

CURRICULUM VITAE

Dr. Harinandan Kumar B.E., Ph.D.

Email: harinandankumar88@gmail.com

Contact No: +91 7735232487

C/O: Jitendra Vir Gupta, Near Ambiwala post office,

Gupta Atta Chakki, Ambiwala, Premnagar, Dehradun Uttarakhand - 248007



CAREER OBJECTIVE

- To work in a healthy competitive growth oriented environment where performance is rewarded and to contribute toward the goals of the institution and further develop my professional skills.
- To initiate and conceptualize new areas in the field of Engineering Education through dedicated academic and research work.
- Staying appropriately networked and keeps abreast of trends, news, events and deadlines.
- Excellent Communication skill to present points precisely and clearly.
- Possess interest in Reservoir Engineering, Coal Bed Methane Production Technology, Fluid Mechanics, Thermal Engineering, Strength of Material, Rock Mechanics, Soil Mechanics
- To be involved in Research and Development, Innovation, to create Patent, Projects etc.

ACADEMIC QUALIFICATION

Ph.D.	: 2018
University/College	: National Institute of Technology, Rourkela-769008
Research Area	: Mechanical Properties of Coal (Coal Bed Methane Technology)
Title	: Estimation and Simulation of Gas Permeability as well as Stress-Strain behaviour of some Indian Coal Seam
Research Type	: Coal Characterization, Adsorption/desorption Characterization, Permeability Characterization and Reservoir Modeling and Simulation
B.E	2008 – 2012
Department	Mechanical & Production Engineering
University/College	: Sathyabama University/Sathyabama University ,Chennai-119
Aggregate Mark	: 82% (First Class with Distinction)
XII	: 2005 – 2007
Board/School	: B.S.E.B/Laloo Mandal College, Gaya, Bihar
Aggregate Mark	: 60.1% (First Class)
X	: 2003
Board/School	: C.B.S.E / S.K.P.V.V, Rajpur, Banka, Bihar
Aggregate Mark	: 69% (First Class)

PROFESSIONAL EXPERIENCE

Teaching and Research Experience

- Lecturer in Department of Mechanical Engineering, Raajdhani Engineering College, Bhubaneswar, Odisha (October, 2012 to March, 2013)
- Research Scholar (Mechanical Behavior of Coal and its Application in Coal Bed Methane) in Department of Mining Engineering, N.I.T., Rourkela, Odisha (April, 2013 to July, 2017)
- Assistant Professor in Department of Mechanical Engineering, MITS, Madanapalle, Chittoor District, Andhra Pradesh (Oct., 2017 to Jun., 2018)
- Mentor for Online Certification Course, Introduction to Composites, NPTEL, SWAYAM, IIT Madras (Jan. 2018 to Jun. 2018)
- Assistant Professor in Department of Petroleum and Earth Sciences, UPES, Dehradun, Uttarakhand (Aug. 2018 to Continuing)

PUBLICATION DETAILS

PUBLICATIONS (JOURNAL & CONFERENCES)

International Journal (published)

1. **Harinandan Kumar (First and Corresponding Author)**, S. Ravi Kumar “An approach to CO₂ capture technology for Mitigating Global Warming and Climatic Change - An Overview”, DOI: 10.1109/RSTSCC.2010.5712870, IEEE Explore, pp. 364-371, 2010. (**Scopus Indexed**) (**Citation 5**), **DOI: 10.1109/RSTSCC.2010.5712870**
2. **Harinandan Kumar (First and Corresponding Author)**, Susmita Mishra, M. K. Mishra, A. Parida, “Petrographic Characteristics of Bituminous Coal from Jharia Coalfield India: It's Implication on Coal Bed Methane Potentiality” Procedia Earth and Planetary Science, Science Direct, Vol. 11, pp. 38-48, 2015. (**Scopus Indexed**) (**Citation 9**), <https://doi.org/10.1016/j.proeps.2015.06.006>
3. **Harinandan Kumar (First and Corresponding Author)** and M. K. Mishra, “Optimization and Evaluation of Fly Ash Composite Properties for Geotechnical Application” Arab. Journal of Geo-science, Vol. 8, pp. 3713-3726, 2015. (**SCI Indexed**) (**Citation 5**), **Impact Factor: 1.3**, <https://doi.org/10.1007/s12517-014-1502-z>
4. **Harinandan Kumar (First and Corresponding Author)**, M. K. Mishra, and S. Mishra, “3D Modelling of Coal Deformation under Fluid Pressure using COMSOL Multiphysics”, Journal of Engineering Science and Technology Review. Vol. 10, pp. 62-69, 2018. (**Scopus Indexed**) (**Citation 1**), **doi:10.25103/jestr.106.09**
5. **Harinandan Kumar (First and Corresponding Author)**, M. K. Mishra, and S. Mishra, “Laboratory Investigation of Gas Permeability and its Impact on CBM Potential”, Journal of Petroleum Exploration and Production Technology, Springer, Vol. 8, pp. 1183-1197, 2018. (**SCI Indexed**) (**Citation 6**) **Impact Factor: 0.3**, <https://doi.org/10.1007/s13202-017-0425-0>
6. **Harinandan Kumar (First and Corresponding Author)**, M. K. Mishra, and S. Mishra, “Effect of Permeability and Geo-mechanical Properties on Coal Matrix During CBM Production – An Overview”, Journal of Engineering Science and Technology Review, Vol. 11, pp. 160-173, 2018. (**Scopus Indexed**) (**Citation 7**), **doi:10.25103/jestr.112.22**
7. M. Muralidhar Singh, **Harinandan Kumar (Corresponding Author)**, G. Hemath Kumar, P. Sivaiah, K. V. Nagesha, K. M. Ajay, G. Vijaya, “Determination of Strength Parameters of Glass Fibers Reinforced Composites for Engineering Applications”, Journal of Silicon, Vol. 12(1), pp. 1-11, 2019. (**SCI Indexed**) (**Citation 6**) **Impact Factor: 1.49**, <https://doi.org/10.1007/s12633-019-0078-3>
8. **Harinandan Kumar (First and Corresponding Author)**, M. K. Mishra, and S. Mishra, “Sorption capacity of Indian coal and its variation with rank parameters”, Journal of Petroleum Exploration and Production Technology, Vol. 9, pp. 2175-2184, 2019. (**SCI Indexed**) (**Citation 2**) **Impact Factor: 0.3**, **DOI:10.1007/s13202-019-0621-1**
9. Muralidhar Singh M., **Harinandan Kumar (Corresponding Author)**, G. Hemath Kumar, P. Sivaiah, K. V. Nagesha, Ajay K M, Vijaya G, “Evaluation of Multilayer Thin Film Coatings for Solar Thermal Applications”, Arabian Journal for Science and Engineering. Vol. 44, pp. 7789-7797, 2019. (**SCI Indexed**) **Impact Factor: 1.71**, **DOI:10.1007/s13369-019-03904-9**
10. **Harinandan Kumar (First and Corresponding Author)**, M. K. Mishra, and S. Mishra, “Experimental and numerical evaluation of CBM potential in Jharia Coalfield India”, Geomechanics and Geophysics for Geo-Energy and Geo-Resources, Vol. 5 (3), pp. 289-314, 2019. (**SCI Indexed**) (**Citation 6**) **Impact Factor: 2.224**, **DOI:10.1007/s40948-019-00114-3**
11. K. V. Nagesha, **Harinandan Kumar (Corresponding Author)**, M. Muralidhar Singh, “Development of statistical models to predict Emission rate and Concentration of Particulate Matters (Pm) for drilling operation in opencast mines”, Journal of Air Quality, Atmosphere & Health, Vol. 12, pp. 1073-1079, 2019. (**SCI Indexed**) (**Citation 1**) **Impact Factor: 2.87**, **DOI:10.1007/s11869-019-00723-7**
12. Upendra Singh Yadav, **Harinandan Kumar (Corresponding Author)**, Vishnu Roy, Saurabh Juyal, Anurag Tripathi, Anveshika Shanker, “Experimental evaluation of partially hydrolyzed polyacrylamide

and silica nanoparticles solutions for enhanced oil recovery”, Journal of Petroleum Exploration and Production Technology, Vol. 10, pp. 1109-1114, 2019. . (SCI Indexed) (Citation 3) Impact Factor: 0.3, DOI:10.1007/s13202-019-00749-8

13. **Harinandan Kumar (First and Corresponding Author)**, Upendra Singh Yadav, Subhash Kumar, Kishan Kumar, Ravi Yadav, Anveshika Shanker, Anurag Tripathi, Gitiksha Khandelwal, “Comparative study of coal rocks compressive behaviors and failure criteria”, Arabian Journal of Geosciences, Vol. 12(23), pp. 710, 2019. (SCI Indexed) (Citation 1) Impact Factor: 1.3, DOI:10.1007/s12517-019-4914-y
14. P Sivaiah, Venkata Ajay Kumar G, Muralidhar Singh M, **Harinandan Kumar**, “Effect of novel hybrid texture tool on turning process performance in MQL machining of Inconel 718 superalloy”, Journal of Materials and Manufacturing Processes, Vol. 35, pp 61-71, 2019. (SCI Indexed) (Citation 20) Impact Factor: 3.046, <https://doi.org/10.1080/10426914.2019.1697444>
15. Upendra Singh Yadav, **Harinandan Kumar (Corresponding Author)**, Vikas Mahto, “Experimental investigation of partially hydrolyzed polyacrylamide–hexamine–pyrocatechol polymer gel for permeability modification”, Journal of Sol-Gel Science and Technology, Vol. 94, pp. 335-346, 2020. (SCI Indexed) (Citation 1) Impact Factor: 2.008, DOI:10.1007/s10971-020-05248-5
16. Koneti Nagesha, **Harinandan Kumar (Corresponding Author)**, Muralidhar Munisingh, “Influence of rock properties on emission rate of Particulates Matter (Pm) during drilling operation in surface mines”, Iranian Journal of Earth Sciences, Vol. 13, pp. 14-20, 2020. (Scopus Indexed) Impact Factor: 0.81
17. Muralidhar Munisingh M., **Harinandan Kumar (Corresponding Author)**, P. Sivaiah, “Alumina Thin film Coatings at Optimized Conditions using RF Magnetron Sputtering Process”, International Journal of Thin Films Science and Technology, Vol. 10, pp. 13-30, 2020. (SCOPUS Indexed) Impact Factor: 0.15, doi:10.18576/ijtfst/100103
18. **Harinandan Kumar (First and Corresponding Author)**, Muralidhar Munisingh M., P. Sivaiah, “Characterization of Aluminium and Alumina Thin Films Coatings using different Deposition Methods for Enhancement of Optical Properties”, International Journal of Materials Engineering Innovation, Accepted, 2020. (Scopus Indexed) Impact Factor: 0.9
19. Prashant Saini, **Harinandan Kumar (Corresponding Author)**, Tarun Gaur, “Cement bond evaluation using well logs: A case study in Raniganj Block Durgapur, West Bengal, India”, Journal of Petroleum Exploration and Production Technology, Vol. 11, pp. 1743-1749, 2021. (SCI Indexed) Impact Factor: 0.3, DOI <https://doi.org/10.1007/s13202-021-01151-z>
20. **Harinandan Kumar (First and Corresponding Author)**, M. K. Mishra, S. Mishra, Muralidhar Singh M., D. K. Srivastava, “ Determination of Methane Sorption Capacity using microstructural analysis in coal of Jharia Coalfield, India”, Arabian Journal of Geosciences, Vol. 14, pp. 690, 2021. (SCI Indexed) Impact Factor: 1.3, DOI:10.1007/s12517-021-07051-0
21. Nirlipta Priyadarshini Nayak, **Harinandan Kumar (Corresponding Author)**, Shivani Bhist, “Application of Hydraulic Flow Unit for Prediction of Flow Zone in Carbonate Reservoir”, Arabian Journal of Geosciences. Vol. 14, pp. 677, 2021. (SCI Indexed) Impact Factor: 1.3, DOI <https://doi.org/10.1007/s12517-021-07052-z>
22. Muralidhar Munisingh M., **Harinandan Kumar (Corresponding Author)**, P. Sivaiah, “Evaluation of Mechanical Properties of Glass Fiber-BMPM/DABAPMC Composite”, Transactions of the Indian Institute of Metals, Accepted, 2021. (SCI Indexed) Impact Factor: 1.2, DOI:10.1007/s12666-021-02314-6

International journal (Communicated for publication)

1. **Harinandan Kumar**, Muralidhar Singh M, Nirlipta Priyadarshini Nayak, Dilip Kumar Srivastava, “Development and Characterization of Fly Ash-BFS-Cement Composite for Engineering Applications”, Australian Journal of Structural Engineering. (Scopus Indexed) (Under Review)
2. **Harinandan Kumar**, Nirlipta Priyadarshini Nayak, Ashish Aggarwal, Muralidhar Singh M., “Geomechanical Characteristics and Failure Analysis of the Limestone Slope at Sahastradhara-Chamasari

Road Dehradun Uttarakhand India”, Journal of Mountain Science. (SCI Indexed) (Under Review)

International Conference (published)

1. **Harinandan Kumar**, S. Mishra, and M. K. Mishra, “Experimental Evaluation of Geo-mechanical properties of Coal using Sonic Wave Velocity”, International Conference on Advances in Agricultural, Biological & Environmental Sciences, July 22 - 23, London (UK), 2015. [Best Paper Award] (Citation 7)
2. **Harinandan Kumar**, S. Ravi Kumar, “Keep Working after Sundown by Energy Storage from Solar Power - An Overview”, International Conference, GTEC - 2011. [Best Paper Award]

National Conference (published)

1. **Harinandan Kumar**, S. Ravi Kumar, “An Innovative Approach to Save Energy in Converting Solar Power to Hydrogen Fuel” National Conference on Trend in Renewable Energy Sources, Applications & Climatic Change, July 23 - 25, 2010. [Best Paper Award]
2. **Harinandan Kumar**, S. Ravi Kumar, “A review of FSW Mechanical Property Study of Aluminum Based Composite”, Aagma - 10, NLTPC, Sept. 17 - 18, 2010. [Best Paper Award]
3. **Harinandan Kumar**, M. K. Mishra, S. Mishra, K. T. Parida, “Petrographic and Dynamic behaviour of coal for CBM production in Jharia coal field”, National Seminar on Recent Practices and Innovations in Mining Industry, NIT Raipur, Feb 19 - 20, 2016.
4. **Harinandan Kumar**, “Review of Experimental studies on Heat Transfer Augmentation”, National Conference on Development in Mechanical Engineering – An Impact on Ecology and Environment, March 09 - 10, 2013.
5. **Harinandan Kumar**, “Nitinol: A Smart Material of Advance Technology”, National Conference on Development in Mechanical Engineering – An Impact on Ecology and Environment, March 09 - 10, 2013.
6. **Harinandan Kumar**, “Effect of Process parameter of Friction Stir Welding on Macro and Microstructure of dissimilar material – An Overview”, National Conference on Process and Characterization of Materials, Dec. 07 - 08, 2012.
7. **Harinandan Kumar**, S. Ravikumar, “Metallurgical study in Friction Stir Welding for Aluminum Alloy – An Overview”, National Conference on Recent Trend in Manufacturing and Industrial Engineering, April 09 - 10, 2010.
8. **Harinandan Kumar**, S. Ravikumar, “A review of FSW microstructure studies on dissimilar Aluminum Alloys”, National Conference on Emerging Trend in Mechanical Engineering, August 09 - 10, 2010.
9. **Harinandan Kumar**, M. K. Mishra, S. Mishra, “Laboratory Investigation of Gas Permeability and its impact on CBM Production”, National Conference on Waste to Energy, Carbon Capture and Storage, August 03 - 05, 2017.

PATENT/DESIGN GRANTED

Si. No.	Name of the Author, and Designation	Title of the patent	Application No.	Date of filing	Indian/ International patent	Author status 1st/ 2nd Author	Date of Grant	Status
01	Harinandan Kumar	Utilization of Waste Poly Ethylene Bags and Fly Ash for Engineering Application	201841017716 A	11/05/2018	Indian Patent	Sole Inventor	27/01/2021	Granted
02	Harinandan Kumar	New Design of Portable and Detachable Vice for Engineering Application	Application Number: 320476-001 Cbr Number: 14969	07-08-2019	Indian Patent	Sole Inventor	05/02/2021	Granted

BOOK CHAPTER PUBLISHED

Mohit Hemath, Arul Mozhi Selvan Varadhappan, Hemath Kumar Govindarajulu, Sanjay Mavinkere Rangappa, Suchart Siengchin, **Harinandan Kumar**, “Mechanical and Physical Test of Hybrid Fiber Composites”, Hybrid Fiber Composites: Materials, Manufacturing, Process Engineering, Print ISBN:9783527346721, Online ISBN:9783527824571, DOI:10.1002/9783527824571, Publisher Wiley, Published on 03 July 2020.

ACADEMIC IDENTITY

1. Vidwan-ID: 96793
2. **Vidwan Score: 10**
3. Orcid Id: 0000-0002-2682-4310
4. Scopus Id: 37036300000
5. Researcher Id: G-2690-2019
6. Google Scholar Id: F2YBpJgAAAAJ
7. Microsoft Academic Search Id: 6977e338-314f-490f-a02e-511a98e7a51d

ONLINE TEACHING, LEARNING AND ASSESMENT SKILL

1. Blackboard
2. Kaltura
3. Code Tantra
4. Google meet, Zoom, Webex, Outlook Team etc.

PROFESSIONAL MEMBERSHIP

- Member of “Institute of Doctors, Engineers and Scientists”, **(2186)**
- Editorial Board Member of “Journal of Autonomous Intelligence”, 21 Serangoon North Avenue 5, #03-03 Ban Teck Han Building, Singapore (554864)
- Editorial Board Member of “Journal of Geological Research”, Bilingual Publishing Co., Singapore
- Reviewer of “Iranian Journal of Earth Science”, Department of Geology, Faculty of Science, Islamic Azad University, 7th Elahiyeh Ave, Mashhad Branch, Mashhad, Iran.

