

# Curriculum vitae



## Personal Details

**Name** Dr Madhusudan Sau

**Designation** Professor of Practice

**DOB** August 27, 1964

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## Educational Qualifications

**PhD**, University of Akron, **Akron, OHIO, USA** (2003), CGPA: 3.8/4.0

**MTech** in Chemical Engineering, **IIT Kanpur, India** (1992), CPI: 9.0/10

**BTech** in Chemical Engineering, **University of Calcutta, India** (1990), 77.8%

## Work Experiences

**October 1992 to August 2024** **Indian Oil Corporation Limited**  
Research & Development Centre  
Last Designation - **Executive Director**

**March 1992 to October 1992** Tata Energy Research Institute, New Delhi, India  
**Position - Research Associate**

## **Experience at Indian Oil Corporation:**

1. **Setting up Cutting Edge Research facilities** in the area of Refining on Processes, Catalysts & proprietary Hardware.
2. Development of **new Processes & Products** (catalysts/adsorbents) in refining domain while addressing **net zero and sustainability**.
3. Scale-up of Processes & Products from Lab to demo/commercial level and **commercial deployment with adequate IP protection** and Collaborations for faster development & deployment
4. **Simulation Studies** using steady state simulators, Technical Services support to Refinery for trouble -shoot and process Optimization.
5. **Research Guidance to more than 70 Engineers/Scientists** (MTech/ PhD) in conventional refining areas of processes (Hydroprocessing, catalytic cracking, light and Heavy end processing), catalysts and upcoming futuristic areas (like bio-refining, green hydrogen, sustainable aviation fuels, waste plastics valorization, etc).
6. Experienced in **National & International collaboration** with academics (IITS), CSIR Labs (IIP, CRR), Oil industry (OIDB), Engg companies (EIL, L&T), MNCs like Shell, Lummus, Axens, etc
7. Have experienced in Technology transferred made to several national and international companies.
8. Spearheaded Commercialization of **20 Process and Product Technologies** in the domain of Refining and Petrochemicals.

**August 1999 to  
April 2003**

Pursued PhD on study leave from "Indian Oil Corporation Limited" at  
**University of Akron, Akron OHIO, USA**

## **Technology Development & Deployment**

Major contributions are Development, Scale-up and Commercialization of several processes and products. Spearheaded research and commercialization of Process technology for ultra low sulphur diesel, Catalysts (in the area of hydroprocessing and FCC), Needle coke production using refinery streams, Gasoline technologies, Eco-friendly process for conversion of waste plastics to fuel & bouquet of hydroprocessing technologies for BS-VI and value added product (Food and Polymer grade Hexane, Naphtha, Kero hydrotreating, etc.), Process optimization of refinery process units to improve middle distillates yield and GRM improvement.

Number of innovative technologies (products or processes) developed and Commercially implemented: 11 (Process – 7, Product – 4)

and under commercial implementation: 9 (Process – 7, Product – 2)

## **Areas of Interest**

1. Petroleum Refining
2. Sustainable process and Bio-Refining
3. Reaction Kinetics
4. Fluid Mechanics
5. Process Modelling & Simulations
6. Scale-up and Commercialization

## **Publication in Journals**

1. "Enhancing Hydrogen and Propylene yields by integration of HGU & OPDH processes", D Hima Bindu, Vineeth V Nath, Bidyut De, G Saidulu, Reshmi Manna, Sarvesh Kumar, Madhusudan Sau, Centre for High Technology, Oil & Gas Technical Journal, 2nd Edition, May 2023
2. "Study of thermal cracking kinetics and co-processing of bio-crude in thermal residual up-gradation unit for converting waste to energy", Jitumoni B, Shivam A Dixit, Pradeep PR, Ravindra Kumar, SK Das, J Christopher, Madhusudan Sau, GS Kapur, SSV Ramakumar, *Journal of Thermal Analysis and Calorimetry*, pages 1-18 (2023/2/14).
3. "Eulerian simulations of liquid distribution generated by Chimney and Bubble cap distributors" Ekta Jain, Madhusudan Sau, Vivek V. Buwa, *Chemical Engineering Journal*, 421, Part-2, 127799 (2021).
4. "Deactivation of a hydrotreating catalyst during hydroprocessing of synthetic crude by metal bearing compounds", K Kohli, R Prajapati, Samir K. Maity, M Sau, Brajendra K. Sharma, *Fuel*, 243, 579-589 (2019).
5. "A carbon-number lump based model for simulation of industrial hydrotreaters: Vacuum gas oil (VGO)", KB Srinivas, KK Pant, SK Gupta, DN Saraf, IR Choudhury and M Sau, *Chemical Engineering Journal*, 358, 504-519 (2019).
6. "Accelerated pre-coking of NiMo/ $\gamma$ -Al<sub>2</sub>O<sub>3</sub> catalyst: Effect on hydroprocessing activity of vacuum residue", KKohli, R Prajapati, S K Maity, M Sau, Brajendra K. Sharma, *Fuel*, 235, 437-447 (2019).
7. "Evaluation of residue hydrotreating catalysts supported on mesoporous aluminas", Kirtika Kohli, Samir K. Maity, Ravindra Prajapati, Madhusudan Sau, Madhukar O. Garg, *Current Catalysis*, Vol 6, Issue 3, 1-9 (2017).
8. "A molecular lump based model for simulation of industrial naphtha hydrotreaters", BK Srinivas, KK Pant, SK Gupta, DN Saraf, IR Choudhury, M Sau, *Fuel Processing Technology*, 166, 146-163 (2017).

9. "Deactivation of hydrotreating catalyst by metals in resin and asphaltene parts of heavy oil and residues", K Kohli, R Prajapati, S KMaity, M Sau, M O Garg, *Fuel*, 175, 264-273 (2016).
10. "Synthesis and characterization of Ni-Mo catalyst using *Jatropha curcas* leaves as carbon support and its catalytic activity for hydrotreating of gas oil, *Jatropha* oil, and their blends", M. Rajesh, M. Sau, R. K. Malhotra & D. K. Sharma, *Petroleum Science and Technology*, Vol 34, No 3, 240-246, (2016).
11. "Synthesis and characterization of Ni-Mo catalyst using pea pod (*Pisum sativum* L) as carbon support and its hydrotreating potential for gas oil, *Jatropha* oil, and their blends", M. Rajesh, M. Sau, R. K. Malhotra & D. K. Sharma, *Petroleum Science and Technology*, Vol 34, No 4, 394-400 (2016).
12. "Hydrotreating of Gas Oil, *Jatropha* Oil, and Their Blends Using a Carbon Supported Cobalt Molybdenum Catalyst", M. Rajesh, M. Sau, R. K. Malhotra & D. K. Sharma, *Petroleum Science and Technology*, Vol 33, No 19, 1653-1659 (2015).
13. "Mesoporous alumina supported NiMo catalysts for residue conversion" Kirtika Kohli, Ravindra Prajapati, Madhusudan Sau, Samir K. Maity, *Procedia Earth & Planetary Science*, 11, 325-331 (2015).
14. "Hydrocracker Performance Optimization and Catalyst Remaining Life Assessment: Methodology and case studies", K Basak, M Sau, U Manna and R P Verma, *Petroleum Science and Technology*, Vol 25, 1199-1213 (2007).
15. "Effect of Organic Nitrogen Compounds on Hydrotreating & Hydrocracking Reactions", Madhusudan Sau, Kaushik Basak, Ujjwal Manna, Manoranjan Santra and Ram Prakash Verma, *Catalysis Today J.*, Vol. 109, 112-119 (2005).
16. "Industrial hydrocracker model based on novel continuum lumping approach for optimization in petroleum refinery", Kaushik Basak, Madhusudan Sau, Ujjwal Manna and Ram Prakash Verma, *Catalysis Today J.*, Vol. 98(1-2), pp 253-264 (2004).
17. "Effect of waveforms on morphology development in chaotic mixing of polymers", Madhusudan Sau and Sadhan C. Jana, *AIChE J*, 50(10), 2346-2358 (2004).
18. "Effects of viscosity ratio and composition on development of morphology in chaotic mixing of polymers", Sadhan C. Jana and Madhusudan Sau, *Polymer*, 45(5), 1665-1678 (2004).
19. "A study on the effects of chaotic mixer design and operating conditions on morphology development in immiscible polymer systems", Madhusudan Sau and Sadhan C. Jana, *Polym. Eng. Sci.*, 44 (3), 407-422 (2004).
20. "Modelling of a semibatch polypropylene slurry reactor", M. Sau, Santosh K. Gupta, *Polymer*, 34, No. 21 (1993).

