

Dr. Ajay Kumar Shukla

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EDUCATION

Ph.D. Materials and Metallurgical Engineering 2011
Indian Institute of Technology (IIT), Kanpur, India

B.Tech Materials and Metallurgical Engineering 1995
Indian Institute of Technology (IIT), Kanpur, India
(IIT JEE All India Rank : 872)

EMPLOYMENT HISTORY

Associate Professor Department of Metallurgical and Materials Engineering IIT Madras, Chennai, India	Oct. 2019 – continuing
Assistant Professor Department of Metallurgical and Materials Engineering IIT Madras, Chennai, India	August 2012 – Oct.2019
Scientist Fellow National Metallurgical Laboratory, Jamshedpur, India	January 2012 – July 2012
Project Associate Department of Materials Science and Engineering, IIT Kanpur	October 2011-December 2011
Deputy Manager Steel Authority of India Limited, Durgapur Steel Plant, India	July 2002–December 2003
Assistant Manager Steel Authority of India Limited, Durgapur Steel Plant, India	July 1999–July 2002
Junior Manager Steel Authority of India Limited, Durgapur Steel Plant, India	July 1996–July 1999
Management Trainee Steel Authority of India Limited, Durgapur Steel Plant, India	July 1995–July 1996

RESEARCH INTERESTS

1. Process modeling, control and optimization of iron and steelmaking.
2. Computational thermodynamics and its application to high temperature metallurgical processes.

3. Application of Artificial Intelligence (ANN, GA) to metallurgical processes.
4. Heat and mass transfer
5. Microwave assisted metal extraction.
6. Extractive Metallurgy
7. Waste recycling and utilization/Circular Economy/Urban Mining
8. Green Steelmaking/Sustainable Metal Production

PARTICIPATION IN INDUSTRIAL PROJECTS

Participated in projects involving development of Level-II Automation comprising of Static and Dynamic Control Models of BOF Steelmaking Process for Visakhapatnam and Rourkela Steel Plant. Also worked on projects like ferro-alloy production, magnesium and iron in low shaft furnace at NML Jamshedpur. At present working on sponsored/consultancy projects in the area of iron-making, steelmaking, waste recycling and management, development of level-2 process control models with industries like JSW Steel Plant, NMDC Ltd. India.

AWARDS

1. Awarded first in ferrous category during Poster Presentation at National Metallurgist Day seminar held at Baroda in 2002.
2. GATE scholarship during Masters study (percentile 93.62 in 2004).
3. Selected for prestigious National Doctoral Fellowship by AICTE (All India Institute for Technical Education) in 2008.
4. MHRD scholarship during PhD studies.
5. Selected for DST-DAAD-PPP (German Academic Exchange Service) 2009 to work on joint project with Institute of Iron and Steel Technology, Technical University Bergakademie, Freiberg, Germany.
6. Visiting Researcher on DAAD Fellowship to Ferrous Metallurgy Division, RWTH Aachen University, Germany during Feb' 2014.
7. Visiting Faculty on DAAD Bilateral Exchange Fellowship to Ferrous Metallurgy Division, RWTH Aachen University, Germany during July' 2015.
8. Keynote speaker at high temperature processing symposium, 2016, Swinburne University, Australia.
9. Visiting Faculty at Iron and Steel Institute, TU Bergakademie Freiberg, Germany during 5-15 January, 2017 to deliver lectures in "Modeling of Steelmaking Processes".

PUBLICATIONS

I. Peer Reviewed journals: (Red marked for students under my supervision)

1. Sunil Yadav, Srishilan C, and **Ajay Kumar Shukla** "Thermodynamic Model of MIDREX Ironmaking Process using FactSageTM and Macro Facility", *Metallurgical and Materials Transactions B*, 2023. (Accepted on September 20).
2. Soumya Ranjan Mohanty, Sunil Yadav and **Ajay Kumar Shukla**, "A novel approach for magnetizing roasting of iron ore composite pellet using conventional and hybrid

microwave furnace”, *Chemical Engineering and Processing - Process Intensification*, 2023, vol. 191, p. 109444.

