





## INTELLECTUAL DARWINISM FOR UNIVERSITIES



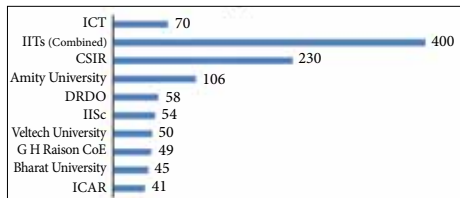
Winston Churchill once said “The empires of the future will be empires of the mind.” These words ring even truer today, and innovation and intellectual property are now the life-lines of nations competing with one another in an increasingly globalized world. One can easily define the modern age as the embodiment of intellectual Darwinism – societies that continuously find innovative solutions to technological, environmental, social and political challenges are the likeliest to succeed and prosper. Innovation is now the

ultimate currency of success. Disappointingly, though, India miserably trails the heavy-weights of the world in this regard. So how can India remedy its innovation gap and begin to punch at a level near or above its weight? India’s universities have a key role to play in this transformation, and the examples of the Massachusetts Institute of Technology (MIT) and Stanford University offer a path forward. MIT, for instance, occupies no more than 0.68 km<sup>2</sup> yet MIT-originated innovations contribute \$2 trillion to the annual GDP of the United States. MIT has succeeded where many others have failed through use of a triple-helix – a strategic partnership between academia, industry and government. The co-development of technologies through collaborative research by universities and industries that is co-funded by government agencies and industries has been demonstrated to spur knowledge-driven businesses, and this strategy must be practiced more aggressively across India. Many US universities have emerged shining examples of wealth creation through IPR generation.

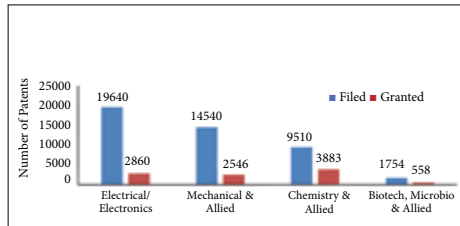
The illustrations below provide the patent filed in different subject domains in India during 2016-2017 and patent filings from various research organizations and institutes during the 2016-2017. IPR creation often leads to start-ups and ventures that attract global collaborators and funding, which greatly expands the geographical reach of IPR generators. However, for this formula to succeed, it is imperative that intellectual property is not only created but also steadfastly protected through the enactment of more robust and globally conformant intellectual property laws. Addressing this challenge requires greater engagement between the legal and scientific communities in India, as well as greater conviction from administrators.

India has made significant strides in recent years and filing patents and protection of IP is encouraged across Universities, Institutes and industry. A long list of patents filed by Institute of Chemical Technology, often in partnership with industry, perfectly illustrates the innovative potential of university-led industry-academia-government collaborations. The Institute of Chemical Technology is a vibrant institute having a great legacy at the forefront of creation of new knowledge and entrepreneurs.

*Patent trends for Research Organisations in 2016-2017\**



*Patent trends in various domains in 2016-2017\**



\*data from [www.ipindia.nic.in](http://www.ipindia.nic.in)

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## ABOUT ICT

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Established on October 1, 1933 as University Department of Chemical Technology (popularly called UDCT) of the University of Bombay (now Mumbai), with the noble intention of advancing India's knowledge reserves in chemical science and technology, the Institute has grown to become a premier (deemed) university devoted to education, training, research and industrial collaboration in chemical engineering, chemical technology, applied chemistry, pharmacy, biotechnology and bio-processing. The then UDCT grew in stature over the years and was granted partial autonomy by the University of Mumbai in 1985, which was taken to the next echelon under the concept of autonomy propagated by the University Grants Commission (UGC). Due to its size and spread of activities, it was converted into University Institute of Chemical Technology (UIC) on 26th January, 2002 and under the TEQIP of the World Bank it was granted full autonomy in 2004. Upon strong recommendation of the UGC through a peer review process, the autonomous institute status was finally converted in to a Deemed-to-be-University by the Ministry of Human Resource Development (MHRD), Govt. of India, on 12 September 2008. Seven convocations have so far taken place in 2012, 2013, 2014, 2015 and 2016, 2017 and 2018.

Based on its stellar performance over the years, the Government of Maharashtra granted it the Elite Status and Centre of Excellence in the State Assembly on April 20, 2012. This is a singular distinction accorded to any institute in the entire country and speaks volumes about the achievements of the ICT.

In November 2017, National Assessment and Accreditation Council (NAAC) Committee visited ICT and graded with A++ CGPA of 3.77 out of 4. ICT has been ranked amongst top ten Engineering Institutes of India and 19th amongst the top universities if the country. It is also recognized at rank 4 amongst the Pharmacy Institutes. In the BRCS QS Universities ranking 2018, ICT ranked at 118; whereas in 2019, ICT is 115 among all BRICS.

On March 2018, ICT for the first times crossed the confines of Maharashtra when the institute inaugurated the "ICT Mumbai Indian Oil Odisha Campus" at Bhubaneswar on 18th March 2018, at the hands of President of India, Honorable Shri Ram Nath Kovind, in the august presence of Honorable Shri S.C Samir, Governor of Odisha, Honorable Shri

Dharmendra Pradhan, Union Minister of Petroleum and Natural gas, Skill Development and Entrepreneurship and distinguished bureaucrats, academicians, industry stalwarts and citizens. The Institute has signed MOU with IIT Kharagpur for collaborating in various research activities.

May 4th 2018 was another glorious day for ICT, when ICT officially established its second campus outside Mumbai. The foundation stone of Marathwada Off-campus Centre of ICT was laid at the hands of Chief Minister of Maharashtra Shri. Devendra Fadnavis among other dignitaries. A land of 203 acres has been allocated at Siraswadi near Jalna to the Institute.

ICT's contribution to wealth creation must be one of the best amongst the branded institutes. The institute has been developing technologies which are consistently being commercialized. An illustration to such effect is technology for hydrogen production by water splitting. The technology has been successfully scaled up to pilot scale and transferred for commercial deployment to ONGC. The technology has been granted patents in Korea, Japan, USA, Canada and China.

A 1 million Litre/Day Demonstration plant based on ICT's Sewage Processing Technology was inaugurated in September 2018 at New Delhi by Dr. Harsh Vardhan, Hon'ble Union Minister of Science & Technology, Environment Forest and Climate Change and Earth Sciences in presence of Shri. Anil Baijal, Lt. Governor of Delhi and Dr. Renu Swarup, Secretary, Dept. of Biotechnology. The plant is based on a combinations of ICT's technologies namely CCR, CTL and Rapid AD technology and is called DBT-ICT Nullah/ River cleaning technology. The plant shall process e at Barapullah Nallah to generate clean water and compressed Biogas (CBG).

ICT's successfully demonstrated and patented DBT-ICT 2G-Ethanol technology has been taken up by major Oil Marketing Companies (OMCs) such as HPCL for establishing commercial scale plants. In July 2018, ICT signed agreements with LSTK bidders, a step taking ICT closer to its goal of commercializing the technology. ICT's Municipal Solid Waste and Liquid Waste (MSW/MLW) technology have been taken by BPCL for putting up a 1ton/day pilot plant at BPCL's Chembur colony in Mumbai.

Technologies for dehydration of vegetables to produce nutritious drinking vegetables (10 ton fresh vegetables/month) have been commercialised. Retort processing to make ready-to-eat traditional Indian curries etc (6-8 tons/month) and technology for making fruit wine (24kl/year) have been commercialized. Start-ups have been established based on the mentioned technologies.

Our endeavours, extending well beyond the confines of the classroom, will aim to enhance public welfare and our attempts to dissipate knowledge will spread to a greater multi- and cross-disciplinary platform to conduct research, discovery, technology development, service to industry and entrepreneurship, in consonance with India's aspirations to be a welfare state.



**Professor Dr. G. D. YADAV,**

Vice Chancellor and R.T. Mody Distinguished Professor

J.C.Bose National Fellow (DST-Govt of India)

INSTITUTE OF CHEMICAL TECHNOLOGY

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## ICT : CULTURE, CREATIVITY AND CONNECTIVITY

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- Three campuses from 2018-19
- University of the Year 2018 by FICCI
- Best Engineering Institute by ISTE Western Region 2019
- 3 Padma Vibhushan, 8 Padma Bhushan, 8 Padma Shri awardees; 2 Fellows of Royal Society (among 5 engineers from India); Several Fellowships- FNA, FNASc, FNAE, FRSC, FTWAS, MUSAE.
- Over 500 first generation entrepreneurs, some owners of Fortune 500 Companies;
- Main Campus at Mumbai: 11 departments and 6 centres of excellence. 9 UG, 18 PG, 29 Ph D, 1 PG Diploma in Chemical Technology Management, 1 Certificate Course in Chemical Safety and Risk Management
- No. 1 in India, 4 globally in publications in ChE
- 9 UG, 18 PG, 29 Ph D programs, 1 PGDCTM, 1CCCSR
- 640 Ph D Students
- Masters ( 331 First Year +225 Second Year)
- 1100 UG students
- 360 UG Scholarship
- 140 Ph Ds during 7th Convocation on 23rd Feb. 2018
- 100+ UG Summer Researcher Fellows
- Rs 10K, 100K per student
- 10.27 Ph D per faculty
- Highest citation per faculty
- Annual citations per year more than 10,000
- SCOPUS Awards: 4 faculty in top 10 Chem Engg and 2 in top Chemistry faculty in India: 20th March 2018
- 4 Fellows of INSA, 4 Fellows of TWAS, 4 JC Bose Fellows
- Many of NASI, IASc, INAE,
- Preferred destination for Faculty Recharge Programme of UGC
- 23 Endowment Chairs; 15 UGCFR, 8 INSPIRE, 2 Ramanujam, 2 Ramalingaswami fellows
- 49 Endowment Visiting Fellowships; 11 endowments for library
- India's five Ph Ds in E & T from ICT in 1941-42
- 468 papers: 406 Patents filed in last 10 years
- 104 Projects including multinational; Publications/faculty highest
- Two Ch E alumni FRS, London
- 1 Company under section 8 of Companies Act
- Donations under CSR, 80G, 35(I) (II) 3 C, 3E
- Many technologies transferred to industry.



## Prof. Ganapati Dadasaheb Yadav

B. Chem. Eng., Ph.D.(Tech.), D.Sc.(Hon.Causa), FTWAS, FNA, FASc, FNASc, FNAE, FISTE, FRSC (UK), ChE, FICHEM(UK), FIICHE, FICS, FMASc, FIICHE Vice Chancellor & R.T. Mody Distinguished Professor  
J.C. Bose National Fellow (DST-Gol)  
Adjunct Professor, RMIT University, Melbourne, Australia  
Adjunct Professor, University of Saskatchewan, Canada  
Padamshri Awardee

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### Granted Patents

- One pot synthesis of oxo-alcohols using heterogeneous catalyst***  
Patent No: IN306714; 2019  
Inventors: **Yadav Ganapati Dadasaheb**; Patankar Saurabh Chandrakant  
**Abstract:** The present invention relates to synthesis of C3 – C4 oxo-alcohols from corresponding aldehyde with greater selectivity in a single pot using recyclable multifunctional catalyst. The said multifunctional catalyst provides cascade reaction in one pot.
- Process of methylation of phenol with increased anisole selectivity***  
Patent No: IN307293; 2019  
Inventors: **Yadav Ganapati Dadasaheb**; BhadraKalpesh Hemraj  
**Abstract:** The present invention relates to a process of methylation of phenol with increased anisole selectivity.
- Process of methylation of phenol with increased cresol selectivity***  
Patent No: IN 308135; 2019  
Inventors: **Yadav Ganapati Dadasaheb**; Bhadrakalpesh Hemraj  
**Abstract:** The present invention relates to process of methylation of phenol with increased cresol selectivity.
- Tunable catalyst for vapor phase methylation and preparation thereof***  
Patent No: IN308448; 2019  
Inventors: **Yadav Ganapati Dadasaheb**; Bhadra Kalpesh Hemraj  
**Abstract:** The present invention relates to tunable catalyst for vapor phase methylation and preparation thereof.
- Process for the synthesis of glycidol directly from glycerol***  
Patent No: IN298791; 2018  
Inventors: **Yadav Ganapati Dadasaheb**; Chandan Payal Arvind  
**Abstract:** Heterogeneous solid base catalyst comprising supported mixed oxide base catalyst has been disclosed herein. Application side of the said catalyst has shown remarkable improvement in process of producing glycerol carbonate and glycidol from glycerol.
- Process for production of [4-(Alkyl/Aryl)-oxy-1,3-Dioxalane-2-One] using heterogeneous reusable catalyst***  
Patent No.: IN 301736; 2018  
Inventors: **Yadav Ganapati Dadasaheb**; Surve Prasad Satish  
**Abstract:** The present invention is related to use of heterogeneous catalyst comprising monovalent metal and divalent metal prepared by combustion synthesis wherein said catalyst composition having particle size in the range of 1nm to 100 nm.

*Process for production of 2-oxazolodones using efficient and reusable heterogeneous catalyst or bio-catalyst*

7. Patent No: IN 304930; 2018  
Inventors: **Yadav Ganapati Dadasaheb**; Surve Prasad Satish; Pawar Sandip Vithoba  
**Abstract:** The present invention is related to use of heterogeneous catalyst comprising monovalent metal and divalent metal prepared by combustion synthesis wherein said catalyst composition having particle size in the range of 1nm to 100 nm or use of supported or unsupported enzyme catalyst.

*Hydrogen production method by multi-step copper-chlorine thermochemical cycle*

8. Patent No: IN 294447; 2018  
9. Patent No.: CA 2841231; 2016  
10. Patent No.: KR10-1619677; 2016  
11. Patent No.: US8968697 B2; 2015  
12. Patent No.: CN 103930365 ; 2016  
13. Patent No.: JP5820928; 2015  
Inventors: **Yadav, Ganapati Dadasaheb**; Parhad Prakash Santoshrao; Nirukhe Ashwini Bhagavan; Parvatalu, Damaraju; Bhardwaj, Anil; Prabhu, Bantwal Narayana; Thomas, Nuzhath Joeman; Kale, Dilip Madhusudan  
**Abstract:** The present invention discloses a method for thermochemical production of hydrogen and oxygen from water by a low temperature, multi-step, closed, cyclic copper-chlorine (Cu-Cl) process involving the reactions of copper and chlorine compounds.

*Effect of operating parameters on the performance of electrochemical cell in copper-chlorine cycle*

14. Patent No: IN 294960; 2018  
15. Patent No: GB2505852; 2018  
16. Patent No.: US9487876; 2016  
17. Patent No.: CA2841234; 2016  
18. Patent No.: JP5908583; 2016  
Inventors: **Yadav, Ganapati Dadasaheb**; Parhad Prakash Santoshrao; Nirukhe Ashwini Bhagavan; Parvatalu, Damaraju; Bhardwaj, Anil; Prabhu, Bantwal Narayana; Thomas, Nuzhath Joeman; Kale, Dilip Madhusudan  
**Abstract:** The electrolysis of cuprous chloride was carried out in the electrochemical cell. The particle size, current density, cathodic current efficiency, conversion of cuprous chloride and yield of copper formed depends strongly on current flow, heat transfer and mass transfer operation.

*Process for the conversion of glycerol in to dichloropropanols using gaseous hydrochloric acid as chlorinating agent in the presence of heterogeneous solid acid as catalyst*

19. Patent No: IN 280232; 2017  
Inventors: **Yadav Ganapati Dadasaheb**; Surve Prasad Satish  
**Abstract:** Processes for chlorination of glycerol with removing water generated in reaction mixture carried out in reactive distillation assembly and without removing water in pressure vessel at superatmospheric pressure of HCl gas. The process gives 99% glycerol conversion with 71% selectivity towards 1,3-dichloropropanol

*A process for preparation of liquid hydrocarbons by fischer tropsh NBSP synthesis*

20. Patent No:IN280555; 2017



Inventors: **Yadav Ganapati Dadasaheb**; Bokade Vijay Vasant

**Abstract:** An improved process for the preparation of liquid hydrocarbons having high selectivity containing at least 6 carbon atoms, said process comprising step of contacting mixture of carbon monoxide and hydrogen with a metal incorporated heteropolyacid catalyst.

*Process for production of propanediol*

21. Patent No: IN 279597; 2017

Inventors : **Yadav Ganapati Dadasaheb**; Chandan Payal Arvind

**Abstract:** A process of production of lower alcohols by selective catalytic hydrogenolysis of polyhydroxy alcohols. In the present process, hydrogenolysis of glycerol is carried out in the presence of a heterogeneous catalyst containing metal incorporated in manganese octahedral molecular sieve type-2 (M-OMS-2).

Electrochemical cell used in production of hydrogen using cu-cl thermochemical cycle

*Development of novel nanoporous composite material*

22. Patent No: IN 282555; 2017

Inventors: **Yadav Ganapati Dadasaheb**; Manyar Gopaldas Haresh

**Abstract:** A novel nanoporous open framework inorganic composite material, of redox nature, possessing unidimensional nanoporous tunnels with vacant oxygen deficient sites in the lattice of its matrix and process for their preparation are disclosed.

*Electrochemical cell used in production of hydrogen using cu-cl thermochemical cycle*

23. Patent No.: US9447512; 2016

24. Patent No.: CA2841236; 2016

25. Patent No.: GB2506318; 2016

26. Patent No: CN103930365; 2016

27. Patent No.: GB1400307.3; 2016

28. Patent No.: JP5852238; 2015

Inventors: **Yadav Ganapati Dadasaheb**; Parhad Prakash Santoshrao; Nirukhe Ashwini Bhagavan; Parvatalu, Damaraju; Bhardwaj Anil; Prabhu Bantwal Narayana; Thomas Nuzhath Joeman; Kale Dilip Madhusudan

**Abstract:** The electrochemical cell consists of hollow tube and centralized copper rod. The anolyte and catholyte compartments are separated by ion exchange membrane fixed over inner hollow tube having holes on the surface. The cell further comprises of a Teflon gasket, a copper rod, a circular ring.

*Method for conversion of sucrose to value-added chemical*

29. Patent No: IN 268179; 2015

Inventors: **Yadav Ganapati Dadasaheb**; Sharma Rajesh V.

**Abstract:** The present invention relates to process for production of 5-HMF from sucrose by using heterogenous solid acid ICaT-2 catalyst in presence of mixture of solvent.

*Catalyst composition (ICaT-3) comprising of transition metals supported on a acidified anatase titania*

30. Patent No.: IN262845; 2010

Inventors: **Yadav Ganapati Dadasaheb**; Sharma Rajesh Vishudev

**Abstract:** The heterogeneous solid acid catalyst (ICaT-3) has been disclosed herein. The catalyst of the invention comprises of transition metals loaded, chlorosulfonic acid treated anatase nano titania. The said catalyst composition has the specific surface area in the range of 20 m<sup>2</sup>/g to 200 m<sup>2</sup>/g.

***Combustion synthesized zirconia as material and catalyst***

31. Patent No.: IN 268910; 2015

Inventors: **Yadav Ganapati Dadasaheb;** Ajaonkar Naishadh Pradeep

**Abstract:** Catalyst comprising sulfated metal oxide synthesized via solution combustion synthesis. A mesoporous superacidic is having surface area in the range of 1 to 1000 m<sup>2</sup>/g, pore diameter in the range of 2 to 25 nm and pore volume in the range of 0.01 to 3 cm<sup>3</sup>/g for use in acid catalyzed reactions which occur in the mesoporous range of the catalysts.

***Process for the production of acrolein and reusable catalyst thereof***

32. Patent No.: IN268194; 2015

Inventors: **Yadav Ganapati Dadasaheb;** Sharma Rajesh Vishudev; Katole Suraj Onkar

**Abstract:** Calcinated catalyst comprising composition of d-block transition metals, p-block metal and silicon as base metal atom along with oxygen wherein catalyst specific surface area is in the range 50 m<sup>2</sup>/g to 1000 m<sup>2</sup>/g. By using calcinated catalyst composition, aqueous glycerol solution is converted under mild reaction conditions to give high purity acrolein.

***A process for the synthesis of glycidol directly from glycerol and catalyst thereof***

33. Patent No.: IN263219; 2014

Inventors: **Yadav Ganapati Dadasaheb;** Chandan Payal Arvind

**Abstract:** A process for producing glycerol carbonate and glycidol from glycerol. The said process comprises reacting glycerol and dimethyl carbonate in a solvent by using a heterogeneous reusable solid base catalyst.

***Process for production of furfural from xylose by using heterogeneous catalyst***

34. Patent No.: IN263215; 2010

Inventors: **Yadav Ganapati Dadasaheb;** Sharma Rajesh Vishnudev

**Abstract:** The invention relates to a process for producing furfural from xylose by using heterogeneous catalyst. Xylose conversion and furfural yield are increased with increasing temperature and amount of catalyst. Xylose conversion is 92% with furfural yield 67% achieved after 3 h at 170 °C. Catalyst is recycled several times without loss of its activity.

***Method for preparation of 2,5-diformylfuran from 5-hydroxymethylfurfural***

35. Patent No.: IN264515; 2010

Inventors: **Yadav Ganapati Dadasaheb;** Sharma Rajesh Vishnudev

**Abstract:** A process for producing 2,5-diformylfuran (DFF) by oxidation of 5-hydroxymethylfurfural by utilizing heterogeneous ICaT-4 catalyst in the presence of oxidant such as oxygen, air or oxygen containing gases has been developed.

***A process for vapour phase alkylation reaction***

36. Patent No.: IN259668; 1997

Inventors: **Yadav Ganapati Dadasaheb;** Sellamuthupillai Krishanan Munivemmal; Atmaram Pujari Ajit; Mujeebur Rahuman Mohmed Sheik Mohmed

**Abstract:** A process for vapour phase alkylation reaction for selectively forming

monoalkylated arylamine, alkylated at para-position.

*A process for the preparation of multimetallic halide catalyst*

37. Patent No.: IN197381; 1997  
Inventors: **Yadav Ganapati Dadasaheb**; Nagarajan Kirthivasan  
**Abstract:** A process for the preparation of multimetallic halide catalyst by mixing under stirring the composition containing 5 to 50 wt% of two or more transition metal halides and 95 to 50 wt% of clay in a non-reactive polar solvent followed by drying at a temperature in the range of 25°C to 150°C to obtain multimetallic halide catalyst.

*A process for preparation of a highly acidic mesoporous solid catalysts*

38. Patent No.: IN232059; 2009  
Inventors: **Yadav Ganapati Dadasaheb**; M. S. Krishnan  
**Abstract:** The invention relates to method for preparation of highly acidic mesoporous solid catalysts.

*Catalytic applications of novel nanoporous composite material*

39. Patent No. IN262489; 2007  
Inventors: **Yadav Ganapati Dadasaheb**; Manyar Gopaldas Hareh  
**Abstract:** A novel nanoporous open framework inorganic composite material, of high industrial importance is disclosed. Also the chemical process catalyzed by the novel nanoporous inorganic composite material produces no inorganic salts and offer several different reactor configurations and thus can replace advantageously conventional hazardous stoichiometric catalysts.

*Novel mesoporous catalysts for industrial processes*

40. Patent No.: IN263277; 2007  
Inventors: **Yadav Ganapati Dadasaheb**; Gaikwad P. Umesh  
**Abstract:** The present invention relates to a novel active mesoporous superacid and stable catalyst characterized by strong acidic centers of molybdenum zirconia in the framework of well-defined mesoporous materials and also to a process for synthesizing the said catalyst.

*A process for selective nitration of aromatic compounds using solid acid catalyst UDCAT-2*

41. Patent No.: IN197359; 2006  
Inventors: **Yadav Ganapati Dadasaheb**; Jayesh Janardhan Nair; Vikas Narendra  
**Abstract:** Relates to nitration of aromatic compounds using solid acid catalyst UDCAT-2.

*A process for selective cyclisation of D-Citronellal to l-isopulerol using solid acid catalyst UDCAT-2*

42. Patent No.: IN197358; 2006  
Inventors: **Yadav Ganapati Dadasaheb**; Jayesh Janardhan Nair  
**Abstract:** Relates to use of UDCAT-2 catalyst for selective cyclisation of D-citronellol.

*Improved Fridel-Crafts process for acylation and alkylation of substituted aromatics using solid acid catalyst UDCAT-1*

43. Patent No.: IN213816; 2008  
Inventors: **Yadav Ganapati Dadasaheb**; M. S. Krishnan  
**Abstract:** The invention relates to improved Fridel-Crafts process for acylation and

alkylation of substituted aromatics using solid acid catalyst UDCAT-1

*A process for producing oligomers from alpha olefins*

44. Patent No.: IN197357; 2007  
Inventors: **Yadav Ganapati Dadasaheb**; Munivemmal Sellamuthupillai Krishnan; Irav Shashikant Doshi  
**Abstract:** The invention relates to a process for producing oligomers from alpha olefins

*Process for the production of glycerol carbonate and reusable catalyst thereof*

45. Patent No.: IN267133; 2009  
Inventors: **Yadav Ganapati Dadasaheb**; Chandan Payal Arvind  
**Abstract:** Calcinated catalyst composition is designed and developed comprising divalent metal trivalent metal, silicon along with oxygen wherein catalyst specific surface area is in the range 50 m/g to 1000 m/g. By using Calcinated catalyst composition, glycerol is reacted with dimethyl carbonate at mild reaction conditions to give high purity glycerol carbonate.

*Method for conversion of sucrose to value-added chemical*

46. Patent No.: IN268179; 2010  
Inventors: **Yadav Ganapati Dadasaheb**; Sharma Rajesh Vishnudev  
**Abstract:** Method for production of 5-hydroxymethylfurfural from sucrose by using heterogeneous solid acid ICaT-2 catalyst in presence of mixture of solvents. Sucrose conversion of 73 % with 5-hy doxy methyl furfural yield 58 % is achieved after 60 min at 180 °C. Reactions are carried out in batch mode operation.

*Method for catalytic dehydration of glycerol*

47. Patent No.: IN270815; 2009  
Inventors: **Yadav Ganapati Dadasaheb**; Sharma Rajesh Vishnudev; Katole Suraj Onkar  
**Abstract:** A process for catalytic dehydration of glycerol on vapour phase fixed bed catalytical reactor by using dodecatungstophosphoric acid supported on hexagonal mesoporous silica as base metal is studied. This process gives glycerol conversion (99%) with acrolein selectivity (80%).

*Process for production of 5-hydroxymethylfurfural*

48. Patent No.: IN270053; 2010  
Inventors: **Yadav Ganapati Dadasaheb**; Sharma Rajesh Vishnudev  
**Abstract:** This invention related to method of producing 5-Hydroxymethylfurfural from fructose by using heterogeneous solid acid catalyst ICaT-2 without giving any considerable byproduct.

*Novel mesoporous superacid catalyst*

49. Patent No.: IN274345; 2007  
Inventors: **Yadav Ganapati Dadasaheb**; Gaikwad P. Umesh  
**Abstract:** A novel mesoporous solid super acid catalyst was synthesized by grinding tungstic acid with initially supported hexagonal mesoporous silica with zirconium hydroxide.

*Catalyst composition (ICaT-2) comprising of rare earth metal*

50. Patent No: IN268182; 2010  
Inventors: **Yadav Ganapati Dadasaheb**; Sharma Rajesh Vishnudev  
**Abstract:** The water tolerant solid heterogeneous acid catalyst (ICaT-2) comprising of

rare earth metals in the form of trifluoromethanesulphonate, anchored with hexagonal organic-inorganic mesoporous silica as base metal through organic-inorganic linkages.

## **Patent Applications Filed**

### ***Process of preparation of 1,2-pentanediol from furfural***

1. Indian Application No: 201921005157  
Inventors: **Yadav Ganapati Dadasaheb**  
**Abstract:** The present invention relates to a process of preparation of 1,2-pentanediol from furfural.

### ***Dual function multiphase microreactor***

2. Indian Application No: 201821031887
3. PCT Application No: PCT/IN2018/050780
4. PCT Application No: PCT/IN2018/050622  
Inventors: **Yadav Ganapati Dadasaheb**  
**Abstract:** The present invention relates to a dual function multiphase microreactor.

### ***Novel eco-friendly insecticides based on silicon compounds and process of preparation thereof***

5. PCT Application No: PCT/IN2018/050050  
Inventors: **Yadav Ganapati Dadasaheb**; Fernandes Godfree P.; Katole Dhiraj O.  
**Abstract:** The present invention provides novel silicon-based compounds or salt thereof of general formula (I), wherein R1 and R2 Represent the Halogen, Hydrogen, alkyl, alkoxy or aryl group and R3, R4, R5 and R6 represents Chlorine or Hydrogen or hydroxyl group. The said compounds are biodegradable active insecticides. The invention also relates to process for the manufacture of said compounds and compositions containing them and their use.

### ***Biocatalytical process for racemization of D-ephedrine***

6. Indian Application No: 201821041686  
Inventors: **Yadav Ganapati Dadasaheb**; Mohire Shalaka S; Ashily Rajendran  
**Abstract:** The present invention relates to biocatalytical process for racemization of D-ephedrine

### ***Dual function multiphase microreactor***

7. Indian Application No: 201721006702  
Inventors: **Yadav Ganapati Dadasaheb**  
**Abstract:** The present invention relates to a dual function multiphase microreactor.

### ***Efficient synthesis of 5-hydroxymethylfurfural catalyzed in heterogeneous acidic ionic liquid***

8. Indian Application No: 201721006714  
Inventors : **Yadav Ganapati Dadasaheb**; Gawade Anil Bhagchand; Talapade Abhijit Deepak  
**Abstract:** The present invention relates to an efficient synthesis of 5-hydroxymethylfurfural catalyzed in heterogeneous acidic ionic liquid.

### ***An improved continuous flow stirred multiphase reactor***

9. Indian Application No: 201721005814
10. PCT Application No.: PCT/IN2018/050535

Inventors: **Yadav Ganapati Dadasaheb**

**Abstract:** The present invention relates to an improved continuous flow stirred multiphase reactor.

*Novel eco-friendly insecticides based on silicon compounds and process of preparation thereof*

11. Indian Application No: 201721003943

Inventors: **Yadav Ganapati Dadasaheb**; Fernandes Godfree Pavalu; Katole; Dhiraj Onkar

**Abstract:** The present invention relates to novel eco-friendly insecticides based on silicon compounds and process of preparation thereof.