## **Patents**

**Total Innovation: 74** in Processes, Catalysts and Hardware in the area of Refining and Petrochemicals.

Patents were filed in Indian and several foreign jurisdictions.

Number of national Patents Granted:

- a. Innovation for which Indian Patent Granted & some of them got granted in foreign countries: **52**
- b. Innovation for which Indian Patent Filed & some of them got granted in foreign countries: **22**

Innovation (Patent Granted and or Filed) demonstrated (in Pilot plant unit/ Commercial unit) and commercialized: 25

## **Patents Granted In India and Foreign Geographies**

1. Production of Linear Alpha Olefins, India Patent No 466111, Application 28-Sep-20, Grant 06-Nov-23; USA Patent No 11548841, Grant 10-Jan-23; Filed in Japan (2021-157270), Europe (EP 21198224.4), Saudi Arabia (121430174).
2. A Process and Apparatus for Conversion of Waste Plastics Pyrolysis Oil into Valuable Products, India Patent No 504109, Application 05-Aug-21, Grant 29-Jan-24; USA Patent No 11859132, Grant 02-Jan-24; Filed in Europe (EP 22188649.2).
3. Pre-Treatment Process for Conversion of Residual Oils in a Delayed Coker Unit, India Patent No 437206, Application 29-Jun-21, Grant 04-Jul-23; USA Patent No 11661556, Grant 30-May-23; Filed in Europe (EP 22179787.1), Brazil (BR 102022012193-1).
4. Process for Isomerization of C5-C7 Hydrocarbons in Light Naphtha Range, India Patent No 433012, Application 19-May-21, Grant 26-May-23; Russia Patent No 2801944, Grant 21-Aug-23; Filed in USA (US 17/663530), Europe (EP 22173428.8).
5. An Additive for Preventing Fouling of Thermal Cracker Furnace, India Patent No 445784, Application 02-Apr-21, Grant 18-Aug-23; USA Patent No 11591530, Grant 28-Feb-23; Saudi Arabia Patent No 14258, Grant 27-Nov-23; Filed in Europe (EP 22166259.6); Kuwait (KW-P-2022-000314), Oman (OM/P/2022/00158).
6. A Process for Enhancement of RON of FCC Gasoline with Simultaneous Reduction in Benzene, India Patent No 437060, Application 25-Mar-21, Grant 04-Jul-23; USA Patent No 11732200, Grant 22-Aug-23; Filed in Europe (EP 22162106.3), Saudi Arabia (122430833).

7. Simultaneous Processing of Catalytic and Thermally Cracked Middle Distillate for Petrochemical Feedstock, India Patent No 411475, Application 05-Nov-20, Grant 15-Nov-22; USA Patent No 11578277, Grant 14-Feb-23; Filed in Europe (EP 21205923.2), Saudi Arabia (121430304).
8. A Process and a System for Production of Multiple Grade De-Aromatized Solvent from Hydrocarbon Streams, India Patent No 507334, Application 21-Sep-20, Grant 06-Feb-24; Saudi Arabia Patent No 14765, Grant 18-Jan-24; Filed in USA (US 17/481077), Europe (EP 21197873.97), Philippines (1-2021-050465), Egypt (1480/2021).
9. A Process for Production of Needle Coke, India Patent No 410984, Application 18-Sep-20, Grant 04-Nov-22; USA Patent No 11788013, Grant 17-Oct-23; Filed in Europe (EP 21196889.6), Saudi Arabia (121430152), UAE (P6001654/2021), Kuwait (KW/P/2021/373), Oman OM/P/2021/ 000372.
10. An Integrated Oxidative Alkane Dehydrogenation and Hydrogen Generation Process, India Patent No 434316, Application 17-Sep-20, Grant 09-Jun-23; USA Patent No 11548839, Grant 10-Jan-23; Russia Patent No 2773213, Grant 31-May-22; S Africa Patent No 2021/06756, Grant 31-Aug-22; Filed in Saudi Arabia (121430140), UAE (P6001634/2021).
11. Fluidized Bed Dehydrogenation Process for Light Olefin Production, Indian Patent No 452158, Application 16-Sep-20, Grant 15-Sep-23; USA Patent No 11873276, Grant 16-Jan-24; Russia Patent No 2790056, Grant 14-Feb-23; S Africa Patent No 2021/06599, Grant 31-Aug-22; Filed in Saudi Arabia (121430141), UAE (P6001620/2021).
12. Process for Preparing a Hydrotreating Catalyst Composition for Producing Ultra Low Sulfur Diesel, India Patent No 436215, Application 09-Sep-20, Grant 28-Jun-23; USA Patent No US 11612884, Grant 28-Mar-23; Russia Patent No 2773151, Grant 31-May-22; Saudi Arabia Patent no 14641, Grant 04-Jan-24; Filed in Europe (EP 21194252.9), UAE (P6001516/2021), Qatar QA/202108/000469.
13. Process for Production of Graphite Coke from an Admixture of Coal and Petroleum based Hydrocarbons, India Patent No 448106, Application 05-Aug-20, Grant 29-Aug-23; USA Patent No 11643607, Grant 09-May-23; Saudi Arabia Patent No 14216, Grant 21-Nov-23; Filed in Europe (EP 21189084.3), UAE (P6001341/2021), Oman (OM/P/2021/00304).
14. Process for Co-conversion of Waste Plastics and Hydrocarbon Feedstock, India Patent No 406041, Application 05-Aug-20, Grant 07-Sep-22; USA Patent No 11421162, Grant 23-Aug-22; Japan Patent No 7289879, Grant 02-Jun-23, Saudi Arabia Patent No 13170, Grant 27-Jun-23; Filed in Europe (EP 21189080.1).
15. Quench-box Assembly for Hydroprocessing Reactors, India Patent No 499135, Application 04-Jul-20, Grant 15-Jan-24; USA Patent No 11498038, Grant 15-Nov-22; Nigeria Patent No 7910, Grant 12-Aug-21; Filed in Europe (EP 21180472.9).