REVIEWER OF RESEARCH PAPER IN INTERNATIONAL JOURNAL

- Effect of cryogenic coolant on turning performance: A Comparative Study, **International Journal of SN Applied Sciences, Powered by Springer**
- Hydrocarbon production analysis in coal reservoirs coupling the matrix shrinkage effect caused by water extraction, **Arabian Journal of Geoscience, SCI and SCOPUS Indexed, Powered by Springer**
- Uniaxial Compression Experiment of CO₂-bearing Coal Using the Visualized and Constant Volume Gas-solid Coupling Test System, **Journal of Visualized Experiments, SCI and SCOPUS Indexed, Powered by Springer**
- Physical and thermomechanical characterization of the novel aluminum silicon carbide-reinforced polymer nanocomposites, Iranian Polymer Journal, **SCI and SCOPUS Indexed, Powered by Springer**
- Hydrocarbon generation potential evaluation of coal shale gas of Permo-Carboniferous in Jiyang Depression, **Journal of Geological Research**
- Origin and Thermal maturity Status of Niger Delta Source Rocks: Evidence from Saturate Biomarkers and Organic Petrology, **Iranian Journal of Earth Sciences, SCOPUS Indexed**
- Bituminous Coal Sorption Characteristics and its Modeling of the Main Coal Seam Gas Component, **Arabian Journal of Geoscience, SCI and SCOPUS Indexed, Powered by Springer**
- Experimental study on the influence of moisture content during gas depressurization extraction, **Arabian Journal of Geoscience, SCI and SCOPUS Indexed, Powered by Springer**
- Bituminous Coal Sorption Characteristics and its Modeling of the Main Coal Seam Gas Component, **Arabian Journal of Geoscience, SCI and SCOPUS Indexed, Powered by Springer**
- Experimental Research on Mechanical Properties of Granite at Different Depth in Beishan area of Gansu, **Geotechnical and Geological Engineering, SCOPUS Indexed, Powered by Springer**
- Analysis of the coal permeability evolution characteristics under loading conditions, **Greenhouse Gases: Science and Technology, SCI and SCOPUS Indexed, Powered by Wiley**
- Petrophysical Analysis and Flow Units Characterization for Abu Madi Pay Zones in the Nile Delta Reservoirs, **Arabian Journal of Geoscience, SCI and SCOPUS Indexed, Powered by Springer**

ADMINISTRATIVE RESPONSIBILITY

- Course Coordinator of UG Students
- Activity coordinator of UG Students
- Member of University Research Core Committee
- DRC Member

- Laboratory In charge
- NAAC Accreditation Process
- Students Placement Support
- Students Internship Support

FIELD OF INTEREST

- Mechanical Characterization and Optimization
- Stress Analysis
- Mechanical behavior of Composite Materials

SUBJECTS HANDLED

- Engineering Mechanics (B.Tech Course)
- Advanced Strength of Materials (B.Tech + M.Tech Course)
- Mechanical behavior of Engineering Materials (B.Tech + M.Tech Course)
- Rock Mechanics (B.Tech + M.Tech Course)
- Material Handling Systems (B.Tech + M.Tech Course)
- Soil Mechanics (B.Tech + M.Tech Course)
- Engineering Stress Analysis (B.Tech + M.Tech Course)
- Theory of Metal cutting and Tool Design (B.Tech + M.Tech Course)
- Finite Element Method (B.Tech + M.Tech Course)
- Introduction to Composites (B.Tech + M.Tech Course)

SOFTWARE HANDLED

- AutoCAD (B.Tech Course)
- Creo-3.0 (B.Tech + M.Tech Course)
- Catia (B.Tech + M.Tech Course)
- Ansys (B.Tech + M.Tech Course)
- Comsol (B.Tech + M.Tech Course)
- Solid Work (B.Tech + M.Tech Course)
- GEM Reservoir Simulation (B.Tech + M.Tech Course)
- Design Xpert (B.Tech + M.Tech Course)
- LISA (B.Tech + M.Tech Course)
- Google Sketch up (B.Tech + M.Tech Course)

STUDENTS GUIDED

Programme	Department	No. of Students	Year
B.Tech.	Mechanical Engineering	5	2018
	Mining Engineering	8	
	Geo Science Engineering	12	
	Mining Engineering	16	2019
	Petroleum Engineering	18	
	Mining Engineering	12	2020
	Petroleum Engineering	8	
	Petroleum Engineering	18	2021
	Mining Engineering	6	

WORKSHOP/SEMINAR/TRAINING PROGRAMME

1. One-day workshop on *New Materials and Applications* at Sathyabama University, Chennai, September 2010.
2. One-day workshop on *Trends in Material Joining Technologies* at Sathyabama University, Chennai, September 2011.
3. Three days' workshop on *design of experiment: An optimization tool* at National Institute of Technology, Rourkela, December 2013.

- Three days' workshop on *Multi-objective Optimization methods and Applications in Manufacturing* at National Institute of Technology, Rourkela, June 2014.
- Two days' workshop on *Aesthetics of Scientific Documentation* at National Institute of Technology, Rourkela, July 2014.
- Five days Executive Training Programme on *Best Practice in Coalbed Methane Exploration and Production (ETP: CBM E&P 2010)* at Central Institute of Mining and Fuel Research, Dhanbad, Jan. 9-13, 2017.
- Three days Exhibition on *Research Scholars' Week* at National Institute of Technology, Rourkela, Feb. 21-23, 2017.
- Three days Faculty Development Program on *Outcome Based Education (OBE)* at School of Engineering, UPES Dehradun, May 25-27, 2020.

PATENTS

Sl. No.	Name of the Author, and Designation	Title of the patent	Application No.	Date of filing	Indian/ International patent	Author status 1st/ 2nd Author	Remarks	Status
01	Harinandan Kumar	Apparatus for determination of CO ₂ /CH ₄ adsorption/desorption capacity on intact as well as powdered sample	201741039402 A	06/11/2017	Indian Patent	Sole Inventor	Published on 17/11/2017	Under Examination
02	Harinandan Kumar	Jet Stream Turning Tool Holder for Cryogenic Spray/Jet cooling Application	201741043529 A	05/12/2017	Indian Patent	Co-Inventor	Published on 15/12/2017	Under Examination
03	Harinandan Kumar	New Invention of low cost creep testing machine with variable temperature and environmental conditions for composite material (PMMC)	201741046532 A	22/12/2017	Indian Patent	Co-Inventor	Published on 05/01/2018	Under Examination
04	Harinandan Kumar	Development of New Thermal Absorber Coatings for Enhanced Solar Application	201841005118 A	12/02/2018	Indian Patent	Co-Inventor	Published on 16/02/2018	Under Examination
05	Harinandan Kumar	Apparatus for determining time dependent deformation as well as fracture propagation of different rock specimens at variable temperature and environmental conditions	201911005534 A	12/02/2019	Indian Patent	Sole Inventor	Published on 22/02/2019	Under Examination
06	Harinandan Kumar	Cutting device for cutting tubular work pieces	201911035138 A	30-08-2019	Indian Patent	Sole Inventor	Published on 06/09/2019	Under Examination

PROJECT APPLIED IN GOVT. OF INDIA

- Harinandan Kumar (PI)**, "Investigation of Adsorption/Desorption Characteristics and their effect on Stress-Strain behavior during CO₂ Sequestration in Indian Coal", Department of Science and Technology, Govt. of India.

PERSONAL INFORMATION

Name	: Harinandan Kumar
Father's Name	: Uday Narayan Choudhary
Gender	: Male
Date of Birth	: 06 August 1988
Marital Status	: Married
Nationality	: Indian
Passport No	: Z1725423
Place and Date of Issue of Passport	: Patna, Bihar, India, 09/08/2012
Validity of Passport	: 08/08/2022
Adhaar Card No.	: 237982089999
PAN Card No.	: CMFPG9696B
Languages Known	: Hindi, English, Tamil and Odia
Permanent Address	: S/O: Uday Narayan Choudhary, Cement Shop, Near Post Office, Kachari Road, Banka, Bihar - 813102. India

DECLARATION

I hereby declare that the above details furnished are correct to the best of my knowledge.

Date :
Place :

Dr. Harinandan Kumar



**INTELLECTUAL
PROPERTY INDIA**
PATENTS | DESIGNS | TRADE MARKS
GEOGRAPHICAL INDICATIONS



समर्थन केंद्र

भारत सरकार
GOVERNMENT OF INDIA
पेटेंट कार्यालय
THE PATENT OFFICE
पेटेंट प्रमाणपत्र
PATENT CERTIFICATE
(Rule 74 Of The Patents Rules)

क्रमांक : 044126346
SL No :



पेटेंट नं. / Patent No. : 356746
आवेदन नं. / Application No. : 201841017716
कायम करने की तारीख / Date of Filing : 11/05/2018
पेटेटी / Patentee : 1.MR. HARINANDAN KUMAR 2.DR. MURALIDHAR
SINGH M 3.DR.G. HEMANTH KUMAR 4.DR.P.SIVAMAH et
al. et al.

प्रमाणित किया जाता है कि पेटेटी को उपरोक्त आवेदन में विषयवस्तु **UTILIZATION OF WASTE POLY ETHYLENE BAGS AND FLY ASH FOR ENGINEERING APPLICATION** नामक आविष्कार के लिए, पेटेंट अधिनियम, 1970 के उपबंधों के अनुसार आज तारीख 11th day of May 2018 से बीस वर्ष की अवधि के लिए पेटेंट अनुदान किया गया है।

It is hereby certified that a patent has been granted to the patentee for an invention entitled **UTILIZATION OF WASTE POLY ETHYLENE BAGS AND FLY ASH FOR ENGINEERING APPLICATION** as disclosed in the above mentioned application for the term of 20 years from the 11th day of May 2018 in accordance with the provisions of the Patents Act, 1970.



अनुदान की तारीख : 27/04/2021
Date of Grant :

पेटेंट नियंत्रक
Controller of Patent

नियम - इस पेटेंट के नवीकरण के लिए फीस, यदि हो जमा रखा जाना है, 11th day of May 2020 की और उसके पश्चात प्रत्येक वर्ष के उसी दिन हो रहेगा।

Note - The fees for renewal of this patent, if it is to be maintained will fall / has fallen due on 11th day of May 2020 and on the same day in every year thereafter.



ORIGINAL

No. 95244

भारत सरकार
GOVERNMENT OF INDIA
पेटेंट कार्यालय
THE PATENT OFFICE

CERTIFICATE OF REGISTRATION OF DESIGN

Design No. 320476-001
Date 07/08/2019 09:17:28
Reciprocity Date*
Country

Certified that the design of which a copy is annexed hereto has been registered as of the number and date given above in class 08-08 in respect of the application of such design to PORTABLE AND DETACHABLE VICE FOR HOLDING WORK PIECE in the name of LUNIVERSITY OF PETROLEUM AND ENERGY STUDIES, ENERGY ACRES, BIDHOLI, PREMNAGER, DEHRADUN, UTTARAKHAND, INDIA-249007 2. DR. HARINANDAN KUMAR, ASSISTANT PROFESSOR, DEPT. OF PETROLEUM ENGG. AND EARTH SCIENCES, UNIVERSITY OF PETROLEUM AND ENERGY STUDIES, ENERGY ACRES, BIDHOLI, PREMNAGER, DEHRADUN, UTTARAKHAND, INDIA-249007

In pursuance of and subject to the provisions of the Designs Act, 2001 and the Designs Rules, 2001.

INTELLECTUAL
PROPERTY INDIA

Controller General of Patents, Designs and Trade Marks

PATENTS DESIGNS TRADE MARKS
COGRAPHICAL INDICATIONS

*The reciprocity date (if any) which has been allowed and the name of the country.

Copyright in the design will subsist for ten years from the date of Registration, and may under the terms of the Act and Rules, be extended for a further period of five years.

This Certificate is not for use in legal proceedings or for obtaining registration abroad

VIKAS ASAWAT,
3/183, GANESH TALAB, BASANT VIHAR, KOTA,
RAJASTHAN PIN 324009 INDIA

Date of Issue 01/02/2021 12:17:06



Laboratory investigation of gas permeability and its impact on CBM potential

Harinandan Kumar¹ · M. K. Mishra² · S. Mishra³

Received: 12 August 2017 / Accepted: 24 December 2017
© The Author(s) 2018. This article is an open access publication

Abstract

Gas permeability is an important characteristic of coal seam(s) to determine the economic success of CH₄ extraction and CO₂ sequestration. There exists no comprehensive approach to predict the mechanical behaviour during CH₄ extraction, and CO₂ sequestration as coal is highly heterogeneous. Exhaustive laboratory experimentation is often the only approach to successfully predict its behaviour. Coal experiences triaxial stress conditions when change of force field occurs. This paper presents the mechanical properties and change in gas permeability at varying confining as well as gas pressures in a triaxial experimental set-up using Darcy's approach. Mutual relations between permeability, in situ confining pressure as well as gas pressure have been established statistically. A reservoir simulation investigation has been carried out to predict the rate of coal bed methane (CBM) production and the cumulative amount of CBM over the 5-year life of production well.

Keywords CBM · Proximate and ultimate analysis · Mechanical properties · Permeability · Reservoir simulation

List of symbols

<i>M</i>	Moisture content
<i>A</i>	Ash content
VM	Volatile matter
FC	Fixed carbon
VM (d)	Volatile matter (dry basis)
FC (d)	Fixed carbon (dry basis)
VM (daf)	Volatile matter (dry ash-free basis)
FC (daf)	Fixed carbon (dry ash-free basis)
C	Carbon
H	Hydrogen
N	Nitrogen
S	Sulphur
HC ratio	Hydrogen carbon ratio
<i>R</i> ₀	Vitrinite reflectance
UCS	Uniaxial compressive strength
<i>E</i>	Elastic modulus
<i>K</i>	Bulk modulus

<i>G</i>	Modulus of rigidity
<i>μ</i>	Poisson's ratio

Introduction

Coal permeability, porosity, cleat structure, adsorption/desorption of gases, in situ stress–strain of coal matrix are major parameters that influence CBM production and CO₂ sequestration. Permeability gives the general outlook of the flow behaviour of gases in coal matrix. Percentage of gas saturation, gas rate and recoverability of gas from a reservoir is mainly determined by adsorption/desorption behaviour and permeability of coal. Planning a successful pilot as well as production wells depends on the permeability characteristics in coal (Moore 2012). It is an important parameter necessary to model gas flow behaviour in the reservoir. The successful and economic growth of CBM production needs to advance knowledge of coal structural properties and their variation under in situ conditions (Holloway 1997; White 2005). The coal seams are extremely heterogeneous reservoirs whose permeability depends not only on geological age, coal rank and purity, but also on gas and water saturations, in situ stresses and sorbed gas content. The natural fractures and cracks are commonly observed in all rock types but is perhaps most prominent in sedimentary rocks like coal (McCulloch et al. 1974). The fracture plane in flat-lying strata is usually perpendicular to the bedding plane commonly

✉ Harinandan Kumar
harinandankumar88@gmail.com

¹ Department of Mechanical Engineering, MITS,
Madanapalle 517325, India

² Department of Mining Engineering, NIT Rourkela, Rourkela,
Odisha 769008, India

³ Department of Chemical Engineering, NIT Rourkela,
Rourkela, Odisha 769008, India

Optimization and evaluation of fly ash composite properties for geotechnical application

Harinandan Kumar · M. K. Mishra

Received: 6 March 2014 / Accepted: 3 June 2014 / Published online: 14 June 2014
© Saudi Society for Geosciences 2014

Abstract India will generate about 283,470 MW of electricity by 2022. Seventy percent of the proposed energy demand is fulfilled by fossil fuel, out of which 54 % of demand is contributed by coal as reported by Krishna (2001). The coal production would be 850 Mt per year to fulfil the demand. Opencast mining plays a major role in meeting the demand of coal for thermal power generation leading to the use of large-capacity haul trucks. Carrying capacity of trucks/dumpers used in opencast mines has grown from 30 to 250 t in recent years. These ultra-capacity trucks/dumpers need well-designed haul roads. At present, design of new haul roads is based on past experience and empirical methods. The sub-grade, sub-base and/or base of haul road typically uses the overburden (O/B) materials which could be replaced by composite material at a particular layer for better performance. There are more than 165 opencast coal mines and many are near to thermal power stations. Present-generation fly ash (FA) from coal-based thermal power plants in India is 135 Mt/year and it is expected to increase to 300–400 Mt/year by 2016–2017 as reported by Çimento (2004). The usage percentage of fly ash is about 60 % leaving the rest as plant waste occupying a huge land area and creating environmental problems. The investigation has characterised fly ash (FA), mine overburden material (O/B) and lime (L). Geotechnical properties of untreated fly ash, mine overburden, fly ash–mine overburden mixes and lime-treated fly ash–mine overburden mixes were investigated using response surface methodology (RSM). Design-Expert software was used to establish the design matrix and to analyse the experimental data. The

relationships between the percentage parameters (%FA + %O/B + %L) and experimentally obtained three responses (California bearing ratio (CBR), unconfined compressive strength (UCS) and BTS) were established. RSM was performed to optimize the interactions of input parameter which showed the best conditions for preparation of composite material. According to the obtained results, the model was developed and further analysis was conducted. The experimental values agreed with the predicted ones, thus indicating suitability of the model employed and the success of RSM in optimizing the composite material. Lime percentage, curing period was observed to have strong influences on the strength parameters of the developed FCMs. The best composite material obtained with highest CBR and UCS values.