*A molten salt composition for high temperature thermal energy storage*

12. Indian Application No: 201721016058

13. PCT Application No: PCT/IN2018/050273

Inventors: **Yadav Ganapati Dadasaheb**; Patange Swanand Raghunath; Bhargava Bharat; Sharma Diwakar; Shankar Uday

**Abstract:** The present invention relates to a molten salt composition for high temperature thermal energy storage.

*Process of methylation of phenol with increased anisole selectivity*

14. PCT Application No.: PCT/IN2017/000027

Inventors: **Yadav Ganapati Dadasaheb**; Bhadra Kalpesh Hemraj

**Abstract:** The present invention relates to a process of methylation of phenol with increased anisole selectivity.

*Tunable catalyst for vapor phase methylation and preparation thereof*

15. PCT Application No.: PCT/IN2017/000028

Inventors: **Yadav Ganapati Dadasaheb**; Bhadra Kalpesh Hemraj

**Abstract:** The present invention relates to tunable catalyst for vapor phase methylation and preparation thereof.

*Heterogenous catalyst for selective hydrogenolysis and method of preparation thereof*

16. Indian Application No: 201621041576

Inventors: **Yadav Ganapati Dadasaheb**; Gawade; Anil Bhagchand; Tiwari Manishkumar Subhashchandra

**Abstract:** The present invention relates to heterogenous catalyst for selective hydrogenolysis and method of preparation thereof.

*A process for synthesis of 2,5-dimethylfuran by selective hydrogenolysis of 5-hydroxymethylfurfural at mild condition*

17. Indian Application No: 201621041577

Inventors: **Yadav Ganapati Dadasaheb**; Gawade Anil Bhagchand; Tiwari Manishkumar Subhashchandra

**Abstract:** The present invention relates to a process for synthesis of 2,5-dimethylfuran by selective hydrogenolysis of 5-hydroxymethylfurfural at mild condition.

*Environmentally benign heterogeneous catalyst for fenton process*

18. Indian Application No: 558/MUM/2014

Inventors: **Yadav Ganapati Dadasaheb**; Kunde Gajanan Bhimraoji

**Abstract:** The present invention provides for oxidation heterogeneous catalysts

comprising of alumina support doped with iron compound in its matrix processed in the form of pellets, powders and nodules for the treatment of organic contaminants present in waste water, a method for production, a method for recycling.

***Titania membrane support and combustion method for making the same***

19. Indian Application No: 474/MUM/2013  
Inventors: **Yadav Ganapati Dadasaheb**; Surve Prasad Satish  
**Abstract:** Preparation of Titania membrane wherein the membrane support comprises of anatase and combination of anatase and rutile nano Titania as basic metal. The said membrane composition has the % porosity in the range of 30 to 80, and a pore diameter in the range of 0.1-10  $\mu\text{m}$  as per Hg Porosimetry.

***Combustion synthesis of nanocrystalline alkali and alkaline earth metal oxides or mixture thereof and its applications***

20. Indian Application No: 628/MUM/2012  
Inventors: **Yadav Ganapati Dadasaheb**; Surve Prasad Satish  
**Abstract:** The present invention relates to the development of nano crystalline heterogeneous solid base catalyst comprising alkali and/or alkaline earth metal oxide and/or of mixture thereof by self-propagating liquid combustion synthesis method. The particle size obtained is in the range of 10-20 nm.

***Combustion synthesis of nanocrystalline alkali and alkaline earth metal oxides or mixture thereof and its applications in synthesis of [4-(alkyl/aryl)-oxy-1,3-dioxolane-2- one] and 2-oxazolidinones***

21. PCT Application No: PCT/IN2013/000146  
Inventors: **Yadav Ganapati Dadasaheb**; Surve Prasad Satish  
**Abstract:** The present invention relates to the development of Nano crystalline heterogeneous solid base catalyst of particle size 10-20nm comprising alkali and/or alkaline earth metal oxide and/or of mixture thereof by self-propagating liquid combustion synthesis method wherein said catalyst composition possesses high catalytic activity.

***Method for production of membrane***

22. Indian Application No: 627/MUM/2012  
Inventors: **Yadav Ganapati Dadasaheb**; Kunde Gajanan; Babu C. Anand  
**Abstract:** Method for production of membrane having high strength enhanced thermal stability and chemical resistance comprising steps of forming and casting of gel, heating of casted gel to form semidried film, sizing and drying of semidried gel film and further calcining dried film by placing it between two plain porous ceramic pieces to obtained membrane.

***Unsupported titania membrane and method for the preparation thereof***

23. Indian Application No.: 1109/MUM/2012  
Inventors: **Yadav Ganapati Dadasaheb**; Doke Suresh Maruti; Chintala Chervu Anand Babu  
**Abstract:** Preparation of unsupported titania comprising of anatase nano titania as basic metal. The said membrane composition has the specific surface area in the range of 20 to 500  $\text{m}^2/\text{g}$ , pore volume in the rage of 0.01 to 0.5  $\text{ml}/\text{g}$  and a pore diameter in the range of 20-500  $\text{\AA}$ .

***System for production of membrane***

24. Indian Application No.: 1823/MUM/2012  
Inventors: **Yadav Ganapati Dadasaheb**; Kunde Gajanan; Babu C. Anand  
**Abstract:** A system for production of membrane comprising of two furnace plates

which are heated by heating coil. The sintering of the semidried metal oxide diaphragms is done between two furnace plates. The heating of metallic coil and working of thermocouple is controlled by electronic digital PID controller. The sandwich assembly of the furnace plates can be locked by the locking shaft.

***System and method for production of membrane***

25. PCT Application No.: PCT/IN2013/000145

Inventors: **Yadav Ganapati Dadasaheb**; Kunde Gajanan; Babu C. Anand

**Abstract:** System and method for production of membrane having high strength, enhanced thermal stability and chemical resistance comprising of at least two furnace plates, at least one heating coils encased in ceramic disc housing, metal sheet and base.

***Hydrogen production method by multi-step copper-chlorine thermochemical cycle***

26. PCT Application No: PCT/IN2012/000483

27. UK Application No: GB1400306.5

Inventors: **Yadav Ganapati Dadasaheb**; Parhad Prakash Santoshrao; Nirukhe Ashwini Bhagavan; Parvatalu, Damaraju; Bhardwaj Anil; Prabhu Bantwal Narayana; Thomas Nuzhath Joeman; Kale Dilip Madhusudan

**Abstract:** The present invention discloses a method for thermochemical production of hydrogen and oxygen from water by a low temperature, multi-step, closed, cyclic copper-chlorine (Cu-Cl) process involving the reactions of copper and chlorine compounds.

***Effect of operating parameters on the performance of electrochemical cell in copper-chlorine cycle***

28. PCT Application No: PCT/IN2012/000485

29. Korean Application No: KR 10-2014-7003290

30. China Application No: CN 201280033678.9

Inventors: **Yadav Ganapati Dadasaheb**; Parhad Prakash Santoshrao; Nirukhe Ashwini Bhagavan; Parvatalu Damaraju; Bhardwaj Anil; Prabhu Bantwal Narayana; Thomas Nuzhath Joeman; Kale Dilip Madhusudan

**Abstract:** The electrolysis of cuprous chloride was carried out in the electrochemical cell. The particle size, current density, cathodic current efficiency, conversion of cuprous chloride and yield of copper formed depends strongly on current flow, heat transfer and mass transfer operation.

***Electrochemical cell used in production of hydrogen using Cu-Cl thermochemical cycle***

31. Indian Application No: 1975/MUM/2011

32. PCT Application No: PCT/IN2012/000486

33. Korean Application No: KR 10-2014-7003294

34. Korean Application No: KR 10-2016-7020676

Inventors: **Yadav Ganapati Dadasaheb**; Parhad Prakash Santoshrao; Nirukhe Ashwini Bhagavan; Parvatalu, Damaraju; Bhardwaj Anil; Prabhu Bantwal Narayana; Thomas Nuzhath Joeman; Kale Dilip Madhusudan

**Abstract:** The electrochemical cell consists of hollow tube and centralized copper rod. The anolyte and catholyte compartments are separated by ion exchange membrane fixed over inner hollow tube having holes on the surface. The cell further comprises of a Teflon gasket, a copper rod, a circular ring.



***Bimetallic manganese oxide octahedral molecular sieve catalysts (M1M2-OMS-2) for hydrogenolysis reaction***

35. Indian Application No: 1775/MUM/2010  
Inventors: **Yadav Ganapati Dadasaheb;** Chandan Payal Arvind; Tekale Devendra Pandurang; Motirale Bhavana Ganesh  
**Abstract:** A novel bimetallic manganese oxide octahedral molecular sieve (M1M2-OMS-2) based catalyst and its synthesis wherein octahedral molecular sieve type two is doped with at least two metals other than manganese oxide.

***Catalyst composition (ICaT-3) comprising of transition metals supported on a acidified anatase titania***

36. PCT Application No: PCT/IN2011/000091  
Inventors: **Yadav Ganapati Dadasaheb;** Sharma Rajesh Vishudev  
**Abstract:** The heterogeneous solid acid catalyst (ICaT-3) has been disclosed herein. The catalyst of the invention comprises of transition metals loaded, chlorosulfonic acid treated anatase nano titania.

***Hydrogenolysis of polyhydroxy alcohols using metal incorporated manganese oxide octahedral molecular sieve as a catalyst***

37. PCT Application No: PCT/IN2010/000406  
Inventors: **Yadav Ganapati Dadasaheb;** Chandan Payal Arvind; Tekale Devendra Pandurang; Motirale Bhavana Ganesh; Mewada Rajubhai Kanaiyalal  
**Abstract:** The invention relates to the hydrogenolysis of polyhydroxy alcohols in the presence of metal incorporated manganese oxide octahedral molecular sieve catalyst (M-OMS) to produce their corresponding lower alcohols.

***Process for the production of acrolein and reusable catalyst thereof***

38. PCT Application No: PCT/IN2010/000755  
Inventors: **Yadav Ganapati Dadasaheb;** Sharma Rajesh Vishudev; Katole Suraj Omkar  
**Abstract:** Calcinated catalyst comprising composition of d-block transition metals, p-block metal and silicon as base metal atom along with oxygen wherein catalyst specific surface area is in the range 50 m<sup>2</sup>/g to 1000 m<sup>2</sup>/g. By using calcinated catalyst composition, aqueous glycerol solution is converted under mild reaction conditions to give high purity acrolein

***Process for converting fructose into 5-hydroxymethylfurfural using a mesoporous silica based catalyst impregnated with rare earth metals***

39. PCT Application No: PCT/IN2011/000048  
Inventors: **Yadav Ganapati Dadasaheb;** Sharma Rajesh Vishnudev  
**Abstract:** This invention related to method of producing 5-hydroxymethyl furfural from fructose by using heterogeneous solid acid catalyst ICaT-2 without giving any considerable byproduct.

***Process for production of furfural from xylose using heterogeneous mesoporous silica based catalyst comprising rare earth metals***

40. PCT Application No: PCT/IN2010/000835  
Inventors: **Yadav Ganapati Dadasaheb;** Sharma Rajesh Vishnudev  
**Abstract:** The invention relates to process for furfural from xylose by using heterogeneous catalyst. Reactions are carried out in batch reactor by using mixture of solvents. Effect of temperature, amount of catalyst loading and xylose concentration are studied in detail.

***Method for converting sucrose to 5 - HMF using a lanthanum containing porous silica catalyst***

41. PCT Application No.: PCT/IN2010/000834  
Inventors: **Yadav Ganapati Dadasaheb**; Sharma Rajesh Vishnudev  
**Abstract:** Method of producing 5-hydroxymethyl furfural from fructose by using heterogeneous solid acid catalyst ICaT-2 without giving any considerable byproduct.

***Preparation of 2, 5 - diformylfuran from 5-HMF with a heterogeneous mesoporous silver containing manganese catalyst***

42. PCT Application No.: PCT/IN2011/000061  
Inventors: **Yadav Ganapati Dadasaheb**; Sharma Rajesh Vishnudev  
**Abstract:** A process for producing 2,5-diformylfuran (DFF) by oxidation of 5-hydroxymethylfurfural by utilizing heterogeneous ICaT-4 catalyst in the presence of oxidant such as oxygen, air or oxygen containing gases has been developed.

***Catalyst composition comprising rare earth metal triflate anchored on mesoporous silicate***

43. PCT Application No.: PCT/IN2011/000102  
Inventors: **Yadav Ganapati Dadasaheb**; Sharma Rajesh Vishnudev  
**Abstract:** The water tolerant heterogeneous acid catalyst (ICaT-2) comprising of rare earth metals in the form of trifluoromethanesulphonate anchored with hexagonal organic-inorganic functionalized mesoporous silica as base metal through organic-inorganic linkages i.e. via mercapto-groups or sulphonate groups.

***Bimetallic heterogeneous catalyst for use in eco-friendly solvents***

44. Indian Application No.: 2511/MUM/2014  
45. PCT Application No.: PCT/IN2015/000314  
Inventors: **Yadav Ganapati Dadasaheb**; Patankar Saurabh Chandrakant  
**Abstract:** The present invention relates to a heterogeneous, bifunctional catalyst comprising a copper and zirconia, coated with palladium, with the result that, it prevents the leaching of first and second metal catalyst in reaction medium, as well as a process for the preparation of this catalyst.

***One pot synthesis of oxo-alcohols using heterogeneous catalyst***

46. PCT Application No.: PCT/IN2015/000455  
Inventors: **Yadav Ganapati Dadasaheb**; Patankar Saurabh Chandrakant  
**Abstract:** The present invention relates to synthesis of C3 – C4 oxo-alcohols from corresponding aldehyde with greater selectivity in a single pot using recyclable multifunctional catalyst. The said multifunctional catalyst provides cascade reaction in one pot.

## **Industrial Consultancy till date**

1. Bombay Oil Industries
3. Rubber Chem, Div. Mumbai (NOCIL)
5. Simpower Eng. Pvt. Ltd.
7. Aminex Group of Companies
9. Aarti Industries Ltd.
11. Aarti Industries Ltd.
13. Kopran Ltd., Khopoli
15. Aminex Group of Companies
17. Alkyl Amines Ltd.
19. Rallies India Ltd.
21. IPCA Laboratories Ltd.
23. United Phosphorus Ltd.
25. EPIC Industries Ltd.
27. Medigraph Pharmaceuticals Pvt. Ltd.
29. US Vitamins Ltd.
31. Dr Reddy's Laboratories Ltd.
33. FinorPiplaj Chemicals Ltd.
35. Asha Cellulose Pvt Ltd.
37. Quimica Industries Pvt Ltd.
39. Gwalior Chemical Industries Ltd.
41. Perstrop Aegis Chemicals Pvt Ltd.
43. Research Support International
45. Perstrop Chemical Pvt Ltd.
47. Sajjan India Ltd.
49. Chemito Group
51. Krishna Solvents and Chemicals
53. McKinsey & Company
55. Kemtech Solutions Pvt Ltd.
57. ONGC Energy Centre
59. Malladi Drugs & Pharmaceuticals
61. ONGC Energy Centre
63. Mckinsey (for Cadilla Zydus)
64. Polyolefins Industries Ltd., Rubber Chemicals Division
65. Dishman Pharmaceuticals & Chemicals Ltd.
66. Dishman Pharmaceuticals and Chemicals Ltd.
2. Polyolefins Industries Ltd.
4. New Insurance Co. Mumbai
6. Bharat Vijay Chemicals
8. AminexAlkalies Ltd.
10. Amex Carbonates& Chemicals Ltd.
12. Industrial Perfumes Ltd.
14. Nascent Chemical Industries
16. Laxmi Organic Industries Ltd.
18. Nascent Chemical Industries
20. Rallis India Ltd.
22. Rallis (India) Ltd.
24. Mangalam Drugs & Organics
26. Sudarshan Chemical Industries Ltd.
28. Kedia Chemicals Pvt. Ltd.
30. Ballarpur Industries Ltd.
32. Mangalam Drugs and Organics
34. Sabero Gujarat Organics Ltd.
36. Asha Cellulose Pvt Ltd.
38. Gharda Chemicals Ltd.
40. Mangalam Group of Companies
42. Perstrop India Ltd.
44. Alembic Group of Companies
46. Gharda Chemicals Ltd.
48. Mangalam Group of Companies
50. Hikal Ltd.
52. ONGC Energy Centre
54. Vinati Organics Ltd.
56. U.K. Aromatics and Chemicals, Bhoysar
58. Malladi Drugs & Pharmaceuticals
60. Resonance Specialities Ltd.
62. Heubach India Pvt Ltd.

# Department of Chemical Engineering

## Research Areas:

Energy and Exergy Engineering

Green Chemistry and Technology

Enzymatic Reactions, Polymer chemistry Biotechnology

Reactive adsorptive Separation

Separation and recovery of organic chemicals and metals





## Prof. Bhaskar N. Thorat

Director, ICT-Mumbai Indian Oil Odisha Campus,  
Bhubaneswar  
Professor of Chemical Engineering

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### Patent Applications Filed

#### *Solar Conduction Dryer with Controlled Radiation*

1. Patent No.: PCT/IN2012/000843
2. Patent No.: 740/MUM/2011

Inventors: **Bhaskar Narayan Thorat**; Vaibhav Tidke; Swapnil Kokate

**Abstract:** UN award winning solar powered electricity free-dehydrator that uses conduction, convection, radiation all modes of heat transfer to deliver the world's highest drying efficiency. Machine that doesn't need any maintenance keeps the nutrients at its peak level. No surprise more than 1500 farmer cooperatives across 10 countries are using it at farm level.

#### *CassavaTech and HaldiTech*

3. Patent No.: PCT/IN2014/000689

Inventors: **Bhaskar Narayan Thorat**; Vaibhav Tidke; Swapnil Kokate

**Abstract:** The low temperature internationally patented technology can dehydrate all tuber crops like ginger, turmeric, cassava to retain 25-50% more the key ingredients like curcumin and ginger oil. The electricity powered machine is highly energy efficient needing only 10% of energy than its competitors

#### *Solar Grain Dryer for Grain and Seed drying*

4. Patent No.: yet to receive

Inventors: **Bhaskar Narayan Thorat**; Vaibhav Tidke; Swapnil Kokate

**Abstract:** Application not yet published

#### *Induction heating based fluidized and agitated vertical dryers*

5. Patent No.: yet to receive

Inventors: **Bhaskar Narayan Thorat**; Aditya Deshmukh; Vaibhav Tidke; Swapnil Kokate

**Abstract:** Application not yet published

#### *Microbutor for water testing*

6. Patent No.: yet to receive

Inventors: **Bhaskar Narayan Thorat**; Vaibhav Tidke; Swapnil Kokate

**Abstract:** Application not yet published

### Copyrights/Trademark

1. Medicare kit
2. Atmospheric Freeze dryer
3. Filtration for portable water
4. Water testing kit

## **Industrial Consultancy**

- |  |                                    |
|--|------------------------------------|
| 1. United Phosphorous Limited                | 2. Sonic Biochem                   |
| 3. Reliance Industries Limited               | 4. Kopran Drugs Limited            |
| 5. Ciba Speciality chemicals                 | 6. Nocil (Rubber Chemical Divison) |
| 7. National Peroxide Pvt. Limited            | 8. Phillip Morris                  |
| 9. EDL, New Zealand                          | 10. SF Dyes Pvt. Limited           |
| 11. SS Techno Pvt. Limited                   | 12. Capital Foods                  |
| 13. Gansons India Limited                    | 14. Asian Paints Limited           |
| 15. Emcure Pharma                            | 16. Reliance Life Sciences         |
| 17. Sandoz Pharma                            | 18. Umang Pharmatech               |
| 19. Orchid Pharmaceuticals                   | 20. Shri Kali Metal Powder Ltd.    |
| 21. Black Rose Pvt. Limited                  | 22. Aarti drugs                    |
| 23. Sudarshan Chemicals                      | 24. Jubilant Life Sciences         |
| 25. Technoforce solutions India Pvt. Limited |                                    |
| 26. Puschner Microwave Power Systems         |                                    |



## Prof. Aniruddha B. Pandit

FTWAS, FNA, FNAE, FNASc, FIASc, FMASc

Dean, Human Resource Development (HRD)

Co-coordinator, Homi Sethna ICT-DAE Centre for Chemical Engineering  
Education and Research

Professor, UGC Research Scientist, "C" (Professor's Grade)

J. C. Bose National Fellow (DST, Govt. of India)

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### Granted Patents

#### *Convex bladed mixed flow impeller*

1. Patent No.: US8617569; 2012

Inventors: **Pandit A. B.**; Niranjana K.; Davidson J.F.

**Abstract:** This patent demonstrates the various impeller designs and its effect on the flow regimes.

#### *Process for the preparation of nanoscale particles of elastic material*

2. Patent No.: US7671113; 2008

Inventors: **Pandit A. B.**; Patil M. N.

**Abstract:** The present invention discloses a method for the manufacture of nanoscale particles of Styrene Butadiene Rubber (SBR). As SBR particles are elastic in nature, conventional methods of size reductions such as impacting, grinding are unable to achieve the final size.

### Patent Applications Filed

#### *Effective check valve for water disinfection*

1. Indian Application No: 4719/MUM/2015

Inventors: **Pandit Aniruddha Bhalachandra**; Mukharjee AnjanCharan; Sarjerao Bapu Doltade; Manchalwar Shirish Mukundrao

**Abstract:** The present invention relates to system for disinfection of water. More specifically, the present invention relates to a modified valve system of a mechanically operated water pump (India Mark-II) to disinfect the drinking water.

#### *Cavitation induced nanoemulsion*

2. Indian Application No: 215/MUM/2015

Inventors: Jadhav A. J.; Holkar C.R.; Karekar S. E.; Pinjari D. V.; **Pandit A. B.**

**Abstract:** The present invention relates to the formation of wax (oil) in water nanoemulsion and process for development of said nanoemulsion by cavitation. Still more particularly, the present invention relates to a low energy process for the development of stable nanoemulsion by cavitation.

#### *Energy efficient cooking pressure vessel*

3. Indian Application No: 2203/MUM/2015

Inventors: **Pandit Aniruddha Bhalachandra**, Shingade Sunil Goroba, Waghmode Amol Tukaram

**Abstract:** The present invention relates to a cooking vessel for efficient and complete cooking of grain like rice, lentils, vegetables, meat etc. In short period of time invention of cooking vessel with time efficient in cooking saves fuel up to 12.48%. The cooking vessel of invention further eliminates the dead zone in the central bottom region of vessel where at least some fluid convection needs to occur ensuring the exchange of heat.



***Energy and time efficient cooking annular vessel***

4. Indian Application No: 1944/MUM/2015  
Inventors: **Pandit Aniruddha Bhalachandra**; Shingade Sunil Gorob; Waghmode Amol Tukaram.  
**Abstract:** The present invention relates to a cooking vessel for efficient and complete cooking of rice, lentils, vegetables, meat etc. In short period of time invention of cooking vessel with time efficient in cooking saves fuel upto 22%.

***Method for preparation doped zinc phosphate and composition thereof***

5. Indian Application No: 1834/MUM/2015  
Inventors: **Pandit Aniruddha Bhalachandra**; Karekar Sammit Ekanath; Jadhav Ananda Jaysing; Holkar Chandrakant Ramnath; Pinjari Dipak Vitthal  
**Abstract:** The present invention relates to an improved process for the synthesis of nanocontainer of doped zinc phosphate. The process involves synthesis of zinc phosphate nanoparticles and doping of N-octylphosphonic acid.

***Lacidipine particles***

6. PCT Publication No.: WO2006113309  
Inventors: **Pandit Aniruddha Bhalachandra**; Sundaram Venkataraman; Kharkar Manoj Ramesh; Narsapur Sharat Pandurang; Devarkonda Surya Narayana; Jawlekar, Suhass Lalitadas; Komareddy Ravi Kumar; Goldwyn Adolf Ceaser; Mishra Mamta; Ghosh Arunava; Singh Gurvinder; Nasare Vijay Dinanathji; Gaikar Vilas Gajanan; Hyacinth Mary Anasthas  
**Abstract:** Lacidipine particles having small particle sizes and a narrow particle size distribution.

***An apparatus for disinfection of sea water / ship's ballast water and a method thereof***

7. PCT Publication No: WO2007054956  
Inventors: **Pandit Aniruddha Bhalachandra**; RanadeVivek Vinayak; Chandra shekhar Anil Arga; Sawant Subhash Shivram; DandayudapaniIlangoan; Rajachandran Madhan; Krishnamurthy Pilarisetee Venkat  
**Abstract:** The invention disclosed provides an apparatus and method for disinfection of ship's ballast water, such as sea water, based on hydrodynamic cavitation

***Method of designing hydrodynamic cavitation reactors for process intensification***

8. Chinese Application No.: CN 200980117515.7  
Inventors: **Pandit Aniruddha Bhalachandra**; Mukherjee Anjan Charan; Kasat Gopal Rameshchandra; MahulkarAmit Vinod  
**Abstract:** The present invention describes an apparatus of Hydrodynamic cavitation, to be used as reactors to achieve tangible effect by producing tailored active cavities either transient or steady or both, in aqueous and non-aqueous media for intensification of the physical and chemical processes in homogenous and heterogeneous systems.

***Synthesis of corrosion inhibiting nano pigment comprising of nano container for corrosion inhibitive coating method for magnesium oxide nanoparticles synthesis using solar energy***

9. Indian Application No.: 1539/MUM/2012  
Inventors: Kapole S. A.; Sonawane S. H.; Kulkarni R. D.; **Pandit A. B.**; Bhanvase B. A.; Pinjari D. V.; GogateP. R.  
**Abstract:** The patent consists of developing corrosion inhibitor based nano carriers for applications.

### *Ultrasound assisted process for synthesis of chalcone*

10. Indian Application No: 1504/MUM/2011  
Inventors: Shankarling S.; **Pandit A. B.**; Jarag K. J.; Pinjari D. V.  
**Abstract:** The patent invents the process of synthesizing organic intermediates like chalcone using cavitation assisted process.

### *Synthesis of calcium carbonate nanoparticles by new recycle reactor using cavitation technique*

11. Indian Application No.: 3546/MUM/2011  
Inventors: Sonawane S. H.; Kulkarni R. D.; Mishra S.; **Pandit A. B.**; Gumfekar S.; Ramje L.; Kunte K. J.; Kate K. H.  
**Abstract:** The patents consist of developing continuous process for manufacturing calcium Carbonate nanoparticles using cavitation process.

### *Method for the synthesis of palladium nanoparticles using solar energy*

12. Indian Application No.: 1842/MUM/2011  
Inventors: Patil A. B.; Deshmukh K. M.; **Pandit A. B.**; Bhanage B. M.  
**Abstract:** The patent invents the process of synthesizing palladium nanoparticles using solar energy.

### *Method for zinc oxide nanoparticle synthesis using solar energy*

13. Indian Application No.: 3275/MUM/2011  
Inventors: Patil A. B.; Lanke S. R.; **Pandit A. B.**; Bhanage B. M.  
**Abstract:** The patent invents the process of synthesizing metal oxide nanoparticles like ZnO using solar energy.

### *Method for magnesium oxide nanoparticles synthesis using solar energy*

14. Indian Application No.: 3276/MUM/2011  
Inventors: Patil A. B.; Bhatte K. D.; **Pandit A. B.**; Bhanage B. M.  
**Abstract:** The patent invents the process of synthesizing magnetic nanoparticles using solar energy.

### *Solar Assisted Method for Preparation of Chalcone Compound*

15. Indian Application No.: 201621015500  
Inventors: Jadhav N. L.; Karekar S. E.; Jadhav A. J.; Holkar C. R.; Pinjari D. V.; **Pandit A. B.**  
**Abstract:** The present invention relates to a novel solar assisted method for the preparation of Chalcone compound. More particularly, Chalcone compound is prepared by concentrated solar radiation method.

### Industrial Consultancy till date

- |  |                                |
|--|--------------------------------|
| 1. Aroni Chemicals                       | 2. India Glycol Ltd.           |
| 3. Bombay Dyeing and Mfg. Ltd.           | 4. M/s Asian Paints Ltd.       |
| 5. Color Frost (Bombay) Pvt. Ltd.        | 6. Marico Industries Ltd.      |
| 7. Dr. Reddy's Laboratory                | 8. Perfect Protein Pvt. Ltd.   |
| 9. Godrej Industries Limited             | 10. Sarang Chemicals Pvt. Ltd. |
| 11. Godrej Soaps Ltd.                    | 12. Unilever Research Labs     |
| 13. Herdilia Oxides and Electronics Ltd. | 14. Voltas Ltd.                |
| 15. Reliance Industries Ltd.             | 16. Encore Polymers            |
| 17. Proctor and Gamble                   | 18. Atul industries Ltd.       |
| 19. Eastman Chemical Corp.               |                                |



## Dr. Anand V. Patwardhan

Professor in Chemical Engineering  
Placement Coordinator for  
Department of Chemical Engineering

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### Granted Patents

#### *A structured catalyst for steam reforming of methane for production of syn gas*

1. Patent No.: 271334; 2016

Inventors: Mathure PV; **Patwardhan Anand V**; Saha R. K.; Swamy, B; Ganguly S.

**Abstract:** The present invention relates to steam reforming of methane for production of syn gas and, in particular, to a meso-scale channeled structured catalyst (PS-CAT) comprising a plurality of square thin-walled rectangular channels obtained of cordierite coated with a selective transition metal or noble metal based catalyst formulation adapted to favour continuous and intimate contact of gas feed with the active catalyst with improve feed rate and conversion in steam reforming.



## Dr. Parag R. Nemade

UGC Assistant Professor in  
Engineering Science

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### Patent Applications Filed

#### *Novel nanocomposites of $\gamma$ -MnO<sub>2</sub> supported on graphene oxide used as a catalyst*

1. Indian Application No.: 473/MUM/2014

Inventors: **Nemade P. R.**; Gaikar V. G., Jha N.; Dhopte K. B.; Kadam M. M.

**Abstract:** The invention relates to graphene oxide supported  $\gamma$ -MnO<sub>2</sub> catalyst, which is more than twice as active other MnO<sub>2</sub> based catalysts reported for oxidation of benzyl alcohol using air at low temperatures.

#### *A water-resistant phosphogypsum composition*

2. Indian Application No.:4024/MUM/2014

Inventors: Sarode D. D.; **Nemade P. R.**; Dalvi V. H.; Sontakke S. M.; Zambare R. H.; Mukadam N. V.; Baviskar U. K.

