com>)
- EBSCOHOST - Academic Search Alumni Edition (2009-.) (<http://search.ebscohost.com>)
- EBSCOHOST - Academic Search R & D (2009-.) (<http://search.ebscohost.com>)
- EBSCOHOST - Academic Search Complete (2009-.) (<http://search.ebscohost.com>)
- Google Scholar - (2008-.) (<http://scholar.google.com>)
- Undip Institutional Repository (<http://eprints.undip.ac.id>)
- Portal Garuda DIKTI (<http://garuda.dikti.go.id>)
- Directory of Open Access Journal (DOAJ) (2009-.) (<http://www.doaj.org>)
- UlrichsWeb Global Serial Directory - (2009-.) (<http://ulrichsweb.serialssolutions.com>)
- OPEN J-GATE Open Access Journal Peer-Reviewed (<http://www.openj-gate.com/browse/ByJournal.aspx?alpha=B>)
- Academic Resources (<http://www.ourglocal.com/journal/?issn=19782993>)
- DMOZ Open Directory Project (<http://www.dmoz.org/Science/Chemistry/Publications/Journals/>)
- ResearchGATE - Scientific Network (<https://www.researchgate.net/application.index.html>)
- SOCOLAR, PR China (<http://www.socular.com>)

For detail please visit BCREC website: <http://ejournal.undip.ac.id/index.php/bcrec/pages/view/indexing>
Online Submission interface at: <http://ejournal.undip.ac.id/index.php/bcrec>

PREFACE

Bulletin of Chemical Reaction Engineering & Catalysis (ISSN 1978-2993) is an international journal. The journal is dedicated as a media for communicating all research activities in chemical reaction engineering and catalysis fields, and disseminating the novel technology and news related to chemical reaction engineering, catalyst engineering and science, bioreactor engineering, membrane reactor, and catalytic reactor engineering.

This issue (BCREC, Volume 9, Issue 3, Year 2014) has published 11 articles with various topics in catalysis and enzymatic catalysis. This issue (Volume 9 Issue 3 Year 2014) was authored and co-authored by 39 authors from 6 countries (USA, Indonesia, India, Algeria, Malaysia, and Japan).

A review article was published by Antony *et al.* about Liquid-liquid Slug Flow in a Microchannel Reactor and its Mass Transfer Properties. This article considers the importance of mass transfer in liquid-liquid systems and the advantage of slug regime over other regimes, the article focuses especially on the mass transfer between two liquid phases in slug flow and the details of experimental studies carried out in this area. The advantages of slug flow over other flow regimes in micro structured reactor applications are showcased.

The first article, Olsen *et al.* suggested One-pot Synthesis of Pt Catalysts Supported on Al-modified TiO₂. They reported that the alumina-stabilized anatase support is superior to other anatase supports for (1) obtaining high Pt dispersions, i.e. more efficiently utilizing this expensive precious metal, and (2) processes in which thermal stability is important due to its constant phase and pore structures at high temperatures.

In second article, Nur *et al.* highlighted Electrochemical Processes for the Formation of Hydroxyapatite Powders. They suggested that the electro-generation of OH⁻ ions by water reduction at the cathode plays an important role in the formation of hydroxyapatite by the electrochemical method. The OH⁻ ions induce the liberation of Ca²⁺ ions and the dissociation of phosphoric acid, which serve as the reactants for the formation of hydroxyapatite.

Another article about Effect of Calcination Temperature on Surface Morphology and Photocatalytic Activity in TiO₂ Thin Films was reported by Mothi *et al.* They reported that cost effective, benign and sustainable TiO₂ thin films having 200 nm thickness was fabricated by Spin coating technique. The fourth article about Effect of pH on Kinetics and Mechanism of Mn(II)-Catalyzed Periodate Oxidation of p-anisidine. Rate-pH profile shows a maximum at a pH of 7.0. This pH effect also suggests the involvement of at least three differently reactive reactant species in the reaction.

Isothermal Kinetics of Diesel Soot Oxidation over La_{0.7}K_{0.3}ZnO_y Catalysts prepared by sol-gel method was highlighted by Prasad *et al.* in fifth article in this issue. This paper describes the kinetics of catalytic oxidation of diesel soot with air under isothermal conditions (320-350 °C). Characterization of the catalyst by XRD and FTIR confirmed that La_{1-x}K_xZnO_y did not exhibit perovskite phase but formed mixed metal oxides.

Another article in this issue focused on synthesis of chemical is Synthesis of Poly(N-vinyl-2-pyrrolidone-co-methylmethacrylate) by Maghnite-H⁺ a Non-toxic Catalyst by Bennada *et al.* In the present work poly(N-vinyl-2-pyrrolidone-co-methylmethacrylate) copolymers were prepared successfully and cleanly by one step process via cationic copolymerization of N-vinyl-2-pyrrolidone (NVP) with methyl methacrylate (MMA), in heterogeneous phase using "Maghnite-H⁺" (Mag-H⁺) as catalyst in bulk, Maghnite is a montmorillonite sheet silicate clay exchanged with protons to produce Maghnite-H⁺.



Next article in this issue is about Catalytic Pyrolysis and a Pyrolysis Kinetic Study of Shredded Printed Circuit Board for Fuel Recovery by Ng *et al.* In this article, investigation about optimum temperature for pyrolyzing waste PCBs, find out the best catalyst to be used in accelerating PCBs' pyrolysis, select suitable ratio of catalyst to PCBs for higher oil yield and examine kinetics pyrolysis of the waste PCBs' decomposition were conducted. Operating temperatures ranged from 200 to 350 °C of PCB's pyrolysis were conducted with the optimum temperature obtained was 275 °C. Fluid catalytic cracking (FCC) catalyst, zeolite socony mobil-5 (ZSM-5), HY-type zeolite and dolomite were used to accelerate PCB's pyrolysis at 275 °C and FCC was identified as the best catalyst to be used. The kinetic study was done through thermogravimetric analysis on waste PCBs under various heating rates and different particle sizes.