Keywords Response surface methodology · Unconfined compressive strength (UCS) · California bearing ratio (CBR) · Brazilian tensile strength (BTS)

Introduction

Opencast mining involves displacement of large amount of overburden (O/B) materials. Fly ash (FA) is, at present, unavoidable coal combustion by product. Fly ash possesses many attributes to be used as an engineering material. The behaviour of the surface course of haul road depends on the bearing capacity of the materials that are beneath it. The surface course exhibits excessive rutting, potholes, settlement, sinking, and overall deterioration. There has been a significant rise in the carrying capacity of dumpers. Typically, truck haulage cost is nearly 50 % of the total operating cost incurred by a surface mine (Thompson and Visser 2003). There is a need to reduce vehicle operating cost and maintenance cost by well-constructed good haul roads. Strengthening of the base and sub-base of the surface coal mine haul road is of vital

H. Kumar (✉) · M. K. Mishra
Department of Mining Engineering, NIT Rourkela, Rourkela,
Odisha 769008, India
e-mail: harinandankumar88@gmail.com

M. K. Mishra
e-mail: mkmishra@nitrrkl.ac.in



Sorption capacity of Indian coal and its variation with rank parameters

Harinandan Kumar¹ · M. K. Mishra¹ · S. Mishra²

Received: 6 October 2018 / Accepted: 7 February 2019 / Published online: 15 February 2019
© The Author(s) 2019

Abstract

The study of gas sorption characteristics is important for practical assessment of coal bed methane (CBM) production and CO₂ sequestration in coal seam. Adsorption isotherm is one of the critical parameters for the establishment of production as well as injection well. Adsorption isotherm provides information about the reservoir conditions and critical desorption pressure as well as volume of gas that can be sequestered in deep coal seam. Alteration in sorption isotherm reflects the increase or decrease of the gas production as well as CO₂ sequestration. Therefore, in this paper, experimental investigation was carried out to determine the CO₂/CH₄ sorption capacity of five different coal samples taken from different locations of Jharia coalfield (Moonidih area) of Gondwana basin. Gas sorption capacity was determined at 27 °C temperature and up to 7.5 MPa pressure. CO₂ adsorption was observed to be higher than that of the CH₄. The sorption ratio of CO₂/CH₄ varied from 1.6:1 to 1.2:1 for all coal samples. Furthermore, the experimental results were correlated using established Langmuir, Freundlich, Temkin and D–R isotherm models. Experimentally obtained values satisfactorily fitted to the Langmuir and Freundlich model with comparable accuracy. The excess adsorption capacity of coal was also compared with different rank parameters to understand the variation of sorption capacity with rank of coal.

Keywords Coal bed methane · Proximate and ultimate analyses · CO₂/CH₄ sorption capacity · Statistical analysis

Introduction

At present, climate change and global warming are the most debated topics. CO₂ is one of the dominant causes of greenhouse gas effect (GHG) and global warming due to its higher concentration in the atmosphere. Thermal generation capacity of India will be 290 GW in 2047, out of which 253 GW will be coal based and 37 GW gas based (1). Increasing demand of energy also increases CO₂ emission. Concentration of CO₂ in the atmosphere was found to be 396 ppmv in 2013 which was 40% higher than that in mid-1800s (2). The rate of emission was 2 ppmv/year for the last 10 years (2) alarming the world for advancement towards technology for the reduction of CO₂ concentration in atmosphere. The CO₂ concentration can be controlled by two ways: one to reduce CO₂ emissions into the atmosphere and the other to reduce

the present concentration of CO₂ in the atmosphere to safe levels through application of various engineering principles. The second way is possible by CO₂ storage in un-minable coal seams, depleted oil and gas reservoirs, abandoned and sealed mines, saline aquifers, oceans, etc. (Ishaq et al. 2009; Shi and Durucan 2005; Robertson 2010). Sequestration of CO₂ in deep coal seam is one of the techniques to reduce CO₂ concentration in the atmosphere and mitigation of global warming. Coal bed reservoir has the ability to store and retain large quantity of CO₂ gas for very long time due to its porous nature (Shi and Durucan 2005; Robertson 2010). Injection of CO₂ in coal seam also facilitates beneficial effect on enhanced coal bed methane recovery (ECBM) (Stevens et al. 1998; Seidle 2000; Pagnier et al. 2005). Estimation of CO₂/CH₄ sorption in deep coal seam requires critical experimental investigation (Hernandez et al. 2006; Vishal et al. 2015; Buscha and Gensterblumb 2011). Investigative effort has been undertaken elsewhere to estimate excess sorption capacity at different temperature and increasing pressure values (13; Prusty 2008; Chen et al. 2011). CO₂/CH₄ sorption ratio was reported to be 10:1 for low-rank coal and less than 2:1 for low- and medium-volatile bituminous coals (Deng et al. 2015). Variation in gas sorption capacity of coal based

✉ Harinandan Kumar
harinandankumar88@gmail.com

¹ Department of Mining Engineering, NIT Rourkela,
Rourkela, Odisha 769008, India

² Department of Chemical Engineering, NIT Rourkela,
Rourkela, Odisha 769008, India



Application of hydraulic flow unit for prediction of flow zone in carbonate reservoir

Nirlipta Priyadarshini Nayak¹ · Harinandan Kumar¹ · Shivani Bhist¹

Received: 23 December 2020 / Accepted: 30 March 2021
© Saudi Society for Geosciences 2021

Abstract

The feasibility of oil production in any reservoir depends on the porosity and the permeability of that reservoir. Particularly, the permeability in the reservoir allows the ease of flow of fluid through it. High permeability is always desirable for the successful production of oil in any reservoir. The porosity and permeability depend on the reservoir rock. In general, the higher value of porosity and permeability makes limestone a suitable reservoir. Therefore, it is very important to characterize the reservoir in terms of porosity and permeability for the feasibility of oil production. In this investigation, reservoir characterization was carried out to determine the porosity and permeability of limestone reservoirs obtained from four different basins of Oilmax Mumbai. A total of 32 core samples of NX size were tested for characterization and determined porosity and permeability values. The variation in porosity and permeability was observed from 0.3 to 20.5% and 0.002 to 1.484 mD at the burial depth from 1618.86 to 1634.14 m, respectively. The normalized porosity and reservoir quality index were determined using the experimentally obtained porosity and permeability values. Normalized porosity values were used to calculate the flow zone indicator (FZI), which varied from 0.071971 to 6.024804. The least-square regression method was used to determine the hydraulic flow units (HFU) for different limestone samples. The porosity range indicates the highly porous reservoir, while the lower permeability was observed due to the non-linearity between porosity and permeability correlations. The results showed the consistent flow regime in five different hydraulic flow units in wellbore A. The consistent fluid regime in the other wellbore is only possible by increasing the reservoir's permeability. Hence, hydraulic fracturing is highly recommended before the establishment of a production well.

Keywords Porosity · Permeability · Flow zone indicator · Hydraulic flow units (HFU)

Introduction

The simulation of a reservoir and prediction of its performance requires an accurate description of the reservoir is necessary. The characteristics parameters like porosity and permeability are essential for determining the hydraulic flow unit (HFU) and the prediction of the reservoir performance. The concept of HFU has been developed to estimate permeability in the cored zone and then use their result in the un-cored zone. Depending upon the nature and availability of data, various

methods are utilized to estimate HFU. Some of these are gamma-ray, flow zone indicator, cumulative flow and storage capacity curve, stratigraphic modified Lorenz plot, etc. (Zargari et al. 2013). Carbonate reservoirs are as crucial as sandstone since they contribute 60% of the world's hydrocarbon containment. Characterization of carbonates is a challenging task owing to their composition. Calcite is composed of calcium carbonate, and it is chemically reactive and more prone to diagenesis than silica. Carbonates in their early stage of deposition exhibit high porosity and permeability. Dissolution and re-precipitation are often seen in carbonates with time. Due to this reason, carbonates mostly exhibit secondary porosity and permeability (Abdullelah et al. 2018). Diagenesis caused heterogeneities in carbonate reservoirs, which makes it tough to characterize carbonate reservoirs (Bagci and Akbas 2007). Thus, making it challenging to comprehend the storage and flow capacity. This heterogeneity resulted from depositional setting and post-depositional diagenesis. Apart from causing the problem in characterization, it also causes variation in pore

Responsible Editor: Santanu Banerjee

✉ Harinandan Kumar
harinandankumar88@gmail.com

¹ Department of Petroleum Engineering and Earth Sciences,
University of Petroleum and Energy Studies, Bidholi, Via Prem
Nagar, Uttarakhand 248007, India



Cement bond evaluation using well logs: A case study in Raniganj Block Durgapur, West Bengal, India

Prashant Saini¹ · Harinandan Kumar¹ · Tarun Gaur²

Received: 14 August 2020 / Accepted: 20 March 2021 / Published online: 29 March 2021
© The Author(s) 2021

Abstract

Cement bond logs (CBL) and variable density log (VDL) are one of the vital logging techniques used to evaluate cement-casing-formation bonds before the well testing or execution of the production operation in the well. These logs are also crucial during the workover operation to maintain the integrity of the well. The logging techniques provide a clear view of the quality of cement bonds with casing and formation. The microannulus and other deviations in bonding between the cement and the casing or formation are recorded using this technique. Therefore, this technique is used by the regulatory authorities worldwide for the determination of the cement bond with casing and formation. In this paper, the CBL/VDL logging technique was used to determine the bonding between cement and casing and cement and formation at two different CBM wells from 850 to 1600 m depths in the Raniganj block of Durgapur, West Bengal. Two well, namely, A and B, were analyzed to determine the cement-casing-formation bonds in the study area's coal seam zone. The analysis was carried out at normal and pressure pass to investigate the integrity of the well using the CBL/VDL data. The normal and pressure pass in well A indicated the presence of microannulus in the bonding between cement and casing/formation in the coal seam zone. The corresponding analysis of well B showed poor cement and formation bond at the coal seam zone during the normal pass but good bonding after the pressure pass. Thus, it was observed that the CBL/VDL data were capable of determining the cement-casing-formation bonds in both the well of the study area and the well's integrity.

Keywords Cementation · Microannulus · Cement bond log (CBL) · Variable density log (VDL)

Introduction

Cement evaluation plays a vital role in determining the bond quality between casing-cement and cement-formation in a wellbore. Detailed cement evaluation is paramount in CBM wells. It affects the perforation placement due to unconsolidated formation, which may permit cross-flow of sand (Jie, et al. (2014)) or water into the reservoir; thus, causing a loss of zonal isolation. Therefore, good cementing is essential to maintain good integrity (Cai 2016). This is due to the relatively low pore pressure present in the coal. Moreover, the presence of an unconsolidated formation

affects the bonding between the cement-formation due to water presence, which loses its viscosity property of bonding with cement. Thus, analysis of the bond quality is an essential parameter in CBM well to predict good integrity. The evaluation of cement-formation bonds is also crucial before the well testing and execution of the production from the well. Out of various techniques, the wireline logging method is the primary method to visualize the quality of the cement-formation bonds. The wireline logging method like cement bond logs (CBL) and variable density logs (VDL) was used elsewhere to evaluate the quality of cement bond behind a cemented casing or liner before a well test or production operation is performed in the well (Kyi and Wang 2015). The wireline logging method was used to determine the isolation zone in drilling operations to avoid unwanted cross-flows from behind the casing during production operations (Thiercelin et al. 1998; Timonin et al. 2014). The CBL/VDL (CBL-V) method was used to evaluate the cement bond behind the casing of thin sandstone beds (< 7 m) separated by thin shale/clay beds (1 to 8 m) in the Assam Oil fields

✉ Harinandan Kumar
harinandankumar88@gmail.com

¹ Department of Petroleum and Earth Science, University of Petroleum and Energy Studies, Bidholi, Dehradun, Uttarakhand 248007, India

² Essar Oil and Gas Exploration and Production Limited, Molandighi, Durgapur, West Bengal 713212, India



Comparative study of coal rocks compressive behaviors and failure criteria

Harinandan Kumar¹ · Upendra Singh Yadav¹ · Subhash Kumar¹ · Kishan Kumar¹ · Ravi Yadav¹ · Anveshika Shanker¹ · Anurag Tripathi¹ · Gitiksha Khandelwal¹

Received: 11 May 2019 / Accepted: 18 October 2019
© Saudi Society for Geosciences 2019

Abstract

The mining practice, particularly in underground mines, undergoes several geomechanical uncertainties including crack propagation due to machine operation and blasting. The geomechanical uncertainties reduce the stability of underground strata. Thus, the assessment of the strength parameters and failure criteria of the coal mass of the underground structure is crucial for safe mining practice. The paper deals with the experimental investigation of geomechanical properties of different coal samples obtained from Raniganj Coalfield, India. The uniaxial and triaxial compressive strength properties (compressive strength (MPa), Young's modulus (MPa), bulk modulus (MPa), modulus of rigidity (MPa), Poisson's ratio, axial strain, lateral strain, vertical stress (MPa), horizontal stress (MPa), cohesion (MPa), and internal friction angle (degree)) were determined as per the prescribed standard. The compressive strength of the coal samples varied from 2 to 7.07 MPa at the depth of 100 to 650 m. The corresponding axial and lateral strains varied from 0.0039 to 0.007 and 0.0012 to 0.03. The moduli (Young's modulus, bulk modulus, and rigidity modulus) of the coal samples varied from 428.571 to 1683.333 MPa, 666.667 to 1309.259 MPa, and 150 to 654.63 MPa. The triaxial parameters like cohesion and angle of internal friction varied from 0.4 to 2 MPa and 31 to 43°. The failure behavior of the coal was determined using different failure criteria (Bieniawski's empirical strength criterion, H-B criterion, and Vipulanandan correlation model) using the statistical method. The constant values obtained from the different failure criteria were utilized to predict the vertical stress. Based on the experimental observation and the predicted values using the established failure criteria, the design of the coal pillar was predicted. The innovation of this paper is to predict the application of the suitable failure criteria for the design of underground support system and determination of design parameters based on the predicted values.

Keywords Compressive strength · Rock failure criteria · Regression analysis

Introduction

The underground coal mine practice is always susceptible to roof collapse above the underground opening and the collapse of overburden above a longwall panel. In both conditions, it is very important to know the strength of structures and the cause of the failure to predict the stability of underground

construction. The geomechanical properties of rock material give an outlook of strength parameters of structure in the underground coal mine. These geomechanical properties are determined using rigorous laboratory experimentation as well as field observations, analysis, and visualization. The laboratory-obtained data not only acknowledge the strength of rock mass but also help to predict the stable design of the underground structure. Several researchers elsewhere determined the strength of rock material in underground mines using laboratory experimentations for the prediction of stable underground strata (Lisjak et al. 2014; Lai et al. 2016; Deisman et al. 2010; Jaiswal and Shrivastva 2012; Liu et al. 2017; Deisman et al. 2013; Bieniawski 1974; Noorian Bidgoli and Jing 2014).

The compressive strength of Irapua coal seam was investigated using laboratory experimentations to predict the strength of the underground strata (Gonzatti et al. 2014). The

Responsible Editor: Ahmed Salih Mohammed

✉ Harinandan Kumar
harinandankumar88@gmail.com

¹ Department of Petroleum and Earth Sciences, University of Petroleum and Energy Studies, Bidholi, Via Prem Nagar, Dehradun, Uttarakhand 248007, India



Determination of methane sorption capacity using microstructural analysis in coal of Jharia Coalfield, India

Harinandan Kumar¹ · Manoj Kumar Mishra² · Susmita Mishra³ · M. Muralidhar Singh⁴ · Dilip Kumar Srivastava¹

Received: 22 October 2020 / Accepted: 30 March 2021
© Saudi Society for Geosciences 2021

Abstract

Micrometer-scale pore and fracture structures of coal seams are the crucial parameters for the adsorption of coalbed methane (CBM) and recovery. This paper deals with the microstructure's influence on coal methane sorption behavior obtained from the Jharia Coalfield, India. Coal samples were collected from different seams to study the variability and heterogeneity of the reservoir parameters. Proximate and ultimate analysis of coal samples were determined to predict the rank of the coal. Microstructural parameters like pore size distribution, surface morphology, and infrared spectroscopy (FT-IR) were studied to predict the extent of gas sorption in the coal. The excess amount of methane sorption was determined using a volumetric method at 47 °C temperature and variable pressure. The identified pore volume varied from 0.2 to 3.07 m³/g. The surface morphology indicated inter- and intraparticle pores with spongy surfaces. The pore volume and surface morphology confirmed the favorable sorption of methane in coal samples. The FT-IR study showed the formation of hydrogen bond and methane sorption in coal. The maximum sorption capacity varied from 5.08 to 9.01 cc/g at 400 to 580 m depth. A strong, positive, and nonlinear correlation was observed with pore volume. The results showed that the presence of meso- and micropores and the spongy surface morphology are vital in defining its methane sorption capacity. As a whole, these coals have a higher porosity from 4.9 to 5.64% and meso- and micropores and are suitable for methane sorption.