**Abstract:** Invention relates to a gypsum plaster that is suitable for use on external walls that can replace expensive and eco-unfriendly cement plasters. Moreover, the plaster has very low incidence of cracks which is a major issue in cement plaster, thereby improving water resistance.

### Industrial Consultancy till date

1. GAIL India Limited
2. Maharashtra State Power Generation Company Ltd.
3. Rashtriya Chemicals and Fertilizers Ltd.
4. Sterlite Technologies Ltd.



**Dr. Prakash D. Vaidya**  
Rashtriya Chemicals and  
Fertilizers Associate Professor of  
Chemical Engineering

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### Granted Patent

#### *Carbon capture solvents and methods for using such solvents*

1. Patent No.: EP2830737; 2012

Inventors: Bumb P.; **Vaidya P. D.**

**Abstract:** A solvent for recovery of carbon dioxide from gaseous mixture having at least amine, and at least one salt of an amino carboxylic acid or amino sulfonic acids. One specific solvent contains less than about 75% by weight of water and has a single liquid phase.

### Patent Application Filed

#### *Solvent composition and method for removing acidic components from industrial gases*

1. Indian Application No.: 714/MUM/2014

Inventors: **Vaidya P. D.**; Bhagwat S. S.; Budhwani N.; Sinha R.; Chugh P.; Someswarudu M. V. R.

**Abstract:** The present invention relates to an aqueous absorbent composition and a method for efficiently removing carbon dioxide (CO<sub>2</sub>) from industrial gases, using an aqueous solution of an effective amount of at least one alkanolamine and an effective amount of at least one activator.

#### *Novel absorbent composition and method for removing acid compounds from industrial gases*

2. Indian Application No.: 1222/MUM/2015

Inventors: Patil, M. P.; **Vaidya, P. D.**

**Abstract:** The present invention relates to a novel absorbent composition and a method for removal of acidic compounds from industrial gases, wherein the absorbent composition can include an effective amount of at least one alkanolamine and an effective amount of at least one promoter and an effective amount of at least one co-solvent for efficiently removing carbon dioxide from industrial gases.

### Industrial Consultancy till date

- |                                  |                             |
|----------------------------------|-----------------------------|
| 1. AquaPharm Chemicals Pvt. Ltd. | 2. Reliance Industries Ltd. |
| 3. Indian Oil Corporation Ltd.   | 4. Carbon Clean Solutions   |
| 5. Atul Ltd.                     | 6. Amines & Plasticizers    |
| 7. GAIL (India) Ltd.             |                             |



**Dr. Ratnesh D. Jain**  
Ramalingaswami Fellow  
Assistant Professor, Department of Chemical Engineering

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### Patent Applications Filed

#### *Microfluidic device for the development of in-vitro co-cultures of mammalian tissues*

1. Indian Application No: 201621000456  
Inventor: Gore Manish Ravikiran; Prajakta Dandekar Jain; **Ratnesh Jain**  
**Abstract:** The technology describes the design of a microfluidic device for 3D co-culture of mammalian cell types of mammalian origin towards development of in-vitro models and/or artificial organ constructs or tissue equivalents, for preclinical and biomedical applications.

#### *Kit for pyrogen detection and depyrogenation of water*

2. Indian Application No: 4070/MUM/2015  
Inventor: Yadav Vijay; Chhabra Rohan; Kalane Nikhil; Pant Tejal, Dey Anomitra; Dandekar Jain Prajakta; **Jain Ratnesh**  
**Abstract:** Pyrogen detection kit mostly animal origin used for identification of micro-cellular component present in water. This invention is non biological with the sustainable and clean chemistry can sense any micro-cellular complainant present in water.

#### *Method of manufacturing concentrated silver nanopowder*

3. Indian Application No: 2797/MUM/2014  
Inventor: Pofali Prasad; Dandekar Jain Prajakta; **Jain Ratnesh**  
**Abstract:** The present invention describes a method for synthesis of highly concentrated and pure silver nanopowder, using micellar nanoreactors, in presence of suitable stabilizers.

#### *Methods for preparation of water-soluble and water-insoluble derivatives of saccharides and alkali, alkaline earth, transition and noble metals*

4. Indian Application No: 2594/MUM/2014  
Inventor: Yadav Vijay; Dandekar Jain Prajakta; **Jain Ratnesh**  
**Abstract:** The work deals with synthesis of nano sized, water-soluble and water-insoluble metal-saccharide derivatives, for biomedical and healthcare applications. The said derivatives are formulated using low temperature chemistry to make the overall process 'green' and safe.

### Industrial Consultancy till date

1. Famy Care Limited
2. Invictus Entreprises
3. Piramal Healthcare



## Prof. Sunil S. Bhagwat

Head, DBT-ICT Centre for Energy Biosciences

Dean, Internal Quality Assurance Cell (IQAC)

Coordinator CTM

Coordinator, Post Graduate Diploma in Chemical Technology Management

Coordinator, Centre for Excellence in Process Intensification

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### Granted Patents

*A method for predicting and controlling the precise rate of dosage of chemicals ammonia and/or its compounds and sulfur and/or its compounds and/or steam either alone or in combination to a flue gas stream for optimizing chemical dosage for reducing*

1. Patent No.: IN 208343; 2005

Inventors: **Bhagwat S. S.**; Trivedi S. N.; Unni P. N.; Phadke R. C.

**Abstract:** A method of predicting the precise rate of dosage of specified chemicals and /or their compounds and /or steam to a flue gas stream from coal combustion and/or thermal processors before electrostatic precipitator to optimize the rate of dosage resulting in control and reduction of emission from the stack preventing excess dosage.

#### *Improved thermodynamic cycle*

2. Patent No: US 8910477; 2010

3. Patent No: AU 2011225700

Inventors: **Bhagwat S. S.**; Satpute Satchidanand; Shankar Ravi; Patil Swapnil.

**Abstract:** A method of improving heat utilization in a thermodynamic cycle, the method comprising heating a working stream in a at least one distillation assembly to produce a rich stream and a lean stream; wherein the distillation assembly comprises a bottom reboiler section, a middle distillation section and a top condenser section.

### Patent Applications Filed

#### *A colour matching formulation system for textiles*

1. Indian Application No.: 109/MUM/2005

Inventors: **Bhagwat S. S.**; Shukla S. R.; Khandual A.

**Abstract:** A method and apparatus for colour recipe prediction are provided for predicting recipe and dispensing dye and additives textiles by applying neural networks and optimization programme.

#### *An absorption refrigeration system and a process for refrigeration utilizing the same*

2. Indian Application No.: 1338/MUM/2008

3. PCT Application No.: PCT/IN2008/000430, PCT/IN2009/000364

Inventors: **Bhagwat S. S.**

**Abstract:** An absorption refrigeration system and a process for producing refrigeration using the system, wherein the system comprises two thermally coupled loops - each loop comprising a working fluid, a reboiler, a distillation column, a condenser, an evaporator, an absorber, a bleed heat exchanger, a refrigerant heat exchanger and a solution heat exchanger.

### *Improved regenerative rankine cycle*

4. Indian Application No.: 2282/MUM/2010  
Inventors: **Bhagwat S. S.**; Mali Nilesh Atmaram; Mudadi Rohit Haridas  
**Abstract:** A regenerative Rankine cycle comprising a Rankine boiler; at least one turbine having at least one low pressure extraction stage; a Rankine condenser; at least one fluid heater; at least one integral heat booster comprising a generator, a condenser, an absorber, and a solution heat exchanger operably linked to each other.

### *Improved thermodynamic cycle*

5. Indian Application No.: 661/MUM/2010  
6. PCT Application No.: PCT/IN2011/000169  
Inventors: **Bhagwat S. S.**; Satpute Satchidanand; Shankar Ravi; Patil Swapnil  
**Abstract:** A method of improving heat utilization in a thermodynamic cycle, the method comprising heating a working stream in a at least one distillation assembly to produce a rich stream and a lean stream; wherein the distillation assembly comprises a bottom reboiler section, a middle distillation section and a top condenser section.

### **Industrial Consultancy till date**

- |   |                                  |
|---|----------------------------------|
| 1. Asian Paints                                   | 2. Axiom Engineers               |
| 3. Balmer & Lawrie                                | 4. Chemithon Engineers           |
| 5. Galaxy Surfactants                             | 6. GSK Healthcare                |
| 7. IPCA laboratories Ltd                          | 8. Laxmi Organic Industries Ltd. |
| 9. L'Oréal Research & Innovation                  | 10. Marico Industries            |
| 11. Miura Trading & Finvest (P) Ltd               | 12. N. S. Chemicals              |
| 13. Oxbow coals                                   | 14. PPG Industries, USA          |
| 15. Ranq Pharmaceutical and Excipients            | 16. Reliance Industries Ltd      |
| 17. Thermax (Chemicals Division)                  | 18. Triton Consultants           |
| 19. Unicon Fibrotech                              | 20. Unilever Industries Ltd      |
| 21. United Phosphorous Ltd                        | 22. Victory Chemicals            |
| 23. Maharashtra Electricity Generation Co.        |                                  |
| 24. Penta Engineering Corporation, USA            |                                  |
| 25. Tata Research Design & Development Center     |                                  |
| 26. Global Energy Technologies Pvt Ltd (Enersave) |                                  |





**Prof. Vilas G. Gaikar**  
Professor of Chemical Engineering

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## **Granted Patent**

### *Plant extracts*

1. Patent No.: US6224877; 2000  
Inventors: **Gaikar Vilas Gajanan**; Dandekar Deepak Vijay  
**Abstract:** The present invention relates to a process for extraction of curcuminoids from *Curcuma* species, wherein the process employs extraction with an aqueous hydrotrope solution at a temperature in the range of 0-100° C.

### *Contacting the fruit of piper species with aqueous hydrotrope solution; separating the solution from the solid residue; and recovering piperine from the solution by a method selected from a group consisting of dilution and solvent extraction*

2. Patent No.: US6365601; 2000  
Inventors: **Gaikar Vilas Gajanan**; Raman Girija  
**Abstract:** The present invention relates to a process for extraction of piperine from the fruits of *Piper* species, comprising the use of aqueous hydrotrope solution at a temperature in the range of 0-100° C.

### *An improved process for extraction of piperine from piper species*

3. Patent No.: IN191584; 2003  
Inventors: Raman Girija; **Gaikar Vilas Gajanan**  
**Abstract:** The present invention relates to an improved process for extraction of piperine from piper species.

### *A process for separation of isomeric substituted benzene compounds from a binary mixture*

4. Patent No.: IN217390; 2008  
Inventors: **Gaikar Vilas Gajanan**; Anasthas Hyacinth Mary  
**Abstract:** The present invention relates to a process for separation of isomeric 1, 2 substituted benzene compound and 1,4 substituted benzene compound of Formula 2 from a binary mixture in any proportions of said compounds.

### *Process of recovery of pure curcumins from turmeric rhizomes*

5. Patent No.: IN205792; 2008  
Inventors: Shettar Ramesh; **Gaikar Vilas Gajanan**; Srivastava Sangeeta; Devendra Leena P  
**Abstract:** The present invention relates to a method for extraction of curcumins from turmeric rhizomes.

### *A process for extraction of curcuminoids from curcuma species*

6. Patent No.: IN252596; 2012  
Inventors: **Gaikar Vilas Gajanan**; Dandekar Deepak Vijay  
**Abstract:** This invention provides is an extraction process with an organic solvent for recovery of curcuminoids from the aqueous solution of hydrotrope after dilution of the hydrotrope solution with water or without dilution at a particular temperature range.

## Patent Applications Filed

### *A process for separating o- and p-substituted benzene compounds*

1. PCT Application No.: PCT/IN2000/000072  
Inventors: **Gaikar Vilas Gajanan**; Anasthas Hyacinth Mary  
**Abstract:** A process for producing o- and p- substituted benzene compounds separately from a binary mixture wherein the process provides for simple and cost effective method of producing pure O- and P-substituted benzene compounds separately in high yield.

### *Process for production of diosgenin from dioscorea species*

2. Indian Application No.: 99/MUM/2004  
Inventors: **Gaikar Vilas Gajanan**; Mishra Sanjay Premnarayan  
**Abstract:** The present invention relates to a process for the production of diosgenin of from the rhizomes of Dioscorea species.

### *Process for production of biodiesel from acid oil*

3. Indian Application No.: 172/MUM/2009  
Inventors: **Gaikar Vilas Gajanan**; Pandit Aniruddha Bhalchandra; Lele Prakash Bhaskar  
**Abstract:** The invention relates to a process for production of biodiesel from acid wherein esterification of the fatty acids in the acid oil with alcohol carried out in countercurrent manner is further intensified by hydrodynamics cavitation.

### *Amine functionalized CO<sub>2</sub> selective polystyrene adsorbents for CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub> separation*

4. Indian Application No.: 4142/MUM/2013  
Inventors: **Gaikar Vilas Gajanan**; Kaur Parminder; Heer Khabinder Singh; Khot Kalpesh Mohan  
**Abstract:** The present invention relates to the synthesis of amine functionalized adsorbents for selective and reversible adsorption of CO<sub>2</sub> for its separation from other gases, preferably CH<sub>4</sub> and N<sub>2</sub>.

### *Synthesis of graphene oxide / $\gamma$ - MnO<sub>2</sub> nanocomposite*

5. Indian Application No.: 473/MUM/2014  
Inventors: **Gaikar Vilas Gajanan**; Nemade Parag; Dopte Kiran; Kadam Mahesh Maruti; Jha Neetu  
**Abstract:** The invention relates to flower and needle shaped  $\gamma$ -MnO<sub>2</sub> supported on graphene oxide wherein the efficiency of  $\gamma$ -MnO<sub>2</sub>/GO as a catalyst has been cited towards selective oxidation of benzyl alcohols to corresponding carbonyl compounds.

## Industrial Consultancy till date

1. Aarti Drugs Ltd.
2. Bharat Oman Refineries Ltd.
3. Fossil Liquid and Minerals Energy Ltd.
4. Libox Goad Pvt Ltd.
5. Alcon Electronics Ltd.
6. Beech Projects Ltd.
7. IPCA Laboratories Ltd
8. Biotor Industries
9. Synthite Ltd.
10. Godavari Biorefineries Ltd
11. Lele and Associate Engrs
12. Reliance Industries Ltd.
13. Vandana Chemo-pharma Ltd.
14. Deepak Nitrite Ltd.
15. Excel Industries Ltd.
16. Sunshield Chemicals Ltd.
17. Morya Global Ltd.
18. Laxmi Organics Ltd.
19. Intec Polymers
20. Polyolefins Industries Ltd.
21. Amar Dye Chem Ltd.



## Dr. Vishwanath Haily Dalvi

R. A. Mashelkar Assistant Professor in Chem. Engg.

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### Patent Applications Filed

#### *Device for concentrating solar radiation*

1. Indian Application No.: 1331/MUM/2014

Inventors: **Dalvi V. H.**; Panse S. V.; Joshi J. B.

**Abstract:** A novel solar concentrator that uses multiple, small-aperture (hence cheaper) parabolic trough reflectors to achieve the optical performance of a single, large-aperture (more expensive) reflector.

#### *A water resistant phosphogypsum combination*

2. Indian Application No.: 4024/MUM/2014

Inventors: Sarode D. D.; Nemade P. R.; **Dalvi, V. H.**; Sontakke, S. M.; Zambare R. S.; Mukadam, N. V.; Baviskar U. K.

**Abstract:** A novel formulation that renders gypsum hydrophobic and hence suitable for external wall plaster.

#### *Low cost, modular solar concentrator capable of being shipped dismantled and field assembled*

3. Indian Application No.: 201621042274

Inventors: **Dalvi V. H.**; Panse S. V.; Joshi J. B.; Shenoy N. V.; Patil, R. G.; Thalange V. C.

**Abstract:** Novel, low-cost parabolic trough made out of mirror strips and a bolted frame. Can be disassembled and reassembled on-site by 2-5 people.

#### *A hybrid system of waste aqueous thermal treatment plant with a gas power cycle*

4. Indian Application No.: 201721029239

Inventors: **Dalvi V. H.**; Barodawala A.; Shinde T.

**Abstract:** Developed a method of simultaneously heat treating aqueous waste streams and recovering the heat by integrating with a gas-power cycle allowing simultaneous waste water treatment along with power boosting.

#### *A novel vacuum tube receiver for solar collectors*

5. Indian Application No.: 201721029818

Inventors: Panse S. V.; **Dalvi V. H.**; Joshi J. B.

**Abstract:** Developed a novel type of vacuum tube receiver for solar collectors that eliminates the problem of glass-to-metal sealing and is facile to fabricate, install and maintain.

### Industrial Consultancy till date

- |                                 |   |
|---------------------------------|---|
| 1. Ecologic Solutions Pvt. Ltd. | 2. Rashtriya Chemicals and Fertilizers Ltd. |
| 3. The Coca Cola Company        | 4. Zoetis Pharmaceuticals Pvt. Ltd.         |
| 5. Paramount Consultants        | 6. Eternis Fine Chemicals Pvt. Ltd.         |

# Department of Chemistry

## Research Areas:

Homogeneous catalysis, Reaction kinetics and mechanism

Preparation and characterization of organometallic complex

Microwave, Ultrasound assisted organic reaction and catalysis

Synthesis of biologically interesting compounds

Degradation of organic pollutants

Emulsification of Vegetable oils





## Prof. Bhalchandra M. Bhanage

Dean (Infrastructure and Campus Development)

Professor of Industrial and Engineering Chemistry

Coordinator: UGC-DRS

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### Granted Patents

#### *An efficient enzyme catalyzed methodology for synthesis of levulinic esters using lipase and supercritical carbon dioxide as a green biocatalyst and solvent*

1. Patent No.: IN 305636; 2019

Inventors: Badgujar Kirtikumar Chandulal; **Bhanage Bhalchandra Mahadeo**

**Abstract:** The present invention describes a method for the synthesis of alkyl levulinic esters using biocatalyst lipase in supercritical carbon dioxide solvent. The said method provides 40-99 % isolated yield of corresponding levulinic ester molecules.

#### *An improved method for benzimidazole synthesis from 2-haloaniline, dihalomethane and sodium azide in presence of copper complex catalyst*

2. Patent No.: IN 297593; 2018

Inventors: Lanke Satish Rohidas; **Bhanage Bhalchandra Mahadeo**

**Abstract:** The present invention discloses one step process for the synthesis of benzimidazole from 2-haloanilines, dihalomethane and sodium azide in presence of copper complex. This method gives 50-80% yield of corresponding benzimidazoles with different carbon sources.

#### *Solar energy assisted synthesis of zinc oxide nanoparticles*

3. Patent No.: IN 271216; 2016

Inventors: Patil A. B.; Lanke S. R.; **Pandit A. B.**; Bhanage Bhalchandra Mahadeo

**Abstract:** Present invention gives a novel method for the synthesis of zinc oxide nanoparticles by zinc acetate as a precursor with 1,4-butanediol as a solvent using solar energy as a driving force. The process was carried out in presence or absence of starch used as a capping agent.

#### *Improved process for nitration of phenol using diluted nitric acid alone as the nitrating agent under sonication*

4. Patent No.: IN247957; 2007

Inventors: **Bhanage Bhalchandra Mahadeo**; Nandurkar Nitin Subhash; Bhanushali Mayur Jagdish; Panda Anil Godavari

**Abstract:** The present invention describes a process for nitration of phenols. The nitration of phenols is carried out with dilute nitric acid (6-40 wt %) alone as the nitrating agent using ultrasound.

#### *An improved process for the sulfonation of aromatic compounds using sulfuric acid under sonication*

5. Patent No.: IN247765; 2008

**Inventors:** Qureshi Ziyauddin Shahabuddin; Deshmukh Krishna Manohar; Nandurkar Nitin Subhash; Bhanage Bhalchandra Mahadeo

**Abstract:** The present invention relates to improved process for selective and rapid sulfonation of aromatic compounds using sulfuric acid as sulfonating agent and ultrasound as promoter having frequency range between 20-100 KHz.

***Improved process for nitration of phenol and substituted phenols using phase transfer catalyst under sonication***

6. Patent No.: IN241202; 2010  
Inventors: Nandurkar Nitin Subhash; **Bhanage Bhalchandra Mahadeo**; Bhanushali Mayur Jagdish; Jagtap Sachin Ramesh  
**Abstract:** The present invention relates to a process for nitration of phenols and substituted phenols to produce o-nitro phenol. The nitration process is carried out by using dilute nitric acid (4-12wt %) and/or tetra alkyl ammonium halide (TAAH) under sonication.

***Process for low temperature recyclable catalyst for heck reaction***

7. Patent No.: IN234966; 2009  
Inventors: Samant Shrinivas Damodar; Ambulgekar Girish Vasant; **Bhanage Bhalchandra Mahadeo**; Bhanushali Mayur Jagdish  
**Abstract:** The present invention describes heck reaction with Pd/C catalyst at low temperature. The heck reaction is carried out using iodobenzene with methyl acrylate in presence of NMP under ultrasound.

***Process for preparing metal complexes of 1,3-diketones using ultrasound***

8. Patent No.: IN236638; 2009  
Inventors: **Bhanage Bhalchandra Mahadeo**; Nandurkar Nithin Subhash; Patil Dinkar Sopan.  
**Abstract:** The present invention relates to a novel process preparing metal complexes of organic 1,3-diketone using Ultrasound

***Process for the preparation of 1,4-butanediols***

9. Patent No.: IN249486; 2007  
Inventors: **Bhanage Bhalchandra Mahadeo**; Panda Anil Godavari; Jagtap Sachin Ramesh; Nandurkar Nitin Subhash  
**Abstract:** The present invention relates to a regioselective hydroformylation process for production of 1, 4-butanediols, wherein said process is carried out by using allylic alcohols with Rh/PPh<sub>3</sub> catalyst in ionic liquid film supported on a suitable porous support (SILPC) and water.

## **Patent Applications Filed**

***An efficient and greener enzyme catalyzed methodology for the synthesis of 2-propenoic -3-phenyl-alkyl compounds in supercritical carbon dioxide media***

1. Indian Application No.: 3172/MUM/2015  
Inventor: **Bhanage Bhalchandra Mahadeo**; Badgujar K. C.  
**Abstract:** The present invention offers a greener and efficient methodology for the synthesis of 2-propenoic -3-phenyl- ester compounds in the supercritical carbon dioxide as a solvent.

***A greener and efficient bio-catalytic methodology for the synthesis of benzoate compounds in supercritical carbon dioxide***

2. Indian Application No.: 3199/MUM/2015  
Inventor: **Bhanage Bhalchandra Mahadeo**; Badgujar K. C.

**Abstract:** The present invention offers a green biocatalytic protocol for the synthesis of benzoate compounds in supercritical carbon dioxide solvent. This methodology possesses advantages like greener biocatalyst and greener reaction media which accomplished a complete greener aspect.

*Novel amino acid-zinc hydroxide hybrid nanomaterials and process of preparation thereof*

3. Indian Application No.: 1623/MUM/2015

Inventor: **Bhanage Bhalchandra Mahadeo**; Badgular K. C.

**Abstract:** The present invention relates to a novel amino acid-zinc hydroxide hybridized nanomaterials and a preparation method thereof. The said nanomaterials are of definite crystal morphology. These hybrid materials may be further use in photodiodes and solar cells.

*Solar energy assisted synthesis of zinc oxide nanoflowers*

4. Indian Application No.: 1624/MUM/2015

Inventor: Bhosale M. A.; Ahire J. P.; **Bhanage Bhalchandra Mahadeo**

**Abstract:** The present invention relates to a process for preparation of controlled sized zinc oxide nanoflowers using direct sunlight/solar energy. The uniform particle distribution and a nanoscale flower-like structure with petals ranging from 80-150 nm and zinc oxide nanoflowers ranging from 500 nm to 800 nm is obtained.

*Method for magnesium oxide nanoparticles synthesis using solar energy*

5. Indian Application No.: 3276/MUM/2011

Inventors: Patil Aniruddha Balkrishna; Bhatte Kushal Deepak; Pandit Aniruddha Bhalchandra; **Bhanage Bhalchandra Mahadeo**

**Abstract:** The present invention describes a process for synthesis of magnesium oxide. The magnesium oxide is synthesized by reacting magnesium acetate with Polyvinylpyrrolidone (PVP) or starch in presence of ethylene glycol/ 1,3-propanediol and solar energy.

*Method for zinc oxide nanoparticles synthesis using solar energy*

6. Indian Application No.: 3275/MUM/2011

Inventors: Patil Aniruddha Balkrishna; Lanke Satish Rohidas; Pandit Aniruddha Bhalchandra; **Bhanage Bhalchandra Mahadeo**.

**Abstract:** The present invention discloses a method for the synthesis of zinc oxide nanoparticles using solar energy as a driving force. Zinc oxide nanoparticles are synthesized by zinc acetate as a precursor with 1, 4-butanediol as a solvent and the use of solar energy.

*Method for the synthesis of palladium nanoparticles using solar energy*

7. Indian Application No.:1842/MUM/2011

Inventors: Patil Aniruddha Balkrishna; Deshmukh Krishna Manohar; Pandit Aniruddha Bhalchandra; **Bhanage Bhalchandra Mahadeo**

**Abstract:** The present invention relates to a process for synthesis of palladium nanoparticles. In this process, the palladium (II) salts are reduced to the metallic palladium at nanosize level with the help of solar energy, citric acid or ethylene glycol as a reducing agent and poly (vinyl pyrrolidone) or starch as a capping agent.



*Improved process for the electrochemical synthesis of palladium nanoparticles in ionic liquid as an electrolyte*

8. Indian Application No.: 1978/MUM/2011  
Inventors: Deshmukh Krishna Manohar; Bhatte Kushal Deepak; Qureshi Ziyauddin Shahabuddin; Nagarkar Jayshree Milind; Rao Polur Ranga; Rao Vasudeva; Thandankorai Ganapathi Srinivasan; Krishnamuthi Nagarajan; Konda Athmaram Venkatesan; **Bhanage Bhalchandra Mahadeo**

**Abstract:** The present invention describes electrochemical preparation of palladium nanoparticles in the range of 1-100 nm using palladium salts, electron as a reducing agent and ionic liquid as an electrolyte in the temperature range of 25-120°C.

*Copper as a catalyst for the carbonylative sonogashira coupling reaction of aromatic/aliphatic alkynes with aryl halides*

9. Indian Application No.: 236/MUM/2008  
Inventors: Tambade Pawan Jagannath; Patil Yogesh Popatrao; Nandurkar Nitin Subhash; **Bhanage Bhalchandra Mahadeo**

**Abstract:** The present invention relates to an improved process for synthesis of alkynyl ketones by carbonylative Sonogashira coupling reaction using copper as a catalyst.

*Carbon-Carbon Bond Forming Reactions Catalyzed By Metal-1,3-Diketonate Complexes*

10. Indian Application No.: 237/MUM/2008  
Inventors: Nandurkar Nitin Subhash; **Bhanage Bhalchandra Mahadeo**.

**Abstract:** The present invention describes a process for formation of transition metal-1-3- diketone complexes useful for coupling reactions, wherein said complex formation is carried out by using oxygen containing 1, 3-diketone ligands with various transition metals.

**Industrial Consultancy till date**

- |                                      |  |
|--------------------------------------|--|
| 1. Chem Cleanzio Pvt. Ltd            | 2. Chemtrols Industries Ltd.           |
| 3. Encove Natural Polymers Pvt. Ltd. | 4. Laxmi Organic Ind. Ltd              |
| 5. MILI Laboratories                 | 6. Monarch Catalysis Pvt. Ltd.         |
| 7. Nanocoat                          | 8. NOCIL Ltd                           |
| 9. Reliance Industries               | 10. Rio Tinto Diamonds                 |
| 11. SQM International                | 12. Hindustan Polyamides & Fibres Ltd. |



**Dr. Vijay Kumar A.**

Assistant Professor in Organic Chemistry

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### Patent Applications Filed

***Nanocrystalline composite of cuprous oxide-cyclodextrin as a heterogeneous catalyst and process of preparation thereof***

1. Indian Application No: 201721035834

Inventors: **Akkilagunta Vijay Kumar**, Suryawanshi Patil Rani Nanasaheb

**Abstract:** The present invention relates to a novel nanomaterial heterogeneous catalyst composite comprising of metal and cyclodextrin. The present invention also relates to a process of preparation thereof.

***One-pot three component catalytic process for the synthesis of propargylamines***

2. Indian Application No: 201721036462

Inventors: **Akkilagunta Vijay Kumar**, Suryawanshi Patil Rani Nanasaheb

**Abstract:** The present invention provides an improved process of three component propargylation synthesis using cuprous oxide-cyclodextrin as a heterogeneous reusable catalyst in neat condition.

***A process of aerobic oxidation of alcohols in environment benign solvent.***

3. Indian Application No: 201721035849

Inventors: **Akkilagunta Vijay Kumar**, Suryawanshi Patil Rani Nanasaheb, Pawar Anil Shweta

**Abstract:** The present invention relates to an improved process of aerobic oxidation of aromatic and aliphatic alcohols is provided, wherein in an aqueous reaction system under a metal-cyclodextrin catalyzed condition preferably at a temperature ranging from 30°C to 100°C and atmospheric pressure.



**Dr. Jayashree M Nagarkar**

Associate Professor of Chemistry

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### Patent Applications Filed

*A simple, green oxidation of sulfide to sulphoxide compounds.*

1. Indian Application No.: 2708/MUM/2015

Inventors: **Nagarkar Jayashree Milind**; Wagh Ravindra

**Abstract:** The present invention relates to green oxidation of sulfide to sulphoxide compounds.

*An improved method for the synthesis of azobenzene from nitrobenzene and sodium hydroxide*

2. Indian Application No.: 1421/MUM/2014

Inventors: **Nagarkar Jayashree Milind**; Gund Sitaram Haribhau

**Abstract:** The present invention relates to production of azobenzene from nitrobenzene



**Prof. Manohar R. Sawant**  
Emeritus Fellow  
(All India Council of Technical Education)

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### Granted Patents

*Improved process for preparation of salt of fatty acyl isethionates using heterogeneous catalyst and catalysis thereof*

1. Patent No.: IN225120; 2005

Inventors: **Sawant Manohar R.**

**Abstract:** It is a novel heterogeneous catalysis for synthesis of acyl isethionates.

*Novel quaternary ammonium glucoside surfactant, process for producing the same and utilisation thereof*

2. Patent No.: IN239578; 2007

Inventors: **Sawant Manohar R.**; Joshi Vishal Y.; Kamath Shrikant S.