16. Aqueous Dispersion of CNT using Chemical Admixture and its Application in Cementitious Materials, India Patent No 437424, Application 17-Apr-20, Grant 05-Jul-23.
17. Process for Removal of Sulfur and Other Impurities from Olefinic LPG, India Patent No 411466, Application 18-Mar-20, Grant 15-Nov-22; USA Patent No 11739277, Grant 29-Aug-23; Filed in Europe (EP 21163041.3), Saudi Arabia (121420571), UAE (P6000378/2021), Kuwait (KW/P/2021/00078).
18. Process for Preparation for Highly Coordinated Sulfated Metal Oxide Catalyst having High Crushing Strength, India Patent No 516926, Application 19-Feb-20, Grant 28-Feb-24; USA Patent No 11731121, Grant 22-Aug-23; Russia Patent No 2780726, Grant 29-Sep-22; Filed in Europe (EP21157936.2).
19. Process for Production of MARPOL Compliant Bunker Fuel from Petroleum Residues, India Patent No 410668, Application 07-Feb-20, Grant 01-Nov-22; USA Patent No 11345866, Grant 31-May-22; Filed in Singapore (SG 10202101327W), Sri Lanka (LK/P/21584).
20. A Catalyst Composition for Oxidative Dehydrogenation of Alkane, India Patent No 456207, Application 02-Jan-20, Grant 03-Oct-23; USA Patent No 11642656, Grant 09-May-23; S Africa Patent No 2021/00010, Grant 27-Oct-21; Filed Europe (EP 20217347.2), Russia (2020143898), Saudi Arabia (121420337), Qatar (QA/202101/000692), UAE (P6000001/2021).
21. Apparatus for Dehydrogenation of Alkanes, India Patent no 394932, Application 27-Nov-19, Grant 19-Apr-22; Russia Patent No 2771816, Grant 12-May-22; S Africa Patent No 2020/06004, Grant 25-Aug-21; Filed in Saudi Arabia (120420099), UAE (P6001372/2020), Kuwait (KW/P/2020/000319), Qatar (QA/202009/000507).
22. A Process for Producing Hydrogen and Light Olefins from Resid Fluid Catalytic Cracking, India Patent No 426047, Application 11-Nov-19, Grant 21-Mar-23; Saudi Arabia Patent No 13791, Grant 02-Oct-23; S Africa Patent No ZA 2020/06924, Grant 29-Sep-21; Filed in USA (US 17/094966), Europe (EP 20206377.2), UAE (P6001554/2020), Kuwait (KW/P/2020/000373), Oman (OM/P/ 2020/ 000434).
23. An Apparatus and a Method for Washing of Hydrocarbon Product Vapour, India Patent No 436176, Application 07-Nov-19, Grant 28-Jun-23; USA Patent No 11345862, Grant 31-May-22; Filed in Europe (EP 20187713.1), Saudi Arabia (120420023).
24. Fluid Catalytic Cracking Additive Composition for Enhancing Gasoline Octane Barrel and Process of Preparation Thereof, India Patent No 396897, Application 04-Oct-19, Grant 13-May-22; USA Patent No 11465132, Grant 11-Oct-22; Russia Patent No 2754146, Grant 30-Aug-21; Filed in Europe (EP 20197133.0).
25. Process & Apparatus for Co-conversion of Waste Plastics in Delayed Coker Unit, India Patent No 434570, Application 23-Sep-19, Grant 14-Jun-23; USA Patent No 11421159, Grant 23-Aug-22; Japan Patent No 7079297, Grant 24-May-22; China Patent No ZL

202010868490.2, Grant 21-Oct-22; Saudi Arabia Patent No 13662, Grant 06-Sep-23; Filed in Europe (EP 20190674.0).

26. Delayed Coking Furnace for Heating Coker Feedstock, India Patent No 425794, Application 12-Jun-19, Grant 20-Mar-23; USA Patent No 11149207, Grant 19-Oct-21; Europe (Germany & Great Britain) Patent No 3750974, Grant 23-Aug-23; Filed Saudi Arabia (120410753).
27. Inlet Diffuser for Fixed-Bed Reactors, India Patent No 472580, Application 03-Jun-19, Grant 23-Nov-23; USA Patent No 11141707, Grant 21-Oct-21; Europe (France, Netherlands, Denmark, Italy) Patent No 3747536, Grant 22-Feb-23; Nigeria Patent No 6223, Grant 01-Apr-21.
28. A Process for Conversion of Fuel Grade Coke to Anode Grade Coke, India Patent No 368737, Application 27-May-19, Grant 07-Jun-21; USA Patent No 10941346, Grant 09-Mar-21; Saudi Arabia Patent No 11222 , Grant 02-Nov-22; S Africa Patent No 2020/02356, Grant 25-Aug-21; Filed in Europe (EP20171342.7), UAE (P6000598/2020), Oman (OM/P/2020/00215).
29. Process for Production of Petrochemical Feedstock and High Octane Gasoline from Middle Distillates, India Patent No 384422, Application 27-May-19, Grant 15-Dec-21; USA Patent No 11001771, Grant 11-May-21; Saudi Arabia Patent No 12241, Grant 06-Feb-23; Filed in Europe (EP 20169546.7).
30. Process for production of Anisotropic Coke, India Patent No 365253, Application 09-Apr-19, Grant 23-Apr-21; USA Patent No 10934494, Grant 02-Mar-21; Europe (Germany, Italy) Patent No 3722392, Grant 01-Sep-21; Saudi Arabia Patent No 12624, Grant 06-Mar-23; S Africa Patent No ZA 2020/ 00573, Grant 28-Jul-21; Nigeria Patent No 6197, Grant 01-Apr-21; Filed in UAE (P6000271/2020), Oman (OM/P/2020/00048).
31. Process Intensification in Hydroprocessing (Divisional Application), USA Patent No 10604708, Grant 31-Mar-20.
32. Co-Solubilization Process for Preparing Modified Bitumen and Product Obtained Thereof, India Patent No 354649, Application 19-Dec-18, Grant 29-Dec-20; Australia Patent No 2019283783, Grant 18-Feb-21.
33. Process for Selective Production of Light Olefins and Aromatics from Cracked Light Naphtha, India Patent No 356757, Application 06-Sep-18, Grant 27-Jan-21; USA patent No 11274257, Grant 15-Mar-22; Saudi Arabia Patent No 10308, Grant 03-Jul-22; Filed in Europe (EP 19194870.2).
34. Method of Making Hydrocarbon Soluble Metal Compositions, India Patent No 360429, Application 16-Jun-18, Grant 05-Mar-21; USA Patent No 11453600, Grant 27-Sep-22; Europe (Germany, Italy) Patent No 3581635, Grant 03-Aug-22; Saudi Arabia Patent No 10025, Grant 17-May-22, Nigeria Patent No NG/PT/C/2019/3770, Grant 26-Nov-19.

35. Delayed Coking Process with Pre-cracking Reactor (Patent of Addition), India Patent No 392254, Application 26-Mar-18, Grant 17-Mar-22; USA Patent No 10808177, Grant 20-Oct-20; Filed UAE (P6000435/2018).
36. Composition and Process Thereof for Catalyst for Hydro-Conversion of LCO Involving Partial Ring opening of Poly-Aromatics, India Patent No 404495, Application 12-Mar-18, Grant 25-Aug-22; USA Patent No 10843177, Grant 24-Nov-20; Saudi Arabia Patent No 10309, Grant 03-Jul-22; Filed in Europe (EP 19162359.4).
37. Catalyst Additive Composition for Reduction of Sulfur in Gasoline, India Patent No 356535, Application 09-Mar-18, Grant 22-Jan-21; USA Patent No 10787613, Grant 29-Sep-20.
38. Process for Production of Petrochemicals from Cracked Streams, India Patent No 406856, Application 09-Mar-18, Grant 16-Sep-22; USA Patent No 10822557, Grant 03-Nov-20; Europe (France, Netherlands, Denmark, Belgium) Patent No 3536765, Grant 31-Aug-22; Saudi Arabia Patent No 10198, Grant 15-Jun-22; Nigeria Patent No 10349, Grant 03-Jul-19; Filed in Egypt 381/2019.
39. A Process for Hydrotreating of Diesel Range Hydrocarbons/ Assorted Co-Staging and Counter Staging in Hydrotreating, India Patent No 405997, Application 07-Mar-18, Grant 07-Sep-22; USA Patent No 10655076, Grant 19-May-20; Europe (France, Netherlands, Denmark, Belgium) Patent No 3536764, Grant 01-Sep-21; Saudi Arabia Patent No 10310, Grant 03-Jul-22; Nigeria Patent No 10434, grant 05-Aug-19; Egypt Patent No 30726, Grant 28-Mar-22.
40. Apparatus for Gas-Liquid Distribution in Hydroprocessing Reactors/ Distribution of a Multi Phase Fluid Mixture, India Patent No 431992, Application 23-Feb-18, Grant 17-May-23; USA Patent No 10900507, Grant 26-Jan-21; Europe (France, Netherlands, Denmark, Belgium) Patent No 3530349, Grant 10-Jan-24; Saudi Arabia Patent No 9008, Grant 06-Dec-21; Nigeria Patent No 10445, Grant 05-Aug-19.
41. 01-Sep-21; Saudi Arabia Patent No 10310, Grant 03-Jul-22; Nigeria Patent No 10434, grant 05-Aug-19; Egypt Patent No 30726, Grant 28-Mar-22.
42. Reactor System for Upgrading Heavy Hydro-Carbonaceous Material, India Patent No 350324, Application 29-Sep-17, Grant 28-Oct-20; USA Patent No 10647930, Grant 12-May-20; Europe (France, Netherlands, Demark, Italy) Patent No 3461876, Grant 12-Aug-20.
43. Vacuum Resid Upgradation and Graphite Production, India Patent No 305271, Application 09-Nov-15, Grant 02-Jan-19; USA Patent No 10201810, Grant 12-Feb-19.
44. Catalyst and Process for Conversion of Vacuum Resid to Middle Distillates, India Patent No 343124, Application 26-Aug-15, Grant 03-Aug-20; USA Patent No 10760014, Grant 01-Sep-20; Europe (France, Netherlands, Italy) Patent No 3135749, Grant 06-Jun-18.
45. Integrated Process For Production Of High Octane Gasoline, High Aromatic Naphtha And High Cetane Diesel From High Aromatic Middle Distillate Range Streams, India Patent

No 333480, Application 24-Mar-14, Grant 28-Feb-20; USA Patent No 9644155, Grant 09-May-17.