<https://www.sciencedirect.com/science/article/pii/S0255270123001812>

3. Prasenjit Singha and **Ajay Kumar Shukla**, "Dynamic Basic Oxygen Steelmaking Process and Its Industry Validation", *JOM-Journal of Metallurgy*, 2023, vol. 75, p. 3890–3899. <https://link.springer.com/article/10.1007/s11837-023-06003-1>

4. Gert Bartzsch, Rennie Christian, Soumya Ranjan Mohanty, **Ajay Kumar Shukla** and Olena Volkova, "Effect of Al₂O₃ and TiO₂ on Viscosity, Surface Tension, and Density of Blast Furnace Slag with CaO/SiO₂=1.13", *Steel Research International*, 2023. <https://doi.org/10.1002/srin.202200798>

5. Prasenjit Singha, Soumya Ranjan Mohanty, Sunil Yadav and **Ajay Kumar Shukla**, “Numerical and Experimental Approach to Heating Iron Ore With Mixed Coal”, *AISTech - Iron and Steel Technology Conference Proceedings*, 2023, p. 870–875.

6. Prasenjit Singha, Vinay Singh and **Ajay Kumar Shukla**, “A Dynamic Model of Basic Oxygen Steelmaking Process”, *AISTech - Iron and Steel Technology Conference Proceedings*, 2023, p. 442–449.

7. Soumya Ranjan Mohanty, Amit Bhalla, Anish Upadhyaya and **Ajay Kumar Shukla**, “Study of Reduction Roasting Behaviour of Lean Hematite Iron Ore Using Laboratory-Scale Hybrid Microwave Furnace: An Approach to Enrich Iron Content by Mineral Beneficiation”, *Particulate Materials*, 2023 (under review)

8. Soumya Ranjan Mohanty and **Ajay Kumar Shukla**, “A kinetic comparison between in situ hybrid microwave and conventional magnetising roasting of low-grade iron ore composite pellet”, *Minerals Engineering*, 2023 (under review)

9. Soumya Ranjan Mohanty and **Ajay Kumar Shukla**, “Optimization of conventional and hybrid microwave reduction roasting for processing of lean Iron Ore”, *Powder Technology*, 2023 (under review)

10. Prasenjit Singha, Sunil Yadav, Soumya Ranjan Mohanty, Abhishek Tiwari and **Ajay Kumar Shukla**, “Simulation Study of Microwave Heating of Hematite and Coal Mixture”, *Numerical Simulation – Advanced Techniques for Science and Engineering*, 2022. [https://mme.iitm.ac.in/shukla/85055%20\(1\).pdf](https://mme.iitm.ac.in/shukla/85055%20(1).pdf)

11. Prasenjit Singha and **Ajay Kumar Shukla**, "Contribution of Hot-Spot Zone in Decarburization of BOF Steel-Making: Fundamental Analysis Based upon the FactSage-Macro Program", *Metals*, 2022, vol. 12(4), p. 638. [Link to the journal website](#)

12. Prasenjit Singha, Sunil Yadav and **Ajay Kumar Shukla**, “Ladle Steelmaking Processes Using FactSage and Its Macro Facility”, *AISTech - Iron and Steel Technology Conference Proceedings*, 2022, p. 1723–1728.

13. Prasenjit Singha, and **Ajay Kumar Shukla**, “Multiple-Reactor Approach Dynamic Basic Oxygen Steelmaking Process”, *AISTech - Iron and Steel Technology Conference Proceedings*, 2022, p. 1686–1693.
14. Oleksandr Kovtun, Meirzhan Karbayev, Iurii Korobeinikov, C Srishilan, **Ajay Kumar Shukla** and Olena Volkova, "Phosphorus Partition Between Liquid Crude Steel and High Basicity Basic Oxygen Furnace Slags", *Steel Research International*, 2021. (<https://onlinelibrary.wiley.com/doi/full/10.1002/srin.202000607>)
15. Prasenjit Singha, Soumya Ranjan Mohanty, Sunil Yadav and **Ajay Kumar Shukla**, “Numerical study of heat transfer for microwave-assisted reduction of hematite”, *AISTech - Iron and Steel Technology Conference Proceedings*, 2021, p. 158–167.
16. Oleksandr Kovtun, Iurii Korobeinikov, Srishilan C **Ajay Kumar Shukla** and Olena Volkova, "Viscosity of BOF Slag", *Metals*, 2020, vol. 10(7), p. 982. (<https://www.mdpi.com/2075-4701/10/7/982/htm>)
17. C Srishilan, Anand Vivek, **Ajay Kumar Shukla**, "Operating Line Prediction of COREX Iron-making Process Using RIST Diagram", *ISIJ International*, 2020, vol. 60(4), p. 656-661. (https://www.jstage.jst.go.jp/article/isijinternational/60/4/60_ISIJINT-2019-429/html/-char/en)
18. **Ajay Kumar Shukla**, B. Deo and D.G.C. Robertson, “Modeling of scrap dissolution in molten iron for the case of heat transfer controlled process by different approaches and comparison of their accuracies”, *Journal of Heat Transfer (ASME)*, 2020, vol. 142(10), p. 012101-1-12 (<https://doi.org/10.1115/1.4045100>).
19. **Ajay Kumar Shukla**, Shwetank Pandey, C. Srishilan, D. Satish Kumar and K. Marutiram, “Static and dynamic control model of BOF steelmaking process and its validation with steel plant data”, *AISTech - Iron and Steel Technology Conference Proceedings*, 2019, p. 997–1007.
20. **Ajay Kumar Shukla**, “Thermodynamics-based modeling of iron- and steelmaking processes using flow sheet-based approach employing METSIM”, *Transactions of the Indian Institute of Metals*, 2019, vol. 73(3), p. 767-775. (<https://link.springer.com/article/10.1007%2Fs12666-018-1529-z>)
21. C. Srishilan, **Ajay Kumar Shukla**, “Thermodynamic model of COREX melter gasifier using FactSage™ and macro facility” *Metallurgical and Materials Transactions B*, 2019, vol. 50(1), p. 312-323. (<https://link.springer.com/article/10.1007%2Fs11663-018-1476-4>)
22. Kali Prasad, C. Srishilan, **Ajay Kumar Shukla**, and Marutiram Kaza, " Thermodynamic assessment and experimental validation of clinker formation from blast