**Abstract:** This invention relates to the production and use of novel biodegradable quaternary ammonium glucoside surfactant for pesticide such as herbicide.

*Novel surface active agent of a class of sugar fatty acid ester and method of preparation*

3. Patent No.: IN245507; 2006

Inventors: **Sawant Manohar R.**; Joshi Vishal Y.; Chaubale Nevedita S.

**Abstract:** It is a new class of fatty acid ester and novel method for its preparation.

### Patent Applications Filed

*Microcapsule and process thereof*

1. Indian Application No.: 2712/MUM/2014

Inventors: **Sawant Manohar R.**, Mahanwar P. A.

**Abstract:** Microencapsulation of pesticide for sustained release.

### Industrial Consultancy till date

1. Deepak Nitrite Limited
2. Dharamshi Morararji Chemical Co. Ltd
3. Jayant Agro Organics Ltd.
4. Unitop Chemicals Pvt. Ltd.
5. Godrej Agro Limited



**Prof. Shrinivas D. Samant**  
Professor of Organic Chemistry

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### Granted Patents

#### *Process for low temperature recyclable catalyst for heck reaction*

1. Indian Patent No.: IN234966; 2005  
Inventors: Ambulgekar G. V.; Bhanushali M.J.; **Samant Shrinivas D.**; Bhanage B. M.  
**Abstract:** The present invention describes heck reaction with Pd/C catalyst at low temperature. The heck reaction is carried out using iodobenzene with methyl acrylate in presence of NMP under ultrasound.

### Patent Applications Filed

#### *An improved process for synthesis of m-diisopropylbenzene by isomerization of p-diisopropylbenzene*

1. Indian Application No.: 1697/MUM/2012  
Inventors: Edake Mahesh S.; **Samant Shrinivas D.**  
**Abstract:** Isomerization of easily available p-diisopropylbenzene to m-diisopropylbenzene was achieved using solid acid catalysts – modified H $\beta$  zeolite and K10 clay. m-diisopropylbenzene is difficult to obtained otherwise. The isomerization was carried out at high temperature under high pressure in the presence of the solid acids.

### Industrial Consultancy till date

1. BASF Ltd.
2. CIBA India Ltd
3. Clariant Ltd.
4. IPCA Limited
5. NOCIL Ltd
6. Zandu Chemicals

# DBT-ICT Centre for Energy Biosciences

## Research Areas:

Bioenergy, Biofuel and biomass to other biochemicals or high value organic/inorganic chemicals

Purification of proteins, nucleic acid, other biomolecules, natural & synthetic APIs

Modelling and adsorptive separation Chromatographic separation techniques

Biocatalyst and biotransformations, algae technology, Synthetic and molecular biology

Process integration and intensification





## Prof. Arvind M. Lali

Head Scientist, DBT-ICT Centre for Energy Biosciences  
Professor, Department of Chemical Engineering

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### Granted Patents

#### *Separation of organic acid from mixtures containing ammonium salt of organic acids*

1. Patent No.: US10221120; 2018

Inventors: **Lali Arvind Mallinath**; Maurya Ritu Rahul

**Abstract:** The invention relates to a process for separation of organic acids from their mixture with each other and with other compounds e.g. inorganic salts, via an integrated process which includes esterification of basic salt of the organic acids, separation of the esters by distillation, and hydrolysis of the individual esters formed.

#### *Process for synthesis of furan derivatives from saccharides using acid catalyst and preparation thereof*

2. Patent No.: US9975866; 2018
3. Patent No.: JP2016-533608; 2018

Inventors: **Lali Arvind Mallinath**; Pawar Hitesh Suresh

**Abstract:** The present invention relates to a process for synthesis of furan derivatives, more particularly 5-hydroxymethylfurfural (5-HMF), with more than 90% yield, from saccharides using an acid catalyst in polar monophasic organic solvent with either microwave radiation or conventional heating.

#### *A process for production of soluble sugars from biomass*

4. Patent No.: JP2016-564438; 2018
5. Patent No.: ZA2016/05597; 2018
6. Patent No.: EP3094733; 2018
7. Patent No.: SG11201605855T; 2018
8. Patent No.: AU2015207338; 2018
9. Patent No.: US9862980; 2018
10. Patent no.: OAPI/18007/; 2015

Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Birhade Sachinkumar Hiranam; Victoria Juliet Joanna; Sawant Sneha Chandrakant

**Abstract:** The present invention provides a process for enzyme mediated hydrolysis of biomass for production of soluble sugars. The process used for enzymatic hydrolysis allows for increased biomass loading, enzyme recycle and mitigation of substrate and product inhibitory effect.

#### *Process for fractionation of oligosaccharides from agri-waste*

11. Patent No.: US 15/112,095; Issued notice of allowance, 2018
12. Patent No.: JP2016-564437; 2018
13. Patent No.: AU2015207336; 2018
14. Patent No.: EP3094734; 2018
15. Patent No.: US9963725; 2018



16. Patent No.: SG11201605857Y; 2017  
17. Patent No.: OAPI/17918; 2015  
Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Pednekar Mukesh Prabhakar

**Abstract:** The present invention provides a continuous and cost effective chemo-enzymatic process for fractionation of holocellulose, obtained from agri-waste, into arabinoxylooligosaccharides, xylooligosaccharides and celooligosaccharides.

#### *Process for Fractionation of Biomass*

18. Patent No.: JP5799091; 2015  
19. Patent No.: ZA2013/00133; 2013  
Inventors: **Lali Arvind Mallinath**; Varavadekar Jayesh Suman; Wadekar Prathamesh Chandrashekher

**Abstract:** The present invention discloses a process of fractionation of biomass using aqueous ammonia into lignin, cellulose and/or hemicellulose in more than 90% purity

#### *Enzymatic process for fat and oil hydrolysis*

20. Patent No.: IN308754; 2019  
21. Patent No.: PH1/2014/501720; 2019  
22. Patent No.: EP2809789; 2018  
23. Patent No.: MX354561; 2018  
24. Patent No.: CN104245949B; 2017  
25. Patent No.: AU2013213921; 2017  
26. Patent No.: JP6159741; 2017  
27. Patent no.: US9512451B2; 2016  
28. Patent No.: SG11201404463P; 2015  
Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Vadgama Rajesh; Warke Mrunal; Bhat Anuradha

**Abstract:** The present invention describes an efficient and cost effective enzymatic hydrolysis process of fats and oil for production of oleochemicals such as fatty acids, sn-regio mono-acylglycerol (MAG), sn-regio diacyl-glycerols (DAG), and glycerol, in a homogenous mixture.

#### *Method for production of fermentable sugars from biomass*

29. Patent No.: AR076925B1; 2018  
30. Patent No.: KR101842080; 2018  
31. Patent No.: CA2763588; 2018  
32. Patent No.: MY160407A; 2017  
33. Patent No.: PH1/2011/502465; 2016  
34. Patent No.: IDP000047770; 2016  
35. Patent no.: AU2010252547; 2015  
36. Patent No.: US8709763 (US-DIV-I); 2014  
37. Patent No.: US8673596 (US-DIV-II); 2014  
38. Patent No.: BD1005172; 2014  
39. Patent No.: PK141809; 2014  
40. Patent No.: US8338139; 2012  
41. Patent No.: ZA2011/09250; 2012  
Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Nagwekar Pooja Devidas; Varavadekar Jayesh Suman; Wadekar Prathamesh Chandrashekher; Gujarathi Swapnali Subhash; Valte Rajeshwar Dattatraya; Bihade Sachinkumar Hiranman

**Abstract:** The present invention describes a process for production of fermentable sugars from biomass using multi-enzyme multi-step system production of biofuel and other by-products.

***Continuous counter current fluidized moving bed (FMB) and/or expanded moving bed (EMB)***

42. Patent No.: CN201080020354.2; 2015

43. Patent No.: CA2754700; 2015

44. Patent No.: ZA 10-1370986; 2014

45. Patent No.: KR101370986B1; 2014

46. Patent No.: US8673225; 2014

Inventors: **Lali Arvind Mallinath**; Kale Sandeep B; Pakhale Vinod D; Thakare Yogeshwar N.

**Abstract:** The present invention discloses continuous countercurrent fluidized moving bed (FMB) and/or expanded moving bed (EMB), useful for adsorptive for continuous recovery, purifications or reactions of various products.

***A process for purification of immunoglobulins using a pseudobioaffinity adsorbent***

47. Patent No.: IN248707; 2007

Inventors: **Lali Arvind Mallinath**; Naik Amith Dattatray; Raina Monika; Kale Sandeep Bhaskar

**Abstract:** The present invention describes a novel pseudobioaffinity adsorbent and process for purification of immunoglobulin G from immunoglobulin containing solutions such as but not limited to plasma, serum, cell culture supernatant, ascites fluids.

***Process for production of chlorinated sucrose based on hydrophobic affinity chromatography***

48. Patent No.: EP1928891; 2005

49. Patent No.: CA2620869; 2005

Inventors: Kale Sandeep Bhaskar; **Lali Arvind Mallinath**; Aurora Sundeep; Rathnam Rakesh

**Abstract:** This invention relates to a process for selective capture and purification of chlorinated sucrose compounds and derivatives, directly from chlorinated reaction mixture by column chromatography.

***Process for separation and purification of lysozyme, conalbumin and other proteins from egg white***

50. Patent No.: IN221908; 2004

Inventors: Kale Sandeep Bhaskar; **Lali Arvind Mallinath**; Ghosalkar Samir

**Abstract:** The process relates to the separation and purification for lysozyme, Conalbumin and other proteins on a single chromatographic step from egg white extract in high purity with recovery of more than 85% and purity between 85% and 99%.

***One step flow-through adsorptive purification of tubulin from tissue homogenate***

51. Patent No.: IN228041; 2004

Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Reena A. Pandit; Madhavi Indap

**Abstract:** The present invention describes a process for purification of tubulin from mammalian brain tissue homogenate employing a macroporous chromatographic media with an inherent hydrophobic and a combination of hydrophobic and ion exchange character.

## **Patent Applications Filed**

### ***High cell density continuous fermentation of C5 sugar/s or both C5 & C6 sugars to ethanol***

1. Indian Application No.: 201821027586  
Inventors: **Lali Arvind Mallinath**; Varavadekar Jayesh Suman; Reshamwala Shamlan M.S.  
**Abstract:** Field of invention relates to high cell density continuous fermentative production of ethanol in a single reactor system using C5 sugar/s or both C5 & C6 sugars. Furthermore, it relates to continuous cell recycle for fermentative production of ethanol with high yield.

### ***Continuous operating system and process for partial or complete deconstruction of polymeric organic feed***

2. Indian Application No.: 201821024740  
Inventors: **Lali Arvind Mallinath**; Wadekar Prathamesh Chandrashekhar; Patil Mallikarjun Laxmiputra; Patil Parmeshwar Shivajirao  
**Abstract:** Present invention relates to continuous operating system for partial or complete deconstruction of a polymeric organic feed comprising sugars and sugar derivatives besides other compounds. It further relates to a process for production of cellulose, hemicellulose; lignin, lignin hydrolysate; and derivatives thereof from polymeric organic feed by using said operating system.

### ***A system and method for preparing pumpable polymeric organic feed slurry***

3. Indian Application No.: 201821024733  
Inventors: Lali Arvind Mallinath; Wadekar Prathamesh Chandrashekhar  
**Abstract:** The present invention relates to a system for preparing pumpable polymeric organic feed slurry. Furthermore, it relates to a method for preparing pumpable polymeric organic feed slurry using said system.

### ***A novel triacylglycerol lipase (rc-TGL); Designing and Production thereof***

4. Indian Application No.: 201821019862  
Inventors: Chandrayan Sanjeev Kumar; **Lali Arvind Mallinath**; Sathe Sneha; Soni Surabhi  
**Abstract:** The present invention discloses a novel triacylglycerol lipase polypeptide and variants/recombinants thereof. The disclosure further provides a polynucleotide sequence encoding the said polypeptide sequence.

### ***Method for enhanced bio-production of zeaxanthin***

5. Indian Application No.: 201821002293  
Inventors: **Lali Arvind Mallinath**; Pandit Reena; Sarnaik Aditya  
**Abstract:** The present invention relates to a method for generation of genetically modified microorganism through homologous recombination. Furthermore it relates to production of zeaxanthin from the genetically modified microorganism.

### ***A method for producing microbial oil from lignin or lignin hydrolysate using oleaginous yeasts***

6. Indian Application No.: 201721027460
7. PCT Application No.: PCT/IN2018/050506  
Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Pawar Pratik Prashant; Chourasia Vallari Ramesh

**Abstract:** The present invention provides a method for producing microbial oil from lignin or lignin hydrolysate using oleaginous yeasts. The lignin hydrolysate is obtained by a reaction of lignin feedstock in presence of at least one catalyst at suitable conditions.

***Ammonia assimilation by recombinant microorganism***

8. Indian Application No: 201721023070  
Inventors: Deb Shalini Subir; Reshamwala Shamlan Mohammed Shafi; **Lali Arvind Mallinath**

**Abstract:** The present invention converts ammonia into innocuous molecules using a genetically modified microorganism. Enzymes of an ammonia assimilation pathway are overexpressed in the host microorganism.

***Extractive production of microbial oil using oleaginous yeasts***

9. Indian Application No: 201721013545  
10. PCT Application No: PCT/IN2018/050225

Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Pawar Pratik Prashant; Warke Mrunal Anil; Vadgama Rajeshkumar Natwarlal; Chourasia Vallari Ramesh

**Abstract:** The present invention discloses the process for extractive in situ production of microbial oil using oleaginous yeast. The present invention further relates to the use of capturing agents for improving carbon assimilation and overall yields of the metabolite.

***Genetically modified microorganism and process for production of zeaxanthin therefrom***

11. Indian Application No: 201721011982  
12. PCT Application No.: PCT/IN2018/050189  
Inventors: **Lali Arvind Mallinath**; Pandit Reena; Sarnaik Aditya; Rai Peeyush Shekhar

**Abstract:** The present invention relates to genetically modified microorganism and production of zeaxanthin. The said invention provides process for production of zeaxanthin from  $\beta$ -carotene by using genetically modified microorganism (*S. elongatus* PCC 7942), wherein microorganism is modified by introducing  $\beta$ -carotene oxygenase (CrtR) gene isolated from *Synechococcus elongatus* PCC7002 into its genome through homologous recombination.

***Process for treating liquid industrial effluents to produce clean water and recovering pollutants for value addition***

13. Indian Application Number: 201721002215  
14. PCT Application No.: PCT/IN2018/050034  
Inventors: **Lali Arvind Mallinath**; Pawar Hitesh Suresh

**Abstract:** Present invention relates to an efficient process for treating an effluent generated from industry to produce clean water with zero liquid discharge. The process described herein, comprises steps of adsorptive separation, anaerobic digestion and/or membrane filtration and finally polishing by using micro filtration or ultra-filtration or nanofiltration or reverse osmosis or combination thereof.

***Process for purification and refining of glycerol***

15. Indian Application No.: 201621000574  
16. PCT Application No.: PCT/IN2017/050013

Inventors: Kale, Sandeep Bhaskar; **Lali Arvind Mallinath**; Patel Bhavin Manubhai; Jha Pamela; Gupta Vinod; Kohli, Ashwani Kumar; Mital Vineet

**Abstract:** The present invention deals with the process for purification and refining of glycerol from its crude or partially purified glycerol like IW grade glycerol. Glycerol obtained using process of present invention is more than 95% with 100 % assay purity.

*A process for generation of biogas from organic matter via its liquefaction to biocrude*

17. Indian Application Number: 201621030327

18. PCT Application No.: PCT/IN2017/050385

Inventors: **Lali Arvind Mallinath**; Sharma Manju; Pawar Hitesh Suresh; Gore Suhas

**Abstract:** The present invention relates to Anaerobic Digestion (AD) process for generation of biomethane in near theoretical yields and enhanced productivities from liquid biocrude obtained from liquefaction of organic matter. AD of liquid biocrude results in > 90% COD reduction with biogas yield greater than 90% containing at least 55% (v/v) methane at OLRs in excess of 15 Kg/m<sup>3</sup>.day in less than 24 h.

*Enzymatic hydrolysis process for production of fermentable sugars*

19. Indian Application Number: 201621030093

20. PCT Application No.: PCT/IN2017/050382

Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Victoria Juliet Joanna; Choudhari Vikram Gunvant; Mahadik Chinmayee Ramray; Sawant Sneha Chandrakant; Khairat Mayur Basavraj; Bihade Sachinkumar Hiraman

**Abstract:** Present invention provides an enzymatic hydrolysis process for production of fermentable sugars (95%), wherein hydrolysis is carried in step wise manner (multi-steps) to achieve complete hydrolysis of substrate (at least 90%) in less than 5 hours. Fermentable sugars separated in each step from soluble fraction can be used further for production of value added products.

*A catalytic liquefaction (CTL) method for production of bio-crude oil using ionic liquid catalyst and preparation thereof*

21. Indian Application Number: 201621025317

22. PCT Application No.:PCT/IN2017/050303

23. US Application No.: Yet to receive

24. Brazil Application No.: Yet to receive

25. EPO Application No.: Yet to receive

Inventors: **Lali Arvind Mallinath**; Pawar Hitesh Suresh; Shravan sreenivasan

**Abstract:** The present invention provides a catalytic liquefaction (CTL) method for converting organic biodegradable waste into bio-crude oil in presence of indigenously prepared sulfonic acid counter ion Bronsted acid ionic liquid catalyst at non-stringent reaction condition.

*A novel glucose tolerant glucosidase enzyme (MbgI)*

26. Indian Application Number: 201621022859

Inventors: **Lali Arvind Mallinath**; Chandrayan Sanjeev Kumar; Sathe Sneha; Soni Suarabhi

**Abstract:** The present invention discloses a novel glucose tolerant, thermo-stable  $\beta$ -glucosidase polypeptide, and variants/ recombinants thereof. The disclosure further provides a polynucleotide sequence encoding the said polypeptide sequence.

### *Continuous process for production of Vitamin B12*

27. Indian Application Number: 201621017230  
28. PCT Application No.: PCT/IN2017/050190  
Inventors: **Lali Arvind Mallinath**; Prakash Gunjan; Pillai Vijita V  
**Abstract:** Present invention provides continuous process for production of vitamin B12 in single reactor system by using high density cell culture. Said process is carried out by growing *Propionibacterium freudenreichii shermanii* under anaerobic condition.

### *Suspended cultivation of macroalgae in photobioreactor*

29. Indian Application Number: 201621013008  
Inventors: **Lali Arvind Mallinath**; Pandit Reena Ajit; Mhatre Akanksha Devinath; Navale Mahesh Maruti; Trivedi Nitin  
**Abstract:** Present invention relates to method for suspended cultivation of macroalgae in photobioreactor. Invention provides a process for cultivation and year-round production of macroalgal biomass in photobioreactor system in suspended mode (without physical support) under controlled conditions.

### *Photosynthetic microorganisms mediated rapid wastewater treatment using continuous photobioreactor*

30. Indian Application Number: 201621011795  
Inventors: **Lali Arvind Mallinath**; Pandit Reena Ajit; Palkar Juilee Ajit; Navale Mahesh Maruti  
**Abstract:** The present invention relates to rapid, continuous process for wastewater treatment by employing photosynthetic microorganism grown under controlled conditions in a photo-bioreactor. The photosynthetic microorganism consumes organic and inorganic matter in soluble and suspended forms.

### *Process for detoxification and improvement of seed meals, cakes and other products*

31. Indian Application Number: 201621011034  
Inventors: Kale Sandeep Bhaskar; **Lali Arvind Mallinath**; Febin Pappachen; Susmita Koley; Narkhed Pitamber Narayan; Naik Rajesh Kasanji  
**Abstract:** The present invention relates to a process for detoxification and improvement of de-oiled and/or oil- containing seed meals, cakes, hulls, brans, husks, other parts of plants and vegetable parts or mixtures thereof.

### *Process for production of pure glucose from cellulose*

32. Indian Application No.: 2782/MUM/2015  
33. PCT Application No.: PCT/IN2016/050248  
34. USA: 15/746,217  
35. Brazil: BR20181101287  
36. China: 201680055129  
37. EPO: EP20160778121  
Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Victoria Juliet Joanna; Choudhari Vikram Gunvant; Wadekar Prathamesh Chandrashekhar; Patil Mallikarjun Laxmiputra; Patil Parmeshwar Shivajirao; Asodekar Bhupal Ravindra; Prakash Indra; Huang Xiaoyan  
**Abstract:** The present invention relates to a process for production of glucose having purity of more than 95% from pretreated cellulosic biomass. Furthermore, it relates to isolation of a cellulose residue comprising polysaccharides that contain more than 99.5% glucose, and that is amenable to enzymatic treatment for production of more than 98% pure monomeric glucose.

*Separation of organic acid from mixtures containing ammonium salt of organic acids*

- 38. PCT Application Number: PCT/IN2016/050162
- 39. India: 201727042715
- 40. EPO: EP20160802710
- 41. China:201680038464.9
- 42. Brazil: BR112017025594A2
- 43. Canada: CA2987371A1
- 44. South Africa: Yet to receive
- 45. Korea: 10-2017-7037570
- 46. Malaysia: PI 2017001746
- 47. Indonesia: Yet to receive

Inventors: **Lali Arvind Mallinath**; Maurya Ritu Rahul

**Abstract:** The invention relates to a process for separation of organic acids from their mixture with each other and with other compounds e.g. inorganic salts, via an integrated process which includes esterification of basic salt of the organic acids, separation of the esters by distillation, and hydrolysis of the individual esters formed.

*A method for production of isoprenoids by MEP pathway in engineered pseudomonas*

- 48. Indian Application No.: 2666/MUM/2015

Inventors: **Lali Arvind Mallinath**; Aruna Mahesh; Krishnan Archana

**Abstract:** The present invention relates to a method for production of isoprenoids from sugars, in engineered *Pseudomonas putida*, wherein the MEP pathway of the *Pseudomonas putida* has been engineered in upstream and downstream modules, resulting in increased production of IPP, the precursor molecule for synthesis of isoprenoids.

*A novel shuttle vector with reversible and extendable modules for engineering of host cells*

- 49. Indian Application No.: 3507/MUM/2014

Inventors: **Lali Arvind Mallinath**; Bajawa Arjun Singh; Matlani Rekha Khushiramani

**Abstract:** The present invention relates to shuttle expression vectors, which are reversible and extendable, for engineering of host cells. The invention also provides for method of transformation of the shuttle vectors for the expression of the gene of interest.

*Constructs for gene expression and integration in host cell*

- 50. Indian Application No.: 3506/MUM/2014

Inventors: **Lali Arvind Mallinath**; Deb Shalini; Reshamwala Shamlan M. S.

**Abstract:** The present invention relates to constructs for gene expression that comprises a promoter and a transcription terminator with an intervening multiple cloning site wherein the selectable marker allows easy selection of cells that have integrated the construct in the genome.

*Algal variants produced by genome shuffling*

- 51. Indian Application No.: 1940/MUM/2014

Inventors: **Lali Arvind Mallinath**; Prakash Gunjan; Shukla Bhavya; Vira Chaitali; Rathod Jayant Pralhad

**Abstract:** The present invention relates to production of genome shuffled variants of algae, the variant comprising those that have the simple genetic combination of two or more parent species, wherein the parent species are selected for specific desired characteristics of interest.

### *Enzymatic production of monoacylglycerol from oil*

52. Indian Patent Application No.: 1583/MUM/2014  
Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Vadgama Rajesh Natwarlal; Tribhuvan Nikhil Vilas  
**Abstract:** The present invention discloses a solvent extraction and chromatographic method for production of different monoacylglycerol (MAG) and diacylglycerol (DAG) compositions using lipase catalyst under controlled temperature and time.

### *Enzymatic process for synthesis of fatty acid ester of polyols*

53. Indian Application No.: 1526/MUM/2014  
Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Yadav Manish Gyanendra  
**Abstract:** The present invention provides an enzyme catalysed process for preparation of fatty acid ester of polyols, wherein process is carried out with shortened reaction time and higher conversion rate.

### *A process for fractionation of oligosaccharides from cereal bran*

54. India: 155/MUM/2014  
55. PCT: PCT/IB2015/000030  
56. Brazil: BR 11 2016 016582 9.  
57. China: 201580014132.2  
58. Indonesia: P00 2016 05324  
59. Malaysia: PI 2016001326  
60. Mexico: MX/a/2016/009364  
61. Canada: 2937077  
62. South Korea: 10-2016-7021731  
63. South Africa: 2016/05596  
64. ARIPO: AP/P/2016/009358  
Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Pednekar Mukesh Prabhakar  
**Abstract:** The present invention provides a continuous and cost effective chemo-enzymatic process for fractionation of holocellulose, obtained from agri-waste, into arabinoxylooligosaccharides, xylooligosaccharides and celooligosaccharides.

### *A process for production of soluble sugars from biomass*

65. India: 154/MUM/2014  
66. PCT: PCT/IB2015/000034  
67. Brazil: BR 11 2016 0165853  
68. China: 201580013527.0  
69. Indonesia: P00 2016 05323  
70. Malaysia: PI 2016001325  
71. Mexico: MX/a/2016/009363  
72. Canada: 2937114  
73. South Korea: 10-2016-7021752  
74. ARIPO: AP/P/2016/009357  
Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Birkhade Sachinkumar Hiranman; Victoria Juliet Joanna; Sawant Sneha Chandrakant  
**Abstract:** The present invention provides a process for enzyme mediated hydrolysis of biomass for production of soluble sugars. The process used for enzymatic hydrolysis allows for increased biomass loading, enzyme recycle and mitigation of substrate and product inhibitory effect.



***Process for extraction of polyphenols from biomass***

75. Indian Application No.: 3808/MUM/2013  
Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Pednekar Mukesh Prabhakar; Singh Niteshkumar Satish; Rathi Abhijit; Iyer Padmini; Deshmukh Sharad

**Abstract:** The present invention relates to an efficient and cost effective process for extraction of polyphenolics from different biomass materials.

***Recombinant E. coli strain and process for production of mannitol therefrom***

76. Indian Application No.: 3807/MUM/2013  
Inventors: **Lali Arvind Mallinath**; Reshamwala Shamlan M. S.  
**Abstract:** The present invention describes a recombinant Escherichia coli strain comprising over expressed mannitol-1-phosphate dehydrogenase (MtlD) and heterologous mannitol-1-phosphatase (M1Pase) and phosphite dehydrogenase (PtxD) for mannitol production.

***Process for synthesis of furan derivatives from saccharides using acid catalyst and preparation thereof***

77. Indian Application No.: 3664/MUM/2013  
78. PCT Application No.: PCT/IB2014/002537  
79. Canada: CA 2931330  
80. EPO: 14819069.7  
81. Brazil: BR 1120160115392  
82. China: 201480073605.1  
83. South Korea: 10-2016-7016531  
Inventors: **Lali Arvind Mallinath**; Pawar Hitesh Suresh

**Abstract:** The present invention relates to a process for synthesis of furan derivatives, more particularly 5-hydroxymethylfurfural (5-HMF), with more than 90% yield, from saccharides using an acid catalyst in polar monophasic organic solvent with either microwave radiattion or conventional heating.

***Multistage membrane tree model for separation of binary mixtures***

84. Indian Application No.: 2478/MUM/2013  
Inventors: **Lali Arvind Mallinath**; Valte Rajeshwar Dattatraya  
**Abstract:** The present invention relates to a novel arrangement of membrane units in a manner to enable near complete separation of two solutes in a mixture that otherwise cannot be separated completely on a single membrane unit with more than 90% recovery.

***A process for immobilization of microbial cells for biotransformation***

85. Indian Application No.: 3291/MUM/2012  
Inventors: **Lali Arvind Mallinath**; Mule Abhishek Dilip; Sawdekar Parikshit Rameshwar; Degweker Gautam Shashikant  
**Abstract:** The present invention relates to a method for preparation of alginate beads for immobilization of viable stationary microbial cells for biotransformation, wherein alginate beads have increased physical stability, low cell leakage, increased biochemical activity and are used for biotransformation of substrates without deterioration and loss of performance.

***Process for extraction and purification of pentacyclic triterpene acid/s in high yield and purity***

86. Indian Application No.: 2172/MUM/2012  
Inventors: **Lali Arvind Mallinath**; Kale Sandeep Bhaskar; Amritkar Vinod Dattatray  
**Abstract:** The present invention relates to simple and robust process for extraction followed by integrated kinetic chromatographic purification and/or crystallization of pentacyclic triterpene acids from natural sources in purity and yield of more than 80 or 99.8 to 100%.

***Raceway pond system for increased biomass productivity***

87. Indian Application No.: 1705/MUM/2012  
88. International Publication No.: WO2013186626  
Inventors: **Lali Arvind Mallinath**; Pandit Reena; Prakash Gunjan; Mathpati Channamallikarjun; Gangal Swanand; Vira Chaitali; Palkar Juilee; Patil Smita; Gaikwad Sujata  
**Abstract:** The present invention describes a raceway pond system for cultivation of photosynthetic cells or organisms having a depth ranging from 60 to 150 cm. It further relates to the use of said system for obtaining higher production of algal biomass per unit land area; reduced cost of production of algal biomass and associated products.

***A process for recovery of xylitol with high yield and purity***

89. Indian Application No.: 421/MUM/2012  
Inventors: **Lali Arvind Mallinath**; Kale Sandeep Bhaskar; Kadam Sandip  
**Abstract:** The present invention discloses a method of recovery of xylitol with more than 98% purity and more than 95% yield from feedstock.

***Process for production of purified hydrophobic/plastifiable protein/s, their hydrolysate/s and applications thereof***

90. Indian Application No.: 420/MUM/2012  
Inventors: **Lali Arvind Mallinath**; Kale Sandeep Bhaskar; Kumar Prashant; Mane Sharmilee  
**Abstract:** The present invention discloses a process for production of purified hydrophobic/plastifiable proteins and/or their reduced form (i.e. subunits) with more than 99% purity from grains/oil seeds.

