Nigerian Journal of Technological Development Volume 17, Number 3, September 2020.

A Quarterly Publication of the Faculty of Engineering and Technology,

University of Ilorin, Ilorin, Nigeria.

Editor-in-Chief Professor A. A. Adedeji

EDITORIAL BOARD

Dean of Faculty

Engr. Prof. D. S. Ogunniyi Department of Chemical Engineering, University of Ilorin, Ilorin, Nigeria.

Editor-in-Chief

Engr. Prof. A. A. Adedeji Department of Civil Engineering, University of Ilorin, Ilorin, Nigeria.

Associate Editor-in-Chief

Engr. Prof. C. J. Ejieji Department of Agricultural and Biosystems Engineering, University of Ilorin, Nigeria.

Managing Editor

Engr. Dr. M. F. Akorede Department of Electrical and Electronics Engineering, University of Ilorin, Ilorin, Nigeria.

Business Manager

Engr. Dr. (Mrs.) T. E. Odetoye Department of Chemical Engineering, University of Ilorin, Ilorin, Nigeria.

Treasurer

Engr. Dr. (Mrs.) N. T. Surajudeen-Bakinde Department of Electrical and Electronics Engineering, University of Ilorin, Ilorin, Nigeria.

Foundation Editor-in-Chief Prof. B. J. Olufeagba

Dept. of Electrical & Electronics Engineering, University of Ilorin, Ilorin, Nigeria.

EDITORIAL ADVISORY BOARD

Prof. J. O. Ojo

Dept. of Electrical and Computer Engineering, Tennessee Technological University, Cookeville, Tennessee, USA.

Prof. J. A. Olorunmaiye

Dept. of Mechanical Engineering, University of Ilorin, Ilorin, Nigeria.

Prof. O. Adegbenro

Dept. of Electrical/Electronics Engineering, University of Lagos, Lagos, Nigeria.

Prof. A. M. Olaniyan

Dept. of Agricultural & Bio-Resource Engineering, Federal University Oye, Ekiti, Nigeria.

Prof. J. O. Omolehin

Dept. of Mathematics, Federal University, Lokoja, Nigeria.

Prof. A. O. Ogunlela

Dept. of Agricultural & Biosystems Engineering, University of Ilorin, Ilorin, Nigeria.

Prof. A. A. Adewara

Dept. of Statistics, University of Ilorin, Ilorin, Nigeria.

Prof. Foluso Ladehinde

Dept. of Mechanical Engineering, State University of New York, Stony Brook, New York, USA.

Prof. B. F. Sule

Dept. of Water Resources and Environmental Engineering, University of Ilorin, Ilorin, Nigeria.

Prof. S. M. Adedayo

Dept. of Mechanical Engineering, University of Ilorin, Ilorin, Nigeria.

Dr. Olugbenga Mejabi

Dept. of Mechanical Engineering, Wayne State University, Detroit, Michigan, USA.

Dr James Titiloye

Dept. of Chemical & Environmental Engineering, Swansea University Swansea, United Kingdom.

Prof. S. A. Abdulkareem

Dept. of Chemical Engineering, University of Ilorin, Ilorin, Nigeria.

Dr. S. S. Zakariyah

College of Engineering and Technology, University of Derby, Derby DE22 3AW, UK.

Prof. Y. A. Jimoh

Dept. of Civil Engineering, University of Ilorin, Ilorin, Nigeria.

Prof. Samuel John

Dept. of Mechanical Engineering, Namibia University of Science & Technology, Windhoek, Namibia.

Prof. J. A. Omoleye

Dept. of Chemical Engineering, Covenant University, Ota, Ogun State, Nigeria.

Prof. T. S. Ibiyemi

Dept. of Electrical & Electronics Engineering, University of Ilorin, Ilorin, Nigeria.

Prof. G. A. Bakare

Dept. of Electrical & Electronics Engineering, Abubakar Tafawa Balewa University, Bauchi, Nigeria.