46. Method for Preparing Hydrotreating Catalyst from Biomass, India Patent No 426159, Application 20-Mar-14, Grant 22-Mar-23.
47. Process Intensification in Hydroprocessing, India Patent No 309876, Application 25-Jun-13, Grant 25-Mar-19; USA Patent No 10017703, Grant 10-Jul-18.
48. Hydrotreating Catalyst, Process for Preparing the Same and Use Thereof, India patent No 313703, Application 07-Dec-12, Grant 03-Jun-19.
49. Process for Quality Enhancement in Hydrocarbon Stream, India Patent No 316195, Application 31-Aug-12, Grant 17-Jul-19; USA Patent No 10443002, Grant 15-Oct-19.
50. Reactor Assembly for improving reaction between two immiscible phases for metal reduction of hydrocarbons, India Patent No 295884, Application 12-Oct-11, Grant 18-Apr-18.
51. A Process for Metal Reduction of Hydrocarbon Oil, India Patent No 296312, Application 12-Oct-11, Grant 27-Apr-18; USA Patent No 10047300, Grant 14-Aug-18.
52. A method for the preparation of Hydrotreating Catalyst, India Patent No 263574, Application 20-Dec-07, Grant 31-Oct-14.

### **Patents Filed in India and foreign Geographies**

1. Process for Selective Conversion of Olefins and Simultaneous Removal of Impurities from Hydrocarbon Feedstocks, India Patent Application No 2024 21014011, 27-Feb-24.
2. A Process for Synergistic Co-conversion of Used Oils to Value Added Products, India Patent Application No 2024 21009311, 12-Feb-24.
3. A Process for Conversion of Waste Tyre Oil to Chemicals, India Patent Application No 2024 21008661, 08-Feb-24.
4. Process and System for Enhancing Petrochemicals, India Patent Application No 2024 21004157, 20-Jan-24.
5. A Catalyst for Hydrogenation of Unsaturated Hydrocarbons and Method for Preparation Thereof, India Patent Application No 2023 21062858, 19-Sep-23.
6. Hydroprocessing Process in Integrated Staging Reaction Vessel, India Patent Application No 2023 21049370, 21-Jul-23.
7. Integrated Staging Hydroprocessing Reaction Vessel, India Patent Application No 2023 21049445, 21-Jul-23

8. Method and Apparatus for Separation of Reusable Low Coke Content Catalyst from Heeled Catalyst of Continuous Catalytic Reforming Unit, India Patent Application No 2023 21022687, 28-Mar-23.
9. A Process and a System for Enhancing the Yield of Light Olefins, India Patent Application No 2023 21021238, 24-Mar-23; Filed in USA (US 18/614527), Russia (2024107100), Japan (2024-047662).
10. Preheating Process Module Integrated with Coke Handling System for Steam Cracking of Hydrocracking Feedstocks, India Patent Application No 2023 21014174, 02-Mar-23; Filed in USA (US 18/593824), Europe (EP 24161031.0).
11. A Process for Production of Needle Coke and Aromatics, India Patent Application No 2022 21070151, 05-Dec-22; Filed in USA (US 18/530039), Europe (EP 23213944.4), Saudi Arabia (123450969).
12. Integrated Process for Production of Chemicals from Crude Oil Using Slurry Hydrocracking, India Patent Application No 2022 21069702, 02-Dec-22; Filed in USA (US 18/526544).
13. A Process for In-Situ Regeneration of Spent Ion Exchange Resin Catalyst, India Patent Application No 2022 21062896, 03-Nov-22; Filed in USA (US 18/524086), Saudi Arabia (SA 123450922).
14. Process and Catalyst System for Conversion of C6 Aromatics to Higher Aromatics, India Patent Application No 2022 21022314, 14-Apr-22; Filed in USA (US 18/133953).
15. Production of High Yields of Light Olefins from Heavy Hydrocarbons, India Patent Application No 2022 21009125, 21-Feb-22; Granted in USA Patent No 11891356, Grant 06-Jan-24; Filed in Europe (EP 23156509.4), Saudi Arabia (123441262), Russia (2023103327), Thailand (2301000892), Kuwait (KW/P/2023/000649).
16. An Integrated Process for Converting Crude Oil to High Value Petrochemicals, India Patent Application No 2022 21003413, 20-Jan-22; Granted in USA Patent No 11840672, Grant 12-Dec-23.
17. Production of Low Benzene Content De-Aromatized Distillates for Speciality Application, India Patent Application No 2021 21059197, 18-Dec-21; Granted in USA Patent No 11866658, Grant 09-Jan-24; Filed in Europe (EP 22214213.5).
18. Method for Producing Anode grade Coke from Crude Oils, India Patent Application No 2021 21044025, 28-Sep-21; Granted in Russia Patent No 2806008, Grant 25-Oct-23; Filed in USA (US 17/950947), Europe (EP 22198174.9), Saudi Arabia (122440255).
19. A Process for Multistage Hydroprocessing in a Single Reactor, India Patent Application No 2021 21033679, 27-Jul-21; Granted in USA Patent No 11731094, Grant 22-Aug-23; Filed in Europe (EP 22185898.1).
20. Multi Sensory External Reformer Tube Crawler, India Patent Application No 2020 21040895, 21-Sep-20.

21. Process for Production and Separation of Alcohols and Oligomerization of Hydrocarbon Feedstock, India Patent Application No 2020 21038395, 05-Sep-20; Granted in USA Patent No 11649200, Grant 16-May-23; Granted in Saudi Arabia Patent No 13892, Grant 18-Oct-23; Filed in Europe (EP 21194347.7), UAE (P 6001536/2021).
22. A Process for Production of Superior Quality Coke, India Patent Application No 2020 21038395, 05-Sep-20; Granted in USA Patent No 11168260, Grant 09-Nov-21; Granted in Russia Patent No 2719995, Grant; 23-Apr-20; Granted in Saudi Arabia Patent No 12166, Grant 31-Jan-23; Granted in Nigeria Patent No NG/PT/C/2019/3762, Grant 26-Nov-19; Filed in Qatar (QA/201906/000315), UAE (P6000819/2019), Oman (OM/P/2019/00219).