Keywords Proximate and ultimate analysis · Microstructural analysis · Sorption capacity · Statistical analysis

Introduction

Coalbed methane is a fast emerging approach to address the growing energy demand. It involves the exploitation of methane gas from a deep-seated reservoir. However, the recovery of methane gas is a very complex exercise. Therefore, the

gas's recovery rate from the coalbed methane (CBM) is significant for its successful economics (Kumar et al. 2018a). Factors as coal permeability, porosity, cleat structure, and methane content influence the recovery rate (Feng et al. 2014; Xie 2015; Chen et al. 2011), and the methane content is one of the most critical factors among these (Vishal et al. 2015; Kumar et al. 2019a). The gas content depends upon the adsorption capacity of coal at a particular location that depends on the porosity and morphological structure of the coal (Perera et al. 2017; Vishal 2017; Chandra et al. 2020). Coal is heterogeneous with a polymeric material and complicated pore structure; therefore, coal's sorption behavior varies from place to place and seam to seam. It is reported that methane sorption increases proportionally to that of the porosity (Kumar et al. 2015; Kumar et al. 2019b). There exist reports that methane sorption rise with an increase in maceral content like vitrinite, porosity, the rank of coal, and reservoir pressure (Liu et al. 2016; Lee et al. 2013; Liu et al. 2013; Dallegge and Barker n.d.).

Similarly, coal's sorption behavior is adversely affected by ash content, mineral matter, moisture content, reservoir

Responsible Editor: Zeynal Abiddin Erguler

✉ Harinandan Kumar
harinandankumar88@gmail.com

¹ Department of Petroleum Engineering and Earth Sciences, University of Petroleum and Energy Studies, Bidholi, Via Prem Nagar, Dehradun, Uttarakhand 248007, India

² Department of Mining Engineering, NIT Rourkela, Rourkela, Odisha 769008, India

³ Department of Chemical Engineering, NIT Rourkela, Rourkela, Odisha 769008, India

⁴ Madanapalle Institute of Technology & Science, Angallu, Madanapalle, Andhra Pradesh, India



Determination of Strength Parameters of Glass Fibers Reinforced Composites for Engineering Applications

M. Muralidhar Singh¹ · Harinandan Kumar² · G. Hemath Kumar¹ · P. Sivaiah¹ · K. V. Nagesha¹ · K. M. Ajay³ · G. Vijaya⁴

Received: 26 April 2018 / Accepted: 7 January 2019
© Springer Nature B.V. 2019

Abstract

The manufacturing of the composite material has been developed tremendously over the years due to its superior properties like low density, stiffness, lightweight and excellent mechanical as well as physical properties. These exceptional properties of composite materials have found its applications widely in aerospace, automotive, marine and many more engineering areas. The synthesis of the varieties of composites is continuously lookout without compromising its mechanical and physical properties. This paper deals in with synthesis as well as mechanical properties (Tensile Strength, Flexural Properties and Fatigue) of Glass-Epoxy as well as Glass-Vinyl Ester composites. The resins used in combination of composites were epoxy as well as Vinyl Ester while the reinforced material was glass fibers. The ultimate tensile strength in Glass-Epoxy composite was observed from 330 to 370 MPa while it was 270 to 330 MPa for Glass-Vinyl Ester Composites. Glass-Epoxy composites showed a 32% increase in flexural strength due to post-curing strength while it was 16% in case of Glass-Vinyl Ester Composites. The results of the fatigue analysis of composites indicate faster growth of cracks and defects at higher frequencies which results in a rapid drop in stress levels in the test specimen. The statistical analysis was carried out to establish mutual correlation among mechanical as well as physical properties.

Keywords Fiber reinforced composites · Glass-epoxy · Glass-vinyl Ester · Mechanical properties · Statistical analysis

1 Introduction

The application of glass fiber reinforced epoxy composites are rapidly increasing in different fields of engineering including aerospace, marine, automobile, etc. But the development of new composite materials with desired mechanical properties is still the real challenge. The selection of the matrix as well as reinforcing material plays a leading

role in the development of composite materials with specific applications. The mechanical, as well as the thermal properties of constituent elements of the composite, govern the long-term performance capabilities [1]. Glass fibers are readily used to develop the fiber-reinforced composite, because of their impact as toughness, medium modulus, high tensile strength, and thermal stability [2, 3]. Several studies have been carried out to determine strength parameters of glass fibers reinforced composite material to achieve the desired mechanical properties [1, 4–8]. An Experimental investigation was carried out to determine the tensile strength of glass fiber reinforcement nylon (PA6) composite at variable weight percentage from 80 to 95% nylon and 5 to 20% glass fibers. The tensile strength of 80% nylon +20% glass fiber composite showed the highest elastic modulus and yield strength as compared to pure nylon. The experimental report revealed that the weight percentage of glass fibers influenced much more in the determination of mechanical properties [9]. Increased tensile and flexural strength from 10 to 25% was reported with the incorporation of 20% (w/w) glass fibers in short bamboo–glass fiber reinforced polypropylene hybrid composites

✉ Harinandan Kumar
harinandankumar88@gmail.com

¹ Madanapalle Institute of Technology and Science,
Madanapalle, India

² Department of Petroleum and Earth Sciences, University of
Petroleum and Energy Studies, Bidholi, Via Prem Nagar,
Dehradun, Uttarakhand 248007, India

³ R. V. College of Engineering, Bangalore, India

⁴ Dayananda Sagar Academy of Technology and Management,
Bangalore, India



Development of statistical models to predict emission rate and concentration of particulate matters (PM) for drilling operation in opencast mines

K. V. Nagesha¹ · Harinandan Kumar² · M Muralidhar Singh¹

Received: 8 February 2019 / Accepted: 19 July 2019
© Springer Nature B.V. 2019

Abstract

Air pollution in mining area is one of the critical concerns because of the generation of large amount of the particulate matters (PM) in opencast mining operations. The emission of PM in the air not only deteriorates the surrounding environment but also impacts adversely to the human health. The majority of the PM particles in opencast mining comprise PM_{2.5} and PM₁₀. The assessment of the limit of the PM particles is very important as it helps in environmental impact analysis (EIA/EMP) and prediction of possible dust generation (PM particles) for any project to be established. In this paper, a model was developed that is capable to predict the respirable dust particulate concentration in the ambient air at various locations near and away from the dust-generating source, especially from a drilling operation in Indian opencast mines. The modeling was carried out using three different methods, i.e., “SPSS,” “R,” and artificial neural network (ANN) methods. Results from these developed models were compared with the US Environmental Protection Agency (USEPA) model for its validity. The predicted values from the developed model showed good correlation and the least variation from the field-monitored values, indicating better accuracy, compared with other models.

Keywords Dust pollution · Dust dispersion · PM · Statistical modeling · USEPA model

Introduction

Dust is one of the major air pollutants, which affects the ambient air, and is a hazardous or environmental nuisance that causes many respiratory disorders when inhaled/exposed to it. Dust generated from mining activities comprises PM_{2.5}, PM₁₀, and respirable suspension particles (RSP). These particulate matters are one of the major concerns of coal mines, as opencast coal mining operations/activities emit large quantities of dust, which disperses to far-off distances and deteriorates the surrounding environment. The increased concentration of PM in the air adversely affects human health as well as nearby flora and fauna.

There are mainly four categories of emission sources, which are point, volume, area, and open pit sources. These sources are the main contributors of the increased PM in the ambient air. The concentration of the pollutants from different sources including industrial source complex is mainly assessed using the ISCST3 model, which is a steady-state Gaussian plume model. The ISCST3 model is mainly used for the hourly assessment and calculation of user-selected short-term averages of the concentration or deposition value of different sources as well as receptor. The input data for the model are usually source dimensions, emission rates, wind speed, wind direction, ambient air temperature, mixing height, stability class, and receptor coordinates (Abdul-Wahab 2001).

The investigation was carried out to determine the concentration of the PM in the ambient air using statistical models over traditional deterministic models. The models were developed based on the previous air quality data for the prediction of cause and effect of the dust particles in the ambient air. The statistical models were developed based on semi-empirical relations among different available data and measurements (Abdul-Wahab et al. 1996; Abdul-Wahab et al. 2003). In order to determine the correlation between input data and targets, empirical relationship between air pollutant concentrations

✉ Harinandan Kumar
harinandankumar88@gmail.com

¹ Madanapalle Institute of Technology & Science, Madanapalle, India

² Department of Petroleum and Earth Sciences, University of Petroleum and Energy Studies, Bidholi, Via Prem Nagar, Dehradun, Uttarakhand 248007, India



Effect of novel hybrid texture tool on turning process performance in MQL machining of Inconel 718 superalloy

P. Sivaiah^a, Venkata Ajay Kumar G^b, Muralidhar Singh M^a, and Harinandan Kumar^c

^aDepartment of Mechanical Engineering, Madanapalle Institute of Technology & Science, Madanapalle, India; ^bDepartment of Mechanical Engineering, Annamacharya Institute of Technology & Sciences, Rajampet, India; ^cDepartment of Petroleum and Earth Sciences, University of Petroleum and Energy Studies, Dehradun, India

ABSTRACT

Higher cutting zone temperatures are responsible for poor turning process performance during dry machining of Inconel 718 material. In the present work, a novel hybrid surface texture tool under minimum quantity lubrication (MQL) has been proposed to reduce the decremental effects that cause during machining of Inconel 718 material. Present work compared to the performance of three tools, namely, untextured tool (T1), texture tool having circular pit holes (T2) and hybrid texture tool combination of circular pit holes and linear grooves (T3) under MQL cooling technique. It was observed that hybrid texture tool (T3) significantly reduced the cutting zone temperature (T_m), tool flank wear (V_b) and surface roughness (R_a) to a maximum of 36%, 59% and 46%, respectively, when compared to the T1 tool whereas it was 22%, 48%, and 30% when compared to the T2 tool, respectively. The present work meets the stringent environmental regulation along with the improved machinability of Inconel 718 superalloy.

ARTICLE HISTORY

Received 10 June 2019
Accepted 11 November 2019

KEYWORDS



Minimum; quantity; lubrication; machining; texture; tool; surface; roughness; Inconel 718; superalloy; wear; temperature

Introduction

Superior heat resistance of Inconel 718 superalloy material leads to having many applications in many fields, especially in aerospace applications. Dry machining of these material results in high manufacturing cost and poor surface quality.^[1] Flood cooling technique is the one and has been used to control the cutting zone temperature during machining of hard to cut materials. However, it has concerns about the environment as well as operators health negatively.^[2] Metal cutting industries are searching for effective methods to recover the process performance along with satisfying the environmental regulations. Cryogenic, MQL and compressed air cooling methods are recently developed to perk up process performance by satisfying the stringent environmental regulations.^[3] Sivaiah and Chakradhar observed superior turning performance characteristics with cryogenic cooling during machining of 17–4 PH stainless steel (PH-SS) material.^[4,5] Nevertheless, cryogenic machining required costly experimental setup. However, recent literature exposes that the surface texture of the tool is also an effective approach to increase the wear resistance of the tool. Palanisamy et al.^[6] look into the R_a , cutting forces (F_c) and V_b outputs by considering the cryogenically treated texture tool using Response Surface Methodology (RSM) during dry turning of 17–4 PH-SS. It was reported that mathematical models were developed by conducting experiments based on L_{27} and found close agreement with experimental results. Further, optimum cutting conditions were identified. Thomas and Kalaichelvan^[7]

developed different single design surface texture tools and carried out machinability studies during dry turning of mild steel (EN3B) and aluminum (AA 6351) materials with texture tools and comparison of results were done with untexture tools, respectively. From results, it was found low F_c and T_m when compared to the untexture tools, respectively, at varying cutting velocity conditions. The given reason for attained favorable conditions in texture tool was due to the increased cooling rate through convection mode at the tool–chip interface. Further, it was reported that square dimple texture tool was outperformed in improving the process performance over other texture tools due to the reduction in the tool–chip contact length (L) at the cutting zone. Arslan et al.^[8] reviewed the literature on surface texture tools and concluded that surface texture tools can improve the metal removal process performance. Further, it was reported that the method of lubricant supply and geometry of texture tool can significantly affect the process performance.

Dinesh et al.^[9] investigated the different texture tools, namely, parallel (P -1), perpendicular (P -2) texture to the chip flow direction as well as untexture tool under external spray cryogenic and dry cutting conditions, respectively, during machining of ZK60 alloy. Favorable machinability was found with P -1 tool under both environments when compared to the P -2 respectively. Additionally, it was found poor turning performance with an untexture tool when compared to texture tool under both cutting conditions, respectively, due to the high ' L ' value. Manikandan et al.^[10]

CONTACT P. Sivaiah  sivaiah.337@gmail.com  Department of Mechanical Engineering, Madanapalle Institute of Technology & Science, Madanapalle 517325, India

Color versions of one or more of the figures in the article can be found online at www.tandfonline.com/immmp.

This article has been republished with minor changes. These changes do not impact the academic content of the article.



Evaluation of Mechanical Properties of Glass Fiber-BMPM/DABA-PMC Composite

M. Muralidhar Singh¹ · Harinandan Kumar² · P. Sivaiah¹

Received: 21 March 2021 / Accepted: 23 May 2021
© The Indian Institute of Metals - IIM 2021

Abstract The design and fabrication of engineering structures require an excellent understanding of loads experienced by these members, the different weather conditions under which they operate, and their effect on operational life and fuel efficiency. Engineers are continuously challenged to find ways of enhancing these structures' operation life and reduce the weight; this demand led to the development of composite materials. This paper's objective was to develop a composite with a high temperature-to-weight ratio and testing their mechanical strength and transition temperature. Therefore, in this paper, glass fiber reinforced composite was developed using 4, 4 bismaleimidodiphenylmethane (BMPM), O, odiallyl bisphenol A (DABA) as resin, and dimethyl formamide (DMF) as a solvent to evaluate their applicability at the higher temperature. Glass-BMPM /DABA-PMC Laminates were fabricated in this regard. The composites were evaluated at variable curing temperatures ranging from 180 to 220 °C. The glass transition temperature of the developed composite was determined to assess its workability at the higher temperature. The mechanical properties like tensile, flexural, and fatigue strength of the developed composite were determined to evaluate its compatibility at the higher temperature. The glass transition temperature increased from 217 to 243 °C after curing the composite between 180 and 220 °C. The ultimate tensile stress was

observed at 340 ± 30 MPa after curing. The flexural stress of Glass BMPM was 276 MPa, before curing and 325 MPa after curing. The increased transition temperature and improved mechanical properties of the composite with curing temperatures confirmed its workability at higher temperatures.

Keywords Polymer composites · Post-curing · Flexural strength · Tensile strength · Fatigue strength

1 Introduction

Composite technology is one of the accelerating factors for fast-growing engineering and development. The development of advanced composites enhances the material's strength and expands their applicability in almost all engineering fields. The composite has gained worldwide recognition over conventional materials used in industries such as mechanical industries, aircraft industries, and automobile industries. Polymer matrix composites are increasingly making their advantages in structural applications because it exhibits the required properties and lightweight for structural development. The versatile nature of composites has attracted the manufacturer to use these materials for several structural applications. As a result, many materials (fibers and resins) with different fabrication processes have been developed elsewhere [1–4]. The study has been carried out to develop fiber reinforced carbon–epoxy resin composite using resin transfer molding and resin infusion molding [5]. The developed composite exhibits comparable strength to be used for aircraft and civil applications. The composite is frequently used as a structural material due to its higher mechanical strength and lightweight [6, 7]. Carbon–epoxy composite has

✉ Harinandan Kumar
harinandankumar88@gmail.com

¹ Madanapalle Institute of Technology & Science,
Madanapalle, India

² Department of Petroleum and Earth Sciences, University of
Petroleum and Energy Studies, Bidholi, Via Prem Nagar,
Dehradun, Uttarakhand 248007, India



Evaluation of Multilayer Thin Film Coatings for Solar Thermal Applications

M. Muralidhar Singh¹ · Harinandan Kumar² · K. V. Nagesha¹ · P. Sivaiah¹ · G. Hemath Kumar¹ · K. M. Ajay³ · G. Vijaya⁴

Received: 13 March 2018 / Accepted: 6 May 2019 / Published online: 14 May 2019
© King Fahd University of Petroleum & Minerals 2019

Abstract

The multilayer thin film coatings are one of the proven technologies for improvement in solar thermal and optical applications. In current solar thermal and optical systems, multilayer thin film coatings find application in many functions such as photovoltaics, heat exchangers, filters, sensor technologies, laser windows, mirrors, reflectors and optics for digital projections. The solar absorptance and thermal emittance of the multilayer thin film coatings are one of the leading factors for its applicability in said areas. The processing conditions, morphology and surface finish influence the solar absorptance and thermal emittance behavior of multilayer thin film coating. Therefore, emphasis has given in this paper to deposit multilayer thin film coatings with an increased solar absorptance and decreased thermal emittance to improve its applicability in solar thermal applications. Multilayer thin film coatings ($\text{Al}_2\text{O}_3/\text{Ni}/\text{W}-\text{Al}_2\text{O}_3/\text{W}$) were deposited using DC/RF magnetron sputtering on the stainless steel substrate to improve its applicability in solar thermal receiver tube for power generation. The performance of this multilayer thin film was investigated by measuring the absorptance and emittance using 410 Solar and ET 100 in the solar spectrum region at a variable incident angle from 20° to 60° . The effect of optical properties, microstructure and morphology of the multilayer thin film coatings was also investigated. The maximum absorptance 0.92 and minimum emittance < 0.1 were observed in deposited multilayer thin film coating with the combination of Tungsten, Al_2O_3 and Nickel, respectively. The observed values indicate the practical applicability of the multilayer coatings in medium-to-high-temperature range of solar thermal receiver tubes.