Prof. Victor Kamara

Dept. of Civil and Environmental Engineering, Namibia University of Science & Technology, Windhoek, Namibia.

Dr. P. Sanjeevikumar

School of Electrical & Electronics Engineering, Dublin Institute of Technology Kevin Street, Dublin-8, Ireland.

Annual Subscription

2020 rates including postage are:

Nigeria (NGN)		Other Africa Countries (USD)	Other Countries (USD)
Individual	4,000	30	40
Institution	5,000	60	80

Correspondence

Nigerian Journal of Technological Development Dean Office, Faculty of Engineering & Technology, University of Ilorin, Ilorin, Nigeria.

E-mail addresses: njtd_editor_chief@unilorin.edu.ng; njtd_man_editor@unilorin.edu.ng

Journal Homepages: http://www.njtd.com.ng http://www.ajol.info/index.php/njtd/index

Copyright & Licensing

The Nigerian Journal of Technological Development (NJTD) allows authors to retain the copyright of their papers without restrictions. Articles are published under the terms of a Creative Commons license CC BY-SA which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

First published in 1989.

Published by the Faculty of Engineering & Technology, University of Ilorin, Ilorin, Nigeria.

Abstracting and Indexing

Scopus, Google Scholar, AJOL, DOAJ, HINARI, DRJI, Journal Factor, Stanford University Libraries, Journals for free, ACADEMIA, Academic Resource Index ResearchBib, AcademicKeys, JournalSeek, Genamics, ROAD, Bielefeld University Library, IIJIF, SIS.

Printed in Nigeria by:

USMOLAG PRINTERS

No. 50 Ajasepo Road, Offa Garage, Ilorin, Kwara State.

Information for Authors

Aim and Scope

The Nigerian Journal of Technological Development publishes high-quality articles focusing on all aspects of Engineering and Applied Sciences. All manuscripts will be double blind peer-reviewed and if found suitable, published according to the subject matter, either as a **Research Paper**, **Review Paper** or a **Technical Note**.

Submission of Manuscript

Submission of manuscript is on the condition that it is an original work of the author(s) and it has neither been published previously nor currently under consideration for publication elsewhere. Authors should submit the electronic copy of their manuscript directly to the journal through the journal's website using the online submission system. Please do not submit a hard copy to the editorial office or send your manuscripts by e-mail.

After the manuscript has been submitted, you will see a confirmation screen and receive an email confirmation stating that your manuscript has been successfully submitted. If you do not receive this, your manuscript will not have been successfully submitted to the journal and the paper cannot progress to peer review. If this is the case your manuscript will still be sitting in the 'Incomplete' section of your 'Author Page' awaiting your attention.

To track your submission's progress through the review and editorial process, you will need to log into the journal website, and choose your role as Author. Click on the linked title to go to the submission record.

Preparation of the Manuscript

Manuscript should be written in English Language and typed in 12 point font size using Times New Roman in double spacing on A4 paper. A margin of 25 mm should be left at the sides. The paper should not exceed twenty (20) pages, including figures and tables. The manuscript should be organised under the following headings:

Title Page

The title page should contain **only** the title of the article, authors' contact details such as names, institutional affiliations, corresponding author's email address and phone number. The page is also to contain the abstract of the article. This should be uploaded as a supplementary document on the Author's portal. Please note that the article title should not exceed fifteen (15) words.

Page 1 of the Manuscript

Page 1 of the manuscript should contain the title of the article, the abstract, five or six keywords, and may include the Introduction Section, etc. However, it must **NOT** contain name(s), and address(es) of author(s), and e-mail addresses and telephone number of the corresponding author. These information will be supplied on the online submission platform in addition to the uploaded title page above. The abstract should not normally exceed 200 words in 12 point font size.

Keywords

Five or six relevant keywords should be provided on the title page.

Symbols, Abbreviations and Units

Symbols and abbreviations should be defined where first mentioned. If the symbols are many, a "Notation" defining the symbols must be included between the abstract and Introduction. SI units should be used.