### **Papers Presented in Conference/ Published in Proceedings**

1. "De-carbonization of Refineries by conversion of Bio-oils in Delayed Coker Unit to achieve Net Zero Goals", SK Das, Shivam A Dixit, Pradeep PR, Sarvesh Kumar, Madhusudan Sau, *2<sup>nd</sup> India Energy Week*, Goa, 6-9 February 2024.
2. "INDEcoP2F Technology: A Solution for achieving Circularity of Waste Plastics for Environment Sustainability", Pradeep PR, SK Das, Shivam A Dixit, Sarvesh Kumar, Madhusudan Sau, *2<sup>nd</sup> India Energy Week*, Goa, 6-9 February 2024.
3. "Waste Polystyrene into Styrene Monomer by Chemical Recycling", Bineesh Vijayan, Preetom Sarkar, Pravesh Kumar, Mohammad Sirajuddin, Alex C Pulikottil, Madhusudan Sau, *2<sup>nd</sup> India Energy Week*, Goa, 6-9 February 2024.
4. "Bio-oil conversion in Delayed Coker Unit", Shivam A Dixit, Pradeep PR, SK Das, Sarvesh Kumar, Madhusudan Sau, *CHEMCON 2023*, Kolkata, 27-30 December 2023.
5. "Petroleum Refining Challenges & Technological solutions for achieving Net Zero Targets", SK Das, Sarvesh Kumar, Madhusudan Sau, *CHEMCON 2023*, Kolkata, 27-30 December 2023.
6. "Aspen-based Optimizer for Automatic Selection of Mixed Amine Solvents for CO<sub>2</sub> Capture", Sahithi Ravuluri, Sk Shabina, PC Sahoo, IR Choudhury, Sarvesh Kumar, Madhusudan Sau, *CHEMCON 2023*, Kolkata, 27-30 December 2023.
7. "Continuous catalytic reforming unit Re-usable low coke content catalyst separation from heel catalyst and its utilization", T. Raju, P. Varshney, S. Saravanan, S. K. Das, Sarvesh Kumar, Madhusudan Sau, *CHEMCON 2023*, Kolkata, 27-30 December 2023.
8. "Role of Catalysis to Handle Challenges of Refineries in an Era of Energy Transition", Alex C. Pulikottil, M. Sau; *Indo-French Seminar on Catalysis for Sustainability*, IISER Trivandrum, 10-13 December 2023.
9. "Advances in Hydrotreating Catalyst technologies for enhancing refinery sustainability", K.O. Xavier, A. V. Karthikeyani, Alex C. Pulikottil, M. Sau; *Refining India Conference*, New Delhi, 6-7 November 2023.

10. "An Eco-friendly Process for Reactive Desulfurization of Olefinic C4/Liquefied Petroleum Gas", S. Saravanan, Prosenjit Maji, S. K. Das, Sarvesh Kumar, M Sau, *26<sup>th</sup> Energy Technology Meet*, New Delhi, 9-11 October 2023.
11. "indSelect-G Technology for Selective Deep Desulfurization of Cracked Gasoline", A. Arun, Yamini Gupta, K. O. Xavier, Ganesh V. Butley, IOCL GR, Sarvesh Kumar, Madhusudan Sau, *26<sup>th</sup> Energy Technology Meet*, New Delhi, 9-11 October 2023.
12. "INDEcoP2F Technology: An Environment Friendly solution for conversion of Waste Plastic to Fuels for Circular Economy", SK Das, Pradeep PR, Shivam A Dixit, KK Vimal, Sarvesh Kumar, Madhusudan Sau, *26<sup>th</sup> Energy Technology Meet*, New Delhi, 9-11 October 2023.
13. "An Eco-friendly process for reactive desulphurization of Olefinic C4/Liquefied petroleum Gas", S Saravanan, Prosenjit Maji, S K Das, Sarvesh Kumar, Madhusudan Sau, *26<sup>th</sup> Energy technology Meet*, New Delhi, 9-11 October 2023.
14. "Conversion of Bio-oils in a Delayed Coker Unit for enabling transition to Greener fuels", Shivam A Dixit, Pradeep PR, SK Das, Sarvesh Kumar, Madhusudan Sau, *4<sup>th</sup> International Refinery & Petrochemical Technology Forum*, New Delhi, 8-9 August 2023
15. "Novel Empirical Model for Estimation of Aniline Point of Petroleum fractions", D Hima Bindu, Bidyut De, G Saidulu, Reshmi Manna, Sarvesh Kumar, Madhusudan Sau, *4<sup>th</sup> International Refinery & Petrochemical Technology forum*, New Delhi, 8-9 August 2023
16. "Continuous catalytic reforming unit Re-usable spent catalyst recovery and its utilization", T. Raju, P. Varshney, S. Saravanan, S. K. Das, Sarvesh Kumar, M Sau, *India Energy Technology Forum*, New Delhi, 13-14 Jun 2023
17. "Unlocking the potential of FCC unit to Process recycle Feedstocks with maximization of light olefin: Role of Catalyst & Additive", Bineesh Vijayan, A.V. Karthikeyani, Alex C.Pulikottil, Madhusudan Sau, S.S.V. Ramakumar, *Global Refining & Petrochemicals Congress, New Delhi 29-30 June, 2023*
18. "Reducing Carbon Footprint of Transportation Fuels by Processing Waste Plastic Pyrolysis Oil in Refinery: Sustainable Approach to Net Zero Goal," Shahil Siddiqui, Pradeep PR, KV Bineesh, Satyen Kumar Das, Sarvesh Kumar, Madhusudan Sau, SSV Ramakumar, International Symposium on Fuels & Lubricants (ISFL-2023), Delhi, 17-19 March, 2023.
19. "Thermal co-carbonization study of petroleum residues and coal tar pitch for production of Electrode Material for Aluminium Industry", Prantik Mondal, Pradeep PR, Dr. Ravindra Kumar, SK Das, Sarvesh Kumar, J Christopher, Madhusudan Sau, Dr. SSV Ramakumar, *International Symposium on Fuels & Lubricants (ISFL-2023)*, Delhi, 17-19 March, 2023.
20. "INDEcoP2F Technology: A Novel Pathway to Address Waste Plastic Disposal by Conversion to Fuel in Refinery", SK Das, Pradeep PR, Sarvesh Kumar, Madhusudan Sau, SSV Ramakumar, *CHT Activity Committee Meet on Hazardous Waste Management*, Mumbai, 17-18 February, 2023.
21. "Integration of Slurry Resid Hydrocracking in Refinery: Yield improvement & benefits thereof", Pravesh Kumar, K. Ramesh, Sarvesh Kumar, Madhusudan Sau, S.S.V. Ramakumar, *India Energy Week-2023*, Bengaluru, 6-8 February, 2023.

22. "Commercialization of Indigenous DHDТ Catalyst: A Case Study", K Ramasubramanian, K O Xavier, A V Karthikeyani Alex C Pulikottil, Madhusudan Sau, *CHT Activity Committee Meeting (ACM)*, Mumbai, 2-3 February, 2023.
23. "Ind-Coker<sup>AT</sup>: Petcoke Reduction Technology for Sustainable Refinery," Shahil Siddiqui, Pradeep PR, SK Das, Sarvesh Kumar, Madhusudan Sau, *CHT Activity Committee Meet on Delayed Coking*, IOCL Barauni Refinery, 19-20 January, 2023.
24. "An investigation into the thermal decomposition behavior of petroleum residues and coal tar pitch," Prantik Mondal, Pradeep PR, SK Das, Sarvesh Kumar, J Christopher, Madhusudan Sau, *National Conference on Frontiers in Chemical Sciences*, Dharamshala, 4-5 November, 2022.
25. "Processing of Waste Plastics through Coker unit at Digboi Refinery", SK Das, Pradeep PR, Madhusudan Sau, GS Kapur, SSV Ramakumar, *Refining India*, New Delhi, 10-11 October, 2022.
26. "Enhancing Hydrogen and Propylene yields by integration of HGU and OPDH processes", D Hima Bindu, Vineeth V Nath, Bidyut De, G Saidulu, Reshmi Manna, Sarvesh Kumar, Madhusudan Sau, *25<sup>th</sup> Energy technology Meet*, Mumbai, 15-17<sup>th</sup> September, 2022.
27. indJet<sup>®</sup>: Technology for ATF production by selective removal of mercaptan sulphur and low severity process for Kero desulfurization for production of Pipeline Compatible Kerosene., Kamal Kumar, Prasenjit Das, K.O. Xavier, Ganesh V. Butley, Sarvesh Kumar, Madhusudan Sau, Ravi Kant Gupta, *25<sup>th</sup> Energy Technology Meet*, 15-17<sup>th</sup> September 2022, *Mumbai, India*.
28. "Rejuvenation of the Catalyst's Benzene Saturation Activity in Light Naphtha Isomerization Unit at Bongaigaon Refinery", V. K. Upadhyay, P. Varshney, S. Saravanan, N. Bora, M. Sharma, S. K. Das, Sarvesh Kumar, M Sau, *25<sup>th</sup> Energy Technology Meet*, Mumbai, September 15-17, 2022.
29. "Advanced Coker Technology: A Key Solution for Reduction of Coke Make for Future Net-Zero Refinery," Shivam A Dixit, Pradeep PR, SK Das, Sarvesh Kumar, Madhusudan Sau, SSV Ramakumar, *25<sup>th</sup> Energy Technology Meet*, Mumbai, 15-17 September, 2022.
30. "Crude Oil to Chemical Transition: Future prospect for Refinery-Petrochemical Integration with olefin-aromatic flexibility", M Sarkar, N Das, Dr. S. K , THVD Prasad, Sarvesh Kumar, M Sau, *World Refining & Petrochemicals Conference (WRPC 2022)*, New Delhi, 10 September, 2022.
31. "Crude oil to Chemical Transition: Technology enabler for Crude to Chemical Transition in Oil refineries," Pradeep PR, THVD Prasad, Mainak Sarkar, SK Das, Sarvesh Kumar, Madhusudan Sau, *3<sup>rd</sup> International Refinery & Petrochemical Technology Forum*, New Delhi, 23-24 August, 2022.
32. "Development of a novel methodology for estimation of residual activity of spent ion exchange resin catalyst used in Hydrocarbon process technologies", P. Maji, S. Saravanan, S. K. Das, J. Christopher, M Sau, S. S. V. Ramakumar, *2<sup>nd</sup> Indian Analytical Congress (IAC-2022)*, Dehradun, 26 – 28 May, 2022.