Keywords Multilayer thin film coating · Absorptance · Emittance · Sputtering

Abbreviations

DC	Direct current
RF	Radio frequency
Ni	Nickel
W	Tungsten
Mo	Molybdenum
V	Vanadium
Al_2O_3	Aluminum oxide (alumina)
SiO_2	Silicon dioxide (silica)
AlN	Aluminum nitride

IR	Infrared
AR	Anti-reflection
FESEM	Field emission scanning electron microscope
SEM	Scanning electron microscope
EDAX	Energy dispersive X-ray
AFM	Atomic force microscopy
mm	Millimeter
sccm	Standard cubic centimeters per minute
nm	Nanometer
μm	Micrometer
keV	Kiloelectron volt
W	Watt
GPa	Giga pascal

✉ Harinandan Kumar
harinandankumar88@gmail.com

- ¹ Madanapalle Institute of Technology and Science, Madanapalle, India
- ² Department of Petroleum and Earth Sciences, University of Petroleum and Energy Studies, Bidholi, Via Prem Nagar, Dehradun, Uttarakhand 248007, India
- ³ R.V. College of Engineering, Bangalore, India
- ⁴ Dayananda Sagar College of Engineering, Bangalore, India

List of Symbols

α	Solar absorptance
ε	Thermal emittance





Experimental and numerical evaluation of CBM potential in Jharia Coalfield India

Harinandan Kumar · M. K. Mishra · S. Mishra

Received: 28 September 2018 / Accepted: 27 May 2019
© Springer Nature Switzerland AG 2019

Abstract Geophysico-mechanical characterization of coal data are important in the economic success of CH₄ extraction as well as a CO₂ injection in deep coal seam reservoir. The heterogeneous nature of coal makes the CH₄ removal quite challenging because of the complex behaviour of the seam at in situ as well as applied stress level. Coal matrix behaviour depends on several parameters as permeability, porosity, pore pressure, gas content, structural features, etc. plays a leading role in methane extraction. Therefore, extensive laboratory investigation is handiest approached to anticipate the behavior of coal effectively. This paper presents the results of coal characterization, gas permeability, adsorption/desorption capacity of coal as well as the performance of CBM production well in the replicated model of JH-MD-XVI-T coal seam at a depth of 580 m. The coal characterization was determined to evaluate the prospects of methane in the study area. The gas permeability was determined in a triaxial experimental set up using Darcy's approach to in situ conditions. The decrease in permeability with an increase in confining as well as gas pressure was observed in all coal samples due to the crushing of

grain, coal deformation and narrowing of fractures as well as cleats leading to hinder the flow of fluid through it. The well performance was evaluated to determine the gas rate as well as cumulative gas volume over twenty-five years of well life. Mutual relation between permeability, in situ confining pressure as well as gas pressure, has been established statistically.

Keywords Coal bed methane · Proximate and ultimate analysis · Permeability · Reservoir simulation · Statistical analysis

1 Introduction

The growing need of industrialization reduces the supply–demand gap of energy all over the globe specially in India. Unconventional energy resources like coal-bed methane (CBM) an alternate energy sources have received greater importance because of its abundant occurrence, less polluting and environmentally friendly attributes (Koenig and Stubbs 1986; Yan et al. 2012, 2017). The CBM occurs in the coal matrix by adsorption process and acts as a source as well as a reservoir (Li and Zhang 2016). The extraction of CBM starts with depletion of the reservoir pressure due to continuous dewatering process (Young et al. 1991). Porosity and permeability attributes coal matrix influence to the extraction well

H. Kumar (✉) · M. K. Mishra
Department of Mining Engineering, NIT Rourkela,
Rourkela, Odisha 769008, India
e-mail: harinandankumar88@gmail.com

S. Mishra
Department of Chemical Engineering, NIT Rourkela,
Rourkela, Odisha 769008, India



Experimental evaluation of partially hydrolyzed polyacrylamide and silica nanoparticles solutions for enhanced oil recovery

Upendra Singh Yadav¹ · Harinandan Kumar¹ · Vishnu Roy² · Saurabh Juyal² · Anurag Tripathi¹ · Anveshika Shanker¹

Received: 7 June 2019 / Accepted: 31 July 2019 / Published online: 3 August 2019
© The Author(s) 2019

Abstract

The establishment of oil production well is becoming a challenge with the increasing demand for energy. The fulfillment of energy need requires large production of oil and gas as it is a primary source of energy. EOR is also important because of the enhancement in oil production from thirty percent to more than fifty percent. The chemical EOR is one of the techniques for the increment in oil production. Chemical flooding using water-soluble polymers like partially hydrolyzed polyacrylamide (PHPA) has been industrially used as an EOR technique. The paper deals with the effect of nano-silica particles on viscosity as well as the shear rate of the polymer solution. The change in viscosity, as well as shear rate, was studied at variable concentrations of the nano particles in the different concentrations of PHPA solution. Mutual correlation between viscosity and other parameters like temperature, shear rate, salinity, nanoparticle concentration, and polymer concentration was established using the statistical method.

Keywords Enhanced oil recovery (EOR) · Nano-silica particles · Viscosity · Shear rate · Optimization

Introduction

Oil and gas are the primary requirement for energy resources throughout the world and it will continue in the future. The continuous production of the hydrocarbon leads to the depletion of oil and gas resources. Only thirty percent production of hydrocarbon is possible with the conventional method. Therefore, it is highly required to recover the remaining unreachable hydrocarbon from fulfilling the increasing demand. The recovery of those unreachable hydrocarbons is possible by using enhanced oil recovery (EOR) methods. Out of several EOR techniques, polymer flooding is the most common and effective chemical EOR methods for potential recovery of oil and gas (Wever et al. 2011; Sheng et al. 2015). This technique overcomes several disadvantages of the conventional waterflooding technique like the fingering and bypassing of water through oil. One of the critical

parameters in the flooding process is the mobility ratio, which is a measure of the combined effect of permeability and fluid viscosities on fractional flow. If the mobility ratio is one or slightly less than one, there will be an efficient and piston-like displacement of oil (Vossoughi 2000). Partially hydrolyzed polyacrylamide (PHPA) is the most frequently used polymer in this respect, owing to its low cost, viscosifying nature, and well-known physiochemical properties (Urbissinova et al. 2010). The molecule of this polymer is a flexible chain which remains in coil-like structure in the absence of a shearing effect. The application of PHPA is limited due to high temperature and salinity (Uddin et al. 2002). In such conditions of elevated temperature, the amide groups of the chain undergo extensive hydrolysis into a carboxylic acid and these hydrolyzed products get precipitated when they come in contact with cations commonly present in reservoir brines (Thorne et al. 2010; Taylor and Nasr-El-Din 1998). PHPA acts as shear-thinning polymer, i.e., it undergoes shear degradation and reduces viscosity at high shear rates. This is because, at high shear rates, the chains of the polymer get cutoff (Song et al. 2006).

An increasing number of research studies using nanoparticles are being carried out every year. This special attention is due to the unusual properties that these particles display because of their extremely small size and large surface area.

✉ Harinandan Kumar
harinandankumar88@gmail.com

¹ Department of Petroleum and Earth Sciences, University of Petroleum and Energy Studies, Bidholi, Via Prem Nagar, Dehradun, Uttarakhand 248007, India

² Department of Petroleum and Energy Studies, DIT University, Dehradun 248009, India



Experimental investigation of partially hydrolyzed polyacrylamide–hexamine–pyrocatechol polymer gel for permeability modification

Upendra Singh Yadav¹ · Harinandan Kumar¹ · Vikas Mahto²

Received: 17 July 2019 / Accepted: 1 February 2020
© Springer Science+Business Media, LLC, part of Springer Nature 2020

Abstract

The crosslinked polymer gel systems are most widely used as injection fluids for the maintenance of adequate mobility control and favorable permeability profiles within the reservoir. The application of these systems requires careful monitoring of the gelation behavior to avoid premature gelation or prolongs shut-in times under reservoir conditions. The paper deals with the investigation of disproportionate permeability reduction (DPR) of reservoir rock using partially hydrolyzed polyacrylamide–hexamine–pyrocatechol gels. Mutual correlation was observed between gelation time of the developed organic polymer gel in bulk gelation studies and other parameters such as the concentration of polymer and crosslinkers as well as temperature. An increase in gelation time was observed with the increase in the concentration of polymer and crosslinkers as well as temperature. The stability of the developed polymer gel was observed at the polymer and crosslinker concentration from 0.9 to 1.1 and from 0.3 to 0.5 wt.%, respectively. The thermal stability of the developed polymer gel was exhibited at a higher temperature of about 120 °C. The stabilized polymer gel was used for in situ gelation study to evaluate the plugging ability of the polymer gel in sand pack. In situ gelation studies showed a good injectivity and plugging ability with potentiality for the DPR in the oil fields.

✉ Harinandan Kumar
harinandankumar88@gmail.com

² Department of Petroleum Engineering, Indian School of Mines,
Dhanbad 826004, India

¹ Department of Petroleum and Earth Sciences, University of
Petroleum and Energy Studies, Bidholi, Via Prem Nagar,
Dehradun, Uttarakhand 248007, India



Influence of rock properties on emission rate of Particulates Matter (Pm) during drilling operation in surface mines

Koneti Venkataravanappa Nagesha¹, Harinandan Kumar^{*2}, Muralidhar Singh Munisingh¹

1. Madanapalle Institute of Technology and Science, Madanapalle, India

2. Department of Petroleum and Earth Sciences, University of Petroleum and Energy Studies, Bidholi, Via Prem Nagar, Dehradun, Uttarakhand 248007, India

Received 1 December 2019; accepted 3 June 2020

Abstract

The mining process generates significant amount of dust in the form of particulate matters into the atmosphere. Out of different mining process, opencast mining produces more dust than that of underground mining because of exposure in the ambience. The mining operations are directly or indirectly involved in the production of dust particles. The activities like drilling operation, Blasting and haul road operations produce fugitive dust and causes significant deterioration of mine atmosphere. This fugitive dust consists of particulate matters (PM), which are more harmful to the human respiratory system. The prevention measures is only possible when the actual prediction of emission of those fugitive dust particles are possible. There is several model that predict the emission of the dust particles, but there is very less model to predict fugitive dust produced from a drilling operation in surface mines. In this paper, study was carried out to develop dust prediction model and to assess the influence of rock properties on dust emission. Based on the results obtained the developed model exhibit close proximity of predicted as well as field measured values with a regression coefficient of 0.75. Thus, the development of the model with effective prediction capability is the novelty of this paper. Decrease in dust emission rate was observed with increased moisture content present in drill cuttings, higher compressive strength, and density.

Keywords: *Dust, Emission, ANN, Multiple regression analysis, Rock properties*

1. Introduction

Dust is a major environmental problem during surface mining operations. Presence of dust particles in the surroundings of surface mines not only causes health problems to the workers but also results in poor visibility that may lead to Heavy Earth Moving Machinery (HEMM) accidents. The HEMM accidents may occur frequently due to the continuous deposition of dust produced from mining operations. In surface mining operations, the dust sources are categorized into 3 types namely point sources, line sources and area sources (Thompson and Visser 2007). The point sources comprises drilling, loading/unloading operation while haul roads and unpaved roads comes under line sources and coal stack yard, dump yard etc. are area sources (Jose and Huertas 2012, BPEMD dust control 1998). The elimination of dust produced at mining site due to various activities is not possible but only their reduction is possible up to some extent. The haul road is major contributor of fugitive dust while drilling and blasting is second most contributor of fugitive dust in mining area (Cole and Zapert 1995). The dust produced during drilling operation in the mine area discharged in the atmosphere in a defined flow stream. The discharged dust in the atmosphere comprises variable sized particles which is harmful to nature and human health. Majority of the dust particles lies between PM_{2.5} and

PM₁₀, which are harmful to human health and leads to major respiratory problems (Chakraborty et al. 2001).

Estimation of emission from respective source is an important factor for any kind of dust dispersion models. Initially dust emits from source is mainly depending on various factors like moisture content, rock density, hardness of rock, compressive strength of rock, etc. Moisture content present in rock virtually leads to less particulate emission (Cole and Kerch 1990). In order to develop a good prediction model, good amount of field data is required and it has to be processed. Though there are various methods available, among them Artificial Neural Network (ANN), Multiple Regression Analysis (MRA) and Cluster methods are commonly used in environment related research including dust prediction models (Lal and Tripathy 2012).

The statistical analysis technique such as multiple regression analysis is often used to analyze the correlation between a single dependent variable and several independent variables. The multiple regression analysis is basic technique used to analyses the several research output including environmental prediction problems. This is highly acceptable regression analysis technique used in versatile dependence area. This technique can be used for various air pollution problems like determination of tropospheric ozone, TSP, PM₁₀, PM_{2.5}, etc. (Sousa et al. 2008). Also the multivariate statistical analyses like Cluster Analysis (CA), Principal Component Analysis (PCA) were also used for assessing

*Corresponding author.

E-mail address (es): harinandankumar88@gmail.com

Global Challenges, Policy Framework & Sustainable Development for Mining of Mineral and Fossil Energy Resources (GCPF2015)

Petrographical Characteristics of Bituminous Coal from Jharia Coalfield India: It's Implication on Coal Bed Methane Potentiality

Harinandan Kumar^a, Susmita Mishra^b, M.K.Mishra^a, A. Parida^a

^a Department of Mining Engineering, NIT Rourkela, Odisha-769008

^b Department of Chemical Engineering, NIT Rourkela, Odisha-769008

Abstract

The ever increasing demand for energy resources forces India to hunt for alternate resources like coal bed methane (CBM) and shale gas. CBM is considered as clean source however its occurrence and extraction poses many challenges. The challenges vary widely across region, depth of occurrence, rank of coal, feature of cover etc. So, its characterization is important for successful extraction. The present paper discussed about the Petrographic study of coal and its correlation with different parameters that influence the recovery of CBM. Sample from deep seated coal field have been evaluated with respect to its proximate and ultimate parameters. Mutual correlations have also been developed statistically among parameters.

© 2015 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of organizing committee of the Global Challenges, Policy Framework & Sustainable Development for Mining of Mineral and Fossil Energy Resources.

Keywords: Coal Bed Methane, proximate analysis, Ultimate analysis, Vitrinite reflectance, Gas content.

1. Introduction

Increasing energy demand requires exploitation of earth resources. Fossil fuel has been the major resources to meet the energy need. But its limited occurrence is not only a concern but also adverse impact on environment is major challenge. CBM a trapped gas in the coal matrix has been found to be a promising alternative to reduce dependency on coal. CBM is similar to natural gas which contains about 95% of pure methane (Rice, 1993; Levine, 1993). Formation of coal bed methane takes place because of biogenic or thermogenic degradation of buried plant materials (Singh, 2010). Microbial action in biogenic conversion is responsible for degradation of plant materials into methane gas (Claypool and Kaplan, 1974) while high temperature and pressure in thermogenic conversion/thermal decarboxylation is responsible for plants degradation (Carothers and Kharaka, 1980). But trapped or adsorbed methane is a serious hazard in deep underground coal excavation method. It causes global warming apart from accidental fire and explosion when released into the atmosphere. But it is a clean energy when burnt, that produce less GHG effect. It is considered as very cost effective compared to coal and oil. CBM is a clean gas having heating value of approximately 8500 KCal/kg compared to 9000 KCal/kg of natural gas (Ojha et. al., 2011). The commercial extraction of coal bed methane is increasing worldwide (Moore, 2012).

3D Modelling of Coal Deformation under Fluid Pressure using COMSOL Multiphysics

Harinandan Kumar^{1,*}, M.K. Mishra² and S.Mishra³

¹Department of Mechanical Engineering Madanapalle Institute of Technology & Science, Madanapalle, Chittoor District, Andhra Pradesh – 517325

²Department of Mining Engineering, NIT, Rourkela - 769008

³Department of Mining Engineering, NIT, Rourkela - 769008

Received 24 October 2017; Accepted 7 December 2017

Abstract

Gas transportation in coal bed is a complex physical process. The Adsorption/desorption process is associated with migration of gas in coal. Adsorption/desorption of CO₂/CH₄ in coal bed includes diffusion of gas from coal matrix and its flow through natural fractures. Therefore, it is necessary to have a clear concept of the flow behavior of gas in coal bed for successful coal bed methane (CBM) production and carbon dioxide sequestration. Flow of gas through natural cracks results in deformation of coal bed. Injection of CO₂ in enhanced coal bed methane (ECBM) depends on the permeability and fluid flow behavior. Deformation in solid coal induced by fluid pressure during CBM and ECBM process is still not clearly understood. Numerical models and Multiphysics are dominant in modelling of complex study of flow induced deformation. Such modelling is required for detailed understanding of deformation as well as flow parameters. In this study 3D model of fractured coal core was developed. The deformation in coal core at multiple injected fluid pressures was analysed. Geo-mechanical parameters (Stress, Strain, Deformation, Pore pressure and Darcy's Velocity etc.) were determined at varying injection pressures. The relations between different Geo-mechanical parameters were established using a statistical approach.