Article focused on Catalytic Studies Featuring Palladium(II) Benzoylthiourea Derivative as Catalyst in Sonogashira Reaction was published by Khairul *et al.* in this issue. A benzoylthiourea derivative (LTU) and its metal complexation of palladium(II) chloride (MLTU) has been successfully synthesized and characterized via typical spectroscopic and analytical techniques namely IR, ¹H and ¹³C Nuclear Magnetic Resonance, UV-Visible and Gas Chromatography Flame Ionization Detector (GC-FID).

Next article in this issue is about Preparation and Characterization of Lithium Zirconium Silicate for CO₂ Capture published by Bhosale *et al.* They reported that the samples of the lithium zirconium silicate were screened for CO₂ capture. Meanwhile, the captured CO₂ at 700 °C was observed at 8.6 wt.% and the samples were reusable for CO₂ capture.

The last article in this issue focusing on enzymatic catalysis and kinetics was published by Cahyaningrum *et al.* This article suggested about Immobilization of Pepsin onto Chitosan Silica Nanobeads with Glutaraldehyde as Crosslink Agent.

Currently, BCREC journal is an open access international journal. Therefore, readers can read and download any full-text articles for free of charge. However, for the new manuscript submission since year 2015, Authors should pay some processing fees (US\$ 100.00) per article for article processing fee and DOI maintenance once their articles have been accepted.

Authors may also pay some fees when they will order **Original Reprint Articles** (with customized cover) with some eligible rates (<http://ejournal.undip.ac.id/index.php/bcrec/pages/view/offprints>). The research articles submitted to the BCREC journal will be peer-reviewed by at least two reviewers. Accepted research articles will be available online following the journal peer-reviewing process as well as assigned to DOI number from CrossRef. Official language used in this journal is English.

Official website address of BCREC journal is: <http://bcrec.undip.ac.id>. Editor would like to appreciate all researchers, academicians, industrial practitioners focused on chemical reaction engineering and catalysis to contribute to this online journal.

Dr. I. Istadi (Editor-in-Chief)

Department of Chemical Engineering, Diponegoro University

E-mail: bcrec@undip.ac.id

(October 2014)

TABLE OF CONTENTS

1. Editorial Board	(i)
2. Aims and Scope; Publication Information; Journal Citations and Impact Factor	(ii)
3. Indexing and Abstracting	(iii)
4. Preface	(iv)
5. Table of Contents	(vi)
6. One-pot Synthesis of Pt Catalysts Supported on Al-modified TiO ₂ (Olsen, R.E., Bartholomew, C.H., Enfield, D.B., Woodfield, B.F.)	(156 - 167)
7. Electrochemical Processes for the Formation of Hydroxyapatite Powders (Nur, A., Setyawan, H., Widjaja, A., Lenggono, I.W.)	(168 - 174)
8. Effect of Calcination Temperature on Surface Morphology and Photocatalytic Activity in TiO ₂ Thin Films Prepared by Spin Coating Technique (Mothi, K.M., Soumya, G., Sugunan, S.)	(175 - 181)
9. Kinetics and Mechanism of MnII Catalyzed Periodate Oxidation of p-anisidine: Effect of pH (Kaushik, R.D., Singh, J., Manila, M., Kaur, M., Singh, P.)	(182 - 191)
10. Isothermal Kinetics of Diesel Soot Oxidation over La _{0.7} K _{0.3} ZnO _y Catalysts (Prasad, R., Kumar, A., Mishra, A.)	(192 - 200)
11. Synthesis of Poly(N-vinyl-2-pyrrolidone-co-methyl methacrylate) by Maghnite-H ⁺ a Non-toxic Catalyst (Benadda, M., Ferrahi, M.I., Belbachir, M.)	(201 - 206)
12. Liquid-liquid Slug Flow in a Microchannel Reactor and its Mass Transfer Properties - A Review (Antony, R., Giri Nandagopal, M.S., Sreekumar, N., Rangabhashiyam, S., Selvaraju, N.)	(207 - 223)
13. Catalytic Pyrolysis and a Pyrolysis Kinetic Study of Shredded Printed Circuit Board for Fuel Recovery (Ng, C.H., Salmiaton, A., Hizam, H.)	(224 - 240)
14. Catalytic Studies Featuring Palladium(II) Benzoylthiourea Derivative as Catalyst in Sonogashira Reaction (Khairul, W.M., Faisol, S.L.M., Jasman, S.M., Shamsuddin, M.)	(241 - 248)
15. Preparation and Characterization of Lithium Zirconium Silicate for CO ₂ Capture (Bhosale, T.S. , Gaikwad, A.G.)	(249 - 262)
16. Immobilization of Pepsin onto Chitosan Silica Nanobeads with Glutaraldehyde as Crosslink Agent (Cahyaningrum, S.E., Sianita, M.M.)	(263 - 269)
17. Author Guidelines (2014 version)	(App.1 - 5)
18. Copyright Transfer Agreement	(App.6 - 7)
19. Publication Ethics and Malpractice Statement	(App.8 - 9)
20. Acknowledgement to Reviewers in this issue.	(App. 10)
21. Authors Index	(App.11)
22. Subjects Index	(App.12)
23. Back Matter - Submission Information	