***Enzymatic process for fat and oil hydrolysis***

91. PCT Publication No.: WO2013114178  
92. UAE: 834/2014  
93. Chile: 02010-2014  
94. Brazil: BR120140186820  
95. Malaysia: PI 2014002218  
96. Thai: 1401004403  
97. Canada: CA 2863162  
98. Indonesia: P00 2014 04861  
99. Vietnam: 1-2014- 02678  
100. S. Korea: 1020147023663  
101. Thailand: 1401004403  
Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Vadgama Rajesh; Warke Mrunal; Bhat Anuradha  
**Abstract:** The present invention describes an efficient and cost effective enzymatic hydrolysis process of fats and oil for production of oleochemicals such as fatty acids, sn-regio mono-acylglycerol (MAG), sn-regio diacyl-glycerols (DAG), and glycerol, in a homogenous mixture.

***A process for isolation of natural & bioactive proteins and other minor components from defatted oil seed material***

102. Indian Application No.: 3577/MUM/2010  
Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Iyer Padmini Raju; Ghosh Bidisha; T. D. Anupama; Rathi Abhijit; Deshmukh Sharad  
**Abstract:** The present invention relates to a method for efficient extraction, concentration and isolation of proteins and other minor components such as saccharides, isoflavones, protease inhibitors, phytates, starch and non-starch polysaccharides from defatted oil seed material.

***Process for fractionation of biomass***

103. PCT Publication No.: WO2011154967  
104. Indian Application No:1762/MUM/2010  
105. Australia Application No: 2010354974  
106. Argentina Application No: 2010 01 04016  
107. Brazil Application No: BR1120120311743  
108. Bangladesh Application No: 281/2010  
109. Sri Lanka Application No: 16959  
110. China Application No: 201080067281.2  
111. Philippines Application No: 1-2012-502357  
112. Paraguay Application No: 47531  
113. EPO Application No: 10803647.6  
114. Indonesia Application No: W00201300070  
115. US Application No: 13/702, 480  
116. Malaysia Application No: PI 2012005262  
117. Uruguay Application No: 32, 9733  
118. Vietnam Application No: 1-2013-00080  
119. S. Korea Application No: 10-2013-700738  
120. Pakistan Application No: 885/2010  
121. Canada Application No.: 2800996  
Inventors: **Lali Arvind Mallinath**; Varavadekar Jayesh Suman; Wadekar Prathamesh Chandrashekher  
**Abstract:** The present invention discloses a process of fractionation of biomass using aqueous ammonia into lignin, cellulose and/or hemicellulose in more than 90% purity.

***Method for production of fermentable sugars from biomass***

122. International Publication No.: WO2010137039  
123. India Application No: 1299/MUM/2009  
124. Brazil Application No: PI10149082  
125. Malaysia Application No: PI 2011005731  
126. Paraguay Application No: 20452/2010  
127. Venezuela Application No: 000847-2010  
128. Vietnam Application No: 1-2011-03614  
129. EPO Application No: 10747688.9  
130. Sri Lanka Application No: 16526  
131. Thailand Application No: 1001000794  
132. Uruguay Application No: 32.973  
133. Japan Application No: 2012-512522  
Inventors: **Lali Arvind Mallinath**; Odaneth Annamma Anil; Nagwekar Pooja Devidas; Varavadekar Jayesh Suman; Wadekar Prathamesh Chandrashekher; Gujarathi Swapnali Subhash; Valte Rajeshwar Dattatraya; Bihade Sachinkumar Hiranman

**Abstract:** The present invention describes a process for production of fermentable sugars from biomass using multi-enzyme multi-step system production of biofuel and other by-products.

***Continuous counter current fluidized moving bed (FMB) and/or expanded moving bed (EMB)***

134. India Application No.: 505/MUM/2009

135. EPO Application No. 13/255,890

Inventors: **Lali Arvind Mallinath**; Kale Sandeep B; Pakhale Vinod D; Thakare Yogeshwar N.

**Abstract:** The present invention discloses continuous countercurrent fluidized moving bed (FMB) and/or expanded moving bed (EMB), useful for adsorptive for continuous recovery, purifications or reactions of various products.

***Compacted upflow extractor and uses thereof***

136. Indian Application No.: 675/MUM/2007

137. PCT/IN2008/000218

Inventors: Kale Sandeep Bhaskar; **Lali Arvind Mallinath**; Sharma Mahendra

**Abstract:** The present invention discloses an extractor and method of using the extractor for extracting active principle from solid materials using an extracting fluid, and said solid material is compacted in a specifically.

***Process for isolation and purification of artemisinin and other constituents from artemisia plant***

138. Indian Application No.: 674/MUM/2007

Inventors: Kale Sandeep Bhaskar; **Lali Arvind Mallinath**; Bhorl Abijar; Sharma Mahendra

**Abstract:** The present invention discloses improved process for extraction, purification and crystallization of artemisinin, scopoletin, artemisinic acid and essential oil from leaves of Artemisia annua. The integrated purification process operates with polymeric adsorbents and gives overall yield of above 95% and artemisinin purity of above 99.5%.

***Preparation of rosiglitazone and its salts***

139. US Application No.: US 11/763,775

Inventors: Kale Sandeep Bhaskar; **Lali Arvind Mallinath**; Kharkar Manoj; Reddy Srinivasula; Thota Sridhar; Manudhane Kushal; Mandava Venkata; Setty Radhakrishna; Mohonty Sandeep; Pericherrla Jaga

**Abstract:** The present invention relates to rosiglitazone and its pharmaceutically acceptable salts free of the dehydro and the succinic acid impurities of rosiglitazone, wherein said impurities are present in an amount of 5 mg to not more than about 15 mg.

***Preparation of dutasteride***

140. PCT Publication No.: WO2007120263

141. European Appln. No.: EP1945615

Inventors: Kale Sandeep Bhaskar; **Lali Arvind Mallinath**; Bhorl Abijar; Kharkar Manoj; Narsapur Sharath; Reddy Srinivasula; Katkam Srinivas

**Abstract:** Dutasteride having low concentrations of impurities, such as dihydrodutasteride and desmethyldutasteride, and processes for purifying dutasteride.

***Process for chromatographic purification of dutasteride from its related impurities***

142. Indian Application No.: 1511/CHE/2005  
Inventors: Kale Sandeep Bhaskar; **Lali Arvind Mallinath**; Bhoori Abijar; Kharkar Manoj; Narsapur Sharath; Reddy Srinivasula; Gudipati Srinivasula; Ramamurthy K.  
**Abstract:** Present invention discloses kinetic chromatographic process for separation of dutasteride from dihydrodutasteride, with dihydrodutasteride impurity below 0.001% in final product.

***Process for treatment of rizatriptan reaction mixture for the separation of rizatriptan from its related and other impurities***

143. Indian Application No.: 1542/CHE/2005  
Inventors: Kale Sandeep Bhaskar; **Lali Arvind Mallinath**; Bhoori Abijar; Kharkar Manoj; Narsapur Sharath; Reddy Srinivasula; Gudipati Srinivasula; Ramamurthy K.  
**Abstract:** Present invention discloses an improved and commercially viable process for the treatment of rizatriptan reaction mixture for removal of related and non-related impurities using adsorptive chromatography.

***Process for separation and purification of bioactive lactoferrin, apo-lactoferrin and lactoperoxidase***

144. Indian Application No.: 504/MUM/2004  
Inventors: Kale Sandeep Bhaskar; **Lali Arvind Mallinath**; Agrawal Manisha.  
**Abstract:** A process of tandem column chromatography on ionic and hydrophobic adsorbents for isolating iron binding lactoferrin (LF), apolactoferrin (A-LF), and enzyme lactoperoxidase (LPO) from milk, skimmed milk and whey is invented with recovery of 95% and SDS-PAGE purity of over 99%.

**Industrial Consultancy till date**

- |                                  |   |
|----------------------------------|---|
| 1. Almet Healthcare Pvt. Ltd.    | 2. ATUL Pvt Limited                           |
| 3. BioRad Laboratories           | 4. Cadila Pharma                              |
| 5. Camlin Fine Sciences Ltd.     | 6. Chemito Technologies Pvt. Ltd.             |
| 7. AquaAgri Processing Pvt. Ltd. | 8. Privi Organics Pvt Ltd                     |
| 9. Sanzyme Ltd.                  | 10. Snowtech Equipments Pvt. Ltd              |
| 11. Strides Arcolab, Bangalore   | 12. Warden International (Agencies) Pvt. Ltd. |

**Technology Commercialization**

- Name of Technology:** Fractionation and enzymatic hydrolysis of biomass  
**Patent:** 1299/MUM/2010; 1762MUM/2010  
**Name of Industry:** India Glycols Ltd.; Hindustan Petroleum Corporation Ltd. (HPCL); & Bharat Petroleum Corporation Ltd. (BPCL)  
**Area of Invention:** Production of Biofuels  
**Revenue Generated:** INR 572 Lakhs
- Name of Technology:** Soya biorefinery  
**Patent:** 3577/MUM/2010  
**Name of Industry:** Kanoria Chemicals and Industries Ltd.  
**Area of Invention:** Bioactive isolation and extraction of proteins isoflavons from oil seed materials  
**Revenue Generated:** INR 50 Lakhs

3. **Name of Technology:** Enzymatic oil hydrolysis  
**Patent:** 278/MUM/2012  
**Name of Industry:** Privi Biotechnologies Ltd.  
**Area of Invention:** Fat/oil hydrolysis
4. **Name of Technology:** Biorefinery of Agriculture wastes  
**Patent:** 155/MUM/2014  
**Name of Industry:** Privi Biotechnologies Ltd.  
**Area of Invention:** Oligosaccharides from agriwastes  
**Revenue Generated:** INR 50 Lakhs
5. **Name of Technology:** Production of glucose from cellulose  
**Patent:** 2782/MUM/2015  
**Name of Industry:** The Coca-Cola Company  
**Area of Invention:** Sugar production
6. **Name of Technology:** Purification and refining of glycerol  
**Patent:** IN201621000574  
**Name of Industry:** In-Now LLC  
**Area of Invention:** Glycerol refining  
**Revenue Generated:** USD 350000
7. **Name of Technology:** Detoxification of seed meal  
**Patent:** IN201621011034  
**Name of Industry:** Godrej Agrovet Ltd.  
**Area of Invention:** Animal feed  
**Revenue Generated:** INR 100 Lakhs + Royalty for 10 years
8. **Name of Technology:** DBT-ICT ZeroD Technology  
**Patent:** IN201721002215  
**Name of Industry:** Spectrum Renewable Energy Pvt. Ltd., IGL, Dhampur Sugar Mills Ltd., Jubilant Life Sciences  
**Area of Invention:** Distillery spent wash treatment
9. **Name of Technology:** DBT-ICT Rapid AD Technology  
**Patent:** IN201621030327  
**Name of Industry:** BPCL  
**Area of Invention:** Biogas production
10. **Name of Technology:** DBT-ICT CTL Technology  
**Patent:** 201621025317  
**Name of Industry:** Spectrum Renewable Energy Pvt. Ltd.  
**Area of Invention:** Biomass to biocrude oil
11. **Name of Technology:** Sugar Purification Technology  
**Name of Industry:** Dhampur Sugar Mills Ltd.  
**Area of Invention:** Sugar purification  
**Revenue Generated:** 50 Lakhs



**Dr. Annamma A. Odaneth**  
Associate Professor in Biochemistry

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## **Granted Patents**

### ***A process for production of soluble sugars from biomass***

1. Patent No.: JP2016-564438; 2018
2. Patent No.: ZA2016/05597; 2018
3. Patent No.: EP3094733; 2018
4. Patent No.: SG11201605855T; 2018
5. Patent No.: AU2015207338; 2018
6. Patent No.: US9862980; 2018
7. Patent no.: OAPI/18007/; 2015

Inventors: Lali Arvind Mallinath; **Odaneth Annamma Anil**; Birhade Sachinkumar Hiranman; Victoria Juliet Joanna; Sawant Sneha Chandrakant

**Abstract:** The present invention provides a process for enzyme mediated hydrolysis of biomass for production of soluble sugars. The process used for enzymatic hydrolysis allows for increased biomass loading, enzyme recycle and mitigation of substrate and product inhibitory effect.

### ***Process for fractionation of oligosaccharides from agri-waste***

8. Patent No.: JP2016-564437; 2018
9. Patent No.: AU2015207336; 2018
10. Patent No.: EP3094734; 2018
11. Patent No.: US9963725; 2018
12. Patent No.: SG11201605857Y; 2017
13. Patent No.: OAPI/17918; 2015

Inventors: Lali Arvind Mallinath; **Odaneth Annamma Anil**; Pednekar Mukesh Prabhakar

**Abstract:** The present invention provides a continuous and cost effective chemo-enzymatic process for fractionation of holocellulose, obtained from agri-waste, into arabinoxylooligosaccharides, xylooligosaccharides and celooligosaccharides.

### ***Enzymatic process for fat and oil hydrolysis***

14. Patent No.: IN308754; 2019
15. Patent No.: PH1/2014/501720; 2019
16. Patent No.: EP2809789; 2018
17. Patent No.: MX354561; 2018
18. Patent No.: CN104245949B; 2017
19. Patent No.: AU2013213921; 2017
20. Patent No.: JP6159741; 2017
21. Patent no.: US9512451B2; 2016

22. Patent No.: SG11201404463P; 2015  
Inventors: Lali Arvind Mallinath; **Odaneth Annamma Anil**; Vadgama Rajesh; Warke Mrunal; Bhat Anuradha  
**Abstract:** The present invention describes an efficient and cost effective enzymatic hydrolysis process of fats and oil for production of oleochemicals such as fatty acids, sn-regio mono-acylglycerol (MAG), sn-regio diacyl-glycerols (DAG), and glycerol, in a homogenous mixture.

*Method for production of fermentable sugars from biomass*

23. Patent No.: AR076925B1; 2018  
24. Patent No.: KR101842080; 2018  
25. Patent No.: CA2763588; 2018  
26. Patent No.: MY160407A; 2017  
27. Patent No.: PH1/2011/502465; 2016  
28. Patent No.: IDP000047770; 2016  
29. Patent no.: AU2010252547; 2015  
30. Patent No.: US8709763 (US-DIV-I); 2014  
31. Patent No.: US8673596 (US-DIV-II); 2014  
32. Patent No.: BD1005172; 2014  
33. Patent No.: PK141809; 2014  
34. Patent No.: US8338139; 2012  
35. Patent No.: ZA2011/09250; 2012  
Inventors: Lali Arvind Mallinath; **Odaneth Annamma Anil**; Nagwekar Pooja Devidas; Varavadekar Jayesh Suman; Wadekar Prathamesh Chandrashekher; Gujarathi Swapnali Subhash; Valte Rajeshwar Dattatraya; Birhade Sachinkumar Hiranman  
**Abstract:** The present invention describes a process for production of fermentable sugars from biomass using multi-enzyme multi-step system production of biofuel and other by-products.

*One step flow-through adsorptive purification of tubulin from tissue homogenate*

36. Patent No.: IN228041; 2004  
Inventors: Lali Arvind Mallinath; **Odaneth Annamma Anil**; Reena A. Pandit; Madhavi Indap  
**Abstract:** The present invention describes a process for purification of tubulin from mammalian brain tissue homogenate employing a macroporous chromatographic media with an inherent hydrophobic and a combination of hydrophobic and ion exchange character.

## **Patent Applications Filed**

*A method for producing microbial oil from lignin or lignin hydrolysate using oleaginous yeasts*

1. Indian Application No:201721027460
2. PCT Application No.: PCT/IN2018/050506  
Inventors: Lali Arvind Mallinath; **Odaneth Annamma Anil**; Pawar Pratik Prashant; Chourasia Vallari Ramesh, Vadgama Rajeshkumar Natwarlal  
**Abstract:** The present invention provides a method for producing microbial oil from lignin or lignin hydrolysate using oleaginous yeasts. The lignin hydrolysate is obtained by a reaction of lignin feedstock in presence of at least one catalyst at



suitable conditions.

*Extractive production of microbial oil using oleaginous yeasts*

3. Indian Application No: 201721013545
4. PCT Application No: PCT/IN2018/050225  
Inventors: Lali Arvind Mallinath; **Odaneth Annamma Anil**; Pawar Pratik Prashant; Warke Mrunal Anil; Vadgama Rajeshkumar Natwarlal; Chourasia Vallari Ramesh  
**Abstract:** The present invention discloses the process for extractive in situ production of microbial oil using oleaginous yeast. The present invention further relates to the use of capturing agents for improving carbon assimilation and overall yields of the metabolite.

*Enzymatic hydrolysis process for production of fermentable sugars*

5. Indian Application Number: 201621030093
6. PCT Application No.: PCT/IN2017/050382  
Inventors: Lali Arvind Mallinath; **Odaneth Annamma Anil**; Victoria Juliet Joanna; Choudhari Vikram Gunvant; Mahadik Chinmayee Ramray; Sawant Sneha Chandrakant; Khairat Mayur Basavraj; Birhade Sachinkumar Hiranman  
**Abstract:** Present invention provides an enzymatic hydrolysis process for production of fermentable sugars (95%), wherein hydrolysis is carried in step wise manner (multi-steps) to achieve complete hydrolysis of substrate (at least 90%) in less than 5 hours. Fermentable sugars separated in each step from soluble fraction can be used further for production of value added products.

*Process for production of pure glucose from cellulose*

7. Indian Application No.: 2782/MUM/2015
8. PCT Application No.: PCT/IN2016/050248
9. USA: 15/746,217
10. Brazil: BR20181101287
11. China: 201680055129
12. EPO: EP20160778121  
Inventors: Lali Arvind Mallinath; **Odaneth Annamma Anil**; Victoria Juliet Joanna; Choudhari Vikram Gunvant; Wadekar Prathamesh Chandrashekhar; Patil Mallikarjun Laxmiputra; Patil Parmeshwar Shivajirao; Asodekar Bhupal Ravindra; Prakash Indra; Huang Xiaoyan  
**Abstract:** The present invention relates to a process for production of glucose having purity of more than 95% from pretreated cellulosic biomass. Furthermore, it relates to isolation of a cellulose residue comprising polysaccharides that contain more than 99.5% glucose, and that is amenable to enzymatic treatment for production of more than 98% pure monomeric glucose.

*Enzymatic production of monoacylglycerol from oil*

13. Indian Patent Application No.: 1583/MUM/2014  
Inventors: Lali Arvind Mallinath; **Odaneth Annamma Anil**; Vadgama Rajesh Natwarlal; Tribhuvan Nikhil Vilas  
**Abstract:** The present invention discloses a solvent extraction and chromatographic method for production of different monoacylglycerol (MAG) and diacylglycerol (DAG) compositions using lipase catalyst under controlled temperature and time.

*Enzymatic process for synthesis of fatty acid ester of polyols*

14. Indian Application No.: 1526/MUM/2014

Inventors: **Lali Arvind Mallinath; Odaneth Annamma Anil;** Yadav Manish Gyanendra

**Abstract:** The present invention provides an enzyme catalysed process for preparation of fatty acid ester of polyols, wherein process is carried out with shortened reaction time and higher conversion rate.

*A process for fractionation of oligosaccharides from cereal bran*

15. India: 155/MUM/2014
16. PCT: PCT/IB2015/000030
17. Brazil: BR 11 2016 016582 9.
18. China: 201580014132.2
19. Indonesia: P00 2016 05324
20. Malaysia: PI 2016001326
21. Mexico: MX/a/2016/009364
22. Canada: 2937077
23. South Korea: 10-2016-7021731
24. South Africa: 2016/05596
25. ARIPO: AP/P/2016/009358

Inventors: Lali Arvind Mallinath; **Odaneth Annamma Anil;** Pednekar Mukesh Prabhakar

**Abstract:** The present invention provides a continuous and cost effective chemo-enzymatic process for fractionation of holocellulose, obtained from agri-waste, into arabinoxylooligosaccharides, xylooligosaccharides and celooligosaccharides.

*A process for production of soluble sugars from biomass*

26. India: 154/MUM/2014
27. PCT: PCT/IB2015/000034
28. Brazil: BR 11 2016 0165853
29. China: 201580013527.0
30. Indonesia: P00 2016 05323
31. Malaysia: PI 2016001325
32. Mexico: MX/a/2016/009363
33. Canada: 2937114
34. South Korea: 10-2016-7021752
35. ARIPO: AP/P/2016/009357

Inventors: Lali Arvind Mallinath; **Odaneth Annamma Anil;** Birhade Sachinkumar Hiranman; Victoria Juliet Joanna; Sawant Sneha Chandrakant

**Abstract:** The present invention provides a process for enzyme mediated hydrolysis of biomass for production of soluble sugars. The process used for enzymatic hydrolysis allows for increased biomass loading, enzyme recycle and mitigation of substrate and product inhibitory effect.

*Process for extraction of polyphenols from biomass*

36. Indian Application No.: 3808/MUM/2013
- Inventors: Lali Arvind Mallinath; **Odaneth Annamma Anil;** Pednekar Mukesh Prabhakar; Singh Niteshkumar Satish; Rathi Abhijit; Iyer Padmini; Deshmukh Sharad

**Abstract:** The present invention relates to an efficient and cost effective process for extraction of polyphenolics from different biomass materials.

### *Enzymatic process for fat and oil hydrolysis*

37. PCT Publication No.: WO2013114178
38. UAE: 834/2014
39. Chile: 02010-2014
40. Brazil: BR120140186820
41. Malaysia: PI 2014002218
42. Thai: 1401004403
43. Canada: CA 2863162
44. Indonesia: P00 2014 04861
45. Vietnam: 1-2014- 02678
46. S. Korea: 1020147023663
47. Thailand: 1401004403

Inventors: Lali Arvind Mallinath; **Odaneth Annamma Anil**; Vadgama Rajesh; Warke Mrunal; Bhat Anuradha

**Abstract:** The present invention describes an efficient and cost effective enzymatic hydrolysis process of fats and oil for production of oleochemicals such as fatty acids, sn-regio mono-acylglycerol (MAG), sn-regio diacyl-glycerols (DAG), and glycerol, in a homogenous mixture.

### *A process for isolation of natural & bioactive proteins and other minor components from defatted oil seed material*

48. Indian Application No.: 3577/MUM/2010  
Inventors: Lali Arvind Mallinath; **Odaneth Annamma Anil**; Iyer Padmini Raju; Ghosh Bidisha; T. D. Anupama; Rathi Abhijit; Deshmukh Sharad  
**Abstract:** The present invention relates to a method for efficient extraction, concentration and isolation of proteins and other minor components such as saccharides, isoflavones, protease inhibitors, phytates, starch and non-starch polysaccharides from defatted oil seed material.

### *Method for production of fermentable sugars from biomass*

49. International Publication No.: WO2010137039
50. India Application No: 1299/MUM/2009
51. Brazil Application No: PI10149082
52. Malaysia Application No: PI 2011005731
53. Paraguay Application No: 20452/2010
54. Venezuela Application No: 000847-2010
55. Vietnam Application No: 1-2011-03614
56. EPO Application No: 10747688.9
57. Sri Lanka Application No: 16526
58. Thailand Application No: 1001000794
59. Uruguay Application No: 32.973
60. Japan Application No: 2012-512522  
Inventors: Lali Arvind Mallinath; **Odaneth Annamma Anil**; Nagwekar Pooja Devidas; Varavadekar Jayesh Suman; Wadekar Prathamesh Chandrashekhar; Gujarathi Swapnali Subhash; Valte Rajeshwar Dattatraya; Birhade Sachinkumar Hiranman  
**Abstract:** The present invention describes a process for production of fermentable sugars from biomass using multi-enzyme multi-step system production of biofuel and other by-products.

## **Industrial Consultancy till date**

- |  |  |
|--|--|
| 1. Acme Synthetic Chemicals              | 2. Camlin Fine Sciences Ltd                    |
| 3. India Glycols Limited                 | 4. Poabs Biotech Pvt Ltd                       |
| 5. Privi Biotechnologies Pvt ltd         | 6. AquaAgri Processing Pvt. Ltd.               |
| 7. Kanoria Chemicals and Industries Ltd. | 8. Dadra and Nagar Haveli Aroma Chemicals Ltd. |

## **Technology Commercialization**

- Name of Technology:** Fractionation and enzymatic hydrolysis of biomass  
**Patent:** 1299/MUM/2010; 1762MUM/2009  
**Name of Industry:** India Glycols Ltd.; Hindustan Petroleum Corporation Ltd. (HPCL) & Bharat Petroleum Corporation Ltd. (BPCL)  
**Area of Invention:** Production of Biofuels  
**Revenue Generated:** INR 572 Lakhs
- Name of Technology:** Soya biorefinary  
**Patent:** 3577/MUM/2010  
**Name of Industry:** Kanoria Chemicals and Industries Ltd.  
**Area of Invention:** Bioactive isolation and extraction of proteins isoflavons form oil seed materials  
**Revenue Generated:** INR 50 Lakhs
- Name of Technology:** Enzymatic oil hydrolysis  
**Patent:** 278/MUM/2012  
**Name of Industry:** Privi Biotechnologies Ltd.  
**Area of Invention:** Bioactive isolation and extraction of proteins isoflavons form oil seed materials.
- Name of Technology:** Biorefinery of Agriculture wastes  
**Patent:** 155/MUM/2014  
**Name of Industry:** Privi Biotechnologies Ltd.  
**Area of Invention:** Oligosaccharides from agriwastes  
**Revenue Generated:** INR 50 Lakhs
- Name of Technology:** Production of glucose from cellulose  
**Patent:** 2782/MUM/2015  
**Name of Industry:** The Coca-Cola Company  
**Area of Invention:** Sugar production



**Dr. Gunjan Prakash**

Associate Professor

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## Patent Applications Filed

### *Continuous process for production of Vitamin B12*

1. Indian Application Number: 201621017230

2. PCT Application No.: PCT/IN2017/050190

Inventors: Lali Arvind Mallinath; **Prakash Gunjan**; Pillai Vijita V

**Abstract:** Present invention provides continuous process for production of vitamin B12 in single reactor system by using high density cell culture. Said process is carried out by growing *Propionibacterium freudenreichii shermanii* under anaerobic condition.

### *Algal variants produced by genome shuffling*

3. Indian Application No.: 1940/MUM/2014

Inventors: Lali Arvind Mallinath; **Prakash Gunjan**; Shukla Bhavya; Vira Chaitali; Rathod Jayant Pralhad

**Abstract:** The present invention relates to production of genome shuffled variants of algae, the variant comprising those that have the simple genetic combination of two or more parent species, wherein the parent species are selected for specific desired characteristics of interest.

### *Raceway pond system for increased biomass productivity*

4. Indian Application No.: 1705/MUM/2012

5. International Publication No.: WO2013186626

Inventors: Lali Arvind Mallinath; Pandit Reena; **Prakash Gunjan**; Mathpati Channamallikarjun; Gangal Swanand; Vira Chaitali; Palkar Juilee; Patil Smita; Gaikwad Sujata

**Abstract:** The present invention describes a raceway pond system for cultivation of photosynthetic cells or organisms having a depth ranging from 60 to 150 cm. It further relates to the use of said system for obtaining higher production of algal biomass per unit land area; reduced cost of production of algal biomass and associated products.



**Dr. Hitesh Pawar**

Assistant Professor

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### Granted Patents

*Process for synthesis of furan derivatives from saccharides using acid catalyst and preparation thereof*

1. Patent No.: US9975866; 2018
2. Patent No.: JP2016-533608; 2018

Inventors: Lali Arvind Mallinath; **Pawar Hitesh Suresh**

**Abstract:** The present invention relates to a process for synthesis of furan derivatives, more particularly 5-hydroxymethylfurfural (5-HMF), with more than 90% yield, from saccharides using an acid catalyst in polar monophasic organic solvent with either microwave radiation or conventional heating.

### Patent Applications Filed

*Process for treating liquid industrial effluents to produce clean water and recovering pollutants for value addition*

1. Indian Application Number: 201721002215
2. PCT Application No.: PCT/IN2018/050034

Inventors: Lali Arvind Mallinat; **Pawar Hitesh Suresh**

**Abstract:** Present invention relates to an efficient process for treating an effluent generated from industry to produce clean water with zero liquid discharge. The process described herein, comprises steps of adsorptive separation, anaerobic digestion and/or membrane filtration and finally polishing by using micro filtration or ultra-filtration or nanofiltration or reverse osmosis or combination thereof.

*A process for generation of biogas from organic matter via its liquefaction to biocrude*

3. Indian Application Number: 201621030327
4. PCT Application No.: PCT/IN2017/050385

Inventors: Lali Arvind Mallinath; Sharma Manju; **Pawar Hitesh Suresh**; Gore Suhas

**Abstract:** The present invention relates to Anaerobic Digestion (AD) process for generation of biomethane in near theoretical yields and enhanced productivities from liquid biocrude obtained from liquefaction of organic matter. AD of liquid biocrude results in > 90% COD reduction with biogas yield greater than 90% containing at least 55% (v/v) methane at OLRs in excess of 15 Kg/m<sup>3</sup>.day in less than 24 h.

*A catalytic liquefaction (CTL) method for production of bio-crude oil using ionic liquid catalyst and preparation thereof*

5. Indian Application Number: 201621025317
6. PCT Application No.: PCT/IN2017/050303
7. US Application No.: Yet to receive
8. Brazil Application No.: Yet to receive

9. EPO Application No.: Yet to receive  
Inventors: Lali Arvind Mallinath; **Pawar Hitesh Suresh**; Shravan sreenivasan  
**Abstract:** The present invention provides a catalytic liquefaction (CTL) method for converting organic biodegradable waste into bio-crude oil in presence of indigenously prepared sulfonic acid counter ion Bronsted acid ionic liquid catalyst at non-stringent reaction condition.

*Process for synthesis of furan derivatives from saccharides using acid catalyst and preparation thereof*

10. Indian Application No.: 3664/MUM/2013  
11. PCT Application No.: PCT/IB2014/002537  
12. Canada: CA 2931330  
13. EPO: 14819069.7  
14. Brazil: BR 1120160115392  
15. China: 201480073605.1  
16. South Korea: 10-2016-7016531

Inventors: Lali Arvind Mallinath; **Pawar Hitesh Suresh**

**Abstract:** The present invention relates to a process for synthesis of furan derivatives, more particularly 5-hydroxymethylfurfural (5-HMF), with more than 90% yield, from saccharides using an acid catalyst in polar monophasic organic solvent with either microwave radiattion or conventional heating.



