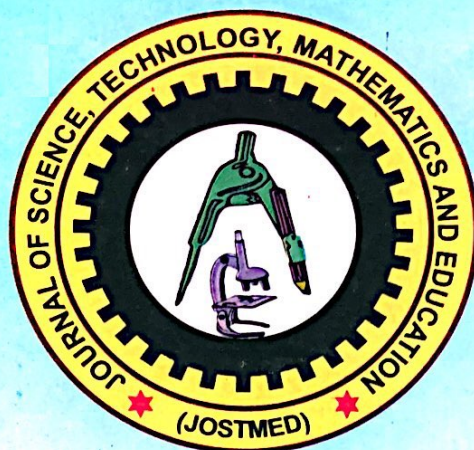


VOLUME 11(2), AUGUST, 2015

ISSN: 0748 – 4710

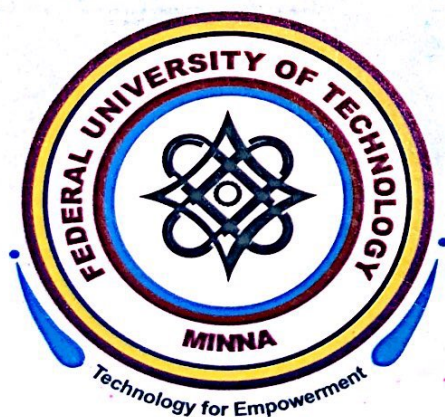


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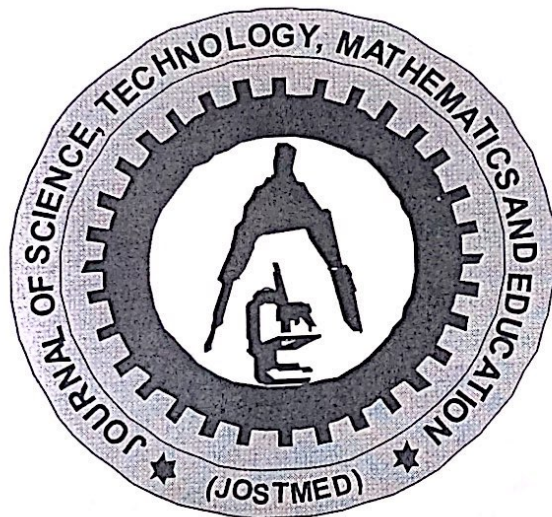
E-mail: jostmedscience@yahoo.com, jostmed@futminna.edu.ng

Phone: +234-816-680-7534



PUBLISHED BY:
DEPARTMENT OF SCIENCE EDUCATION
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA,
NIGERIA, AFRICA

**JOURNAL OF SCIENCE, TECHNOLOGY,
MATHEMATICS AND EDUCATION
(JOSTMED)**



ISSN: 0748 – 4710

VOLUME 11(2), AUGUST, 2015

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Dr. Gambari, A. I.

The Managing Editor, (JOSTMED),

Department of Science Education,

Federal University of Technology,

P. M. B. 65, Minna, Niger State, Nigeria.

E-mail: gambarii@yahoo.com; gambariisiaka@gmail.com
gambari@futminna.edu.ng ; gambari@codel.futminna.edu.ng