Introduction

This should include the background to the study, a brief review of literature and clearly-stated objectives.

Theoretical Analysis

The mathematical principles or theories used should be included as appropriate.

Materials and Methods/Methodology/Experimental Procedure

This section should include apparatus and equipment setup, work materials, design, experimental methods, as applicable.

Results and Discussion

Results could be presented in descriptive, tabular or graphical form. Information presented in tables should not be repeated as figures. Discussion should be focused on the interpretation of experimental findings.

Conclusion

The conclusion should be a brief summary of findings. It should clearly state the contributions, relevance of the findings and recommendations, as appropriate.

References

The Harvard system (alphabetical listing) of referencing should be used in the body of the manuscript while only essential references must be cited and listed. Examples of citing references include: Omeiza (2012) or (Omeiza, 2012) as appropriate; Olaniyan and Oje (2002) or (Olaniyan and Oje, 2002) as appropriate; Ogunlela *et al* (2006) or (Ogunlela *et al*, 2006) as appropriate. Examples of listing references are as follows:

Books

Adedayo, S. M. (2000). Graphics for Engineers. Indemac Publishers, Ilorin, Nigeria.

Journals

Omeiza, I. O. A. (2012). An Investigation on the Problem of Thinning in Fingerprint Processing. Nigerian Journal of Technological Development, 9 (1): 26 - 36.

Olaniyan, A. M. and Oje, K. (2002). Some Aspects of the Mechanical Properties of Shea Nuts. Biosystems Engineering, 81 (4): 413-420.

Ogunlela, A. O.; M. Y. Kasali and I. E. Ahaneku. (2006). Hydrologic Characterization of the National Centre for Agricultural Mechanization (NCAM) Watershed. Journal of Science and Technology Research, 5 (3): 69-73.

Conference Papers

Akorede, M. F., and Hizam, H. (2009). Teaching power system analysis courses using MATPOWER. Paper presented at International Conference on Engineering Education (ICEED2009), Kuala Lumpur, Malaysia, 45-51, USA: IEEE.

Reports, Thesis and Dissertation

Abioye, A. M. (2001). Design of Engineering Power Transmission Elements using Visual Basic. Unpublished M.Eng. Thesis, Department of Electrical & Electronics Engineering, University of Ilorin, Ilorin, Nigeria.

Web Publications

Anderson, T. (1996). A Data Envelopment Analysis (DEA). Available online at: www.emp.pdx.edu/dea/homedea.html. Accessed on March 7, 2013.

Tables and Figures

Tables and Figures should be placed as close as possible to the first place of reference. References should be made to all the tables and figures in the manuscript.

Processing and Publication Charges

A processing fee of N8,000.00 should be paid while sending the manuscript and a publication page charge of N12,000.00 shall be charged after acceptance. All payment should be made to the following Account:

Account Name: Nigerian Journal of Technological Development [NJTD]

Name of Bank: United Bank for Africa Plc Location: University of Ilorin, Ilorin, Nigeria

Account Number: 1013302840

A copy of the payment teller should be enclosed while submitting the manuscript. The scanned copy of the teller should be uploaded as a supplementary file along with the manuscript in the author's portal.

To encourage foreign authors, the processing fee is waived for any submission which does not have any Nigerian author.

Acknowledgements

Acknowledgement of the individuals who provided help during the research should be collated in a separate section at the end of the article before the references and should, therefore, not be included on the title page, as a footnote to the title or otherwise.

Suggested Reviewers

A list of, at least, three suggested reviewers should be provided with their current institutional affiliations as well as email addresses. However, please note that the Managing Editor reserves the right to determine the appropriate reviewers to review your manuscript. This request is simply to populate our database of reviewers in diverse fields.

Subscription and Advertisement

The subscription and advertisement rates can be obtained from the Editor-in-Chief, the Managing Editor or the Business Manager. Current and past volumes of the journal are available at Room **G11**, Department of Materials and Metallurgical Engineering, Faculty of Engineering and Technology, University of Ilorin, Ilorin; at Options Bookshop, Ibadan; or Jasper Books Nig. Ltd, Ilorin, for sale at reduced price.