33. "Co-Conversion of Waste Plastic to Light Distillates in Delayed Coking Process", Pradeep PR, THVD Prasad, SK Das, Madhusudan Sau, GS Kapur and SSV Ramakumar, *23<sup>rd</sup> World Petroleum Congress*, Houston, USA, 5-9 Dec 2021.
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35. "CFD Simulations of Vapor-Liquid Distribution in Packed Bed Generated by Industrial Distributor Tray", Ekta Jain, Madhusudan Sau and Vivek V. Buwa, 2020, *26<sup>th</sup> Intl. Symp. on Chemical Reaction Engineering (ISCRE 26)*, New Delhi (India), 5-8 December 2021.
36. "Importance of Asphaltene aromaticity in kinetic modeling of Slurry Hydrocracking Process", VK Kompally, Shabina SK, M Sarkar, I Roy Choudhury, M Sau, G S Kapur, *26<sup>th</sup> Intl. Symp. on Chemical Reaction Engineering (ISCRE26)*, New Delhi, December 5-8, 2021.
37. "Process study for development of refinery configuration for production of low pour point MARPOL compliant Bunker FO", Pradeep PR, S A Dixit, P Mondal, THVD Prasad, SK Das, M Sau, GS Kapur and SSV Ramakumar, *12<sup>th</sup> Intl. Symp. on Fuels & Lubricants (ISFL)*, Delhi NCR, 2021.
38. "Effect of middle distillate slippage in UCO on product yields in recycle hydrocracker and economic analysis", Hima Bindu V N V, M Sarkar, S Kumar, K Ramesh, S Kumar, M Sau, G S Kapur and S S V Ramakumar, *12<sup>th</sup> Intl. Symp. on Fuels & Lubricants (ISFL)*, Delhi NCR, 2021.
39. "Study of Co-processing Bio-crude in thermal residual upgradation unit in a Petroleum Refinery Configuration for converting waste to energy", J Brahma, S A Dixit, Pradeep PR, SK Das, M Sau, GS Kapur and SSV Ramakumar, *12<sup>th</sup> Intl. Symp. on Fuels & Lubricants (ISFL)*, Delhi NCR, 2021.
40. "Kinetics for conversion of waste plastic to fuel in a Delayed Coking Unit", S A Dixit, J Brahma, Pradeep PR, THVD Prasad, SK Das, M Sau, GS Kapur and SSV Ramakumar, *12<sup>th</sup> Intl. Symp. on Fuels & Lubricants (ISFL)*, Delhi NCR, 2021.
41. "An Innovative and Simple Etherification Process for Light Cracked Naphtha to High Octane Gasoline", S Saravanan, P Maji, A Vignesh, Reshmi Manna, M Sau, G S Kapur and S S V Ramakumar, *12<sup>th</sup> Intl. Symp. on Fuels & Lubricants (ISFL)*, Delhi NCR, 2021.
42. "Utilization Of Gaseous & Solid Refinery Waste for The Production of Light Olefins", D Hima Bindu, R M Thakur, M Sau, GS Kapur, SSV Ramakumar, *12<sup>th</sup> Intl. Symp. on Fuels & Lubricants (ISFL)*, Delhi NCR, 2021.
43. "Estimation of Zeolite & Matrix Surface Area of FCC Catalysts using crystallinity data & exploring their correlation with Micro Reactor (ACE) Yields", D Eswar Prasad, P Venkatesan, V Pandey, A Yadav, BVHP Gupta, R Manna, AC Pulikottil and M Sau, *58<sup>th</sup> Annual Convention of Chemists & Intl. Conference on "Recent Trends in Chemical Sciences" (RTCS)*, 2021.
44. "Improvement of Anode Grade Delayed Coker unit profitability through Online Process Optimization", P Mondal, Pradeep PR, THVD Prasad, SK Das, M Sau, GS Kapur and SSV Ramakumar, *24<sup>th</sup> Refining and Petrochemicals Technology Meet (RPTM)*, Bengaluru, January 19-21, 2020.

45. "Effect of Particle Frictional Stress on Dynamics of Unary Gas-Solid Flow in a Pseudo-3D Fluidized Bed", Ekta Jain, Madhusudan Sau and Vivek V. Buwa, 2019, *25<sup>th</sup> National and 3rd International ISHMT-ASTFE Heat and Mass Transfer Conference (IHMTC-2019)*, Roorkee (India), December 28-31, 2019.
46. "Crude Oil to Chemicals Conversion in Future Refinery Configurations", Madhusudan Sau, *72<sup>nd</sup> Annual Session of Indian Institute of Chemical Engineers, CHEMCON*, December 16-19, 2019.
47. "Study of structural changes in crystalline petroleum coke during thermal treatment", Pradeep PR, THVD Prasad, S K Das and M Sau, *72<sup>nd</sup> Annual Session of Indian Institute of Chemical Engineers, CHEMCON*, December 16-19, 2019.
48. "Improving energy efficiency of Delayed Coker Unit Gascon section by heat integration", Md Sirajuddin, Hemant Kumar, S K Shabina, I Roy Choudhury, S Singh and M Sau, *72<sup>nd</sup> Annual Session of Indian Institute of Chemical Engineers, CHEMCON*, December 16-19, 2019.
49. "Study on the response and Blending Octane number of different Octane enhancers in different base fuels", T. Raju, P. Varshney, M. Muralidharan, S. Saravanan, R Manna and M Sau, *72<sup>nd</sup> Annual Session of Indian Institute of Chemical Engineers, CHEMCON*, December 16-19, 2019.
50. "Failure due to Faulty Material of Construction of A Reciprocating Compressor Under Hydrogen Service", D S Rao, S P Singh, Madhan Gopal, S Bhattacharya and M Sau, *72<sup>nd</sup> Annual Session of Indian Institute of Chemical Engineers, CHEMCON*, December 16-19, 2019.
51. "Kerosene Valorization to Chemicals", Madhusudan Sau, *Lovraj Kumar Memorial Trust (LKMT) Workshop on Changing Energy Paradigm- Challenges and Opportunity, India International Centre*, New Delhi, November 15-16, 2019.
52. "Advancement in DHDS catalyst technology for meeting clean fuel challenges", K.O Xavier, Alex C. Pulikottil, H. Biswas, M. Sau, K. Mohan Prabhu, B. Kumar and S. Rajagopal, *10<sup>th</sup> International Oil & Gas Conference and Exhibition, PETROTECH*, New Delhi, October 14-17, 2019.
53. "Resid Upgradation Options: Future Scenario", Madhusudan Sau, *FIPI R&D Conclave,Coorg*, July 11-13, 2019.
54. "Integration of FCC and Dehydrogenation processes for enhanced light olefin yields", D Hima Bindu, Vineet V Nath, R M Thakur, M Sau, S K Mazumdar and SSV Ramakumar, *45<sup>th</sup> CHT Activity committee meeting on Fluid catalytic cracking & Sulphur Recovery Unit*, 2019.
55. "Gasoline Octane Improvement through in-house Developed Technologies of IndianOil", R. Manna, S. Saravanan, P. Varshney, P. Maji, M. Sau, G. S. Kapur, S.S. V. Ramakumar, *FIPI R&D Conclave,Coorg*, July 11-13, 2019.
56. "A Methodology to Simulate Gas-liquid Distribution through Distributor-trays using Two-phase Eulerian Model", Ekta Jain, Madhusudan Sau and Vivek Buwa, 2019, *10<sup>th</sup> International Conference on Multiphase Flow (ICMF 2019)*, Rio de Janeiro (Brazil), May 19-24, 2019.