## Dr. Jayesh Varavadekar

Research Scientist

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### Granted Patents

#### *Process for Fractionation of Biomass*

1. Patent No.: JP5799091; 2015
2. Patent No.: ZA2013/00133; 2013  
Inventors: Lali Arvind Mallinath; **Varavadekar Jayesh Suman**; Wadekar Prathamesh Chandrashekher

**Abstract:** The present invention discloses a process of fractionation of biomass using aqueous ammonia into lignin, cellulose and/or hemicellulose in more than 90% purity

#### *Method for production of fermentable sugars from biomass*

3. Patent No.: AR076925B1; 2018
4. Patent No.: KR101842080; 2018
5. Patent No.: CA2763588; 2018
6. Patent No.: MY160407A; 2017
7. Patent No.: PH1/2011/502465; 2016
8. Patent No.: IDP000047770; 2016
9. Patent no.: AU2010252547; 2015
10. Patent No.: US8709763 (US-DIV-I); 2014
11. Patent No.: US8673596 (US-DIV-II); 2014
12. Patent No.: BD1005172; 2014
13. Patent No.: PK141809; 2014
14. Patent No.: US8338139; 2012
15. Patent No.: ZA2011/09250; 2012

Inventors: Lali Arvind Mallinath; Odaneth Annamma Anil; Nagwekar Pooja Devidas; **Varavadekar Jayesh Suman**; Wadekar Prathamesh Chandrashekher; Gujarathi Swapnali Subhash; Valte Rajeshwar Dattatraya; Bihade Sachinkumar Hiranman

**Abstract:** The present invention describes a process for production of fermentable sugars from biomass using multi-enzyme multi-step system production of biofuel and other by-products.

### Patent Applications Filed

#### *High cell density continuous fermentation of C5 sugar/s or both C5 & C6 sugars to ethanol*

1. Indian Application No.: 201821027586  
Inventors: Lali Arvind Mallinath; **Varavadekar Jayesh Suman**; Reshamwala Shamlan M.S.

**Abstract:** Field of invention relates to high cell density continuous fermentative production of ethanol in a single reactor system using C5 sugar/s or both C5 & C6 sugars. Furthermore, it relates to continuous cell recycle for fermentative production



of ethanol with high yield.

***Process for fractionation of biomass***

3. PCT Publication No.: WO2011154967
4. Indian Application No:1762/MUM/2010
5. Australia Application No: 2010354974
6. Argentina Application No: 2010 01 04016
7. Brazil Application No: BR1120120311743
8. Bangladesh Application No: 281/2010
9. Sri Lanka Application No: 16959
10. China Application No: 201080067281.2
11. Philippines Application No: 1-2012-502357
12. Paraguay Application No: 47531
13. EPO Application No: 10803647.6
14. Indonesia Application No: W00201300070
15. US Application No: 13/702, 480
16. Malaysia Application No: PI 2012005262
17. Uruguay Application No: 32, 9733
18. Vietnam Application No: 1-2013-00080
19. S. Korea Application No: 10-2013-700738
20. Pakistan Application No: 885/2010
21. Canada Application No.: 2800996

Inventors: Lali Arvind Mallinath; **Varavadekar Jayesh Suman**; Wadekar Prathamesh Chandrashekher

**Abstract:** The present invention discloses a process of fractionation of biomass using aqueous ammonia into lignin, cellulose and/or hemicellulose in more than 90% purity.

***Method for production of fermentable sugars from biomass***

22. International Publication No.: WO2010137039
23. India Application No: 1299/MUM/2009
24. Brazil Application No: PI10149082
25. Malaysia Application No: PI 2011005731
26. Paraguay Application No: 20452/2010
27. Venezuela Application No: 000847-2010
28. Vietnam Application No: 1-2011-03614
29. EPO Application No: 10747688.9
30. Sri Lanka Application No: 16526
31. Thailand Application No: 1001000794
32. Uruguay Application No: 32.973
33. Japan Application No: 2012-512522

Inventors: Lali Arvind Mallinath; Odaneth Annamma Anil; Nagwekar Pooja Devidas; **Varavadekar Jayesh Suman**; Wadekar Prathamesh Chandrashekher; Gujarathi Swapnali Subhash; Valte Rajeshwar Dattatraya; Bihade Sachinkumar Hiranman

**Abstract:** The present invention describes a process for production of fermentable sugars from biomass using multi-enzyme multi-step system production of biofuel and other by-products.



**Dr. Manju Sharma**

Assistant Professor

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### **Patent Applications Filed**

*A process for generation of biogas from organic matter via its liquefaction to biocrude*

1. Indian Application Number: 201621030327
2. PCT Application No.: PCT/IN2017/050385

Inventors: Lali Arvind Mallinath; **Sharma Manju**; Pawar Hitesh Suresh; Gore Suhas  
**Abstract:** The present invention relates to Anaerobic Digestion (AD) process for generation of biomethane in near theoretical yields and enhanced productivities from liquid biocrude obtained from liquefaction of organic matter. AD of liquid biocrude results in > 90% COD reduction with biogas yield greater than 90% containing at least 55% (v/v) methane at OLRs in excess of 15 Kg/m<sup>3</sup>.day in less than 24 h.

### **Technology Commercialization**

1. **Name of Technology:** DBT-ICT Rapid AD Technology  
**Patent:** IN201621030327  
**Name of Industry:** BPCL  
**Area of Invention:** Biogas production



**Dr. Nitin Trivedi**  
Assistant Professor, DST Fellow

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### **Patent Applications Filed**

#### ***Suspended cultivation of macroalgae in photobioreactor***

1. Indian Application Number: 201621013008  
Inventors: Lali Arvind Mallinath; Pandit Reena Ajit; Mhatre Akanksha Devinath; Navale Mahesh Maruti; **Trivedi Nitin**

**Abstract:** Present invention relates to method for suspended cultivation of macroalgae in photobioreactor. Invention provides a process for cultivation and year-round production of macroalgal biomass in photobioreactor system in suspended mode (without physical support) under controlled conditions.



**Dr. Reena Pandit**

Associate Professor

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### Granted Patents

#### *One step flow-through adsorptive purification of tubulin from tissue homogenate*

1. Patent No.: IN228041; 2004  
Inventors: Lali Arvind Mallinath; Odaneth Annamma Anil; **Reena A. Pandit**; Madhavi Indap

**Abstract:** The present invention describes a process for purification of tubulin from mammalian brain tissue homogenate employing a macroporous chromatographic media with an inherent hydrophobic and a combination of hydrophobic and ion exchange character.

### Patent Application Filed

#### *Method for enhanced bio-production of zeaxanthin*

1. Indian Application No:201821002293  
Inventors: Lali Arvind Mallinath; **Pandit Reena**; Sarnaik Aditya  
**Abstract:** The present invention relates to a method for generation of genetically modified microorganism through homologous recombination. Furthermore it relates to production of zeaxanthin from the genetically modified microorganism.

#### *Genetically modified microorganism and process for production of zeaxanthin therefrom*

2. Indian Application No: 201721011982
3. PCT Application No.: PCT/IN2018/050189  
Inventors: Lali Arvind Mallinat; **Pandit Reena**; Sarnaik Aditya; Rai Peeyush Shekhar  
**Abstract:** The present invention relates to genetically modified microorganism and production of zeaxanthin. The said invention provides process for production of zeaxanthin from  $\beta$ -carotene by using genetically modified microorganism (*S. elongatus* PCC 7942), wherein microorganism is modified by introducing  $\beta$ -carotene oxygenase (CrtR) gene isolated from *Synechococcus elongatus* PCC7002 into its genome through homologous recombination.

#### *Suspended cultivation of macroalgae in photobioreactor*

4. Indian Application Number: 201621013008  
Inventors: Lali Arvind Mallinath; **Pandit Reena Ajit**; Mhatre Akanksha Devinath; Navale Mahesh Maruti; Trivedi Nitin  
**Abstract:** Present invention relates to method for suspended cultivation of macroalgae in photobioreactor. Invention provides a process for cultivation and year-round production of macroalgal biomass in photobioreactor system in suspended mode (without physical support) under controlled conditions.

*Photosynthetic microorganisms mediated rapid wastewater treatment using continuous photobioreactor*

5. Indian Application Number: 201621011795  
Inventors: Lali Arvind Mallinath; **Pandit Reena Ajit**; Palkar Juilee Ajit; Navale Mahesh Maruti

**Abstract:** The present invention relates to rapid, continuous process for wastewater treatment by employing photosynthetic microorganism grown under controlled conditions in a photo-bioreactor. The photosynthetic microorganism consumes organic and inorganic matter in soluble and suspended forms.

*Raceway pond system for increased biomass productivity*

6. Indian Application No.: 1705/MUM/2012  
7. International Publication No.: WO2013186626  
Inventors: Lali Arvind Mallinath; **Pandit Reena**; Prakash Gunjan; Mathpati Channamallikarjun; Gangal Swanand; Vira Chaitali; Palkar Juilee; Patil Smita; Gaikwad Sujata

**Abstract:** The present invention describes a raceway pond system for cultivation of photosynthetic cells or organisms having a depth ranging from 60 to 150 cm. It further relates to the use of said system for obtaining higher production of algal biomass per unit land area; reduced cost of production of algal biomass and associated products.



**Dr. Rajesh Vadgama**

Research Scientist

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### Granted Patents:

#### *Enzymatic process for fat and oil hydrolysis*

1. Patent No.: IN308754; 2019
2. Patent No.: PH1/2014/501720; 2019
3. Patent No.: EP2809789; 2018
4. Patent No.: MX354561; 2018
5. Patent No.: CN104245949B; 2017
6. Patent No.: AU2013213921; 2017
7. Patent No.: JP6159741; 2017
8. Patent no.: US9512451B2; 2016
9. Patent No.: SG11201404463P; 2015

Inventors: Lali Arvind Mallinath; Odaneth Annamma Anil; **Vadgama Rajesh**; Warke Mrunal; Bhat Anuradha

**Abstract:** The present invention describes an efficient and cost effective enzymatic hydrolysis process of fats and oil for production of oleochemicals such as fatty acids, sn-regio mono-acylglycerol (MAG), sn-regio diacyl-glycerols (DAG), and glycerol, in a homogenous mixture.

### Patent Applications Filed

#### *Extractive production of microbial oil using oleaginous yeasts*

1. Indian Application No: 201721013545
2. PCT Application No: PCT/IN2018/050225

Inventors: Lali Arvind Mallinath; Odaneth Annamma Anil; Pawar Pratik Prashant; Warke Mrunal Anil; **Vadgama Rajeshkumar Natwarlal**; Chourasia Vallari Ramesh

**Abstract:** The present invention discloses the process for extractive in situ production of microbial oil using oleaginous yeast. The present invention further relates to the use of capturing agents for improving carbon assimilation and overall yields of the metabolite.

#### *Enzymatic production of monoacylglycerol from oil*

3. Indian Patent Application No.: 1583/MUM/2014

Inventors: Lali Arvind Mallinath; Odaneth Annamma Anil; **Vadgama Rajesh Natwarlal**; Tribhuvan Nikhil Vilas

**Abstract:** The present invention discloses a solvent extraction and chromatographic method for production of different monoacylglycerol (MAG) and diacylglycerol (DAG) compositions using lipase catalyst under controlled temperature and time.

#### *Enzymatic process for fat and oil hydrolysis*

4. PCT Publication No.: WO2013114178
5. UAE: 834/2014

6. Chile: 02010-2014
7. Brazil: BR120140186820
8. Malaysia: PI 2014002218
9. Thai: 1401004403
10. Canada: CA 2863162
11. Indonesia: P00 2014 04861
12. Vietnam: 1-2014- 02678
13. S. Korea: 1020147023663
14. Thailand: 1401004403

Inventors: Lali Arvind Mallinath; Odaneth Annamma Anil; **Vadgama Rajesh**; Warke Mrunal; Bhat Anuradha

**Abstract:** The present invention describes an efficient and cost effective enzymatic hydrolysis process of fats and oil for production of oleochemicals such as fatty acids, sn-regio mono-acylglycerol (MAG), sn-regio diacyl-glycerols (DAG), and glycerol, in a homogenous mixture.

***A method for producing microbial oil from lignin or lignin hydrolysate using oleaginous yeasts***

15. Indian Application No:201721027460
16. PCT Application No.: PCT/IN2018/050506

Inventors: Lali Arvind Mallinath; Odaneth Annamma Anil; Pawar Pratik Prashant; Chourasia Vallari Ramesh, **Vadgama Rajeshkumar Natwarlal**

**Abstract:** The present invention provides a method for producing microbial oil from lignin or lignin hydrolysate using oleaginous yeasts. The lignin hydrolysate is obtained by a reaction of lignin feedstock in presence of at least one catalyst at suitable conditions.



**Dr. Sanjeev Chandrayan**  
DBT Energy Science Overseas Fellow

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### Patent Applications Filed

#### *A novel triacylglycerol lipase (rc-TGL); Designing and Production thereof*

1. Indian Application No.: 201821019862  
Inventors: **Chandrayan Sanjeev Kumar**; Lali Arvind Mallinath; Sathe Sneha; Soni Surabhi

**Abstract:** The present invention discloses a novel triacylglycerol lipase polypeptide and variants/recombinants thereof. The disclosure further provides a polynucleotide sequence encoding the said polypeptide sequence.

#### *A novel glucose tolerant glucosidase enzyme (Mbgl)*

2. Indian Application Number: 201621022859  
Inventors: Lali Arvind Mallinath; **Chandrayan Sanjeev Kumar**; Sathe Sneha; Soni Suarabhi

**Abstract:** The present invention discloses a novel glucose tolerant, thermo-stable  $\beta$ -glucosidase polypeptide, and variants/ recombinants thereof. The disclosure further provides a polynucleotide sequence encoding the said polypeptide sequence. The polypeptide, referred as Mbgl, was derived from a gene encoding a GH1  $\beta$ -glucosidase – Mbgl from *Methylococcus capsuatus* (bath) and cloned in host cell *E. coli*.





**Dr. Shalini Deb**

Research Scientist

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### **Patent Applications Filed**

#### ***Ammonia assimilation by recombinant microorganism***

1. Indian Application No: 201721023070  
Inventors: **Deb Shalini Subir**; Reshamwala Shamlan Mohammed Shafi; Lali Arvind Mallinath

**Abstract:** The present invention converts ammonia into innocuous molecules using a genetically modified microorganism. Enzymes of an ammonia assimilation pathway are overexpressed in the host microorganism.

#### ***Constructs for gene expression and integration in host cell***

2. Indian Application No.: 3506/MUM/2014  
Inventors: **Deb Shalini**; Reshamwala Shamlan M.S.; Lali Arvind Mallinath  
**Abstract:** The present invention relates to constructs for gene expression that comprise of a promoter and a transcription terminator with an intervening multiple cloning site. A gene coding for a selectable marker may be proximally present to allow easy selection of cells that have integrated the construct in the genome.



## Dr. Shamlan M.S. Reshamwala

Assistant Professor

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### Granted Patent

#### *A nucleic acid construct for gene expression*

1. Patent No: 272788  
Inventors: **Reshamwala Shamlan M. S.**; Noronha S. B.  
**Abstract:** This invention relates to nucleic acid construct for gene expression.

### Patent Applications Filed

#### *High cell density continuous fermentation of C5 sugar/s or both C5 & C6 sugars to ethanol*

1. Indian Application No.: 201821027586  
Inventors: Lali Arvind Mallinath; Varavadekar Jayesh Suman; **Reshamwala Shamlan M.S.**  
**Abstract:** Field of invention relates to high cell density continuous fermentative production of ethanol in a single reactor system using C5 sugar/s or both C5 & C6 sugars. Furthermore, it relates to continuous cell recycle for fermentative production of ethanol with high yield.

#### *Ammonia assimilation by recombinant microorganism*

2. Indian Application No: 201721023070  
Inventors: Deb Shalini Subir; **Reshamwala Shamlan Mohammed Shafi**; Lali Arvind Mallinath  
**Abstract:** The present invention converts ammonia into innocuous molecules using a genetically modified microorganism. Enzymes of an ammonia assimilation pathway are overexpressed in the host microorganism.

#### *Constructs for gene expression and integration in host cell*

3. Indian Application No.: 3506/MUM/2014  
Inventors: Deb Shalini; **Reshamwala Shamlan M.S.**; Lali Arvind Mallinath  
**Abstract:** The present invention relates to constructs for gene expression that comprise of a promoter and a transcription terminator with an intervening multiple cloning site. A gene coding for a selectable marker may be proximally present to allow easy selection of cells that have integrated the construct in the genome.

#### *Recombinant E. coli strain and process for production of mannitol therefrom*

4. Indian Application No.: 3807/MUM/2013  
Inventors: **Reshamwala Shamlan M.S.**; Lali Arvind Mallinath  
**Abstract:** The present invention describes a recombinant Escherichia coli strain comprising over expressed mannitol-1-phosphate dehydrogenase (MtlD) and heterologous mannitol-1-phosphatase (M1Pase) and phosphite dehydrogenase (PtxD).



# Department of Dyestuff Technology

## Research Areas:

Synthesis of multistep Heterocyclic and Fused Heterocyclic compounds

Green methods for fluorescent compounds

Metal complex dyes for photovoltaic

Fibre reactive dyes, vat dyes, carbohydrate chemistry,  
Natural product synthesis

Functional colorants for Dye Sensitized Solar Cell

Synthesis and formulation of perfumes and flavours





**Prof. Ganapati S. Shankarling**  
Head, Dyestuff Technology Department  
Coordinator, Perfumery and Flavour Technology

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## Granted Patents

### *Composition, Method of authenticating, methods of making authenticatable compositions, authenticatable articles made therefrom*

1. Patent No.: US8178702; 2012
2. Patent No.: US7635778; 2009  
Inventor: Chauhan Y.; Chaudhari M.; Dhalla A.; Maruvada S.; Naik S.; Pai-Paranjape V.; Schottland Philippe.; **Shankarling G. S.**; Puthamane K.; Sait M.

**Abstract:** This patent describes Composition, Method of authenticating, Methods of making authenticatable compositions, Authenticatable articles made therefrom

### *Thermally stable Anthrapyridone*

3. Patent No.: US7655085; 2010  
Inventor: **Shankarling G.S.**; Sivakumar M.; Dhalla A.M.

**Abstract:** This patent describes thermally stable Anthrapyridone

### *Synthesis and characterization of benzothiazole based solid state fluorescent dyes*

4. Patent No: IN 273978; 2009  
Inventor: Kasture Prakhar P; Sonawane Yogesh A.; Rajule Rajkumar N.; **Shankarling G. S.**

**Abstract:** This patent describes synthesis of benzothiazole based solid state fluorescent dyes.

### *Chemical composition for authenticable polymers and articles and authentication methods thereof*

5. Patent No.: US7230113; 2007  
Inventor: Chauhan Y.; Dhalla A.; Maruvada S.; Naik S.; Pai-Paranjape V.; Puthamane K.; Sait M.; Schottland Philippe.; **Shankarling G. S.**

**Abstract:** This patent describes chemical composition for authenticable polymers and articles and authentication methods.

### *An Anthrapyridone of formula (i)*

6. Indian Application No: IN252801; 2006  
Inventor: **Shankarling G. S.**; Krishnamoorthy S.; Dhalla A. M.

**Abstract:** This patent describes an Anthrapyridone of formula (i)

### *3-ethylcarbonate-2-(4-(3-ethylcarbonate-4-oxo-4H-chromen-2-yl)phenyl)-4H-chromen-4-one: authentication markers for use in data storage media substrates*

7. Patent No.: US 7635778; 2004  
Inventor: Chauhan Y.; Dhalla A. M.; Maruvada S.; Naik S.N.; Pai-Paranjape V.; Puthamane K.; Sait M.M.; Schottland Philippe.; **Shankarling G. S.**

**Abstract:** This patent describes composition, method of authenticating.

*Chemical compositions for authenticatable polymers and articles, and authentication methods thereof*

8. Patent No.: US 7645884; 2004  
Inventor: Chauhan Y.; Dhalla A. M.; Maruvada S.; Naik S.N.; Pai-Paranjape V.; Puthamane K.; Sait M. M.; Schottland Philippe.; **Shankarling G. S.**  
**Abstract:** This patent describes synthesis chemical compositions for authenticatable polymers.

*Thermally stable anthrapyridone colorants*

9. Patent No.: US 6995266; 2003  
Inventor: **Shankarling G. S.**; Sivakumar K.; Dhalla A. M.  
**Abstract:** This patent describes synthesis of thermally stable Anthrapyridone colorants.

*Limited play optical storage medium, method for making the same*

10. Patent No.: US 7087282; 2003  
Inventor: **Shankarling G.S.**; Schottland Philippe.; Sahoo B.B.; Ali M.M.; Sait M.; Dhalla A. M.  
**Abstract:** This patent describes synthesis method for making limited play optical storage medium.

*Colored polymeric resin composition with 1,8-diaminoanthraquinone derivative, article made therefrom, and method for making the same*

11. Patent No.: US 7202292; 2003.  
Inventor: Schottland Philippe.; **Shankarling G. S.**; Sivakumar K.; Sahoo B.B.; Ali M. M.; Sait M.; Dhalla A. M.  
**Abstract:** This patent describes method for making the colored polymeric resin composition

## **Patent Application filed**

*Synthesis of copper phthalocyanine using deep eutectic solvent*

1. Indian Application No: 432/MUM/2016  
Inventor: Joglekar Amruta; **Shankarling G. S.**  
**Abstract:** This patent describes synthesis of copper phthalocyanine using Deep Eutectic Solvent.

*Process for preparing cucurbituril in high yield*

2. Indian Application No.: 4510/MUM/2015  
Inventor: **Shankarling G. S.**; Borsate Deepak  
**Abstract:** This patent describes process for preparing cucurbituril in high yield.

*A class of quaternary ammonium catalysts*

3. Indian Application No.:1129/MUM/2011  
Inventor: Sonawane Yogesh A.; Jarag Krishna J.; Pawar Poonam M.; Phadtare Sunanda B.;Bumgara Rashad S.; Lobo Hyacinta R.; Singh Balvant.; Yadav Urmila N.; **Shankarling G. S.**  
**Abstract:** This patent describes application of Deep Eutectic solvents in various organic transformations.

- Styryl molecules based on substituted-1, 4-diphenethyl-1, 2, 3, 4-tetrahydroquinoxaline-6-carbaldehyde*
4. Indian Application No.:1503/MUM/2011  
Inventor: Jarag Krishna.; **Shankarling G. S.**  
**Abstract:** This patent describes synthesis of novel styryl colorants.
- Ultrasound assisted process for synthesis of chalcone*
5. Indian Application No.:1504/MUM/2011  
Inventor: Jarag Krishna.; **Shankarling G. S.**; Pinjari Deepak.; Pandit Aniradha  
**Abstract:** Novel chalcone derivatives are synthesized using ultrasound.
- Synthesis and characterization of novel anthrapyrimidine based colorants for polymers from 1-aminoanthraquinone*
6. Indian Application No: 151/MUM/2010  
Inventor: Menon Sreejit.; **Shankarling G.S.**; Menon Sreejit.  
**Abstract:** This patent describes synthesis and characterization of novel anthrapyrimidine based colorants for polymers from 1-amino anthraquinone
- Synthesis of novel colorants containing styryl units from 1-amino anthraquinone for polymers*
7. Indian Application No: 586/MUM/2010  
Inventor: **Shankarling G.S.**; Menon Sreejit  
**Abstract:** This patent describes synthesis of novel styryl colorants from 1-amino anthraquinone for polymers
- Halogenation reactions in biodegradable solvent*
8. Indian Application No: 587/MUM/2010  
Inventor: Phadtare Sunanda; **Shankarling G. S.**  
**Abstract:** This patent describes bromination of amino anthraquinone using environmentally benign DES as a solvent
- Synthesis of diphenylamine-based styryl colorants*
9. Indian Application No: 489/MUM/2009  
Inventor: Sonawane Yogesh.; **Shankarling G. S.**  
**Abstract:** This patent describes synthesis of diphenylamine based styryl dyes.
- Diphenylamine based styryl dyes using quinoxaline derivative*
10. Indian Application No: 150/MUM/2009  
Inventor: Sonawane Yogesh A.; **Shankarling G. S.**  
**Abstract:** This patent describes synthesis of Diphenylamine based styryl dyes using quinoxaline derivative
- Synthesis of novel fluorescent anthrapyrimidine colorants from 1,4-diamino-anthraquinone for polymers*
11. Indian Application No: 488/MUM/2009  
Inventor: Menon Sreejit.; **Shankarling G. S.**



**Abstract:** This patent describes synthesis of novel fluorescent anthrapyrimidine colorants from 1, 4-diamino anthraquinone for polymers.

**Industrial Consultant till date**

- |                                   |  |
|-----------------------------------|--|
| 1. Metropolitan Eximchem Pvt.Ltd. | 2. Mallak Speciality chemicals             |
| 3. Reliance Industries Ltd.       | 4. Essilor International                   |
| 5. Jyoti Laboratories Ltd.        | 6. Melog Speciality chemicals Ltd.         |
| 7. Hindustan Unilever Ltd.        | 8. Diversely India Pvt. Ltd.               |
| 9. Cavin Kare Pvt.Ltd.            | 10. Midas Import Corporation               |
| 11. Asahi India Glass Ltd.        | 12. Prem Mehandi Centre                    |
| 13. Cyclopharma Chem. Pvt.Ltd     | 14. Enviro Control Associates              |
| 15. Sunbeam Monochem Pvt. Ltd.    | 16. Megafine speciality chemicals Pvt. Ltd |



## Prof. N. Sekar

Professor, Dyestuff Technology  
Coordinator, UGC CAS in  
Physico-chemical aspect of textile fibres,  
dyes and polymers

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### Patent Applications Filed

#### *Azo compounds and methods of preparation and uses thereof*

1. Indian Application No: 2083/MUM/2011  
Inventor: DeshmukhMininath S.; **Sekar Nethi**  
**Abstract:** Present invention relates to azo dyes with an unusual substituent pattern to obtain red shifted absorption is described.

#### *Fused heterocyclic compounds and uses thereof*

2. Indian Application No: 2108/MUM/2011  
Inventors: DeshmukhMininath S.; **Sekar Nethi**  
**Abstract:** Present invention describes an innovative addition to the simple perinone family of colorants.

#### *Solid state fluorescent compound and NBSP: derivative thereof and method of preparation and uses thereof*

3. Indian Application No:3371/MUM/2011  
Inventors: Chaudhari Amol; **Sekar Nethi**  
**Abstract:** Solid state fluorescent molecules having use in organic light emitting devices are described.

#### *Azo-azine compound and method of preparation and uses thereof*

4. Indian Application No:2263/MUM/2011  
Inventors: Chaudhari Amol; **Sekar Nethi**  
**Abstract:** Near Infra Red absorbing motifs with azo and azine functionalities are described here.

### Industrial Consultancy till date

- |   |                                |
|---|--------------------------------|
| 1. Amrital Chemaux Pvt Ltd                | 2. BRNS                        |
| 3. Cavincare                              | 4. Dyanamic Product Ltd.       |
| 5. Heubeach Colour                        | 6. Huntsman International Ltd. |
| 7. Nirup Synchrome Ltd.                   | 8. Nishita Technociates        |
| 9. Pearl Fraben Chem Pvt. Ltd.            | 10. Serene Industries Ltd.     |
| 11. Spectrum Dyes and Chemicals Pvt. Ltd. |                                |



**Prof. Prakash Bhate**  
Professor of Dyestuff Technology

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### Patent Application Filed

#### *Novel reactive dyes system based on diazonium salts*

1. Indian Application No.: 4052/MUM/2013  
Inventors: **Bhate Prakash**; Rajkumari Vijilata Devi; Masand Shruti; Shaikh Lisan; Vaidya Samiksha

**Abstract:** A new reactive system has been developed for dyeing cellulosic fibres. It is based on the reaction of diazonium salts with cellulose to give cellulose ethers wherein the reactive dyes does not need an external reactive system as is the case with the current range of chlorotriazinyl and vinyl sulphone dyes.

#### *Preparation of disperse azo dyes from cyclic enol ethers*

2. Indian Application No.: 3256/MUM/2014  
Inventor: **Bhate Prakash**

**Abstract:** A new class of azo disperse dyes has been developed. The dihydrofuran and dihydropyran are manufactured from renewable feedstocks, these azo disperse dyes have the advantage of a lower carbon footprint when compared with conventional disperse dyes.



## Dr. Surajit Some

UGC Assistant Professor, Dyestuff Technology

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### Patent Applications Filed

#### *Flame retardant transparent liquid based on novel functionalized graphene quantum dots.*

1. Indian Application No: 201821006525

Inventor: **Some Surajit**

**Abstract:** This patent relates to the synthesis of highly efficient transparent flame retardant which can be used day in and day out.

#### *Graphene supported green approach for highly efficient fire retardant*

2. Indian Application No: 201721017621

Inventor: **Some Surajit**

**Abstract:** This patent application relates to graphene supported approach for highly efficient fire retardant.

#### *Magnetic graphene-carrageenan-iron oxide composite for absorption of oils with recycles and reuse.*

3. Indian Application No: 201721018413

Inventor: **Some Surajit**

**Abstract:** This patent application relates to the synthesis of highly efficient oil removable magnetically separable graphene material.

#### *Development of method to synthesize aqueous dispersible reduced graphene oxide.*

4. Indian Application No.: 201821023312

Inventor: **Some Surajit**; Wadekar Pravin

**Abstract:** This patent relates to the synthesis of water dispersible reduced graphene oxide.

#### *Development of method to synthesize novel polymer based composite as an efficient flame retardant.*

5. Indian Application No.: 201821031706

Inventor: **Some Surajit**; Pethsangave Dattatray A.

**Abstract:** This patent relates to the synthesis polymer supported graphene composite as a good fire retardant.

#### *Flame retardant comprising graphene oxide doped phosphorus on the surface*

6. Application No.: US 20160186061

7. Application No.: KR 2016079529

Inventor: Jun Seong Chan; **Some Surajit**; Nam Min Sik

**Abstract:** This patent relates to the graphene oxide doped phosphorus as a good fire retardant.

*Antibacterial compositions comprising graphene oxide-iodine/iodide complex*

8. Application No.: KR2016040894  
Inventor: Jeon Seong Chan; **Some Surajit**; Nam Min Sik  
**Abstract:** This patent relates to the graphene oxide-iodine/iodide complex as biocompatible antibacterial composite.

*Graphene derivative-based drug carrier and its preparation method*

9. Application No.: US 20150283239  
10. Application No.: KR 1533036  
Inventor: Lee Hyoyeong; **Some Surajit**  
**Abstract:** This patent relates to the graphene derivative-based material as drug carrier.