Website: www.gambariisiaka.com

Blogsite: www.drgambari.com

Mobile Phone: +234-816-680-7534; +234-803-689-7955; +234-805-558-6716

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ISSN 0748-4710

CONTRIBUTORS TO THE ISSUE

1. **OLATUNJI, SAMINU^{1*} & OJULARI, BASHIRU ALABA²**
¹Department of Geophysics, University of Ilorin, Ilorin, Nigeria
²Department of Geology and Mineral Sciences, University of Ilorin, Ilorin, Nigeria
E-mail: sam61ng@gmail.com **Phone No:** +234-803-289-2742
2. **ADETONA, A, A¹. & ABU, MALLAM²**
¹Department of Physics, Federal University of Technology Minna
²Department of Physics, University of Abuja, Gwagwalada-Abuja
E-mail: adetonabass@futminna.edu.org; mallamabu@yahoo.com,
Phone No: +234-803-691-5982
3. **JONAH, S. A., OLASEHINDE, P. I¹., JIMOH, M. O¹., UMAR, M². & YUNANA, T³**
Department of Physics, Federal University of Technology, Minna, Nigeria
¹Department of Geology, Federal University of Technology, Minna, Nigeria
²Department of Physics, University of Abuja, Abuja
³Department of Physics, Kaduna State College of Education, Kaduna State
E-mail: sajonah2003@yahoo.com **Phone No:** +234-806-468-7977
4. **IBRAHIM, I. L¹.; MOHAMMED, S. H²., MOHAMMED, D. Z². & ABDULRAHMAN, A¹.**
¹Department of Chemistry,
Ibrahim Badamasi Babangida University, Lapai, Niger State, Nigeria.
²Department of Chemistry, College of Education, Minna
E-mail: isahlahan@gmail.com **Phone No:** +234-803-365-3492
5. **BELLO-SALAU, H¹., AIBINU, A. M²., ONWUKA, E. N¹., ONUMANYI, A. J¹. & BIMA, M. E².**
¹Department of Telecommunication Engineering
²Department of Mechatronics Engineering
Federal University of Technology, Minna, Niger State, Nigeria
E-Mail: {¹habeeb.salau, ²abiodun.aibinu ¹onwukaliz, ¹adeiza1,
²bimamhammad@futminna.edu.ng
Phone No: +234-807-960-5830
6. **KATAMBA, A. S. (Ph.D)**
Department of Library & Information Technology,
Federal University of Technology, Minna – Niger State, Nigeria
Email: s.katamba@futminna.edu.ng **Phone No:** +234-703-870-6880
7. **JONAH, S. A., JAMES, G. O., ADEKU, D. E., AHMED, F., ALHASSAN, A., HAMZA, S., IGBIDEBA, O. I., KWAGHHUA, F. I., KYARI, M., MACAULAY, V. F., OLAREWAJU, S.I., ONYEODILI, G., POPOOLA, G.B., SOFESO, O.A., SWITZER, F. K., AND UMOH, U. E.**
Department of Physics, Federal University of Technology, Minna, Nigeria
E-mail: sajonah2003@yahoo.com **Phone No:** +234-806-468-7977

8. **AKANBI MOHAMMED LAWAL^{1, 2}, BASRI HASSAN¹ ADEMOLAKE & BOLA HAWAH²**
¹Department of Library and Information Science, Kulliyah of Information and Communication and Technology, International Islamic University, Malaysia
²Department of Library and Information Science, Faculty of Communication and Information Sciences, University of Ilorin, Nigeria
E-mail: mohammedlawala@gmail.com **Phone No:** +234-704-527-5397
9. **SHEHU, AMADA T¹. & NWANKWO, LEVI I².**
¹ Physics Unit, Centre for Preliminary and Extra-Mural Studies, Federal University of Technology Minna, Nigeria.
²Department of Geophysics, University of Ilorin, PMB 1515, Ilorin, Nigeria.
E-mail: atshehu2006@gmail.com; levinwankwo@yahoo.com
Phone No: +234-817-970-8785
10. **ROWLAND M. O. KAYODE¹, BUKOLA I. KAYODE², SUNDAY A. LABA³, & KHADIJAT O. SALAMI¹**
¹Division of Biotechnology, Department of Food Science and Home Economics, Faculty of Agriculture, University of Ilorin, Ilorin, Nigeria.
²Department of Food Science and Technology, College of Food Science and Human Ecology, Federal University of Agriculture Abeokuta, Nigeria.
³Department of Microbiology, Faculty of Live Sciences, University of Ilorin, Ilorin, Nigeria.
E-mail: kayodermosnr@gmail.com; **Phone No:** +234-803-585-0545
11. **GARBA, M. U.**
Chemical Engineering Department, Federal University of Technology Minna, Nigeria
E-mail: tanimugarba@yahoo.com, **Phone No:** +234-805-245-0032
12. **OLAJOYE, IBUKUN JAMES¹ & ALALADE OLUWASEGUN AYODEJI²**
¹Department of Agricultural Economics and Farm Management
²Department of Agricultural Extension and Rural Development
^{1&2}University of Ilorin, Ilorin, Nigeria
E-mail: olaoyeibukunjames@yahoo.com, segunalalade@gmail.com
Phone No: +234-805-340-0889, +234-706-089-6827, +234-706-388-0416
13. **ADAMU, M.¹; OKAFOR, J. O.² & DAVID, G. T.³**
^{1,3}Department of Chemical Engineering, Federal Polytechnic, Bida, Niger State
²Department of Chemical Engineering, Federal University of Technology, Minna, Niger State
E-mail: mudams2004@gmail.com **Phone No:** +234-806-529-5882
14. **FALOLA, ABRAHAM; AYINDE, O. E.; SALAMI, M. F. & EZEKIEL ISRAEL**
¹Department of Agricultural Economics and Farm Management, University of Ilorin, Ilorin, Nigeria
E-mail: markmercy12@gmail.com **Phone No:** +234-703-047-3809