furnace slag through lime addition", *Ceramic International*, 2018, vol.44(16), p. 19434-19441.

<https://doi.org/10.1016/j.ceramint.2018.07.180>

23. C. Srishilan, **Ajay Kumar Shukla**, "Static thermochemical model of COREX melter gasifier", *Metallurgical and Materials Transactions B*, 2018, vol. 49(1), p. 388-398. (<https://link.springer.com/article/10.1007/s11663-017-1147-x>)

24. Yuvaraj Patil, **Ajay Kumar Shukla**, "Numerical simulation of effect of process parameters on cooling rate and secondary dendrite arm spacing (SDAS) in high speed twin roll strip casting of Al-15wt%Cu alloy", *Journal of Heat Transfer (ASME)*, 2019, vol. 141(10), p. 102101-1 (<https://doi.org/10.1115/1.4044108>).

25. Deepjyoti Mukherjee, **Ajay K. Shukla**, Dieter G. Senk, "Prediction of decarburization process along with hydrogen and nitrogen removal by mathematical modeling of RH degassing process", *Ironmaking and Steelmaking: Processes, Products and Applications*, 2018, vol. 45(5), p. 412-419. (<http://www.tandfonline.com/doi/full/10.1080/03019233.2016.1274847>)

26. Deepjyoti Mukherjee, **Ajay K. Shukla**, Dieter G. Senk, "Cold Model based investigations to study the effects of operational and non-operational parameters on RH degassing process", *Metallurgical and Materials Transactions B*, 2017, vol. 48(2), p. 763-771. (<https://link.springer.com/article/10.1007/s11663-016-0877-5/fulltext.html>)

27. Ravindra Dhirhi, Kali Prasad, **Ajay Kumar Shukla**, Sabita Sarkar, T Renganathan, S. Pushpavanam, Marutiram Kaza, "Experimental Study of Rotating Dry Slag Granulation Unit: Operating Regimes, Particle Size Analysis and Scale Up", *Applied Thermal Engineering*, 2016, 2016, vol. 107, p. 898-906. (<http://www.sciencedirect.com/science/article/pii/S1359431116311784>)

28. **A. K. Shukla**, B. Deo and D.G.C. Robertson, "Scrap dissolution in molten iron containing carbon for the case of coupled heat and mass transfer control", *Metallurgical and Materials Transactions B*, 2013, vol. 44(6), p. 1407-1427. (<http://link.springer.com/article/10.1007/s11663-013-9905-x>)

29. **A. K. Shukla**, B. Deo and D.G.C. Robertson, "Role of air gap in scrap dissolution process", *Metallurgical and Materials Transactions B*, 2013, vol. 44(6), p. 1398-1406. (<http://link.springer.com/article/10.1007/s11663-013-9906-9>)

30. **A. K. Shukla**, Dmitry Reybov, Olena Volkova, P.R.Scheller and Brahma Deo, "Cold model investigations of melting of ice in a gas stirred ladle", *Metallurgical and Materials Transactions B*, 2011, vol. 42(1), p. 224-235. (<http://link.springer.com/article/10.1007/s11663-010-9442-9>)