57. "Technical Services for Catalytic Reforming And Isomerization", P. Varshney, S. Saravanan, R. Manna, M. Sau, *41<sup>st</sup> CHT Activity Committee Meet on Catalytic Reforming and Isomerization*, Paradip Refinery, April, 2019.
58. "Novel Technologies for meeting future fuel quality challenges", Madhusudan Sau, *13<sup>th</sup> International Oil & Gas Conference and Exhibition, PETROTECH*, New Delhi-NCR, January 22-24, 2019.
59. "Advanced Hydrotreating Catalyst for Selective Saturation of Diolefins in Cracked Gasoline" Ram. Ramasubramanian, K.O. Xavier, Alex Pulikottil, M. Sau, S.K. Mazumdar, S.S.V. Ramakumar, *13<sup>th</sup> International Oil & Gas Conference and Exhibition, PETROTECH*, New Delhi-NCR, February 10-12, 2019.
60. "Implementation of Energy Efficient & Eco-friendly Anode Grade Coker Technology", SK Das, THVD Prasad, Pradeep PR, M Sau, SK Mazumdar and SSV Ramakumar, *13<sup>th</sup> International Oil & Gas Conference and Exhibition, PETROTECH*, New Delhi-NCR, February 10-12, 2019.
61. "An Indigenous Technology for Conversion of Cracked C4 Stream to High-octane Gasoline", R Manna, S Saravanan, P Varshney P Maji, M Sau, D Bhattacharyya, SK Mazumdar, L W Khongwir, SSV Ramakumar, *23<sup>rd</sup> Refining and Petrochemicals Technology Meet (RPTM)*, Mumbai, January 12-14, 2019.
62. "indeDiesel®: Innovative Hydrotreating Technology for Production of BS-VI/Euro-VI Diesel Fuel", H Biswas, S Kumar, M Sau, SK Mazumdar, SSV Ramakumar (IOCL) and RN Maiti, SR Singh (EIL), *IRPC Europe*, Milan Italy, June 5-7, 2018.
63. "Residue Hydrocracking – Ebullated & Slurry Bed Technologies", Madhusudan Sau, *FIPi R&D Conclave*, Mussoorie, February 17, 2017.
64. "Gas-liquid Flow through Chimney and Bubble-cap Distributors", Ekta Jain, Vivek V. Buwa and Madhusudan Sau, *13<sup>th</sup> International Conference on Gas-Liquid and Gas-Liquid-Solid Reactor Engineering (GLS13)*, Brussels, Belgium, 2017.
65. "Mesoporous alumina based NiMo catalysts for residue upgradation", Kirtika Kohli, Ravindra Prajapati, Madhusudan Sau, Samir K. Maity, *International conference on Energy Innovations*, HP Green R&D Centre, Bangalore, October, 2016.
66. "Residue hydroprocessing with mesoporous alumina based NiMo catalysts", Kirtika Kohli, Ravindra Prajapati, Madhusudan Sau, Samir K. Maity, *National conference organized by CSI at CSIR-IICT Hyderabad*, June, 2016.
67. "Used cooking oils & Palm stearin processing in Petroleum Refinery to produce improved cetane diesel: A commercial run experience", B Ravi Kumar, Ganesh V Butley, S Kumar, M Sau, Alok Sharma and Brijesh Kumar, *20<sup>th</sup> Refining and Petrochemicals Technology Meet (RPTM)*, Gandhinagar, September 7-9, 2016.
68. "indJet Process for Selective removal of Mercaptan Sulfur from ATF Stream", A Vignesh, H Biswas, S Kumar, M Sau, SSV Ramakumar, B Kumar, BP Das (IOCL), S Agarwala, RK Gupta, V Shukla (EIL), *20<sup>th</sup> Refining and Petrochemicals Technology Meet (RPTM)*, Gandhinagar, September 7-9, 2016.
69. "Used Tea leaves derived activated carbon as catalyst support for hydrotreating of Gas oil, Jatropha oil and their blends", M Rajesh, M Sau, R K Malhotra and D K Sharma, *12<sup>th</sup>*

*International Oil & Gas Conference and Exhibition, PETROTECH*, New Delhi, December 5-7, 2016.

70. "Development of High Asphaltene VGO Hydrocracking Process", P Naresh, K Ramesh, VK Chaudhary, M Sau, S Kumar, SSV Ramakumar, BP Das (IOCL), P Font, E Guillon, F Bertoncini (IFPEN), P Bourges, E Caprani, S Saha (Axens), *12<sup>th</sup> International Oil & Gas Conference and Exhibition, PETROTECH*, New Delhi, December 5-7, 2016.
71. "Benchmarking of Hydrocrackers", M Sarkar, G V Butley, Y Gupta, A Arun. S Kumar, M Sau, *Intl. Symp. on Fuels & Lubricants (ISFL)*, Delhi NCR, 2016.
72. "Synthesis of mesoporous alumina as support for residue hydroprocessing catalyst", Kirtika Kohli, Ravindra Prajapati, Madhusudan Sau, Samir K. Maity, *CATSYMP-22, CSMCRI Bhavnagar, Gujarat*; January, 2015.
73. "Mesoporous alumina supported NiMo catalysts for residue conversion", Kirtika Kohli, Ravindra Prajapati, Madhusudan Sau, Samir K. Maity, *International conference on Global challenges, policy framework & sustainable development for mining of mineral and fossil energy resources (GCPF2015)*, 2015.
74. "Selective Diolefins Saturation of Cracked Gasoline", A Arun, B R Kumar, KO Xavier, GV Butley, S Kumar, AC Pulikottil, M Sau, and B Kumar, *19<sup>th</sup> Refining Technology Meet (RTM)*, Chennai, November, 2014.
75. "Synthesis of mesoporous alumina as support for residue hydroprocessing catalysts", Kirtika Kohli, Ravindra Prajapati, Madhusudan Sau, Samir K. Maity, *8<sup>th</sup> National Symposium of Chemical Research Society India (CSI) held at CSIR-NEIST, Jorhat, Assam*, July, 2014.
76. "Light Cycle Oil (LCO) Upgradation- A New Look", Mainak Sarkar, Ganesh V. Butley, A Arun, M Sau, Brijesh Kumar, Santanam Rajagopal and R K Malhotra, *18<sup>th</sup> Refining Technology Meet (RTM)*, Kochi, November, 2013.
77. "Indigenous Diesel Hydrotreating Technology at IOCL Bongaigaon Refinery", M Sau, B Kumar, S Rajagopal, RK Jha, A Saran (IOCL), RN Maiti, A deshpane (EIL), *10<sup>th</sup> International Oil & Gas Conference and Exhibition (PETROTECH)*, New Delhi, October 16-17, 2012.
78. "Commercialization of indigenous Diesel Hydrotreating Technology for production of Euro-V diesel", H Biswas, M Sau, B Kumar, S Rajagopal, RK Malhotra, RK Jha, MN Das, A Saran (IOCL), RN Maiti, G Gautam, G Prasad (EIL), *17<sup>th</sup> Refining Technology Meet (RTM)*, Bangalore, July 18-20, 2012.
79. "Upliftment of heavy diesel in DHDT unit for production of BS-VI diesel", DP Dolui, H Biswas, M Sau, B Kumar, S Rajagopal, RK Malhotra, (IOCL), M Rao, S Kijlstra, L Limin, LS Kraus (Shell, Criterion), *17<sup>th</sup> Refining Technology Meet (RTM)*, Bangalore, July 18-20, 2012.
80. "Development of high active diesel hydrodesulfurization catalyst: Concept to commercial success", K O Xavier, Alex C Pulikottil, H. Biswas, M Sau and S Rajagopal (IOCL), S. Rajkumar, B. Kothandaraman and N.Nachiappan (CPCL), *7<sup>th</sup> Intl. Symp. on Fuels & Lubricants*, New Delhi, March, 2010.