Keywords: 3D modelling, Comsol Multiphysics, Geo-mechanical properties, Statistical Analysis

1. Introduction

Coal bed methane (CBM) is unconventional energy source. It comprises 95% pure methane with calorific value 8500 Kcal/g (Zhang et al., 2015; Ojha et al., 2011). It is one of the promising technologies to fulfil the rapid increasing demand of energy. Methane resides in the coal matrix through sorption phenomena. Despite of gas in place of coal reservoir in depth knowledge of coal-gas interaction and flow induced deformation is important for successful and economical production of CBM as well as CO₂ sequestration. Coal shows dual-porous nature with multiple sized pores (micro, meso and macro pores) that lower its permeability (Vandamme et al., 2010). CBM production and CO₂ sequestration is very difficult for the reservoir with less understanding of gas transport phenomena (Swami and Settari, 2012). Importance of fluid transport and its impact on mechanical properties of coal bed have been studied elsewhere (Xiao et al., 2004; Yang and Zoback, 2011; Wang et al., 2012; Bigi et al., 2013; Ye et al., 2014; Ghanizadeh et al., 2014; Zhang et al., 2015). Diffusion of methane from the matrix and flow through the natural cracks (fractures and cleats) leads deformation in coal bed (Zhao and Jin, 1994; Wang et al., 2013; Liu et al., 2015). Migration of the gas within the matrix is driven by the concentration gradient while its flow through natural cracks is driven by the gas

pressure gradient (Andreas and Yves, 2011). Transportation of CO₂/CH₄ gases through coal at different pressure results swelling/shrinking of coal matrix. Deformation in coal matrix makes opening and closing of cleats more complicated (Chunguang et al., 2014).

In this paper 3D model of coal core was developed using Comsol Multiphysics 4.3. Poroelastic model was adopted for gas-solid coupling and determination of pressure induced deformation and change in mechanical properties. The model focuses on the elastic deformation in solid coal structure at different gas injection pressure. The poroelastic simulations were used for coupling of Darcy's flow with structural deformation. Experimentally evaluated input data for coal bed in Jharia coal field at a depth of 580 m was applied for analysis. The model was evaluated using Biot's well as pressure equation. The correlation between different Geo-mechanical properties and fluid pressure was established using a statistical approach.

2. Geometry of Model

The coal core representing the coal bed was developed using 3D modeling tool. The NX size of coal core of 54 mm diameter and 108 mm length with L/D ratio 2 as per recommendation (ASTM, D2113-99) was considered for study (fig 1). Core was cut along the vertical axis to show the cleat structure clearly. The fractures of 1 to 2 mm wide and 1 mm deep were created in coal core to represent intact coal structure.

*E-mail address: harinandan.kumar88@gmail.com

ISSN: 1791-2377 © 2017 Eastern Macedonia and Thrace Institute of Technology. All rights reserved.
doi:10.25103/jestr.106.09

Alumina Thin film Coatings at Optimized Conditions using RF Magnetron Sputtering Process

Muralidhar Singh M¹, Harinandan Kumar^{2,*}, P. Sivaiah¹

¹Madanapalle Institute of Technology & Science, Madanapalle, Andhra Pradesh, India

²Department of Petroleum and Earth Sciences, University of Petroleum and Energy Studies, Bidholi, Via Prem Nagar, Dehradun, Uttarakhand 248007, India

Received: 21 Jun. 2020, Revised: 22 Aug. 2020, Accepted: 24 Sep. 2020

Published online: 1 Jan. 2021

Abstract: This study deals with the extensive investigation of Alumina thin film coating deposited on glass, stainless steel, and polycarbonate substrates at 25°C. The transmittance, reflectance, and surface roughness were determined. Transmittance was observed from 88 to 91 % for alumina thin film coating on glass and polycarbonate substrates. The stiffness, hardness, and elastic modulus were 58, 52, and 47 $\mu\text{N}/\text{nm}$, 7.52, 7.14, 6.87, 103, 112, and 122 GPa thin-film coating on different substrates. An increase in surface roughness and transmittance was observed with sputtering power and the thickness of the coating.

Keywords: Alumina thin film coating; Optical characteristics; Reflectance; Transmittance; Mechanical properties; Statistical Analysis

1 Introduction

The Thin-film is the oldest known term used for decorations in caves, pottery, gold, and silver coatings on statues, jewels, amulets, etc. [1]. A thin film is a layer of material ranging from a nanometer to several micrometers in thickness [2, 6]. The thin film properties are quite different from their constituent materials because of increasing surface to volume ratio with decreasing film thickness [2]. The thin-film technique involves the deposition of thin-film coatings on the substrate's surface to sustain the adverse environmental condition at improved performance. The most common form of the thin film coating material is the Alumina (Aluminium oxide). The natural forms of alumina are Corundum, Diaspore, Gibbsite, Boehmite, Bayerite, and Nordstrandite. The alumina is used as a coating material because of its abrasive nature, high melting point (2000°C), density (3.96 g/cm³ at 20°C), Tensile Strength (220 MPa at 20°C), and Elastic Modulus (375 GPa at 20°C), etc. The unit cell structure of Aluminium Oxide is hexagonal with side "a" is equal to "b," at an angle of 120 degrees, and side "c" is at an angle of 90 degrees. The hexagonal lattice structure makes the alumina suitable for application in the thin film coating material. The deposition of alumina on the different

substrate materials has been studied elsewhere [7,10]. The study of the effect of temperature on microstructural parameters and optical properties was reported elsewhere [11]. In this observation, thin-film coating of aluminum oxide (Al₂O₃) was deposited on two different substrates, namely silicon and quartz, using pulsed laser deposition at 3.0×10⁻³ mbar pressure and 300 to 973K temperature respectively. The X-ray diffraction results showed amorphous Al₂O₃ at 300 to 673 K and polycrystalline cubic γ -Al₂O₃ at temperatures ≥ 773 K. Smooth morphology of the films and increased roughness from 0.3 nm to 2.3 nm was observed with temperature. The increased temperature from 300 to 973 K resulted in an increase in crystallite size from 5 to 10 nm. Thus, it is clearly shown that the crystalline size is an important factor for enhancing the temperature zone in the material. The optical properties like transmittance and refractive indices (RI) were evaluated as 80% and 1.80. An increase in RI was observed with temperature and was attributed to an increase in film density [11]. Further improvement in the alumina thin film coating in terms of transmittance and refractive indices is highly required for the enhanced workability. The effect of the thickness of aluminum thin films on optical properties was studied elsewhere [12]. The study reveals different surface characteristics and small nucleation due to short time growth and different growing conditions. The impact

*Corresponding author E-mail: harinandankumar88@gmail.com

An approach of CO₂ Capture Technology for Mitigating Global Warming and Climate Change-an overview

Harinandan Kumar, S. Ravikumar,
Sathyabama University,
Chennai, India.
harinandankumar88@gmail.com

Abstract— Energy and the environment are two of the most important issues this century. More than 80 % of our energy comes from the combustion of fossil fuels, which will still remain the dominant energy source for years to come. It is agreed that carbon dioxide produced from the combustion process to be the most important anthropogenic greenhouse gas leading to global warming. Atmospheric CO₂ concentrations have indeed increased by almost 100 ppm since their pre-industrial level, reaching 384 ppm in 2007 and still increasing with a total annual emission of over 35 Gt. Prompt global actions to resolve the CO₂ crisis is therefore needed. To pursue such an action, we are urged to save energy without the unnecessary production of carbon emissions and to use energy in more efficient ways, but alternative methods to mitigate the greenhouse gas have to be considered. There is a large energy penalty in the proven technology of chemical absorption/stripping of CO₂ using amine solvents. The aim in this study is to develop fast catalytic absorption/ desorption of CO₂ at low temperatures using water as solvent. The naturally occurring zinc metallo-enzyme carbonic anhydrase (CA) can concentrate CO₂ using a reversible Hydration /dehydration cycle at neutral pH and at ambient temperatures. Some tripodal complexes of zinc (II), and other metals mimic the CA catalytic process, which proceeds by hydration of CO₂ to bicarbonate followed by the reverse dehydration of the bicarbonate to regenerate CO₂. This Minireview highlights some recent promising research activities and their prospects in the areas of carbon capture and storage and chemical fixation of CO₂ in constructing a future low-carbon global economy with reference to energy

Keywords- Carbon capture and storage (CCS); catalysts; catalytic absorption; catalytic desorption; post combustion capture; Monoethanolamine – MEA;

I. INTRODUCTION

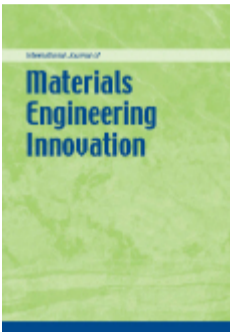
Anthropogenic CO₂ production is a major contributor to atmospheric CO₂ levels that have increased from around 250 ppm at the start of the industrial revolution to around 380 ppm currently. Projections by the International Panel on Climate Change predict that a business as usual (BAU) scenario will produce a level of 850 ppm by 2050 and will result in serious climate extremes (melting polar ice, sea level increases, and disruption of ocean currents). Reductions from this projected level, could be achieved from efficiencies, by switching to generation of energy from renewable or non-carbon sources, (solar, wind, hydro or nuclear generation), however fossil

fuels will still be essential to maintain future energy demands. To achieve the emission reductions desired, carbon capture and storage will be required as the major technology that must be implemented. While new power plants may use the newer technologies that facilitate CO₂ capture (decarbonisation with pre-combustion capture, oxy-fuels), retrofitting of existing conventional power generating plants (fig.1.) is more problematical. Carbon dioxide (CO₂), a major greenhouse gases, is the major contributor to global warming (Marland et al., 2003). About 24 gigatonnes (Gt) of CO₂ are released into atmosphere each year due to human activities (1Gt = 1*10⁹ metric tonnes) (Marland et al., 2003), capture and sequestration is thus critical for environmental preservation. Existing technologies using absorption, adsorption and reactive absorption can capture the CO₂ but they cannot do so economically. This is largely due to the need for thermally driven desorption. As long as hydrocarbons remain the principal source of power more efficient technologies will be needed to provide economical, post-combustion capture. The large installed base of coal, oil and natural gas burning power plants as well as abundant supplies of coal mean that post-combustion methods will remain important for a long time and thus economical postcombustion clean-up technologies are essential. This paper discusses how the main CCS systems as well as mineral carbonation and industrial uses of CO₂, could be incorporated into national greenhouse gas inventories and accounting schemes. However, inventory or accounting issues specific to enhanced oil recovery or enhanced coal bed methane are not addressed here. The paper gives an overview of the existing framework, the main concepts and methodologies used in preparing and reporting national greenhouse gas emissions and removals with the aim of identifying inventory categories for reporting CCS systems. In addition, areas are identified where existing methodologies could be used to include these systems in the inventories, and areas where new methodologies (including emission/removal factors and uncertainty estimates) would need to be developed. Treatment of CCS in corporate or company reporting is beyond the scope of the paper. Issues related to accounting similar accounting schemes that would limit emissions, provide credits for emission reductions, or encourage emissions trading. The paper addresses issues that could warrant special rules and modalities in accounting schemes because of specific features of CCS systems, such as permanence of CO₂ storage and liability issues related to

[International Journal of Materials Engineering Innovation](#) > Forthcoming and Online First Articles


Forthcoming and Online First Articles

International Journal of Materials Engineering Innovation




Forthcoming articles have been **peer-reviewed** and **accepted for publication** but are pending final changes, are not yet published and may not appear here in their final order of publication until they are assigned to issues. Therefore, the content conforms to our standards but the presentation (e.g. typesetting and proof-reading) is not necessarily up to the Inderscience standard. Additionally, titles, authors, abstracts and keywords **may change before publication**. Articles will not be published until the final proofs are validated by their authors.


Forthcoming articles must be purchased for the purposes of research, teaching and private study only. These articles can be cited using the expression "in press". For example: Smith, J. (*in press*). Article Title. *Journal Title*.

 Articles marked with this shopping trolley icon are available for purchase - click on the icon to send an email request to purchase.

Online First articles are published online here, before they appear in a journal issue. Online First articles are fully citeable, complete with a DOI. They can be cited, read, and downloaded. Online First articles are published as Open Access (OA) articles to make the latest research available as early as possible.

 Articles marked with this Open Access icon are Online First articles. They are freely available and openly accessible to all without any restriction except the ones stated in their respective [CC licenses](#).

[Register for our alerting service](#), which notifies you by email when new issues are published online.

 We also offer [Latest issue contents as RSS feed](#) which provide timely updates of tables of contents, newly published articles and calls for papers.

International Journal of Materials Engineering Innovation (12 papers in press)

Regular Issues

- **Selection of materials formulation for non-asbestos friction materials using multi-criteria decision making (MCDM)** 

by Dinesh Shinde, Mukesh Bulsara, K.N. Mistry

Abstract: Friction materials (FM) should possess higher & stable coefficient of friction at the same time should have high resistance to wear sustained at higher temperature too. In order to develop a friction material exhibiting many functional requirements, one should think from different viewpoints, which gives motivation for use of multi-criteria decision making (MCDM) in selection of materials formulation for the friction materials. In this work, three material formulations (CSP0, CSP15, & CSP30) for friction materials and specimens were prepared as per industry standards. The FMs were subjected to a standard friction material quality test procedure named as Chase friction test under controlled condition as recommended by SAE J661. The results of the chase test were interpreted for two fade & recovery cycles through different attributes crucial to thermal behavior of the FMs and the test data was used in multi-criteria

[Sign up for new issue alerts](#)

[Subscribe/buy articles/issues](#)

[View sample articles](#)

[Latest issue contents as RSS feed](#) 

[Forthcoming articles](#)

[Journal information in easy print format \(PDF\)](#)

Keep up-to-date

 [Our Blog](#)

 [Follow us on Twitter](#)

 [Visit us on Facebook](#)

 [Our Newsletter \(subscribe for free\)](#)

 [RSS Feeds](#)

 [New issue alerts](#)

decision making for the selection of best material formulation using Grey Relation Analysis (GRA). To understand the surface wear behavior of the materials, tested samples were subjected to microstructural analysis using SEM/EDS. It is concluded that the materials formulations are ranked as CSP30
Keywords: *Friction materials; Fade & recovery; GRA; SEM; EDS.*

- **Characterization of Aluminium and Alumina Thin Films Coatings using different Deposition Methods for Enhancement of Optical Properties** 

by Harinandan Kumar, Muralidhar Singh M., Sivaiah Potta

Abstract: The enhancement of optical properties such as transmittance, absorptance, and reflectance is possible by applying selective metal and ceramic coatings to the surfaces. Aluminum oxide coatings have potential advantages in this regard. The coating is used for passivation, wear resistance, anti-reflection purpose, etc. in combination with other materials. The aluminum-based coating characteristics include transmittance, reflectance, absorptance, surface roughness, etc. depending on the type of deposition method, operating principles involved, and working conditions maintained during the deposition process. In this study, Aluminium and Alumina thin films of different thicknesses were deposited on borosilicate glass substrates using thermal evaporation, e-beam, and sputtering process with a substrate temperature from 25oC to 100oC. The properties such as transmittance, reflectance, and absorptance were evaluated for the thin film coating. The surface roughness of the thin film was also analyzed. The Rrms values of aluminum and alumina thin films deposited using thermal evaporation and sputtering process with a coating thickness from 100 nm to 300 nm varied from 2 to 5 nm and 1 nm. An increase in reflectance of aluminum coatings was observed with surface roughness.

Keywords: *Thin films; Aluminium Coating; Alumina Coating; Thermal Evaporation Method; E-Beam Method; Sputtering Method.*

- **Implementation of topsis optimization technique in comparative analysis of conventional tig and activated tig welding of stainless steel 304L** 

by Vaibhav Sutar, Baliram Jadhav

Abstract: The Activated tungsten inert gas (TIG) welding mainly focuses on increasing depth of penetration, reducing width of weld, increase speed of welding and improve weld quality. The objective of this Experimental work is to find optimal set of process parameters that achieve higher tensile strength, hardness and depth of penetration. The process parameters selected for Experimental work were welding current, gas flow rate & root gap. The design of experiment was carried out using central composite design of response surface methodology. Silicon dioxide activated flux powder was used along with Acetone for activated TIG welding process. For experimentation austenitic Stainless Steel grade of 304L was used as parent material also the filler material was having same composition. The ANOVA was carried out determine significance of different process parameters on response factors. Further comparative analysis was presented with help of graphs. The TOPSIS optimization approach was used to optimize the factors.

Keywords: *Tungsten Inert Gas welding; Tensile strength; Hardness; Response surface methodology; TOPSIS optimization technique.*

- **Evaluation of the Mechanical and Tribological characteristics of AA6061/TiB2 metal matrix composite and parametric optimization of its casting process by using Taguchi Technique and NSGA-II** 

by Ganesh Suryawanshi, Sachin K. Patil, Ramchandra G. Desavale

Abstract: The present work proposes an experimental methodology and optimization strategy of the process parameters for fabrication of AA6061/TiB2 composite. This composite comprises metal matrix of AA6061 reinforced with TiB2 ceramic and fabricated by stir casting technique. The aim of this work is to find influence of process parameters viz. weight fraction of TiB2 (8%, 10% and 12%), stirrer speed (400rpm, 550 rpm and 700 rpm) and casting temperature (725

Keywords: *AA6061/TiB2 metal matrix composite; stir casting; Mechanical properties; Analysis of variance (ANOVA); Signal to noise ratio (S/N); Non-dominated sorting genetic algorithm (NSGA-II).*

- **Effect of Bonded Stepped and Scarf Repair on Impact Damaged Glass Fiber Reinforced Polymer Composite Properties** 

by Mithun H A, Krishna M, Shrikanth Bailahongal

Abstract: To investigate the effect of bonded stepped and scarf repair methods on the tensile strength restoration was the objective of the present work. The glass fiber composites were fabricated by hand lay-up technique. Impact damage was carried out for two impact energies of 41 J and 44.3 J on the specimens, which was assessed using dye penetration and CAD image scaling technique. Damage repaired specimens were characterized for the tensile test which was carried out on a cut portion of the plate having repair identical to the parent laminate. Tensile strength restoration for 41 J and 44.3 J impact energies of scarf

Effect of Permeability and Geomechanical Properties on Coal Matrix During CBM Production – An Overview

Harinanandah Kumar^{1,*}, M.K. Mishra¹ and S. Mishra²

¹Department of Mining Engineering N.I.T., Rourkela, 769008, India

²Department Chemical Engineering N.I.T., Rourkela, 769008, India

Received 15 October 2017; Accepted 10 February 2018

Abstract

This review presents a comprehensive overview of the technologies and engineering of permeability behaviour of coal matrix as well as impact of induced stress-strain during CBM production. It emphasises on the transport of gas in coal matrix as well as behaviour of coal matrix towards permeability conditions during adsorption/desorption processes. The impacts of stress-strain on permeability of coal matrix are also discussed. The effect on permeability of coal matrix and its shrinkage/swelling during adsorption/desorption of gases has been deliberated. The pore pressure and permeability of cleat structure that regulates the production of coal bed methane was reflected. In this paper the overview of coal bed methane generation and production, gas transport in coal matrix, changes in coal matrix during adsorption/desorption process, permeability behaviour of coal matrix and impact of spatial stress-strain on coal matrix were studied.