31. **A. K. Shukla**, B. Deo, S. Millman, B. Snoeijer, A. Overbosch and A. Kapilashrami, “An insight into the mechanism and kinetics of reactions in BOF Steelmaking process: Theory vs. practice”, *Steel Research International*, 2010, **vol. 81(11)**, p. 940-948.
(<http://onlinelibrary.wiley.com/doi/10.1002/srin.201000123/abstract>)
32. A.Mondal, **A.K.Shukla**, A. Upadhyaya and D.Agrawal, “Effect of porosity and particle size on microwave heating of copper”, *Science of Sintering*, 2010, **vol. 42(2)**, p. 169-182.
(<http://www.doiserbia.nb.rs/img/doi/0350-820X/2010/0350-820X1002169M.pdf>)
33. **A .K. Shukla**, A.Mondal,A. Upadhyaya, “Numerical modeling of microwave heating”, *Science of Sintering*, 2010, **vol. 42(1)**, p. 99-124.
(<http://www.doiserbia.nb.rs/img/doi/0350-820X/2010/0350-820X1001099S.pdf>)
34. Brahma Deo, **Ajay Kumar Shukla**, M.S. Aslam and Rob Boom, “Production of low phosphorus steels and ensuring direct tap practices for the BOF steelmaking process”, *Proceedings ICS 2008: The 4th International Congress on the Science and Technology of Steelmaking*, 2008, p. 598–601.
35. M. Malathi, **A.K. Shukla**, N. Singh, B. Deo and R. Boom, “Theoretical and practical aspects of lance skulling and slag foaming in BOF vessels”, *AISTech - Iron and Steel Technology Conference Proceedings*, 2007, p. 1155–1162.
36. **A. K. Shukla**, B. Deo and K. Deb, “Steel production at optimal cost”, *Directions (the scopus listed journal of IIT Kanpur)*, 2006, **vol. 7(2)**, p. 27-34.
(<https://mme.iitm.ac.in/shukla/Article06.pdf>)

II. Contributions to symposia and compiled volumes :

1. “Numerical and Experimental Approach to Heating Iron Ore With Mixed Coal”, presented in AISTech (American Iron and Steel Technology) 2023 conference.
2. “Extraction of Critical Minerals: General Overview” presented in Indo-Australia Joint Workshop on Critical Minerals Research for Sustainable Transition to Green Energy during 3-4 March 2023.
3. “Decarbonization potential in Steel Industry: A way forward to Green Steelmaking” presented in One-day National Conference on “Recent Advancements in Iron & Steel industries and Emerging areas” RAISE-2023, on February 24, 2023 at CSIR-IMMT, Bhubaneswar.
4. “Decarbonization potential in Steel Industry” presented in EnVision 2022 conference at IIT Madras on November 4th, 2022.

5. “Ladle Steelmaking Processes Using FactSage and Its Macro Facility”, presented in AISTech (American Iron and Steel Technology) 2019 conference at Pittsburgh, USA during 16-18 May 2022.
6. “Multiple-Reactor Approach Dynamic Basic Oxygen Steelmaking Process”, presented in AISTech (American Iron and Steel Technology) 2019 conference at Pittsburgh, USA during 16-18 May 2022.
7. “Numerical study of heat transfer for microwave-assisted reduction of hematite”, presented in AISTech (American Iron and Steel Technology) 2021 conference at Pittsburgh, USA during July 01, 2021.
8. “Static and Dynamic Control Model of BOF Steelmaking Process and Its Validation With Steel Plant Data”, presented in AISTech (American Iron and Steel Technology) 2019 conference at Pittsburgh, USA during 6-9 May 2019.
(<https://mme.iitm.ac.in/shukla/AIST%20paper%202019%20Ajay%20Shukla.pdf>)
9. “Use of biomass as a partial replacement of fossil fuel in ironmaking process with reduction in CO₂ emissions” presented in DST-Sensitization workshop at VNIT Nagpur during 11-12 March 2019.
10. “Modified Rist Operating Diagram of COREX Melter Gasifier”, presented in ASIC (Asia Steel International Conference) 2018 conference at Bhubaneswar during 6-9 February 2018.
11. “Thermodynamic modeling of COREX melter gasifier using FactSage”, presented in STIS (Science and Technology of Iron and Steelmaking) 2017 conference at IIT Kanpur during 11-13 December 2017.
(<https://mme.iitm.ac.in/shukla/stis%20paper%202017.pdf>)
12. “Recent Developments in Optimization and Control in BOF Steelmaking”, presented in National Seminar on “Make In Steel for Make In India - Perspectives for Iron and Steel Industry 2017 conference at CGCRI Kolkata during 27-28 April 2017.
13. “Application of computing approach to model steelmaking processes employing FactSage/METSIM”, presented in National Metallurgist day’ 2016, IIT Kanpur, organized by Indian Institute of Metals.
14. “Mathematical and Physical Modeling of RH Degassing Process”, presented in National Metallurgist day’ 2016, IIT Kanpur, organized by Indian Institute of Metals.
15. “Mathematical Model Based Approach to Optimize and Control Iron and Steelmaking Processes”, keynote address delivered at High Temperature Processing Symposium, 2016, Swinburn University, Australia.