81. "Flow Regime Transition in Trickle Bed Hydroprocessing Reactors", P Kumar, M Sau, M Santra, B Kumar, B. Basu, *6<sup>th</sup> Intl. Symp. on Fuels & Lubricants (ISFL)*, New Delhi, March, 2008.
82. "Optimization & Performance Monitoring of Commercial Hydrocracker Units -Case studies of Indian Oil Refineries", Madhusudan Sau, *Criterion Catalysts and Technologies Conference on Clean Fuels Solutions*, Goa, India, April 10-11, 2007.
83. "Upgradation of Cracked Components through Hydroprocessing RouteTheme: Recent Developments in FCC & Hydroprocessing", Madhusudan Sau, *Centre for High Technology & Chennai Petroleum Corporation Ltd.*, March 26-27 2007.
84. "Development of new catalyst systems and innovative solutions for meeting new diesel specifications", Madhusudan Sau, Ujjwal, Manna, Ganesh V. Butley, Hillol Biswas, Manoranjan Santra and Ram Prakash Verma, *Annual Meeting, AIChE*, Atlanta, USA, April 10-14, 2005.
85. "Hydrodynamic Model for Trickle Bed Hydroprocessing Reactors", P Kumar, K Basak, M Sau, C.S.L. Narasimhan, U. Manna, M. Santra and R.P. Verma, *IChE Annual Meeting*, New Delhi, 2005.
86. "Ultra Low Sulphur Diesel (ULSD) by Catalytic process meeting Euro-IV specifications in the existing DHDS units", H Biswas, GV Butley, M Sau, U Manna, M Santra and RP Verma, *Intl. Symp. on Fuels & Lubricants (ISFL)*, New Delhi, 2004.
87. "Hydrocracker Optimization using novel simulators", RP Verma, CSL Narasimhan and M Sau, *Proceedings World Round Table Conference*, New Delhi, India, December, 1998.
88. "Modelling Heat Effects of VGO Hydrocracking", CSL Narasimhan, M Sau, and RP Verma, *Proceedings 213 National Meeting, American Chemical Society (ACS)*, Sanfrancisco, USA, April 13-17, 1997.
89. "Continuum theory of Lumping Approach to model hydrocracking kinetics for predicting paraffins, naphthenes & aromatics (PNAs) yields", M Sau, CSL Narasimhan and RP Verma, *Proceedings American Chemical Society (ACS) Symposium*, Chicago, USA, August, 1995.
90. Reactor model for hydrodesulphurisation using continuum theory of lumping approach", M Sau, CS Laxminarasimhan, U Manna and RP Verma, *IChE Annual Meeting*, IIT Kharagpur, India, 1994.
91. "Modelling of Trickle-Bed and Packed Bubble Column reactors- Hydrodynamic aspects", M Sau, CS Laxminarasimhan, RP Verma and PA Ramachandran, *IChE Annual Meeting*, IIT Bombay & UDCT Bombay, India, 1993.

## Guide to PhD Students

### Co-Guided 3 PhD students & 2 ongoing PhD student:

1. "Studies on the hydrotreating of jatropha oil, gas oil and their blends to obtain hydrogenated oil (green diesel) using organic waste derived carbon based catalysts", Rajesh. M, Centre for energy studies, *Indian Institute of Technology Delhi*, 2015.
2. "Deactivation Study of Residue Hydrotreating Catalysts", Ms. Kirtika Kohli, *CSIR-Indian Institute of Petroleum*, 2017.
3. "Characterization of Gas-Liquid Flow through Distributors and Porous Beds for Co-current Downflow Packed Bed Reactor", Ekta Ajit Jain, Department of chemical engineering, *Indian Institute of Technology Delhi*, 2021.

### Pursuing PhD (2 students):

4. "Biomass to Energy Conversion Through Co-processing with Petroleum Residue", Pradeep PR, Department of chemical engineering, *Indian Institute of Technology Delhi*, started in 202.
5. "Production of Hydrogen/Syn-gas by tri-reforming of methane/Carbon di-oxide over metal supported catalyst derived from metal organic framework precursors", Anjali Garg, Department of Chemical Engineering, *Indian Institute Technology Roorkee*, started in 2024.

## Chapters in Book

Authored 2 chapters in "**Catalysts in Hydrocarbon Processing and Fertilizer Industry-A Compendium**" ed. M.A. Siddiqui and R.P. Verma, NewDelhi (2005).

## Awards & Fellowship Received

1. MOPNG CHT (Centre for High Technology) **Innovation Award 2023** for the category of **Best Innovation in R&D Institute** on "**INDEcoP2F: Technology for Waste Plastic to Fuel Conversion in Refinery for Sustainable Environment**".
2. **Technology Development Board (TDB), DST, National Award 2022** on "Octamax: An indigenous Technology for Conversion of cracked C4 streams to High-Octane Gasoline".
3. MOPNG CHT (Centre for High Technology) **Innovation Award 2022 for best indigenously developed Technology** "IndJet Technology for ATF production by selective removal of mercaptan sulphur and low severity process for KERO desulphurization for production of Pipeline Compatible Kerosene" jointly with EIL.

4. **FIPI (Federation of Indian Petroleum Industry) Innovator of the Year – Team Award 2020:** on “Development & commercialization of diesel hydrotreating catalyst for BS-VI”
5. **MOP&NG CHT (Centre for High Technology) Innovation Award 2020 for best indigenously developed Technology(declared):** on “INDAdept-G Technology: Removal of sulphur from cracked gasoline streams”
6. **PETROTECH Special Technical Award 2019**(Jointly to IOCL and Engg Partner- EIL): Greening of Oil & Gas, Business & Sustainability for DHDT Technology
7. **PETROFED (Petroleum Federation of India) Innovator of the Year - Team (Special Commendation) Award 2012**(Jointly to IOCL and Engg Partner- EIL):on“Development of Diesel Hydrotreating & Light Naphtha Isomerization Technologies for Production of Clean Transportation Fuel”.
8. **International Atomic Energy Agency (IAEA)/RCA** (in cooperation with the Government of Malaysia, through the Malaysian Nuclear Agency), **sponsored Training Fellowship (2010)** on “Industrial Process Gamma Tomography for Multiphase Process Investigation of Petrochemical Plants” at Malaysia, 19 – 23 July 2010.
9. **PETROFED (Petroleum Federation of India) Innovator of the Year - TeamAward2010:** on “Development & Commercialization of a new diesel hydrotreating catalyst for BS-IV diesel production”
10. **WPC (World Petroleum Congress) excellence Award 2008**(to IOCL): on “Hydroprocessing technology for green fuels: basics to commercialization through Innovation”.
11. The **Association for Overseas Technical Scholarship (AOTS)** and the Energy conservation Centre, Japan **sponsored Training Fellowship (2006)** on “Energy Conservation for India (ECIN-2)” during 14 – 24 November, 2006 at Japan.
12. **Omnova Solution SignatureAward 2001** for “Best Performing PhD Student”, University of Akron, Ohio, USA.
13. **Research Assistantship**, 1999 TO 2003, University of Akron, Ohio, USA.
14. **UGC Scholarship & National Scholarship**, Government of India

## **Membership & Other Engagement**

1. **Life member** of "Indian Institute of Chemical Engineers", LM 73302
2. **Member of the Academic Council** in "TERI School of Advanced Studies", 10 Institutional Area, Vasant Kunj, New Delhi-110070.
3. **Member in Board of Governance (BoG)** at Parala Maharaja Engg College, Behrampur, Ganjam, Odisha.
4. **Served as Member in technical committee of BIS PCD-3** on “Petroleum and their related products of synthetic Origin)

5. **Served as External Examiner** for Several M Tech and PhD students in Chemical Engineering at IIT Delhi

## **Software Proficiency**

### **Languages**

- Fortran, Visual Basic

### **Packages**

- PRO-II / PROVISION
- ASPEN Hysys
- CFD package (FLUENT)