Keywords: Coal Bed Methane, Transport of gas, Coal Matrix, Permeability, Geo-mechanical Properties

1. Introduction

Successful production of coal bed methane and sequestration of carbon dioxide in coal seams requires knowledge of coal structural properties and their variation under in situ conditions. Coals, irrespective of their rank, macerals composition and nature of occurrence, retain large amounts of mixture of gases (methane and other gases) within it. The extraction of coal bed methane is well established and establishing in some of the developed as well as developing countries like USA, Australia, China, India and Canada etc. It was observed that coal bed methane is formed under coalification process either by biogenic or thermogenic degradation of buried plant materials [1]. Biogenic conversion of plant materials into methane occurs due to microbial action [2, 3] while thermogenic conversion/thermal decarboxylation is due to high temperature and pressure [4]. Thermogenic conversion of plant materials is the chemical process which converts the vegetal remains into CH₄. Methane is found adsorbed in internal surface of coal matrix and hence amount of methane in coal matrix depend on the pore surface area of matrix [5-7]. Pores of coal matrix mainly divided into macro pores (> 50 nm), meso pores (between 2 and 50 nm) and micro pores (< 2 nm) [8, 9]. Micro pores consist of majority of methane gas in coal matrix while probability of finding methane gas in meso and macro pores is less [8, 9]. It is estimated that majority of the methane is typically adsorbed in the micro pores and very little resides in the macro pores [10]. The gas content in coal bed is determined by presence of macerals in coal. The major macerals presents in coal are Vitrinite,

Liptinite and Inertinite [11]. Weishauptova et al., 2014 [12] observed that the sorption capacity of the organic matter in a coal sample with a prevalence of inertinite (63.0%) was lower than in a sample with a prevalence of vitrinite (65.3%) by only 14% for CO₂ and by 18% for CH₄. Moore, 2012 [13] observed that the organic composition of coal holds principal role in determination of porosity and permeability character and maximum gas holding capacity. The low pressure in coal reservoir in CBM production cause matrix shrinkage that enlarges cleat aperture and as a result micro cleats opens to enhance gas permeability [14-16]. Cleat structure plays leading role for the flow of methane in coal matrix. Flow of gases in coal bed is usually dendritic in nature i.e. migration of gas takes place from small pores (micro cleats) to medium pores (meso cleats) and then moves to large pores (macro cleats) respectively. Characterisation of CBM in coal matrix is a challenge to determine the permeability and percentage gas saturation. Permeability gives the general outlook of flow behaviour of gases in coal matrix. Percentage of gas saturation, gas rate and recoverability of gas from a reservoir mainly determined by adsorption/desorption behaviour of coal matrix [17-19]. These parameters are highly applicable during the modelling of gas flow behaviour in reservoir. Designing a successful pilot well programme as well as production wells depends on the permeability and percentage gas saturation character in coal matrix [13]. The approach taken in this review aims to satisfy a deceptive need for a current and brief summary of permeability, flow behaviour and geo-mechanical properties of coal matrix. Statistics of coal and coal bed methane across the globe is shown in (Table 1, 2 and Figure 1).

Methane is always hazardous in underground mining. The ventilation system is generally provided to combat accidental explosion of methane gas, and release of methane

*E-mail address: harinanandankumar88@gmail.com

ISSN: 1791-2377 © 2018 Eastern Macedonia and Thrace Institute of Technology. All rights reserved.

doi:10.25103/jestr.112.22



IICBE INT'L CONFERENCE

www.iicbe.org

Session Best Paper Certificate

*This is to certify that the paper titled
Experimental Evaluation of Geo-mechanical Properties of coal using
Sonic Wave Velocity
presented by*

*Dr. Manoj Kumar Mishra
was adjudged the best session paper in*

**International Conference on Advances in Agricultural, Biological &
Environmental Sciences (AABES-2015)**



IICBE Chair

**July 22-23, 2015
London (United Kingdom)**



National Conference

on

Trends in Renewable Energy Sources, Applications & Climate Change

23-25 July 2010

Sponsored by Ministry of Earth Sciences (Govt. of India), New Delhi

CENTRE FOR NANOSCIENCE & NANOTECHNOLOGY

(A Joint Initiative of IGCAR, Kalpakkam & Sathyabama University)

SATHYABAMA UNIVERSITY

Chennai-600119

TRESAC '2010

Certificate of Excellence

This is to Certify that..... **HARINANDAN KUMAR**.....has presented a

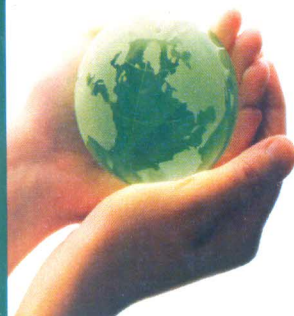
paper/ ~~poster/ model~~ entitled **An Innovative Approach to Save Energy in**.....in
Converting Solar power to Hydrogen fuel.

TRESAC-2010 as an Author & Received **Best Paper/ Poster/ Model Award.**


Organising Secretary
TRESAC-2010


Director


Director





International Conference on Green Technology and Environmental Conservation **GTEC-2011**

15th - 17th December, 2011



Organized by

SATHYABAMA UNIVERSITY

(Established under section 3 of the UGC Act, 1956)

Jeppiaar Nagar, Rajiv Gandhi Road,
Chennai – 600 119, India.



in association with



Certificate of Excellence



This is to certify that Dr./[✓]Mr./Ms. HARINANDAN KUMAR of
SATHYABAMA UNIVERSITY has participated in the
International Conference on "Green Technology and Environmental Conservation" organized by
Sathyabama University, Chennai during 15th - 17th December, 2011. The paper entitled
"KEEP WORKING AFTER SUN DOWN BY ENERGY STORAGE FROM SOLAR POWER -
AN OVERVIEW" has been presented and awarded as the Best paper.

Er. MARIE JOHNSON
DIRECTOR
Sathyabama University

Er. MARIAZEENA JOHNSON
DIRECTOR
Sathyabama University

Aagama 10



Devineni Venkata Ramana & Dr Hima Sekhar
MIC College of Technology
Kanchikacherla - 521180, Krishna Dt., AP
Ph : 08678 273535, 201044
Fax: 08678 273569
www.mictech.ac.in



NATIONAL LEVEL TECHNICAL PAPER CONTEST

17 - 18 SEPTEMBER 2010



This is certify that Mr. / Ms. HARINANDAN KUMAR
of SATYABAMA UNIVERSITY, CHENNAI

has presented a Paper/ ~~Poster~~ and won FIRST Prize in Aagama 10.

PAPER TITLE: A Review of FSW Mechanical Properties Studies for
Aluminium based composites

Organizing Secretary

Convenor

International Conference on
RECENT ADVANCES IN SPACE TECHNOLOGY SERVICES & CLIMATE CHANGE - 2010
(RSTS&CC - 2010)
13th - 15th NOVEMBER, 2010



Organized by
SATHYABAMA UNIVERSITY

(Established under section 3 of the UGC Act, 1956)
Chennai, India.



in association with
**INDIAN SPACE RESEARCH
ORGANISATION (ISRO)**

Department of Space, Government of India,
Bangalore, India



Certificate of Presentation

This is to certify that Dr./Mr./Ms. Hanrandon kumar has presented
a paper entitled An approach to CO₂ capture technology for mitigating global
warming and climate change - an overview
in the International Conference on Recent Advances in Space Technology Services & Climate
Change - 2010 organized by Sathyabama University, Chennai in association with Indian Space
Research Organisation (ISRO), Bangalore and IEEE during 13th - 15th November, 2010.

JOINT ORGANIZING SECRETARY
Dr. K. GANESHA RAJ,
Dy. Director (RESPOND), ISRO

DIRECTOR
Er. MARIAZEENA JOHNSON
Sathyabama University

DIRECTOR
Er. MARIE JOHNSON
Sathyabama University



Department of Metallurgical
and Materials Engineering
NIT ROURKELA



Indian Institute of Metals, Rourkela Chapter

NCPCM 2012

National Conference on Processing
and Characterization of Materials
December 7-8, 2012, Rourkela

Certificate of Participation

This is to certify that

HARINANDAN KUMAR

from

Raajdhani Engineering College, Bhubaneswar

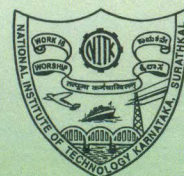
presented a paper entitled "*Effect of process parameter of friction stir welding on macro and microstructure of dissimilar material - an overview*" in the National Conference on Processing and Characterization of Materials (NCPCM 2012) held at National Institute of Technology Rourkela during December 7-8, 2012.


Convener



International Conference
on

Global Challenges, Policy Framework & Sustainable Development
for Mining of Mineral and Fossil Energy Resources: 2015-20



17 - 18 April, 2015

www.gcpf2015.com

To,
Mr. Harinandan Kumar, Ms. Susmita Mishra,
Mr. M. K. Mishra & Mr. A. Parida
Dept. of Mining Engineering & Dept. of Civil Engineering
NIT Rourkela
Odisha- 769 008
India

Date: 02-03-2015

Dear Sir,

Sub – Your paper entitled “Petrographical characteristics of bituminous coal from Jharia coalfield India: Its implication on coal bed methane potentiality” for inclusion in the Conference Proceedings– Reg.

Ref – Manuscript ID No. GCPF-NITK-MN-54

The Editorial team of International Conference on “Global Challenges, Policy Framework and Sustainable Development for Mining of Mineral and Fossil Energy Resources (GCPF:2015-20)” scheduled to be held on April 17-18, 2015 is please to inform you that your paper entitled “Petrographical characteristics of bituminous coal from Jharia coalfield India: Its implication on coal bed methane potentiality” has been accepted. However, before the paper can be sent for publication to Elsevier, you are requested to Register* for the conference. Attached to this mail is the soft copy of the Registration Form. Kindly expedite the process of registration.

The Organizing Team will be glad to see you and welcome you at NITK Surathkal.

Thanking you

With regards

On behalf of the Editorial team

*There is confusion among the authors about Registration Fee. All authors, whose paper is accepted for publication (including Research Scholars, M.Tech and B.Tech students) have to pay a registration fee of Rs. 5000/-. In case of multiple authored papers, the remaining authors may pay Rs. 2500/- each in case they are attending the conference.

Organized by:

Department of Mining Engineering
National Institute of Technology Karnataka (NITK), Surathkal
Mangalore - 575 025, Karnataka, INDIA

E-mail : mininghod@gmail.com Ph.: +91-824-24743051, 2474052 Fax : +91-824-2474033

National Conference
On

Recent Trends in Manufacturing and Industrial Engineering

NCRTMIE 2010

9 & 10 April, 2010



Organized by
Department of Mechanical & Production Engineering
SATHYABAMA UNIVERSITY, Chennai – 600 119

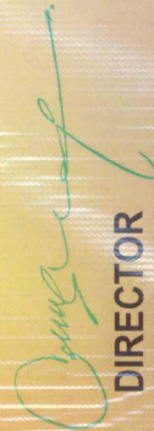


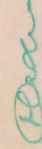
In association with
Indian Institution of Production Engineers
IIPE - Tamil Nadu Chapter

Certificate

This is to certify that Mr/~~Ms~~ **HARINANDAN KUMAR**.....has participated
in the "National Conference on Recent Trends in Manufacturing and Industrial Engineering"
(NCRTMIE 2010) organized by Department of Mechanical & Production Engineering, Sathyabama
University, Chennai in association with Indian Institution of Production Engineers, Tamil Nadu Chapter, from
9-10 April, 2010. The paper entitled **METALLURGICAL STUDIES IN FRICTION STIR**.....
WELDING FOR ALUMINIUM ALLOYS - AN OVERVIEW...... has been presented.


CONVENER


DIRECTOR

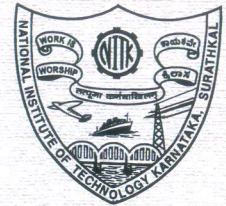


DIRECTOR



DEPARTMENT OF MINING ENGINEERING

National Institute of Technology Karnataka, Surathkal, Mangaluru – 575025,



This is to certify that *Mr. Harinandan Kumar*
participated in the International Conference on "GLOBAL CHALLENGES, POLICY
FRAMEWORK & SUSTAINABLE DEVELOPMENT FOR MINING OF MINERAL AND FOSSIL
ENERGY RESOURCES : 2015-20 (GCPF:2015-20)" held during 17-18 April, 2015.

H. G. Srinivas
Chairman
GCPF : 2015-20

Anand V. Ch
Convenor
GCPF : 2015-20

[Signature]
Head of the Department



NATIONAL SEMINAR

on



RECENT PRACTICES & INNOVATIONS IN MINING INDUSTRY

CERTIFICATE

This is to certify that *Shri/Dr. Harinandan Kumar*
of *NIT Rowkela* has presented a paper on
title *Petrographic and Dynamic Behaviour of Coal for CBM Production in*
Jharía Coal Field

in the two-day Seminar organized by Department of Mining
Engineering, National Institute of Technology, Raipur on 19th - 20th
February, 2016 held at Hotel Babylon Inn, Raipur, Chhattisgarh,
India.


PROF. M. D. PATEL
Organising Secretary


DR. MANOJ PRADHAN
Organising Chairman


DR. RITESH D. LOKHANDE
Convener

RAAJDHANI ENGINEERING COLLEGE, BHUBANESWAR

CERTIFICATE OF PARTICIPATION



AICTE
New Delhi



OES



ISCA
Bhubaneswar



ISTE
Odisha Section

This is to certify that, *Mr/Ms Harinandan Kumar* of
Rajdhani Engineering College, Odisha have participated / presented a paper
entitled *Review of experimental studies on heat transfer Augmentation* in
the National Conference on "Development in Mechanical Engineering- An impact on Ecology and
Environment" Organised by Rajdhani Engineering College, Bhubaneswar on 9th -10th March 2013.


Principal Coordinator


Chief Guest


Principal



One Day Workshop
on
TRENDS IN MATERIAL JOINING TECHNOLOGIES

TMJT 2011

7th September, 2011

Organized by

Department of Mechanical and Production Engineering

SATHYABAMA UNIVERSITY

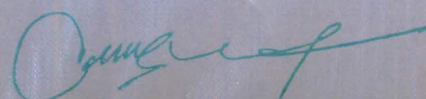
Chennai - 600 119

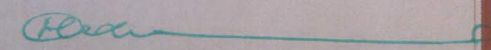
Certificate



This is to certify that Mr./Ms. HARINANDAN KUMAR..... has participated in the "One Day Workshop On Trends in Material Joining Technologies " (TMJT 2011) organized by the Department of Mechanical and Production Engineering, Sathyabama University, Chennai on 7th September 2011.


CONVENER


DIRECTOR


DIRECTOR



*One Day Workshop
On*

NEW MATERIALS AND APPLICATIONS

(NMA 2010)

29th September, 2010



Organized by

Department of Mechanical & Production Engineering

SATHYABAMA UNIVERSITY

Chennai – 600 119

Certificate of Participation

This is to certify that Mr / Ms.....**HARINANDAN KUMAR**.....has participated in the One Day Workshop on “**New Materials and Applications**” (NMA 2010) organized by Department of Mechanical & Production Engineering, Sathyabama University, Chennai on 29th September, 2010.

CONVENER

DIRECTOR

DIRECTOR



SRI RAMANUJAR ENGINEERING COLLEGE

VANDALUR, CHENNAI-600048.

(APPROVED BY AICTE AND AFFILIATED TO ANNA UNIVERSITY OF TECHNOLOGY, CHENNAI.)



DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SOCIETY FOR PRODUCTIVE, INNOVATIVE & CREATIVE ELECTRICAL ENGINEERING

PRAVEG '11

"accelerating ideas..."

CERTIFICATE

This is to certify that Mr/Ms HARINANDHAN KUMAR of SATYABAMA UNIVERSITY has participated in PAPER PRESENTATION during Spice's PRAVEG '11 held on 16th september 2011.