16. "Static thermochemical model of COREX process", presented in National Metallurgist day' 2015, Coimbatore, organized by Indian Institute of Metals.
17. "Physical modeling based analysis of dry slag granulation process", presented in National Metallurgist day' 2015, Coimbatore, organized by Indian Institute of Metals.
18. "Thermodynamic modeling of ferrous/non ferrous extraction processes involving flow-sheet based approach using FactSage/METSIM", presented in National Metallurgist day' 2015, Coimbatore, organized by Indian Institute of Metals.
19. "Numerical investigation of high speed Vertical Twin Roll Casting process for Al 15%Cu binary alloy", presented in National Metallurgist day' 2015, Coimbatore, organized by Indian Institute of Metals.
20. "Expert model of BOF Steelmaking process and its industrial validation", presented in National Metallurgist day' 2015, Coimbatore, organized by Indian Institute of Metals.
21. "Development of dynamic control model of RH degassing process and its industrial validation", presented in National Metallurgist day' 2015, Coimbatore, organized by Indian Institute of Metals.
22. "Control of hot metal treatment by fundamental as well as Data based modeling approach using Artificial Neural Network (ANN)", presented in National Metallurgist day' 2015, Coimbatore, organized by Indian Institute of Metals.
23. "Steady state numerical model of COREX Melter Gasifier", presented in National Metallurgist day' 2014, Pune, organized by Indian Institute of Metals. (<https://mme.iitm.ac.in/shukla/Steady%20State%20Numerical%20Model%20of%20COREX%20Melter%20Gassifier%20NMD2014%20poster.pdf>)
24. "Heat transfer, fluid flow and solidification modeling of Twin Roll casting process", presented in National Metallurgist day' 2014, Pune, organized by Indian Institute of Metals. (<https://mme.iitm.ac.in/shukla/Poster%20-1.pdf>)
25. "Flow Sheet Based Modeling Approach Coupled with Application of Thermodynamics for the Control of Various Iron and Steelmaking Processes" presented in 2014 TMS Annual Meeting and Exhibition, San-Diego, USA. (<http://www.programmaster.org/PM/PM.nsf/ApprovedAbstracts/E20730EB38B335C885257BA90063086C?OpenDocument>)
26. "Lean Operations Strategy to Combat Uncertainties in Temperature at BOF Endpoint, Tapping, Deoxidation, Alloy Addition and Thermal History" presented in 2014 TMS Annual Meeting and Exhibition, San-Diego, USA. (<http://www.programmaster.org/PM/PM.nsf/ApprovedAbstracts/A415920A05E2663385257BA9005D98B4?OpenDocument>)

27. "Data based modeling approach to control iron and steel making processes" presented in STIS (Science and Technology of Iron and Steelmaking) 2013 conference at NML Jamshdepur during 16-18 December 2013.

(<https://mme.iitm.ac.in/shukla/Data%20based%20modeling%20approach%20of%20iron%20and%20steelmaking%20processes1.pdf>)

28. Flow Sheet based modeling approach to control iron and steel making supply chain, presented in National Metallurgist day' 2013, IIT Varanasi, organized by Indian Institute of Metals.

(https://mme.iitm.ac.in/shukla/Poster%20Ajay%20Kumar%20Shukla_metsim.pdf)

29. "Application of Gibbs energy minimization technique to oxygen steelmaking process", presented in National Metallurgist day' 2012, Jamshedpur, organized by Indian Institute of Metals.(<https://mme.iitm.ac.in/shukla/NMDATM2012.pdf>)

30. "Models for oxygen steelmaking process: Theoretical analysis vs practical trends" presented in International Congress on Science and Technology of Steelmaking, ICS 2012, Dresden, Germany.(<https://mme.iitm.ac.in/shukla/bdeoics2012.pdf>)

31. "Contribution of metal droplets in Oxygen steelmaking process: Theoretical analysis vs practical investigations" presented in National Metallurgist day'2011, Hyderabad, organised by Indian Institute of Metals.