15. **AGBAJELOLA, D. O.¹, MUSA, UMARU¹, MOHAMMED, I. A., BALA ALHAJI², SULEIMAN, B. & KURE, A¹**
¹Department of Chemical Engineering, Federal University of Technology Minna
²Department of Civil Engineering, Federal University of Technology Minna, Nigeria
E-mail: umar.musa@futminna.edu.ng **Phone No:** +234-803-231-8723
16. **ONUORAH MARTINS .O.* OJO MOSES S.*, USMAN DAHIRU JNR*, ABAH ROSE .T.****
^{*}Department of Mathematics & Statistics, Federal Polytechnic Nasarawa, Nigeria.
^{**}Department of Mathematics, University of Abuja, Nigeria.
E-mail: martins.onuorah@yahoo.com **Phone No:**+234-803-076-4334
17. **ABUBAKAR, U.¹; MARIAM, A. O.² & ABDULHAKEEM, O. A.³**
^{1,3}Department of Statistics, School of Physical Science, Federal University of Technology, Minna, Nigeria.
²Department of Statistics, School of Physical Science, University of Ilorin, Nigeria
E-mail: abu.usman@futminna.edu.ng **Phone No:** +234-803-592-4242
18. **GARBA, M. K.¹, AJAO, K. R.², YAHYA, W. B.¹ & OYEYEMI, G. M.¹**
¹Department of Statistics, University of Ilorin, Ilorin, Nigeria
²Department of Mechanical Engineering, University of Ilorin, Ilorin, Nigeria
E-mail: garba.mk@unilorin.edu.ng **Phone No:** +234-803-556-8461
19. **MUHAMMAD, R., YAHAYA, Y. A. & IDRIS, L.**
Department of Mathematics, Federal University of Technology, Minna, Nigeria,
E-mail: r.muhd@futminna.edu.ng; ²yusuphyahaya@futminna.edu.ng; laminu.idris@futminna.edu.ng
Phone No: +234-803-570-3358
20. **PROF. CLEMENT O. ABAH¹, PROF. JOELO O. ERIBA² & VICTORIA M SHIKAAN³**
^{1&2}Department of Curriculum and Teaching, Benue State University, Makurdi
³Shepherd Academy, Makurdi, Benue State Nigeria
E-mail: nuelachor@yahoo.com **Phone No:** +234-805-781-5311
21. **FALODE, O. C., BELLO, A., USMAN, H. & ABDUL, I. W.**
Department of Science Education, Federal University of Technology Minna, Nigeria
E-mail: facominsight2@gmail.com **Phone No:** +234-806-962-6979
22. **USMAN, I. G. (Ph.D)**
Department of Counselling Psychology, Faculty of Education and Arts, Ibrahim Badamasi Babangida University, Lapai, Niger State
E-mail: usmanidris@gmail.com **Phone No:** +234-701-292-8880
23. **ALHASSAN DOKOCHI SAFO¹., HASSAN USMAN² & NDAGARA A SADIQ³**
¹Department of General Studies Education (GSE), College of Education, Minna
^{2,3}Department of Mathematics, College of Education Minna.
E-mail: alhassansafo@gmail.com, babaibro73@gmail.com, abubakarsn@yahoo.com
Phone No: +234-703-716-4073