CONVENOR


poorvika
mobile
world


PRINCIPAL

CERTIFICATE OF PARTICIPATION



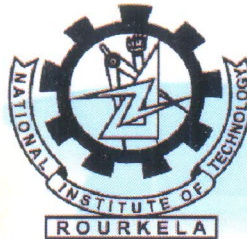
Principal Coordinator

Perrin
Chief Guest


Principal

NATIONAL INSTITUTE OF TECHNOLOGY ROURKELA

ROURKELA-769 008



A Short Term Training Programme

on

DESIGN OF EXPERIMENTS: AN OPTIMISATION TOOL (DOEOT-2013)

*This is to certify that Dr./Mr./Ms. **HARINANDAN KUMAR** of **NIT, Rourkela** has participated in Short Term Training Programme on “Design of Experiments: An Optimisation Tool (DOEOT-2013)” held at Department of Mechanical Engineering, National Institute of Technology Rourkela from 27th Dec. - 29th Dec. 2013*

Coordinator
NIT Rourkela

Dean (SRICCE)
NIT Rourkela



ASHOK LEYLAND

CERT. No: HRD/T&D/353/2010

Date: 25 06 10

CERTIFICATE

This is to certify that, **Mr. HARINANDAN KUMAR II Year B.E MECHANICAL AND PRODUCTION ENGINEERING**, student of **"SATHYABAMA UNIVERSITY"**, was offered in-plant training from **11 05 10 to 22 05 10** at **ASHOK LEYLAND**, Ennore, Chennai – 57.

DETAILS OF TRAINING ATTENDED

SL.No.	Department	Period of Exposure
01	Shops I,II, III & IV	From 11 05 10 to 22 05 10

Assessments

1. Attendance.

No. of days available ----- **06(Six Days)**


No. of days attended ----- **06 (Six Days)**

2. Punctuality ----- **Good**

3. Interest ----- **Good**

4. Conduct ----- **Good**

5. General remarks ----- **NIL**


D.RATHINASABAPATHY
DIV. MANAGER - HR

ASHOK LEYLAND LIMITED

Ennore, Chennai - 600 057, India. Tel: (91) 44-2575 1001 / 0233 Fax: (91) 44-2575 1798 / 2273 Cable: Leyind

Regd. Office: No: 1, Sardar Patel Road, Guindy, Chennai - 600 032, India. Tel: (91) 44-2220 6000 Fax: (91) 44-2220 6001 www.ashokleyland.com



HINDUJA GROUP

(54) Title of the invention : CUTTING DEVICE FOR CUTTING TUBULAR WORKPIECES

(51) International classification	:B26D	(71)Name of Applicant :
(31) Priority Document No	3/16	1)University of Petroleum and Energy Studies
(32) Priority Date	:NA	Address of Applicant :Energy Acres, Bidholi, Premnager,
(33) Name of priority country	:NA	Dehradun, Uttarakhand, India-248007 Uttarakhand India
(86) International Application No	:NA	(72)Name of Inventor :
Filing Date	:NA	1)Dr. Harinandan Kumar
(87) International Publication No	: NA	2)Dr. Upendra Singh Yadav
(61) Patent of Addition to Application Number	:NA	3)Dr. Sunil Kumar Khare
Filing Date	:NA	4)Mr. Anurag Tripathi
(62) Divisional to Application Number	:NA	5)Ms. Anveshika Shanker
Filing Date	:NA	6)Ms. Gitiksha Khandelwal

(57) Abstract :

The present invention relates to a cutting device for cutting a tubular workpiece (17), wherein the cutting device comprising: a cutting blade (1) housed in a circular casing (7), where said cutting blade (1) is affixed to a blade holder (3) through a blade holder pin (2). a plurality of rollers (16) housed in said circular casing (7); at least two solid plates (4a, 4b) adapted to affix to said circular casing (7), where said one solid plate (4a) supports said blade holder (3) and said another solid plate (4b) supports a spring (12); and a two sided threaded stud (10) adapted to be placed in a hole provided on said circular casing (7), where said stud (10) holds a roller support plate (13) at one side and connects to a pulling pin (11) at another side. The pulling pin (11) is connected at outer side of said stud (10) for pulling said plurality of rollers (16) towards outward. The outward movement of said plurality of rollers (16) assists said cutting device (2) in adjusting and accommodating various sizes of said tubular workpieces (17). Each roller (16) is adapted to rotate around said tubular workpiece (17) for providing required push force for cutting said tubular workpiece (17).

No. of Pages : 15 No. of Claims : 10

(12) PATENT APPLICATION PUBLICATION

(21) Application No.201841005118 A

(19) INDIA

(22) Date of filing of Application :12/02/2018

(43) Publication Date : 16/02/2018

(54) Title of the invention : DEVELOPMENT OF NEW THERMAL ABSORBER COATINGS FOR ENHANCED SOLAR APPLICATION

(51) International classification	:H01L31/0232, H01L31/0352	(71)Name of Applicant : 1)Dr. Muralidhar Singh. M Address of Applicant :Department of Mechanical Engineering, Madanapalle Institute of Technology and Science, Post Box No: 14 Angallu, Chittoor Dist. Andhra Pradesh 517 325, India Andhra Pradesh India
(31) Priority Document No	:NA	2)Mr Harinandan Kumar
(32) Priority Date	:NA	3)Mr Harinandan Kumar
(33) Name of priority country	:NA	4)Dr. G. Hemath Kumar
(86) International Application No	:NA	5)Dr. K. V. Nagesha
Filing Date	:NA	6)Mr. Vijaya. G.
(87) International Publication No	: NA	(72)Name of Inventor :
(61) Patent of Addition to Application Number	:NA	1)Dr. Muralidhar Singh. M
Filing Date	:NA	2)Mr Harinandan Kumar
(62) Divisional to Application Number	:NA	3)Dr. G. Hemath Kumar
Filing Date	:NA	4)Dr. K. V. Nagesha
		5)Mr. Vijaya. G.

(57) Abstract :

Abstract Solar receiver tubes are coated with multilayer thin film coatings which have strong solar energy absorptance in the wavelength range of 200-2500 nm, and very little beyond this, improving the properties of the selective coating on the receiver tubes is one of the opportunities to enhance the performance of solar receiver tubes. Despite significant progress made in the coating technology selection of materials used in solar selective absorptance is one of challenge in the field solar thermal and the use of physical vapor deposition and chemical vapor deposition methods is desirable to coat on stainless steel substrate. The invention deals with development of new advanced coating materials with multiple layers for application in enhancement of solar absorptance and to reduce the thermal emittance in solar receiver tubes. A new coating material was deposited on solar receiver tubes in order to enhance the temperature from 120 to more than 450°C.

No. of Pages : 7 No. of Claims : 7

(54) Title of the invention : JET STREAM TURNING TOOL HOLDER FOR CRYOGENIC SPRAY/JET COOLING APPLICATIONS

<p>(51) International classification :B23Q17/09, B23Q17/24, B23Q11/10</p> <p>(31) Priority Document No :NA</p> <p>(32) Priority Date :NA</p> <p>(33) Name of priority country :NA</p> <p>(86) International Application No :NA</p> <p>Filing Date :NA</p> <p>(87) International Publication No : NA</p> <p>(61) Patent of Addition to Application Number :NA</p> <p>Filing Date :NA</p> <p>(62) Divisional to Application Number :NA</p> <p>Filing Date :NA</p>	<p>(71)Name of Applicant :</p> <p>1)Dr. P. SIVAIAH Address of Applicant :DEPARTMENT OF MECHANICAL ENGINEERING, MANDANAPALLE INSTITUTE OF TECHNOLOGY AND SCIENCES, ANDHRA PRADESH - 517325 Andhra Pradesh India</p> <p>2)DR. D. CHAKRADHAR</p> <p>3)Mrs. B. UMA</p> <p>4)Mr. HARINANDAN KUMAR</p> <p>5)Dr. G. HEMATH KUMAR</p> <p>6)Mr. P. MALLIKARJUNA</p> <p>(72)Name of Inventor :</p> <p>1)Dr. P. SIVAIAH</p> <p>2)DR. D. CHAKRADHAR</p> <p>3)Mrs. B. UMA</p> <p>4)Mr. HARINANDAN KUMAR</p> <p>5)Dr. G. HEMATH KUMAR</p> <p>6)Mr. P. MALLIKARJUNA</p>
---	--

(57) Abstract :

Abstract Cryogenic machining is an environmental clean machining technique. Supply of cryogenic coolant (liquid nitrogen/liquid carbon dioxide) at the machining zone significantly reduces the cutting zone temperatures and improves the any metal removal processes performance greatly while machining of difficult to cut materials. General flooding of cryogenic coolant at the machining zone causes for more production cost. Also, flood cooling with cryogenic coolant leads to unwanted cooling areas results in more energy consumption. These drawbacks can be reduced with help of cryogenic spray/jet cooling, where cryogenic coolant is supplied at the exact cutting area where heat will develop using micro nozzles. From extensive study in the field of cryogenic machining, it was revealed that the way of cryogenic coolant supply at the machining zone with micro nozzles can significantly affect the machining performance. Therefore, a tool holder design has been modified and fabricated to supply the cryogenic coolants in the novel way to the machining zone. The modified tool holder acts as a jet stream tool holder for supplying the cryogenic coolant to both rake and flank faces of cutting tool simultaneously. This is an efficient method and assists to obtain significant favorable turning process performance characteristics. Also, the fabrication of jet stream tool holder involves less cost and cheaper when compared to the commercially available tool holders providing only rake face cooling.

No. of Pages : 7 No. of Claims : 7

(12) PATENT APPLICATION PUBLICATION

(21) Application No.201741046532 A

(19) INDIA

(22) Date of filing of Application :26/12/2017

(43) Publication Date : 05/01/2018

(54) Title of the invention : NEW INVENTION OF LOW COST CREEP TESTING MACHINE WITH VARIABLE TEMPERATURE AND ENVIRONMENTAL AND ENVIRONMENTAL CONDITIONS FOR COMPOSITE MATERIAL(PMMC)

		(71)Name of Applicant :
		1)DR.G. HEMATH KUMAR
		Address of Applicant :DEPARTMENT OF MECHANICAL
		ENGINEERING, MADANAPALLE INSTITUTE OF
		TECHNOLOGY AND SCIENCE, POST BOX NO: 14,
		ANGALLU, CHITTOOR DIST. ANDHRA PRADESH -
		517 325. Andhra Pradesh India
		2)DR. C. YUVARAJ
		3)MR. HARINANDAN KUMAR
		4)DR. P. SIVAIAH
		5)MR. PRABHU JAYARAMAN
		(72)Name of Inventor :
		1)DR.G. HEMATH KUMAR
		2)DR. C. YUVARAJ
		3)MR. HARINANDAN KUMAR
		4)DR. P. SIVAIAH
		5)MR. PRABHU JAYARAMAN
(51) International classification	:G01M11/088	
(31) Priority Document No	:NA	
(32) Priority Date	:NA	
(33) Name of priority country	:NA	
(86) International Application No	:NA	
Filing Date	:NA	
(87) International Publication No	: NA	
(61) Patent of Addition to Application Number	:NA	
Filing Date	:NA	
(62) Divisional to Application Number	:NA	
Filing Date	:NA	

(57) Abstract :

A thorough study of notched creep testing of different composite material at variable temperature as well as environmental conditions are very important for determination of cracking resistance developed by the applied stress in the materials. The study of creep testing of Polymer Metal Matrix Composite (PMMC) materials at different input conditions (Temperature, and Environmental etc.) provides accurate characterization of material towards cracking resistance and its applications in material engineering. In order to understand the creep resistance of composite materials, a new apparatus with low cost and enhanced capabilities has been designed to determine the crack propagation in notched specimen at variable temperature and environmental conditions. The setup is designed in such a way that it can accommodate the standard size of specimen and can apply tensile load without electrical energy. The setup is designed to apply load continuously as well as constantly for numbers of days to determine the crack propagation precisely and clearly. It is designed for variable temperature as well as different environmental conditions to represent the in situ conditions and to achieve accurate determination of creep resistance in materials.

No. of Pages : 14 No. of Claims : 1

(12) PATENT APPLICATION PUBLICATION

(21) Application No.201741039402 A

(19) INDIA

(22) Date of filing of Application :06/11/2017

(43) Publication Date : 17/11/2017

(54) Title of the invention : APPARATUS FOR DETERMINATION OF CO₂/CH₄ ADSORPTION/DESORPTION CAPACITY ON INTACT AS WELL AS POWDERED SAMPLES

(51) International classification	:C07C7/12, B01D53/047
(31) Priority Document No	:NA
(32) Priority Date	:NA
(33) Name of priority country	:NA
(86) International Application No	:NA
Filing Date	:NA
(87) International Publication No	: NA
(61) Patent of Addition to Application Number	:NA
Filing Date	:NA
(62) Divisional to Application Number	:NA
Filing Date	:NA

(71)Name of Applicant :

1)Dr. Harinandan Kumar

Address of Applicant :Department of Mechanical Engineering,
Madanappalle Institute of Technology and Science, Chittoor
District, Andhra Pradesh - 517325 Andhra Pradesh India

2)Dr. G. Hemath Kumar

(72)Name of Inventor :

1)Dr. Harinandan Kumar

2)Dr. G. Hemath Kumar

(57) Abstract :

6. Abstract A thorough study of methane and carbon dioxide adsorption/desorption capacity of coal is critical for coal bed methane. (CBM) production and CO₂ sequestration in underground coal seam. Adsorption isotherm provides information about the reservoir conditions and critical desorption pressure as well as volume of gas that can be sequestered in deep coal seam. Therefore it is important to understand the adsorption/desorption capacity of shale as well as coal seam for successful execution of CBM production and CC, sequestration. In order to understand the adsorption/desorption capacity the new setup has designed to determine the adsorption/desorption capacity of sorbent. The setup is based on the volumetric method and mass balance principle to determine the volume of gas adsorbed or desorbed from the sorbent. The setup is designed determine the gas adsorption/desorption capacity of powdered as well as intact samples.

No. of Pages : 7 No. of Claims : 7

(54) Title of the invention : APPARATUS FOR DETERMINING TIME DEPENDENT DEFORMATION AS WELL AS FRACTURE PROPAGATION OF DIFFERENT ROCK SPECIMENS AT VARIABLE TEMPERATURE AND ENVIRONMENTAL CONDITIONS

(51) International classification	:E21B43/26	(71)Name of Applicant :
(31) Priority Document No	:NA	1)University of Petroleum and Energy Studies
(32) Priority Date	:NA	Address of Applicant :Energy Acres, Bidholi, Premnager,
(33) Name of priority country	:NA	Dehradun, Uttarakhand, India-248007 Uttarakhand India
(86) International Application No	:NA	(72)Name of Inventor :
Filing Date	:NA	1)Dr. Harinandan Kumar
(87) International Publication No	: NA	2)Dr. Sunil Kumar Khare
(61) Patent of Addition to Application Number	:NA	3)Dr. Upendra Singh Yadav
Filing Date	:NA	4)Mr. Subhash Kumar
(62) Divisional to Application Number	:NA	
Filing Date	:NA	

(57) Abstract :

Present invention relates to an apparatus for determining time dependent deformation and also fracture propagation of a rock specimen at variable temperature and environmental conditions. More particularly, the invention relates to an apparatus for determining time dependent deformation and fracture propagation of a rock specimen, in real time, at variable temperature and environmental conditions. According to an embodiment of the invention, there is provided an apparatus for determining time dependent deformation and fracture propagation of a rock specimen, said apparatus comprising:a container for holding a fluid medium and enclosing a lower punching base to keep the rock specimen;an upper punching base over the rock specimen;a flat top and flat bottom plunger to apply pressure onto the upper punching base;a dual camera arrangement over respective adjustable rods, to cover the front and back view of the rock specimen.

No. of Pages : 13 No. of Claims : 0

Name	Designation	Department	Institution	Email	Mobile
Prof. D. K. Srivastava	Professor and Ex. GGM, ONGC, Govt. of India	Petroleum Engineering and Earth Sciences	UPES, Dehradun, Uttarakhand India	srivastavadilip@hotmail.com	+91 9410390627

Name	Designation	Department	Institution	Email	Mobile
Dr. Sivaiah Potta	Associate Professor	Mechanical Engineering	MIT, Madanapalle, Andhra Pradesh India	sivaiah.337@gmail.com	+919848360295

Name	Designation	Department	Institution	Email	Mobile
Dr. Muralidhar Singh M	Associate Professor	Mechanical Engineering	R. V. College of Engineering, Bangalore, India	muralisingh23@gmail.com	+919663875393

From

Dr. Harinandan Kumar
Assistant Professor (Senior Scale)
Dept. of Petroleum Engineering & Earth Sciences (School of Engineering)
University of Petroleum & Energy Studies (UPES)
Energy Acres: Bidholi via Premnagar, Dehradun – 248007
Mob: +91-7735232487

Respected Madam/Sir,

I have completed Ph.D. from NIT, Raurkela (an institution of Govt. repute, Govt. of India) in the topic related to Solid Mechanics. I have been working as Research Scholar in the department from past 04 years, Assistant Professor in Department of Mechanical Engineering, MITS, Madanapalle, Andhra Pradesh, India and currently working as Assistant professor in UPES Dehradun.

I am looking forward to an excellent platform to work in a healthy competitive growth-oriented environment and to contribute toward the quality research. Also, further develop my professional skills; conceptualize new areas in the field of Engineering Education through dedicated academic and research work. I published several papers in international journals and conferences. Recently I was granted two patent from Govt. of India based on my research work.

I have enclosed my CV along with this letter. I would be grateful to you if you could consider my application for the Postdoctoral Position.

I look forward to hearing from you. Thank you for your time and kind consideration.

Sincerely yours,

Dr. Harinandan Kumar