32. "On-Time thermal tracking of liquid metal temperature in an integrated steel melt shop", presented in National Metallurgist day'2011, Hyderabad, organised by Indian Institute of Metals.

33. "An insight into the mechanism and kinetics of reactions in BOF steelmaking process: Theory vs. practice", presented in International Conference on the Advances in Theory of Ironmaking and Steelmaking, ATIS 2009, organized by Indian Institute of Science.

34. "Application of Neural Networks for the prediction of Steel Temperature in ladle", presented in National Metallurgist day' 2009, Kolkata,organised by Indian Institute of Metals.

35. "Production of Low Phosphorous Steels and Ensuring Direct Tap Practices for the BOF Steelmaking Process", presented in International Congress on Science and Technology of Steelmaking, ICS 2008, organised by Tokyo Institute of Technology, Japan. (<https://mme.iitm.ac.in/shukla/ICS2008%20dephos%20paper%20shukla.pdf>)

36. "Production of Low Phosphorous Steel in Basic Oxygen Steelmaking Process", presented in National Symposium for Materials Research Scholars (MR08), 2008, organised by Department of Metallurgical Engineering and Materials Science, IIT Bombay.

37. "Mathematical Modeling of Phosphorous Prediction in BOF Steelmaking Process : A Fundamental Approach to Produce Low Phosphorous Steels and Ensure Direct Tap Practices", presented in International Conference on Metal and Alloys METALLO'07, organized by IIT Kanpur, India.

(<https://mme.iitm.ac.in/shukla/Poster%20Ajay%20Kumar%20Shukla.pdf>)

38. "Coupled heat and mass transfer approach to simulate the scrap dissolution in steelmaking process", presented in International Symposium for Research Scholars 2006 on Metallurgy, Materials Science & Engineering , organized by IIT Chennai , India.

(<https://mme.iitm.ac.in/shukla/isrs%202006%20paper.pdf>)

39. "Theoretical and practical aspects of lance skulling and slag foaming in BOF vessels", presented in AISTech '2007.(<https://mme.iitm.ac.in/shukla/bdeoAIST2007.pdf>)

40. "Theoretical Aspects of Scrap Dissolution in Oxygen Steelmaking Converters", presented in AISTech 2004 Conference. (<https://mme.iitm.ac.in/shukla/232.pdf>)

41. "Efficacy of advanced variable selection and regression techniques for analysis of BOF data.", presented in National Metallurgist day'2004, organised by Indian Institute of Metals.

42. "End Point Control in BOF Steelmaking at Durgapur Steel Plant",presented in National Metallurgist Day'2003,Kolkata,organised by Indian Institute of Metals.

43. "Stabilisation of Six Hole Lance in BOF Shop at Durgapur Steel Plant ", presented in National Metallurgist day'2002,Baroda,organised by Indian Institute of Metals.

(AWARDED FIRST IN FERROUS CATEGORY)

(<https://mme.iitm.ac.in/shukla/Stabilisation%20of%20Six%20Hole%20Lance%20in%20BOF%20Shop%20at%20Durgapur%20Steel%20Plant.pdf>

DETAILS OF SPONSERED/CONSULTANCY PROJECTS

S. No.	Title	Duration	Funding Agency	Cost (in INR)
1.	Studies on kinetics of scrap dissolution and effect of other parameters on dynamic control of steelmaking process	2009-2011 (completed)	DST-DAAD (visited Institute of Iron and Steel Technology, Technical University Bergakademie, Freiberg, Germany)	2,00,000
2.	Microwave assisted reduction of metal oxides: An innovative approach for production of iron and steel	2013-2017 (completed)	IIT Madras faculty seed grant	19,00,000