*Reduced graphene oxide, preparing method thereof, and ink including the same*

11. Application No.: KR 1533034  
Inventor: Lee Hyoyeong; **Some Surajit**  
**Abstract:** This patent relates to the ink including the reduced graphene oxide.

*Catalyst for organic reaction and method of use thereof*

12. Application No.: US20150283239  
Inventor: Lee Hyoyeong; Kim Youngmin; **Some Surajit**  
**Abstract:** This patent relates to the graphene used as catalyst in addition or condensation reaction.

*Optical fiber containing graphene oxide and reduced graphene oxide and a gas sensor containing the same*

13. US Application No.: US20140204384  
14. South Korea Application No.: KR101327501  
Inventor: Lee Hyoyeong; **Some Surajit**  
**Abstract:** This patent relates to the graphene oxide and reduced graphene oxide for gas sensor.

# Department of Fibres and Textile Processing Technology

## Research Areas:

Eco-friendly processing, advanced techniques of processing textiles and apparels

Nano technology, Biotechnology

Composites, Non-woven's, Technical textiles,

Effluent treatment and waste minimization in textile wet processes, Polymer waste recycling





## Prof. Ravindra V. Adivarekar

Head of the Department &  
Professor in Fibre Chemistry

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### Patent Applications Filed

#### *Demonstrating efficacy of cleansing products*

1. Indian Application No.: 2158/MUM/2012  
Inventors: **Adivarekar Ravindra Vithal**; Deshpande Nitin Siddheshwar; Manthena Vamsi Krishna; Sanzgiri Vibhav Ramrao  
**Abstract:** The present invention pertains to method of printing using natural dye on coloured background to demonstrate the efficacy of cleansing product particularly hand-washes. The visual impact depicts the antibacterial effect in innovative way.

#### *Preparation of nano titanium oxide using dispersing agents*

2. Indian Application No.:473/MUM/2013  
Inventors: **Adivarekar Ravindra Vithal**; Khurana Neha  
**Abstract:** The present invention provides a process for the preparation of nano-sized titanium dioxide possessing high purity and crystalline property. These High purity and crystalline nano titanium dioxide particles are prepared by a sol-gel method using various dispersing agents.

### Industrial Consultancy till date

1. BASF India Ltd.
2. Hindustan Unilever Ltd.
3. Hindustan Unilever Research Centre
4. Welspun India Ltd.





**Prof. Mangesh D. Teli**  
Professor of Textile Chemistry

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### Patent Applications Filed

#### *A novel superabsorbent hydrogel and process to prepare the same*

1. Indian Application No.: 2073/MUM/2011  
Inventors: **Teli Mangesh Dhondu**; Waghmare Nilesh Guruling  
**Abstract:** The present invention relates to a process for preparation of novel super absorbent hydrogel. The Superabsorbent hydrogel is made by using bio-polymer.

#### *Mosquito repellent dye and its process of dyeing*

2. Indian Application No.: 4200/MUM/2014  
Inventors: **Teli Mangesh Dhondu**; Chavan Pravin Pralhadrao  
**Abstract:** The present invention relates to improved mosquito repellent composition comprises of improved form of mosquito repellent agent and when applied on fabric like cotton textile material it provides prolongs mosquito repellent properties.

#### *Medical Textile Mosquito repellent dye and its process of dyeing*

3. Indian Application No.: 1622/MUM/2015  
Inventors: **Teli Mangesh Dhondu**, Chavan Pravin  
**Abstract:** The present invention relates to mosquito repellent dye and its process of dyeing

### Industrial Consultancy till date

1. Adiv Nature Pure Ltd.



**Dr. Ravindra D. Kale**  
Assistant Professor in Textile Chemistry

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### Patent Application Filed

#### *Biodegradable foam composition and process thereof*

1. Indian Application No.: 281/MUM/2015  
Inventors: **Kale Ravindra D.**; Jagtap Priyanka S.; Katre Gaurav B.; Garje Ambadas N.  
**Abstract:** The present invention relates to a hydrophobic biodegradable foam sheet and method of preparation thereof. The biodegradable foam comprises at least one water soluble polymer, at least one Polyhydroxy polymer, at least one foaming agent and optionally plasticizer, wax emulsion, cross-linking agent.

#### *A process for the preparation of mosquito repellent fabric using herbal formulation and composition thereof*

2. Indian Application No.: 2201/MUM/2015  
Inventors: **Kale Ravindra D.**; Dr. V. D. Gotmare; Latika Bhatt  
**Abstract:** Present invention relates to the process for the preparation of mosquito repellent fabric using herbal formulation and composition thereof



**Prof. Sanjeev R. Shukla**  
Professor of Technology of Dyeing & Printing

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### Patent Applications Filed

#### *A novel colour matching formulation system for textiles*

1. Indian Application No.: 109/MUM/2005  
Inventors: **Shukla S. R.**; Bhagwat S. S.; Khandual A.  
**Abstract:** A method and apparatus for colour recipe prediction are provided for predicting recipe and dispensing dye and additives textiles by applying neural networks and optimization programme.

#### *Lipase catalyzed Knoevenagel condensation of aromatic aldehyde with active methylene group*

2. Indian Application No.: 2684/MUM/2009  
Inventors: Borse Bhushan N.; **Shukla S. R.**  
**Abstract:** A method for the condensation of aromatic aldehydes with active methylene group in the presence of lipase. The recovery of catalyst and reusability of the catalyst has also been carried out.

#### *Cationic dyeing assistant from aminolytic depolymerization of poly (ethylene terephthalate) bottle waste*

3. Indian Application No.: 2773/MUM/2009  
Inventors: Pingale Navnath D.; **Shukla S. R.**  
**Abstract:** A process for producing an amine functional oligomeric product from PET waste involving the steps of (a) aminolysis of the PET to produce amine functional oligomeric product; (b) cationization of the oligomeric product obtained and application of the cationic oligomeric product in the dyeing of polyacrylonitrile fibres with cationic dyes.

#### *Novel synthesis and biological activity of barbituric acid derivatives*

4. Indian Application No.: 2094/MUM/2010  
Inventors: Borse Bhushan N.; **Shukla S. R.**  
**Abstract:** A series of novel synthesis of Barbituric acid derivatives has been developed by green process. The antimicrobial activity of all compound show good results.

#### *Novel synthesis of N1, N1, N4, N4 - tetrakis (2-hydroxyethyl) terephthalamide (THETA) and terephthalic acid (TPA)*

5. Indian Application No.: 3494/MUM/2012  
Inventors: Parab Yogesh S.; **Shukla S. R.**  
**Abstract:** The invention relates to a method for synthesis of N1, N1, N4, N4 - tetrakis (2-hydroxyethyl) terephthalamide (THETA) and terephthalic acid (TPA). The present technique is useful to recycle the PET waste and resulting into monomers

### Industrial Consultancy till date

- |   |                               |
|---|-------------------------------|
| 1. Clariant (I) Ltd                         | 2. GOTs, India                |
| 3. Indian Gum Industries                    | 4. Johnson & Johnson (I) Ltd. |
| 5. Navin Fluorine International Ltd., Dewas | 6. Polyfibres Ltd. Vapi       |
| 7. Reliance Industries Ltd.                 | 8. Rossari Biotech Ltd.       |

# Department of Food Engineering and Technology

## Research Areas:

Chemistry and Technology of traditional foods

Food product/process development

Fruit and vegetable processing

Fermentative production and downstream processing of enzymes/metabolites

Nutraceuticals & natural pigments





## Prof. Uday S. Annapure

Head & Professor, Department of  
Food Engineering and Technology

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### Patent Applications Filed

#### *Thermostable probiotic breakfast flakes*

1. Indian Application No: 201821031403

Inventors: **Annapure Uday**; Singu Bhupender; Bhushette Pravin

**Abstract:** The present invention relates to food product for the human consumption, more specifically, it provides a processed ready-to-eat cereal flakes fortified with combination of probiotic and prebiotic, further it provides a process of incorporating combination of probiotics and prebiotics in flakes with the aim of increasing the stability and activity of probiotics in gastro-intestinal fluid and at high temperature.

#### *Pharmaceutical composition comprising sophorolipids*

2. Indian Application No: 2696/MUM/2013

Inventors: Bajaj Vinit; **Annapure Uday**; Patel Ketan; Vavia Pradeep

**Abstract:** The present invention relates to niosomes/proniosomes and more particularly to a process for the preparation of niosomes/proniosomes of a pharmaceutically active agent with sophorolipid as non ionic surfactant.

#### *Sophorolipid based niosomal/proniosomal formulations*

3. Indian Application No: 3774/MUM/2013

Inventors: Bajaj Vinit; Patel Ketan; **Annapure Uday**; Mahajan; Monpara Ketan Jasmin; Vavia Pradeep

**Abstract:** The present invention provides a proniosomal to form vesicular system, nano/microparticles and/or emulsion. The method of preparation of niosomes or an oil-in-water emulsion comprising of sophorolipid is disclosed in present invention. Water insoluble carotenoids and xanthophylls are incorporated into delivery cargo comprising of sophorolipid.

### Industrial Consultancy till date

- |   |                                     |
|---|-------------------------------------|
| 1. Lactose India Limited                                | 2. Godrej & Boyce Mfg. Co. Ltd.     |
| 3. Adivasi Foods Pvt. Ltd.                              | 4. Godfrey Phillips India Ltd.      |
| 5. Kancor Ingredients Ltd.                              | 6. Roquette India Ltd.              |
| 7. Heinz India Pvt. Ltd.                                | 8. Pepsico Holdings India Pvt. Ltd. |
| 9. Kellogg India Pvt. Limited                           | 10. Marico Limited                  |
| 11. Kamani Oil Industries Limited                       | 12. General Mills                   |
| 13. Prachin Research and Development Pvt. Ltd.          |                                     |
| 14. Aditya Birla Science & Technology Company Pvt. Ltd. |                                     |



## Prof. Rekha S. Singhal

Dean, Research Consultancy and

Resource Mobilisation (RCRM)

Professor, Food Engineering and Technology

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### Patent Applications Filed

#### *A solid-state fermentation process for the preparation of clavulanic acid*

1. PCT Application No.: WO2008132531

Inventors: Saudagar P. S.; Singh S. K.; **Singhal R. S.**; Pandey A.

**Abstract:** The present invention provides a fermentative production of clavulanic acid using agro-industrial residues and solid-state fermentation technique.

#### *Lipidic nanocarrier based topical composition and method of seabuckthorn oil based formulations*

2. Indian Application No.: 187/MUM/2013

Inventors: Patravale V. B.; A. S.; Patil S. C.; **Singhal R. S.**; Kagliwal L. D.

**Abstract:** The present invention relates to alipidic nanocarrier based topical composition and method of seabuckthorn oil based formulations.

### Industrial Consultancy till date

1. DP Beverages Limited
2. Kamani Oil Mills
3. Raptakos Brett & Co. Ltd.
4. Tata Chemicals Limited
5. Unilever Industries Pvt. Ltd



## Prof. Smita S. Lele

Director, ICT-Marathwada Campus, Jalna  
Professor of Biochemical Engineering

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### Granted Patents

#### *A novel process for dehydration of bovin colostrum*

1. Patent No.: IN 284477; 2017

Inventors: **Lele S. S.**; Suhas Rajeeva; Amebar S. A.

**Abstract:** The present invention relates to the dehydration of natural bovine colostrum to crystalline powder with good retention of immunoglobulin content, which could be added to infant formula to give similar immunological properties as human milk and process thereof.

#### *Extracellular biosynthesis of gold nanoparticles using thurmus aquaticus*

2. Patent No.: IN 294710; 2018

Inventors: **Lele S. S.**; Bhagat Anupam

**Abstract:** The invention relates to the biosynthesis of gold nanoparticles using thermophilic bacteria, *Thermus aquaticus* is a non-pathogenic, optimum growth temperature of 70°C.

### Patent Applications Filed

#### *Food products with reduced natural sugar content and process of preparation thereof*

1. Patent Application No.: 201721008679

Inventors: **Lele S. S.**, Sai Nikam

**Abstract:** The present invention relates to food products with reduced natural sugar content. More preferably, the present invention provides low sugar fruit or vegetable food products for diabetes patient without loss of natural fibers, nutrients and organoleptical properties.

#### *Iron fortified legume based flour premixes and method of manufacture thereof*

2. Indian Application No.: 439/MUM/2012

Inventors: **Lele S. S.**; Ambekar S. A.; Ananthanarayan L.

**Abstract:** The present invention is on preparation of a legume-enriched powder mix that is compounded to deliver bioavailable iron along with nutritionally beneficial components, wherein the powder could be used as soups, gravy thickener, Indian bread etc.

### Industrial Consultancy till date

1. Alpha Laval Tetra Pak
2. Godrej Tyson Foods
3. Trilok Food India
4. Sawarde Valley Food Foundation





# Department of General Engineering

## Research Areas:

Composite Materials

Plastic Blends and Composites

Concrete Technology and Construction Chemicals

Materials and Means for Sustainable Development

Recycling of plastic and Industrial Wastes

Plastic Mold Design and Product Development

Sustainable Energy

Computer Aided Simulations and Analysis





## Dr. Dilip Dhondu Sarode

Head & Professor,  
Department of General Engineering

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### Patent Applications Filed

#### *A water-resistant phosphogypsum composition*

1. Indian Application No.: 4024/MUM/2014  
Inventors: **Sarode D. D.**; Nemade P. R.; Dalvi V. H.; Sontakke S. M.; Zambare R. H.; Mukadam N. V.; Baviskar U. K.

**Abstract:** Invention relates to a gypsum plaster that is suitable for use on external walls that can replace expensive and eco-unfriendly cement plasters. Moreover, the plaster has very low incidence of cracks which is a major issue in cement plaster, thereby improving water resistance.

### Industrial Consultancy till date

1. Rashtriya Chemicals and Fertilizers Ltd



# Department of Oils, Oleochemicals and Surfactants Technology

## Research Areas:

Biolubricants and Tribology,  
Additives and Speciality products,  
Biosurfactants,  
Synthesis of Nanopigments,  
Perfumes, Waxes & Cosmetics,  
Processing of Oleochemicals





**Dr. Amit P Pratap**  
Head, Department of Oils,  
Oleochemicals & Surfactants Technology

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## **Patent Applications Filed**

### *Synthesis of novel linear diamido diester of (3-aminopropyl) trimethoxysilane*

1. Indian Application No.:3262/MUM/2014  
Inventors: **Pratap Amit P;** Patil Pramod D.  
**Abstract:** The present invention is relates to novel linear diamido diester of (3-Aminopropyl) trimethoxysilane compound represented by the formula (IV); the process of preparation of the same and the use of these novel linear amido ester of (3-Aminopropyl) trimethoxysilane compound as coating material for metal surface, wherein (n' is an integer from 1 to 20.

### *Synthesis of novel linear amido ester of (3-aminopropyl) trimethoxysilane*

2. Indian Application No.: 3263/MUM/2014  
Inventors: **Pratap Amit P;** Patil Pramod D.  
**Abstract:** The present invention is relates to novel linear amido ester of (3-Aminopropyl) trimethoxysilane compound represented by the formula (IV); the process of preparation of the same and the use of these novel linear amido ester of (3-Aminopropyl) trimethoxysilane compound as coating material for metal surface, wherein R = Hydrocarbons with number of carbon from C2 to C21-And 'n' is an integer from 1 to 20.

### *Synthesis of novel linear diamido diester of (3-aminopropyl) trimethoxysilane derivative with phthalide derivative.*

3. Indian Application No.: 3267/Mum/2014  
Inventors: **Pratap Amit P;** Patil Pramod D.  
**Abstract:** The present invention is relates to novel linear diamido diester of (3-Aminopropyl) trimethoxysilane compounds represented by the formula (III); the process of preparation of the same and the use of these novel linear diamido diester of Q-Aminopropyl) trimethoxysilane compounds as coating material for metal surfaces.

### *Synthesis of novel linear amido ester of (3-aminopropyl) trimethoxysilane derivative with phthalide derivative.*

4. Indian Application No.: 3268/MUM/2014  
Inventors: **Pratap Amit P;** Patil Pramod D.  
**Abstract:** The present invention is relates to novel linear amido ester of (3-Aminopropyl) trimethoxysilane compounds represented by the formula (III); the process of preparation of the same and the use of these novel linear amido ester of (3-Aminopropyl) trimethoxysilane compounds as coating compositions.



### *Synthesis of Novel Trialkanolamide Phosphate Ester from Linear Fatty Materials*

5. Indian Application No.: 3273/MUM/2014  
Inventors: **Pratap Amit P;** Patil Pramod D.  
**Abstract:** The present invention relates to novel compound used as additives to impart rheological and viscosity modification properties to a wide range of oil and organic based systems. More specifically the invention relates to a novel compounds and method of synthesis thereof. The present invention relates to a new trialkanolamide phosphate esters compound and synthesis process thereof.

### *Synthesis of Heterocyclic Based Surface Active Compounds and Application*

6. Indian Application No.:3795/MUM/2015  
Inventors: **Pratap Amit P;** Patil Pramod D.  
**Abstract:** The present invention relates to synthesis of heterocyclic based surface active compounds and application. The present invention relates to novel compounds, which are which are useful as extreme pressure additives, friction modifier, anticorrosion agent, additives in base stock materials, engine oils and also used as dispersing agent, surface active agent, emulsifier.

### *Value Added Surface Active Compounds and Application*

7. Indian Application No.:3800/MUM/2015  
Inventors: **Pratap Amit P;** Patil Pramod D.  
**Abstract:** The present invention relates to novel compounds the present invention provide the novel compound and process of preparation thereof. More specifically, which are which are useful as extreme pressure additives, friction modifier, anticorrosion agent, additives in base stock materials, engine oils and also used as dispersing agent, surface active agent, emulsifier.

### *Synthesis of Polymeric Compounds*

8. Indian Application No.:2940/MUM/2015  
Inventors: **Pratap Amit P;** Patil Pramod D.  
**Abstract:** More specifically the invention relates to a novel polymeric compounds and method of synthesis thereof. The present invention relates to a new imidazole esters based compound and synthesis process thereof. The said compounds are use as pour point depressant, viscosity improver, friction modifier, anticorrosion agent, additives etc in base stock materials , engine oils and also used as polymeric dispersing agent surface active agent, emulsifier etc. in diverse application tools.

### *Synthesis of Novel Surface Active Compounds*

9. Indian Application No.:2941/MUM/2015  
Inventors: **Pratap Amit P;** Patil Pramod D.  
**Abstract:** The present invention relates to novel compounds having anti-corrosion properties and which are derived from renewable and biodegradable materials. More preferably, the present invention relates to a new imidazole esters compound and synthesis process thereof.

### *Synthesis of Linkage Dispersing Compounds*

10. Indian Application No.:2942/MUM/2015  
Inventors: **Pratap Amit P;** Patil Pramod D.  
**Abstract:** More specifically the invention relates to a novel polymeric compounds and method of synthesis thereof. The present invention relates to a new imidazole esters based compound and synthesis process thereof. The said compounds are use as pour point depressant, viscosity improver, friction modifier, anticorrosion agent, additives etc in base stock materials , engine oils and also used as polymeric dispersing agent surface active agent, emulsifier etc. in diverse application tools.

### ***Preparation of Cross Link Surface Enhancer Compounds***

11. Indian Application No.:2943/MUM/2015  
Inventors: **Pratap Amit P;** Patil Pramod D.  
**Abstract:** The present invention relates to synthesis of novel cross link surface enhancer compounds. More preferably, the present invention relates to novel compounds which are derived from diacid materials. It is employed as polymeric dispersing agent surface active agent, emulsifier etc.

### ***Preparation of Surface Enhancer Compounds***

12. Indian Application No.:2944/MUM/2015  
Inventors: **Pratap Amit P;** Patil Pramod D.  
**Abstract:** The present invention relates to novel compounds having anti-corrosion properties and which are derived from renewable and biodegradable materials. More preferably, the present invention relates to a new imidazole esters compound and synthesis process thereof.

### ***Levulinic Acid Based Additive Synthesis and its Diverse Application***

13. Indian Application No.:4867/MUM/2015  
Inventors: **Pratap Amit P;** Patil Pramod D.  
**Abstract:** The present invention relates to a novel heterocyclic compound based feed stock synthesis and its diverse application. More preferably, the present invention is providing a novel compound of Zinc dithiophosphate (ZDDP) moiety having antioxidant properties and useful as an antiwear/extreme pressure (EP) additive properties.

### ***Heterocyclic Compound Based Feed Stock Synthesis and its Diverse Application***

14. Indian Application No.:4868/ MUM/2015  
Inventors: **Pratap Amit P;** Patil Pramod D.  
**Abstract:** More specifically the invention relates to a novel levulinic acid ester based compound and method of synthesis thereof. The present invention relates to a new levulinic acid esters based compound comprising of imidazole moiety and synthesis process thereof.

### ***Synthesis of Novel Dispersing Compound***

15. Indian Application No.:2837/ MUM/2015  
Inventors: **Pratap Amit P;** Patil Pramod D.  
**Abstract:** Present invention provides synthesis of novel dispersing compound



# Department of Pharmaceutical Sciences and Technology

## Research Areas:

Engineering of nanoparticulate drug delivery systems for cancer and infectious diseases,

Non-invasive (nasal and sublingual) delivery systems for peptides, proteins and nucleic acids;

Surfactant based innovative self-assembled structures for drug delivery application,

Controlled Release Drug Delivery Systems (NDA and ANDA),

Improvisation Techniques for Manufacture and Evolution of Solid Dosage Forms





## Prof. Mariam S. Degani

Professor, Department of  
Pharmaceutical Sciences & Technology

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### Patent Applications Filed

#### *Preparation of novel pyrimidone compounds as antimicrobial and anti-mycobacterial*

1. Indian Application No: 879/MUM/2007

Inventors: **Degani Mariam S.**; Bairwa Ranjeet; Bag Seema; Anam Swapnil D.; Alate Amruta

**Abstract:** The present invention describes novel 2-hydrzino-pyrimidin-4(3h)-one derivatives of formula I and processes for preparation thereof comprising reacting ketones with guanylhydrazine hydrochloride and a b-ketoester in presence of triethylamine to yield the final compound of formula I.

#### *Preparative process for ether derivative of artemisinin*

2. PCT Application No: PCT/IN2008/000039

Inventors: **Degani Mariam S.**; Narkhede Sachin S.; Pedgaonkar Yogesh Y.; Chavan Sunil S.

**Abstract:** The present invention relates to a process for synthesis of ether derivative of artemisinin by reducing artemisinin to dihydroartemisinin using a mixture of sodium borohydride and a dihydroxy compound, followed by etherification in presence of an acid catalyst and an alcohol.

#### *Preparative process for artesunate from artemisinin*

3. PCT Application No: PCT/IN2008/000041

Inventors: **Degani Mariam S.**; Narkhede Sachin S.; Pedgaonkar Yogesh Y.; Chavan Sunil S.

**Abstract:** The present invention describes a process for synthesis of ester derivative of artemisinin by reducing artemisinin to dihydroartemisinin with a mixture of sodium borohydride and a dihydroxy compound and subsequently esterifying in presence of succinic anhydride and imidazole or its derivatives.

### Industrial Consultancy till date

- |                          |  |
|--------------------------|--|
| 1. Almet Co. Pvt. Ltd.   | 2. Atmam Pharmaceuticals                 |
| 3. Bajaj Healthcare Ltd. | 4. Bioplus Pvt. Ltd.                     |
| 5. Rubicon Pvt. Ltd.     | 6. Salpra Pharmaceuticals                |
| 7. Spring Bank Pharma,   | 8. Techno Drugs & Intermediates Pvt. Ltd |



## Prof. Pradeep R. Vavia

Dean, Academic Programmes (AP)

Professor, Pharmaceutical Sciences and Technology

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### Granted Patents

#### *Pharmaceutical composition containing acrylate type aqueous based pressure sensitive adhesive for transdermal drug delivery*

1. Patent No.: IN285298; 2017

Inventors: **Vavia Pradeep Ratilal**; Achyut Khire

**Abstract:** Present invention relates to pharmaceutical composition containing acrylate type aqueous based pressure sensitive adhesive for transdermal drug delivery

#### *Multiparticulate controlled porosity osmotic system*

2. Patent No.: IN280989; 2017

Inventors: **Vavia Pradeep Ratilal**; Nilesh Saindane

**Abstract:** Present invention relates to multiparticulate controlled porosity osmotic system

#### *Novel silicon pressure sensitive adhesive composition for transdermal drug delivery*

3. Patent No.: IN291817; 2018

Inventors: **Vavia Pradeep Ratilal**; Achyut Khire

**Abstract:** Present invention relates to novel silicon pressure sensitive adhesive composition for transdermal drug delivery.

#### *Novel Tri-polymer Combination based controlled release composition*

4. Patent No.: IN284820; 2017

Inventors: **Vavia Pradeep Ratilal**; Snehal Bhatt

**Abstract:** Present invention relates to novel tri-polymer combination based controlled release composition.

#### *A process for manufacture of floating; swelling and bioadhesive sustainable release dosage form*

5. Patent No.: IN205078; 2007

Inventors: **Vavia Pradeep Ratilal**; Chavan Patil; Mahesh Dattatray; Chaudhari Sachin Vasant; Jain Paras Rameshla

**Abstract:** Present invention relates to a process for manufacture of floating; swelling and bioadhesive sustainable release dosage form

#### *A novel hollow multiparticulate excipient for drug delivery*

6. Patent No.: IN 292575; 2018

Inventors: **Vavia Pradeep Ratilal**; Nilesh Saindane

**Abstract:** Present invention relates to a novel hollow multiparticulate excipient for drug delivery.

## **Patent Applications Filed**

### ***Controlled-release formulation comprising hcg***

1. PCT Application No.: PCT/IB2012/000272  
Inventors: **Vavia Pradeep Ratilal**; Lalit vora  
**Abstract:** Present invention relates to controlled-release formulation comprising hcg.

### ***Oral pharmaceutical composition***

2. PCT Application No.: PCT/IN2006/000042  
Inventors: Vijaya Kumar Velidi; Chancharusiri Apichai; Snehal Mukund Mehta; Wongpayak Pornchai; Madhav Pai Rajesh; Torane S. Jyotsna; **Vavia Pradeep Ratilal**; Satyen Torne; Shankar Swaminathan; Aradee Kunchom  
**Abstract:** Present invention relates to oral pharmaceutical composition.

### ***Polyvinyl alcohol particles, pharmaceutical binder using same, pharmaceutical tablet, sustained-release pharmaceutical tablet, and method for producing polyvinyl alcohol particles***

3. PCT Application No.: PCT/JP2015/071168  
Inventors: Furo Chizuko; Kanda Taiji; Hara Koji; **Vavia Pradeep Ratilal**; Monpara Jasmin Dhirajlal; Jadhav Pankaj Hanumantrao  
**Abstract:** Present invention relates to polyvinyl alcohol particles, pharmaceutical binder using same, pharmaceutical tablet, sustained-release pharmaceutical tablet, and method for producing polyvinyl alcohol particles.

### ***Oral pharmaceutical composition for controlled release of drug***

4. Indian Application No.: 1914/MUM/2009  
Inventors: **Vavia Pradeep Ratilal**; Sharad Darandale  
**Abstract:** Present invention relates to oral pharmaceutical composition for controlled release of drug.

### ***Novel immediate release telmisartan composition***

5. Indian Application No.: 3004/MUM/2010  
Inventors: **Vavia Pradeep Ratilal**; Mayur Sangwai  
**Abstract:** Present invention relates to novel immediate release telmisartan composition.

### ***Sublingual formulation of Buprenorphine hydrochloride***

6. Indian Application No.: 1188/MUM/2011  
Inventors: **Vavia Pradeep Ratilal**; Chavan Sandip Sheshrao  
**Abstract:** Present invention relates to sublingual formulation of buprenorphine hydrochloride.

### ***Nanoformulations for brain delivery***

7. Indian Application No.: 1176/MUM/2011  
Inventors: **Vavia Pradeep Ratilal**; Chavan Sandip Sheshrao  
**Abstract:** Present invention relates to nanoformulations for brain delivery.

### ***Multiparticulate extended release composition of carbamazepine***

8. Indian Application No.: 1119/MUM/2011  
Inventors: **Vavia Pradeep Ratilal**; Chavan Sandip Sheshrao  
**Abstract:** Present invention relates to multiparticulate extended release composition of carbamazepine.



***Oral concentrated nanoemulsions based formulation of tetrahydrolipstatin***

9. Indian Application No.: 2966/MUM/2011  
Inventors: **Vavia Pradeep Ratilal**; Mayur Sangwai  
**Abstract:** Present invention relates to oral concentrated nanoemulsions based formulation of tetrahydrolipstatin.

***Ezetimibe nanosuspension and preparation method thereof***

10. Indian Application No.: 3421/MUM/2014  
Inventors: **Vavia Pradeep Ratilal**; Jasmin Monpara  
**Abstract:** Present invention relates to ezetimibe nanosuspension and preparation method thereof.

***Oral composition of calcium***

11. Indian Application No.: 3418/MUM/2014  
Inventors: **Vavia Pradeep Ratilal**; Mayur Sangwai  
**Abstract:** Present invention relates to oral composition of calcium.

***Solid pharmaceutical composition of propofol***

12. Indian Application No.: 149/MUM/2011  
Inventors: **Vavia Pradeep Ratilal**; Sharad Darandale  
**Abstract:** Present invention relates to solid pharmaceutical composition of propofol.

***Solid oral pharmaceutical composition comprising of poorly water soluble drug***

13. Indian Application No.: 610/MUM/2011  
Inventors: **Vavia Pradeep Ratilal**; Smita Pawar  
**Abstract:** Present invention relates to solid oral pharmaceutical composition comprising of poorly water soluble drug.

***Gamma-oryzanol enriched natural oil for enhancement of solubility and bioavailability of pharmaceutical actives***

14. Indian Application No.: 1895/MUM/2011  
Inventors: **Vavia Pradeep Ratilal**; Smita Pawar  
**Abstract:** Present invention relates to gamma-oryzanol enriched natural oil for enhancement of solubility and bioavailability of pharmaceutical actives.

***Composition for parenteral delivery of anticancer drug***

15. Indian Application No.: 1130/MUM/2011  
Inventors: **Vavia Pradeep Ratilal**; Ketan Patel  
**Abstract:** Present invention relates to composition for parenteral delivery of anticancer drug.