Submission Checklist

The following list will be useful during the final checking of your article prior to sending it to the journal for review. Please ensure that the following items are present:

- The title page contains **only**:
 - Title of the manuscript;
 - The Abstract; and
 - Authors' names, affiliations, and contact details of the corresponding author.
- Ensure that page 1 of the manuscript **DOES NOT** contain the authors' details and contacts such as names, postal address, email address, and phone number.
- Further considerations
 - A list of three suggested reviewers and their email addresses has been provided.
 - Manuscript has been 'spell-checked' and 'grammar-checked'
 - References are in the correct format for this journal
 - All references mentioned in the Reference list are cited in the text, and vice versa
- Processing fee
 - The processing fee of eight thousand naira (N8,000.00) has been paid directly to the Managing Editor or paid into the Journal Bank Account earlier provided. It should be noted that this does not apply to foreign authors.
 - A scanned copy of deposit teller is e-mailed to the Managing Editor, indicating the title of the submitted manuscript in the mail.

Complimentary Copies

Since authors can always download their published papers from our website at www.njtd.com.ng, author's complimentary copy shall no longer be sent to the authors. However, any author that so requires a print version of the journal shall pay a sum of Four Thousand Naira (N4,000:00) per copy.

TABLE OF CONTENTS

Volume 17, Number 3, September 2020

	Page
Optimisation of Artificial Lifts Using Prosper Nodal Analysis for BARBRA-1 Well in Niger	
Delta	150
Tega Odjugo, Yahaya Baba, Aliyu Aliyu, Ndubuisi Okereke, Lekan Oloyede,	
Olabisi Onifade	
http://dx.doi.org/10.4314/njtd.v17i3.1	
Experimental Investigation of Temperature Effects on Low Salinity Enzyme Enhanced	
Oil Recovery Process	156
Tinuola H. Udoh	
http://dx.doi.org/10.4314/njtd.v17i3.2	
Mobile Robot Path Planning in an Obstacle-free Static Environment using Multiple	
Optimization Algorithms	165
C. O. Yinka-Banjo, U. Agwogie	
http://dx.doi.org/10.4314/njtd.v17i3.3	
Diversity Control in Evolutionary Computation using Asynchronous Dual-Populations	
with Search Space Partitioning	174
H. A. Bashir	
http://dx.doi.org/10.4314/njtd.v17i3.4	
Cost Reduction of Fluid Catalytic Cracking Unit in Kaduna Refining and Petrochemical	
Company using Pinch Technology	189
Abdulkareem Abubakar	
http://dx.doi.org/10.4314/njtd.v17i3.5	
Effect of Changing Cement Grade on the Properties of Structural Concrete	197
C. A. Fapohunda, B. I. Famodimu, B. C. Adigo, A. S. Jeje	
http://dx.doi.org/10.4314/njtd.v17i3.6	
Effect of Tillage Practices on Selected Engineering Properties of Cassava (Manihot	
esculenta) Tubers	205
O. A. Adetola, O. J. Olukunle, A. P. Olalusi, O. O. Olubanjo	
http://dx.doi.org/10.4314/njtd.v17i3.7	

Evaluating the Quality Assurance and Control of Hot-Mix Asphalt from Selected Plants	
in South West, Nigeria	217
A. O. Olutaiwo, A. Adanikin	
http://dx.doi.org/10.4314/njtd.v17i3.8	
Rainfall Intensity Analysis for Synoptic Stations in Northern Nigeria	223
S. O. Oyegoke, A. S. Adebanjo, H. J. Ododo	
http://dx.doi.org/10.4314/njtd.v17i3.9	
Thermodynamic and Optimization Studies of Castor Leaf Extract as Corrosion Inhibitor	
on Stainless Steel (301)	229
A. O. Okewale, A. T. Adebayo	
http://dx.doi.org/10.4314/njtd.v17i3.10	