3.	Development of static and dynamic control for BOF process	2014-2017 (completed)	JSW Steel Limited	2,00,000
4.	Mathematical modeling of RH steelmaking process for IF steel production	2014-2017 (completed)	JSW Steel Limited	2,00,000
5.	Data based modeling approach to control Hot Metal Desulphurization (HMDS) at JSW	2014-2017 (completed)	JSW Steel Limited	2,00,000
6.	JSW-IITM Center for applied Research (JICAR) (First project on 'Dry slag granulation process for energy recovery and to produce cement clinker' is underway)	2015-2020 (I am Co-PI in this Center)	JSW Steel Limited	50,00,000
7	Dry slag granulation process for energy recovery and cement clinker production	2016-2020 (I am Co-PI in this project)	Ministry of Steel, Govt. of India	1,60,00,000
8.	Microwave assisted beneficiation of ironore/coal fines: An Innovative approach of steelmaking	2018-2022 (I am PI in this project.	Ministry of Human Resource/JSW Steel Plant/NMDC Limited/IIT Kanpur	3,31,00,000
9.	Development of new dephosphorisation model for primary steel making	2018-2020 (I am PI in this project; German Investigator: Prof. Olena Volkova, Director, Iron and Steel Institute, TU Freiberg, Germany	DST-DAAD Project Based Personal Exchange Program (PPP) -2017; with Institute of Iron and Steel Technology, Technical University Bergakademie, Freiberg, Germany)	7,00,000
10	Estimation of physical properties of slag and investigation of slag morphology during solidification and development of mathematical model to	2019-2021 (I am PI in this project; German Investigator: Prof. Olena Volkova, Director, Iron and Steel Institute,	DST-DAAD Project Based Personal Exchange Program (PPP) -2018; with Institute of Iron and Steel Technology, Technical University	7,00,000

	estimate heat transfer coefficient in continuous casting molds	TU Freiberg, Germany	Bergakademie, Freiberg, Germany)	
11	Center for Pyrometallurgy-IoE	2021-2026	Ministry of Education/IIT Madras	35,00,000- as seed grant, Target to develop it to bigger scale by industry support.
12	Green steelmaking by hydrogen assisted reduction of iron oxide	2023-2026	DST-SERB	27,00,000

COURSES TAUGHT

1. Iron and Steelmaking (UG Course, taught in 2012-13-II, 2013-14-II, 2014-15-II, 2015-16-II, 2017-18-II, 2018-19-II, 2019-20-II and 2020-21-II semester, Class strength 50-60).
2. Principles of Extractive Metallurgy (UG Course, taught in 2012-13-II, 2013-14-II, 2015-16-II, 2017-18-I, 2018-19-I, 2019-20-I, 2020-21-I, 2021-22-I and 2022-23-I semester, Class strength 50-75).
3. Advanced Metallurgical Thermodynamics (PG Course, taught in 2013-14-I, 2014-15-I, 2015-16-I and 2016-17-I semester Class strength 15-35).
4. Metallurgical Plant Design (PG Course, taught in 2014-15-I semester, 2015-16-I, 2016-17-I and 2017-18-I semester, Class strength 25-45).
5. Special Topics in Iron and Steelmaking (PG Course, taught in 2016-17-I semester and 2016-17-II semester, Class strength 15-20).
6. Hydrogen Assisted Green Steelmaking (PG Course, taught in 2012-23-II semester)

STUDENT GUIDANCE

M.Tech: Completed 14 (out of which 3 worked under DAAD sandwich with RWTH Aachen), Ongoing: 01
MS: Completed: 02;
Ph.D: Completed: 02; Ongoing: 04 (2 students as participants in Indo-German (DST-DAAD) projects, One under JDP with Swinburne University

The topics of student projects are as follows:

1. Expert model of BOF Steelmaking Process
2. Physical and Mathematical Modeling of RH Degassing Process
3. Physical and Mathematical Modeling of Dry Slag Granulation Process
4. Data Based Modeling Approach to Control Iron and Steelmaking Process
5. Optimization of Steel Plant Supply Chain using Innovative AI techniques

6. Mathematical Modeling of COREX Iron-making Process and its Industrial Validation
7. Heat Transfer and Fluid Flow Modeling of Twin-Roll Casting Process
8. Mathematical Modeling of MIDREX Iron-making Process and its Industrial Validation
9. Microwave assisted beneficiation of lean quality iron ores
10. Modeling of pulverized coal injection in modern blast furnace.
11. Green Steelmaking-Hydrogen based reduction process
12. Modeling of Ferro-Chrome reactor
13. Sustainable Production of Ferro Alloys
14. Application of AI/ML for steel industry process control
15. Recovery of zinc from ausmelt slag

CONFERENCE/FOREIGN VISITS/INVITED SEMINARS

Conference:

1. National Metallurgist day and Annual Technical Meeting , Nov 2002 ,Baroda ,India.
2. Asia Steel Seminar, April 2003 ,Jamshedpur ,India .
3. National Metallurgist day and Annual Technical Meeting ,Nov 2003 ,Kolkata ,India
4. International Symposium for Research Scholars 2006 on Metallurgy, Materials Science & Engineering , organised by IIT Chennai , India .
5. International Conference on Science and Technology of Iron and Steelmaking, Gifu Japan,2008.
6. SANO Symposium, University of Tokyo, 2008.
7. International Conference on the 'Advances in Theory of Ironmaking and Steelmaking', Bangalore, India, 2009.
8. National Metallurgist day and Annual Technical Meeting , Nov 2012 ,Jamshedpur , India.
9. National Metallurgist day and Annual Technical Meeting , Nov 2013 ,IIT Varanasi, India.
10. International Conference on Science and Technology of Steelmaking (STIS 2013), Dec 2013, NML Jamshedpur, India.
11. TMS Annual Technical Meeting, Feb 2014, San-Diego, USA.
12. National Metallurgist day and Annual Technical Meeting , Nov 2015 , Coimbatore, India.
13. High Temperature Conference (HTTP 16), Feb 2016, Swinburn University of Technology, Australia.
14. National Metallurgist day and Annual Technical Meeting , Nov 2016 , IIT Kanpur, India.
15. International Conference on Science and Technology of Steelmaking (STIS 2017), Dec 2017, IIT Kanpur, India.
16. AISTech (American Iron and Steel Technology) 2019 conference at Pittsburgh.

Foreign visits:

1. University of Tokyo, October 2008 to attend SANO symposium (also visited the International Conference on Science and Technology of Steelmaking held at Gifu, Japan). Total visit was for ten days.
2. Visited Institute of Iron and Steel Technology, Technical University Bergakademie,

Freiberg, Germany (from October-December 2009) as a participant of DST-DAAD-PPP project.

3. Visited RWTH Aachen University on DAAD fellowship during Feb 2014 and as a visiting faculty during July 2015.

4. Visited San-Diego to attend TMS Annual Technical Meeting during Feb 2014.

5. Visited Swinburn University Australia during Feb 2016.

6. Visiting Professor, Iron and Steel Institute, TU Bergakademie, Freiberg, Germany during January 2017.

7. Visited RWTH Aachen University under Research Mission program under IITM - RWTH IGP during April 2018.

8. Visiting Professor, Iron and Steel Institute, TU Bergakademie, Freiberg, Germany during December 2018 under Indo-German Exchange (DST-DAAD) program.

9. Visited Pittsburgh, USA to attend AISTech-2019 conference during May 2019.

Invited seminar:

1. Invited to deliver a presentation on modeling of BOF steelmaking process at National Metallurgical Laboratory, Jamshedpur on December 2, 2011.

2. Invited to deliver a presentation on automation control and data based modeling of steelmaking process at ABB Bangalore on May 7, 2011.

3. Invited talks at JSW Steel limited about process control on BOF steelmaking during July 2013.

4. Invited talk at JSW Steel on flow sheet modeling approach of iron and steelmaking processes during December 2014.

5. Invited talk at NMDC R&D on microwave assisted reduction of iron-ore and coal fine mix to produce iron at cheaper cost during February 2014.

6. Invited talk at JSW Steel limited on post combustion control of BOF steelmaking during January 2015.

7. Invited talk at JSPL Raigarh on mathematical model based control of iron and steelmaking processes during April 2015.

8. Invited talk at SAIL-RDCIS Ranchi on quantitative approaches in iron and steelmaking during May 2015.

9. Invited talk at NML Jamshedpur on Flow-sheet based modeling approaches applied to ferrous/non-ferrous extraction during May 2015.

10. Invited talk at Gerdau Steel Plant, Tadipatri on control of Oxygen steelmaking process during June 2018.

WORKHOPS ORGANISED

1. Three-Days workshop on Steelmaking for practicing engineers and scientists organized at JSW Steel Limited, Bellary, India during August 2015.

2. Two days' workshop on Copper Extraction by Pyrometallurgy Route for Practicing Engineers and Scientists organized at Sterlite Copper Ltd. Tutikorin, India (in ten batches covering approx.. 150 participants) during 2016-2017.

3. A number of courses are organized under GIAN Scheme of Govt. of India in the area of Metal Extraction and Steelmaking during September-December 2016 (<https://mme.iitm.ac.in/shukla/Gian%20courses.pdf>).

PROFESSIONAL SERVICE/MEMBERSHIP

1. **Life Member**, Indian Institute of Metals

2. **Member**, AISTech-American Iron and Steel Technology

2. Reviewer for journals: Metallurgical Transactions B, Journal of Sustainable Metallurgy, Transactions-Indian Institute of Metals

EXTRA-CURRICULAR

1. NCC cadet during B.Tech studies, participated in rock-climbing and trekking.
2. Member of IIT SBRA Hostel Executive Committee during Ph.D studies.
3. BOD member, Alumni Association, IIT Kanpur (2013-2018)

REFERENCES

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