24. **OYELEKAN, OLOYEDE SOLOMON; BAANU, TITILAYO FUNMISHO & OLORUNDARE, ADEKUNLE SOLOMON**
Department of Science Education, Faculty of Education,
University of Ilorin, Ilorin, Nigeria
E-mail: solomonoyelekan@hotmail.com **Phone No:** +234-806-054-9228
25. **ABIOLA LATEEF OLORI¹ & ABIONA SUNDAY AINA²**
¹Department of Science and Technology Education,
Olabisi Onabanjo University, Ago-Iwoye, Ogun State Nigeria
²Department of Agricultural Education
Tai Solarin College of Education, Omu-Ijebu, Ogun State, Nigeria
E-mail: ajabo4sure@gmail.com **Phone No:** +2348067525596
26. **ROBERT OGBANJE OKWORI¹ & OGUNNIRAN G. DARE²**
¹Department of Industrial and Technology Education
Federal University of Technology, Minna, Niger State Nigeria
²Department of Science and Technology Education,
University of Lagos, Akoka, Lagos
Email: okworirobert@yahoo.com **Phone No:** +234-806-096-6524
27. **ZUBAIRU, SULEIMAN ABUBAKAR (Ph.D)**
Instructional Technology Section,
Department of Educational Foundations and Curriculum,
Faculty of Education, Ahmadu Bello University
E-mail: sazubairu@gmail.com **Phone No:** +234-802-957-3340
28. **ADENIJI, K. A.**
Department of Science Education
Federal University, Dutsin-Ma, Katsina
E-mail: xyoriented@gmail.com **Phone No:** +234-803-766-0561
29. **HASSAN USMAN¹, KURE ISAH DANJUMA² & ALHASSAN DOKOCHI SAFO³**
¹Department of Mathematics,
College of Education, Minna, Niger State, Nigeria
²Department of Science Education,
Ibrahim Badamasi Babangida University, Lapai, Nigeria
³Department of General Studies,
Niger State College of Education, Minna, Niger State, Nigeria
E-mail: babanibro73@gmail.com **Phone No:** +234-806-565-1578
30. **AWEDA, ABDULWAHID KOLAWOLE¹, UMAR, UMAR MOHAMMED¹, IGE, OLUSEGUN OMONIYI² & YUSUF, MUKAILA²**
¹Department of Geology and Mining,
Ibrahim Badamasi Babangida University, Lapai, Niger State, Nigeria.
²Department of Geology and Mineral Sciences,
University of Ilorin, Ilorin Kwara State, Nigeria.
E-mail: awedaka@yahoo.com, umarumarflex@yahoo.com,
vickyige2002@yahoo.com, y_mukaila@yahoo.com
Phone No: +234-806-307-6837, +234-806-151-9808, +234-803-676-2252,
+234-703-384-0810

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PREDICTION OF SLAG FORMATION DURING COAL COMBUSTION USING FACTSAGE EQUILIBRIUM MODELLING

GARBA, M. U.

Chemical Engineering Department,

Federal University of Technology Minna, Nigeria

E-mail: tanimugarba@yahoo.com Phone No: +234-805-245-0032

Abstract

In this paper, a thermo-dynamic model (based on FACTSage) has been used to predict the slag behaviour of coals under the high temperature conditions existing in the pf boilers. The viscosity of the slags has been calculated based on the amount and composition of the predicted molten phase and compared with the experimental data derived from entrained flow reactor (EFR). The nature of the deposits collected varies from completely molten, strong to weak deposit depending on the probe location in the EFR. The results of the slag viscosities obtained at specific temperatures between 1300 °C and 1250 °C fall within the region that corresponds to the probe 2 where sintered deposits were collected from the EFR. The Factsage calculation also revealed that this region corresponds to the region where the percentage of iron and calcium in the slag liquid reached its peak. The results revealed that the abundance of melted ash particles are dominant factors can be used to assess the strength of deposits.

Keywords: Coal; EFR; FactSage; Viscosity; Slag

Introduction

The coal ash contains significant proportion of mineral and inorganic components that lead to slagging and fouling deposits in boilers. Uncontrolled and/or unexpected formation of ash deposits on the heat transfer surfaces in a boiler can interfere with operation and reduce output or efficiency. With reduces furnace heat absorption capacity, increase furnace temperature elsewhere where may cause intensive slagging. These factors affect the overall performance of the plant including electricity production capability, equipment failure rate and hence the power generation cost (Wigley & Williamson, 1998).

Slagging refers to ash deposition in the furnace region of the boiler where heat transferred is exposed to radiant heat. The ash deposit is commonly molten and composed of highly fused particles. Another form of slagging is sintered deposit which is composed of partially fused particles. Slag may be homogenous or heterogeneous depending on factors such as the concentrations of dissolved inorganic elements, the rate of crystallization of inorganic species and the cooling rate of the liquid (Kondratiev and Jak, 2001). In a coal-fired power station, the sintered deposits can become very hard and difficult to remove by sootblowing. The strength of the deposit may be more important than the rate of deposition to an operator. The degree of sintering and hence the strength of the deposit is dependent on the chemical and mineralogical composition of the fly ash particles, the particle temperature, the surface temperature of the deposit and the gas temperature. The most widely used methods for characterizing coal ash deposition and slagging are ash fusion temperature (AFT), ash particle viscosity and ash chemistry (McLennen, Bryant, W. Bailey, Stanmore & Wall, 2000). The AFT, which determines the temperature at which the various stages of the ash deformation and flow takes place, is based on the judgment of the analyst as to when the ash reaches and passes through the defined stages of the deformation. Since the assessment of this method is considered more empirical and subjective in nature and the results obtained may be unreliable.