***Pharmaceutical composition for immediate release of weakly acidic potent drugs***

16. Indian Application No.: 3416/MUM/2011  
Inventors: **Vavia Pradeep Ratilal**; Lalit Vora  
**Abstract:** Present invention relates to pharmaceutical composition for immediate release of weakly acidic potent drugs.

***Solid lipid nanoparticles based formulation of antifungal agent and preparation method thereof***

17. Indian Application No.: 611/MUM/2011  
Inventors: **Vavia Pradeep Ratilal**; Wavikar Preeti Ramesh  
**Abstract:** Present invention relates to solid lipid nanoparticles based formulation of antifungal agent and preparation method thereof.

- A pharmaceutical composition of niosomal gel for the topical delivery of lornoxicam*
18. Indian Application No.: 3417/MUM/2010  
Inventors: **Vavia Pradeep Ratilal**; Kumbhar Deepak  
**Abstract:** Present invention relates to a pharmaceutical composition of niosomal gel for the topical delivery of lornoxicam.
- Pharmaceutical composition containing crosslinked cyclodextrin polymer*
19. Indian Application No.: 3419/MUM/2010  
Inventors: **Vavia Pradeep Ratilal**; Dinesh Brahmane  
**Abstract:** Present invention relates to pharmaceutical composition containing crosslinked cyclodextrin polymer.
- Modified release formulations of oxcarbazepine*
20. Indian Application No.: 1755/MUM/2011  
Inventors: **Vavia Pradeep Ratilal**; Shelar Dnyanesh Bharat  
**Abstract:** Present invention relates to modified release formulations of oxcarbazepine.
- Solid antiretroviral composition for oral delivery*
21. Indian Application No.: 2627/MUM/2011  
Inventors: **Vavia Pradeep Ratilal**  
**Abstract:** Present invention relates to solid antiretroviral composition for oral delivery.
- Pharmaceutical composition containing Olmesartan medoxomil in an amorphous form prepared by hot melf extrusion*
22. Indian Application No.: 2252/MUM/2015  
Inventors: **Vavia Pradeep Ratilal**; Jadhav Pankaj Hanumantrao  
**Abstract:** Present invention relates to pharmaceutical composition containing olmesartan medoxomil in an amorphous form prepared by hot melf extrusion.
- A novel extended release bilayer, matrix tablet of furosemide*
23. Indian Application No.: 1588/MUM/2010  
Inventors: **Vavia Pradeep Ratilal**; Sharad Wawdhane  
**Abstract:** Present invention relates to a novel extended release bilayer, matrix tablet of furosemide.
- Biocapsules for drug delivery*
24. Indian Application No.: 1656/MUM/2009  
Inventors: **Vavia Pradeep Ratilal**; Mayur Sangwai  
**Abstract:** Present invention relates to biocapsules for drug delivery.
- Modified release formulations of oxcarbazepine*
25. Indian Application No.: 1755/MUM/2011  
Inventors: **Vavia Pradeep Ratilal**; Shelar Dnyanesh Bharat  
**Abstract:** Present invention relates to modified release formulations of oxcarbazepine.
- Pharmaceutical compositions of Thiocolchicoside*
26. Indian Application No.: 2403/MUM/2013  
Inventors: **Vavia Pradeep Ratilal**; Mayank Patel ; Wavikar Preeti Ramesh  
**Abstract:** Present invention relates to pharmaceutical compositions of thiocolchicoside.

*Novel Multiparticulate controlled porosity osmotic pump of oxybutynin hydrochloride*

27. Indian Application No.: 2601/MUM/2009  
Inventors: **Vavia Pradeep Ratilal**; Sharad Wawdhane  
**Abstract:** Present invention relates to novel multiparticulate controlled porosity osmotic pump of oxybutynin hydrochloride.

*Pharmaceutical nasal spray composition for delivery of drugs*

28. Indian Application No.: 2676/MUM/2011  
Inventors: **Vavia Pradeep Ratilal**; Saindane Nilesh  
**Abstract:** Present invention relates to pharmaceutical nasal spray composition for delivery of drugs.

*A process for manufacture of an oral sustained release tablet dosage form having one or more drugs in non gas generating, floating, swellable and bio adhesive carrier composition*

29. Indian Application No.: 360/MUM/2002  
Inventors: **Vavia Pradeep Ratilal**; Chavan Patil Mahesh; Paras Jain  
**Abstract:** Present invention relates to a process for manufacture of an oral sustained release tablet dosage form having one or more drugs in non gas generating, floating, swellable and bio adhesive carrier composition.

*A process of manufacture of clear, transparent pharmaceutical dosage form containing hydrophobic drugs and drugs will less water*

30. Indian Application No.: 735/MUM/2005  
Inventors: **Vavia Pradeep Ratilal**; Rajendra Tandale  
**Abstract:** Present invention relates to a process of manufacture of clear, transparent pharmaceutical dosage form containing hydrophobic drugs and drugs will less water.

*A process for manufacture of floating, swellable and bioadhesive sustained release dosage form*

31. Indian Application No.: 769/MUM/2002  
Inventors: **Vavia Pradeep Ratilal**  
**Abstract:** Present invention relates to a process for manufacture of floating, swellable and bioadhesive sustained release dosage form.

*A method of achieving oral contraception in female using pharmaceutical composition comprising of danazol in lower dose with enhanced solubility*

32. Indian Application No.: 849/MUM/2005  
Inventors: **Vavia Pradeep Ratilal**; Ganesh Jadhav  
**Abstract:** Present invention relates to a method of achieving oral contraception in female using pharmaceutical composition comprising of danazol in lower dose with enhanced solubility.

*Pharmaceutical composition comprising sophorolipid*

33. Indian Application No.: 2696/MUM/2013  
Inventors: Annapure Uday; **Vavia Pradeep Ratilal**; Patel Ketan; Vinit bajaj  
**Abstract:** Present invention relates to pharmaceutical composition comprising sophorolipid.

***A novel Formulation of Darifenacin hydrobromide***

34. Indian Application No.: 201721014044  
Inventors: Annapure Uday; Bajaj Vinit; Patel Ketan; Mahajan; Monpara Ketan Jasmin; **Vavia Pradeep**

**Abstract:** Present invention relates to Sophorolipid based niosomal/prniosomal formulations.

***Supercritical processed starch nanosponge for dissolution enhancement and flow properties improvement of poorly water soluble and flowable drugs***

35. Indian Application No.: 2071/MUM/2014  
Inventors: **Vavia Pradeep Ratilal**; Nitin Jadhav

**Abstract:** Present invention relates to Supercritical processed starch nanosponge for dissolution enhancement and flow properties improvement of poorly water soluble and flowable drugs.

***Pickering dry emulsion system for dissolution enhancement of poorly water soluble drugs***

36. Indian Application No.: 2072/MUM/2014  
Inventors: **Vavia Pradeep Ratilal**; Nitin Jadhav

**Abstract:** Present invention relates to Pickering dry emulsion system for dissolution enhancement of poorly water soluble drugs.

***Akylamine template based hexagonal mesoporous silica for dissolution enhancement of poorly water soluble drugs***

37. Indian Application No.: 2073/MUM/2014  
Inventors: **Vavia Pradeep Ratilal**; Nitin Jadhav

**Abstract:** Present invention relates to akylamine template based hexagonal mesoporous silica for dissolution enhancement of poorly water soluble drugs.

***Pharmaceutical invention of bromocriptine***

38. Indian Application No.: 201721009236  
Inventors: **Vavia Pradeep Ratilal**; Sita V G.

**Abstract:** Present invention relates to pharmaceutical invention of bromocriptine.

***A novel Formulation of darifenacin hydrobromide for over active bladder syndrome (OAB)***

39. Indian Application No.: 201721014044  
Inventors: **Vavia Pradeep Ratilal**; Yash Nakhva

**Abstract:** Present invention relates to a novel formulation of darifenacin hydrobromide for over active bladder syndrome (oab).

**Industrial Consultancy till date**

1. Uni Sankyo Pvt. Ltd.
2. Lubrizol Advanced Materials Pvt. Ltd.
3. Lotus Surgical Pvt. Ltd.
4. DSIR Project
5. Nippon Synthetic Chemicals Pvt. Ltd.
6. Johnson and Johnson Pvt. Ltd



## Prof. Padma V. Devarajan

Professor, Pharmaceutical Sciences and Technology  
Coordinator, Technical Education Quality Improvement Programme  
Coordinator, M. Tech. Pharma Biotech

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### Granted Patents

#### *A novel transmucosal delivery system*

1. Patent No.: EP1667681; 2003  
Inventors: **Devarajan Padma Venkitachalam**; Mandal Jayanta Kumar; Patel Shashank Bababhai; Bansidhar Maheshwari Kirti  
**Abstract:** This patent discloses an innovative sublingual delivery system of proton pump inhibitors like Omeprazole, Rabeprazole and others.

#### *A process for the preparation of palatable oral composition of active basic medicaments*

2. Patent No.: IN188854; 2000  
Inventors: **Devarajan Padma Venkitachalam**; Gore Subhash P.; Gandhi Anil S.  
**Abstract:** This patent discloses an innovative approach of taste masking bitter drugs.

#### *Bioadhesive polymer composition for transmucosal drug delivery systems with enhanced bioadhesion and process thereof*

3. Patent No.: IN206334; 2003  
Inventors: **Devarajan Padma Venkitachalam**; Gore Subhash P.; Gandhi Anil S.  
**Abstract:** This patent discloses an innovative approach of enhancing the mucoadhesive property of sublingual and buccal drug delivery systems to deliver drugs rapidly degraded in the Gastro intestinal tract.

#### *Process for the preparation of transmucosal formulations with improved bioadhesive properties*

4. Patent No.: IN192518; 2001  
Inventors: **Devarajan Padma Venkitachalam**; Gandhi Anilkumar Surendra; Gore Subhash P.; Mukherjee Gour S.  
**Abstract:** This patent discloses an innovative approach of enhancing the mucoadhesive property of sublingual and buccal drug delivery systems to deliver drugs rapidly degraded in the Gastro intestinal tract.

#### *Palatable oral compositions and process thereof*

5. Patent No.: IN224226; 2004  
Inventors: **Devarajan Padma Venkitachalam**; Sonavane Ganesh; Patel Jitendra  
**Abstract:** This patent discloses an innovative approach of taste masking bitter drugs

#### *Oil in water microemulsion compositions for transmucosal administration of proteins and peptides and process thereof*

6. Patent No.: IN233413; 2004  
Inventors: **Devarajan Padma Venkitachalam**; Sonavane Ganeshchandra S.; Gala Hetal J.  
**Abstract:** This patent discloses an innovative sublingual delivery system of insulin as

a potential alternative to subcutaneously injected insulin.

***Novel biodegradable aliphatic polyesters and pharmaceutical compositions and applications thereof***

7. Patent No.: IN224114; 2003  
Inventors: **Devarajan Padma Venkitachalam**; Malshe V.C.; Shastri Sayalee  
**Abstract:** This patent discloses a new biodegradable polymer which could have a wide range of applications in drug delivery and also probably as a scaffold polymer for tissue engineering.

**Patent Applications Filed**

***Pharmaceutical compositions that spontaneously form lipidic particulate dispersion***

1. Indian Application No.: 201621024980  
Inventors: **Devarajan Padma Venkitachalam**; Maithania Heena; Samad Abdul  
**Abstract:** This patent discloses a simple nanotechnology for drug loading. This formulation is used against veterinary infection. This invention enabled great therapeutic and cost advantage.

***Transmucosal coated delivery devices and process thereof***

2. Indian Application No.: 282/MUM/2005
3. PCT Application No.: PCT/IN2006/000089  
Inventors: **Devarajan Padma Venkitachalam**; Redkar Milind Rajaram; Shelke Rahul Ramesh  
**Abstract:** This patent discloses a novel method to enhance surface area and hence improve bioavailability from sublingual and buccal tablets.

***Pharmaceutical compositions for colloidal drug delivery***

4. Indian Application No.: 3053/MUM/2010
5. PCT Application No.: PCT/IN2011/000730  
Inventors: Kapse Sonali V.; Jindal Anil B.; **Devarajan Padma Venkitachalam**  
**Abstract:** This patent discloses a very innovative nanoformulation for drug delivery. The nanoformulation reported herein is prepared using an unbelievably simple technique which can be readily scaled up and is applicable for a wide range of drugs.

***Bioadhesive barrier film and spontaneous plug forming teat dips***

6. Indian Application No.: 1998/MUM/2012  
Inventors: Pranatharthiharan Sandhya; **Devarajan Padma Venkitachalam**  
**Abstract:** This patent discloses a very interesting product for veterinary application which enables formation of a barrier protective film with spontaneous plug formation at the teat orifice of cattle.

***Nanocarriers for targeted delivery of active agents***

7. Indian Application No: 2166/MUM/2012  
Inventors: Soni Maheshkumar; **Devarajan Padma Venkitachalam**  
**Abstract:** This patent discloses the development of a targetted drug nanoformulation which delivers drug in high concentration to the infected sites in cattle suffering from theileriosis a parasitic infection. The invention enabled great therapeutic and cost advantage.

***Point of Care Reagent Strip for Calcium Level Detection in Biological Fluids***

8. Indian Application No: 201621031293

Inventors: **Devarajan Padma Venkitachalam**; Das Saugandha; Dawre Shilpa; Darsheen Kotak; Lokhande Amit; More Suraj

**Abstract:** This patent discloses a point of care simple visual colorimetric reaction based calcium detection test kit. It provides ease of handling to end user and highly applicable in veterinary field where there is a need of such point of care diagnostics to treat animals.

***Device for conserving low temperatures***

9. Indian Application No: 201721018468

Inventors: **Devarajan Padma Venkitachalam**; Das Saugandha; Devarajan Archit

**Abstract:** This patent discloses an improved non-electronic, light weight, portable device for conserving low temperature comprising of an insulating housing, an insulating compartment of air and a cold chamber containing cryogenic mixture. The device facilitates the cold storage of medical supplies or food stuffs and beverages for more than 12h.

***Dialysis assembly for dissolution testing***

10. Indian Application No: 11472/MUM/2017

Inventors: **Devarajan Padma Venkitachalam**; Lokhande Amit

**Abstract:** This patent discloses a simple dialysis assembly for in vitro dissolution of nanosystems. This assembly is userfriendly and effective.

***A Kit for Extended Blood Group Determination and Method thereof***

11. Indian Application No: 201721046817

Inventors: **Devarajan Padma Venkitachalam**; Chawla Shweta; Kanjakasha Ghosh; Manisha Madaikar; Ajit Gorakshakar

**Abstract:** This patent relates to development of a rapid blood group detection kit for determination of extended blood group red cell antigens to detect genotype.

**Industrial Consultancy till date**

- |   |                                |
|---|--------------------------------|
| 1. Astron Research Ltd.                       | 2. Emcure Pharmaceuticals Ltd. |
| 3. Industrial Aromatics Ltd.                  | 4. Mahaan Proteins Ltd.        |
| 5. Novartis Enterprises Pvt Ltd.              | 6. Pfizer Ltd.                 |
| 7. Phoenix Pharmaceuticals LLC                | 8. Universal Capsules Ltd.     |
| 9. Wintac Ltd.                                | 10. Zim Laboratories Ltd.      |
| 11. Patani Scientific and Industrial Research |                                |
| 12. Patani Scientific and Industrial Research |                                |

**Technology Commercialization**

- Name of Technology:**LIVERUBIN  
**Patent:** IN188854  
**Name of Industry:** Alkem Phytoceuticals, Delhi  
**Revenue Generated:** Rs 2.5 lakhs  
**Area of Invention:** Taste masking
- Name of Technology:**Saife'LEX™  
**Patent:** 2166/MUM/2012  
**Name of Industry:** Saife Vetmed, Delhi  
**Revenue Generated:** Upfront Fee Rs.1.5 lakhs; Lifetime royalty  
**Area of Invention:** Nanotechnology for veterinary infections

3. **Name of Technology:** NOVA'DIP  
**Patent:** 1998/MUM/2012  
**Name of Industry:** Saife Vetmed, Delhi  
**Revenue Generated:** Upfront Fee Rs.0.5 lakhs;Lifetime royalty  
**Area of Invention:** Prevention of mastitis in cattle
  
4. **Name of product/process/technology developed:** BU'ANTRAP  
**Patent:** 201621024980  
**Name of Industry:** Saife Vetmed  
**Revenue Generated:** Lifetime royalty  
**Area of Invention:** Nanotechnology for Veterinary infection





**Dr. Prajakta D. Jain**  
UGC Assistant Professor,  
Pharmaceutical Sciences and Technology

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### Patent Applications Filed

#### *Microfluidic device for the development of in-vitro co-cultures of mammalian tissues*

1. Indian Application No.: 201621000456  
Inventors: Gore Manish Ravikiran; **Prajakta Dandekar Jain**; Ratnesh Jain  
**Abstract:** The technology describes the design of a microfluidic device for 3D co-culture of mammalian cell types of mammalian origin towards development of in-vitro models and/or artificial organ constructs or tissue equivalents, for preclinical and biomedical applications.

#### *Kit for pyrogen detection and depyrogenation of water*

2. Indian Application No.: 4070/MUM/2015  
Inventors: Vijay Yadav; Rohan Chhabra; Nikhil Kalane; Tejal Pant; Anomitra Dey; **Prajakta Dandekar Jain**; Ratnesh Jain  
**Abstract:** Pyrogen detection kit mostly animal origin used for identification of micro-cellular component present in water. This invention is non biological with the sustainable and clean chemistry can sense any micro-cellular complainant present in water.

#### *Method of manufacturing concentrated silver nanopowder*

3. Indian Application No.: 2797/MUM/2014  
Inventors: Pofali Prasad Ashok; Jain Ratnesh Dharamchandra; **Prajakta Dandekar Jain**; Pattani Aditya Sunil  
**Abstract:** The present invention describes a method for synthesis of highly concentrated and pure silver nanopowder, using micellar nanoreactors, in presence of suitable stabilizers.

#### *Methods for preparation of water-soluble and water-insoluble derivatives of saccharides and alkali, alkaline earth, transition and noble metals*

4. Indian Application No.: 2594/MUM/2014  
Inventors: Yadav Vijay; **Prajakta Dandekar Jain**; Jain Ratnesh Dharamchandra  
**Abstract:** The present invention relates to a method for synthesis of nano sized, water-soluble and water-insoluble metal-saccharide derivatives, for biomedical and healthcare applications.

### Industrial Consultancy till date

1. Bajaj Healthcare Pvt. Ltd



## Prof. Purnima D. Amin

Vice President-Tech. Asso. and  
Dean-Student and Alumni Affairs  
Professor, Pharmaceutical Sciences and Technology

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### Granted Patents

#### *Preparation and use of oligosaccharide imprinted mesoporous silica*

1. Patent No.: IN279192, 2017  
Inventors: Meer Tarique AliSadique Ali; Patole Rahul Kashinath; Fule Ritesh Amol;  
**Amin Purnima Dhanraj**  
**Abstract:** The present invention relates to preparation and use of silica materials using oligosaccharide as a template under mild acidic or basic conditions. The reaction for the preparation of silica takes place at ambient condition in presence of acid or a base.

#### *A process of preparing free flowing polyacrylic acid granules*

2. Patent No.: IN274978; 2016  
Inventors: **Amin Purnima Dhanraj**; Shah Sejal Pravin; Jain Satishkumar Pannala; Sathaye Sameer Shashank; Sawant Kiran Parshuram  
**Abstract:** The present invention relates to free flowing poly acrylic acid and process for preparing the same. The granules formed there from, wherein the granules are flowable, possess an increased bulk density and very low amount of dust generation.

#### *A method of making a sustained release hot melt extrudates composition*

3. Patent No.: IN264312; 2014  
Inventors: **Amin Purnima Dhanraj**; Rajadhyaksha Namita Sham; Jain Satishkumar Pannalal; Soni Umangi Kalyankumar; Pirthi Pal Singh Partap Singh; Shah Sejal Pravin; Deshmukh Ketkee Anil  
**Abstract:** The present invention relates to sustained release hot melt extrudates using hot melt extrusion suitable for oral and ophthalmic drug delivery systems comprising at least one active pharmaceutical ingredient, at least one plasticizer and hydroxypropyl cellulose

#### *Ion exchange resin based extended release gastro-retentive dosage forms*

4. Patent No.: IN249226; 2006  
Inventors: **Amin Purnima Dhanraj**; Prabhu Namita Baburao; Jain Satisjkumar Pannalal; Marathe Ajit Srinivas; Shah Sejal Pravin  
**Abstract:** Novel extended release gastro retentive dosage form suitable for once a day administration is disclosed. The extended release gastro retentive dosage forms essentially comprise active ingredient; ion exchange resin; cellulose polymer; buoyancy imparting agent, release modifying agent and other suitable excipients.

## **Patent Applications Filed**

### ***Oral dispersible film compositions prepared by twin-screw hot melt extrusion technology***

1. Indian Application No.: 20174100424  
Inventors: Vishal Kataria; Geeta Umesh Yadav; Kailas Kalicharan Moravkar; Swikruti Sen; **Amin Purnima Dhanraj**

**Abstract:** Present invention relates to pharmaceutical and nutraceutical composition in the form of oral dispersible films (ODFs) using twin-screw hot melt extrusion was described. Water soluble polymers and their combinations were explored for feasibility and optimization of the screw design (single vs twin-screw) in the melt extrusion process.

### ***Topical preparations of carbomer based gel and emulgel using twin-screw hot melt extrusion technology***

2. Indian Application No.: 20174100425  
Inventors: Vishal Kataria; Geeta Umesh Yadav; Devanshi Sandeep Shah; Kailas Kalicharan Moravkar; **Amin Purnima Dhanraj**

**Abstract:** Present invention relates to pharmaceutical and cosmetic formulations of carbomer based gels and emulgels containing diclofenac sodium and/or other drug/actives as produced by hot melt extrusion process in a single step was described.

### ***Pharmaceutical compositions containing melt extruded ibuprofen and fixed dose combinations thereof***

3. Indian Application No.: 201621015845  
Inventors: Gejage Santosh Maruti; Divakar Ramsawar Jaiswar; Shinde Umesh Keshav; **Amin Purnima Dhanraj**; Aware Rahul Suresh; Boundugulapati Murali Krishna; Vasanth Kumar Shetty; Dhande Shirish

**Abstract:** The present invention describes pharmaceutical composition containing ibuprofen and or other drug as fixed dose combination produced by melt extrusion process was described. The lower melt point of ibuprofen was acting as plasticizing effect in melt extrusion process.

### ***Continuous manufacturing process for preparing directly compressible grade API's by melt granulation technology***

4. Indian Application No.: 201621015220  
Inventors: Gejage Santosh Maruti; Moravkar Kailas Kalicharn; Khatik Tousif Ayyub; **Amin Purnima Dhanraj**

**Abstract:** Present invention relates to directly compressible grade paracetamol granules prepared by extruding paracetamol along with polymer having very low concentration at controlled temperature parameters to get granules preferably by continuous melt granulation technology.

### ***Pharmaceutical dosage form comprising antimalarial ingredient in a solid dispersion using hot melt extrusion technology***

5. Indian Application No.: 1674/MUM/2013  
Inventors: **Amin Purnima Dhanraj**; Fule Ritesh Amol

**Abstract:** The present invention relates to pharmaceutical dosage form comprising one or more antimalarial ingredient(s) belong(s) to the BCS class II or to the BCS class IV in the form of a solid dispersion or solid solution in a matrix, with high aqueous solubility and improved dissolution rate, suitable for inclusion in solid

dosage, forms such as capsules, tablets and the like.

***Fabrication of cyclodextrin template mesoporous silica particles for improved dissolution of carbamazepine***

6. Indian Application No.: 422/MUM/2013

Inventors: **Amin Purnima Dhanraj**; Fule Ritesh Amol

**Abstract:** The present invention relates to a facile process for the fabrication of carbamazepine loaded on cyclodextrin imprinted mesoporous silica particles for improved dissolution of carbamazepine.

***Pharmaceutical compositions containing rifampicin using hot melt extrusion***

7. Indian Application No.: 1581/MUM/2012

Inventor: **Amin Purnima Dhanraj**

**Abstract:** The present invention relates to pharmaceutical compositions of Rifampicin. The improved pharmaceutical composition further relates to melt extruded Rifampicin containing formulations with enhanced stability and bioavailability. It further extends to melt extruded extended release compositions of Rifampicin and other physiologically active agent/s.

***Co-processed excipients and process for preparing the same***

8. Indian Application No.: 3212/MUM/2010

Inventors: **Amin Purnima Dhanraj**; Gangurde Avinash Bhaskar; Sharma Vanita Jagdish; Desai Harita Ramchandra; Jaiswar Divakar Ramswar

**Abstract:** This invention relates producing co-processed excipient for sustained release application. The granules so obtained from the process which consists of polyethylene oxide and Hydroxypropylmethyl cellulose in the composition of 70:30 and 80:20 ratios are useful for direct compression with sustained release application.

***Granular assemblies of hydroxy propyl methyl cellulose and process of preparing the same***

9. Indian Application No.: 572/MUM/2009

Inventors: **Amin Purnima Dhanraj**; Shah Sejal Pravin; Singh Pirthipal; Singh Partap; Jain Satishkumar Pannalal

**Abstract:** This invention relates to a process for producing granular assemblies of hydroxy propyl methyl cellulose. The granular assemblies of hydroxyl propyl methyl cellulose produced by the process of the present invention are useful in various pharmaceutical applications preferably sustained release dosage form.

***Formulation and development of topical or transdermal film***

10. Indian Application No.: 201741033521

Inventors: Vishal Kataria; Kailas Kalicharan Moravkar; Swikruti Sen; **Amin Purnima Dhanraj**

**Abstract:** Present invention relates to pharmaceutical composition in the form of topical or transdermal films using twin-screw hot melt extrusion was described. Water soluble polymers and their combinations were explored for feasibility and optimization of the screw design (single vs twin-screw) in the melt extrusion process.

## **Industrial Consultancy till date**

1. Anshul Life Sciences
2. Aриhant Trading Ltd.
3. Bajaj Healthcare Ltd.
4. Evonik Degussa India Pvt. Ltd.
5. GC Chemie Pharma
6. Mascot Universal Pvt. Ltd.
7. Merck Ltd
8. PT Pharmacon Pvt. Ltd.
9. Rubicon Research Pvt. Ltd.
10. S B Panchal & Company
11. SAPAC Agro
12. Scope Excipients Pvt. Ltd.
13. VVF Ltd
14. Waksman Pharma Pvt. Ltd.
15. Lifescient, Inc.
16. ICPA Health Products Ltd.
17. Cheryl Laboratories Pvt. Ltd.
18. Salicylates & Chemicals
19. Hindustan Unilever Ltd.
20. Croda
21. BASF
22. Gattefosse



## Prof. Vandana B. Patravale

Professor, Pharmaceutical Sciences and Technology

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### Granted Patents

#### *Lipid nanoparticles based composition and method of formulation and use thereof*

1. Patent No.: IN279598; 2017

Inventor: **Vandana Bharat Patravale**; Pratikumar Anilbhai Patel

**Abstract:** The oral solid dosage form of solid lipid nanoparticles (SLN) loaded with Amphotericin B having LD50 of atleast 200mg/kg in mice and process for making the same have been described.

#### *Pharmaceutical composition of curcumin*

2. Patent No.: US9474727; 2016

3. Patent No.: EP 2616053; 2016

4. Patent No.: IN 283059; 2017

Inventors: Bakulesh Mafatlal Khamar; Ashish Premkumar Gogia; Chirag Chandrakant Goda; Dinesh Balkunje Shenoy; Rajneesh Ramesh Shrivastava; **Vandana Bharat Patravale**; Indravadan Ambalal Modi; Ritu Nitin Laddha; Imran Ahmad Khan

**Abstract:** The present invention relates to stable liquid pharmaceutical compositions of curcumin or its pharmaceutically acceptable salts or its derivatives with higher curcumin concentration and improved bioavailability without the use of buffer and/or molecular aggregation inhibitor(s).

#### *Pharmaceutical composition of taxoids*

5. Patent No.: US 9345683, 2016

6. Patent No. EP 2637655, 2016

Inventors: Bakulesh Mafatlal Khamar; Ashish Premkumar Gogia; Ritu Nitin Laddha; Imran Ahmed Khan; **Vandana Bharat Patravale**; Indravadan Ambalal Modi

**Abstract:** The present invention relates to a stable oral pharmaceutical composition with improved solubility and bioavailability; comprising a taxoid, a solubilizer, a stabilizing agent, a surfactant(s), a solvent(s), and oil wherein the concentration of taxoid is in the range of 0.1 to 10%

#### *Lipid nanoparticulate based dosage forms of antiparasitics and antiinfectives*

7. Patent No.: IN248977; 2012

Inventors: **Patravale Vandana**; Joshi Medha; Sharma Shobhona

**Abstract:** The present invention is directed to compositions, method of preparation and uses of mixed complex lipid nanoparticulate based dosage forms for drug substance's and/or immunomodulators selected from antiparasitics or antiinfective category.

*Process for preparation of self micro/nano emulsifying systems and compositions thereof*

8. Patent No.: IN208589; 2007  
Inventor: **Patravale Vandana**  
**Abstract:** A processing technique for the formulation of SMETs /SNETs which enhances the bioavailability of poor water soluble drug substance and eliminates the fluctuation in bioavailability due to the fed and non fed condition is disclosed.

*Process for preparation of free flowing, non-sticky, porous and highly loaded spherules*

9. Patent No.: IN211495; 2007  
Inventor: **Vandana Patravale**  
**Abstract:** Described herein is a process for converting sticky, non-porous and compact physical form of wax into free flowing, non-sticky and porous highly loaded spherules to allow utilization of waxes for extraction of their one or more components having pharmaceutical, cosmeceutical, nutraceuticals, diagnostic and / or agricultural applications.

## **Patent Applications Filed**

*Pharmaceutical composition of taxoids*

1. PCT Application No.: PCT/IB2011/054944 (WO/2012/063182)  
Inventor: **Patravale Vandana**  
**Abstract:** The present invention relates to the stable oral pharmaceutical composition with improved solubility and bioavailability; comprising of taxoid, solubilizer, stabilizing agent, surfactant(s), solvent(s), and oil wherein the concentration of taxoid is in the range of 0.1 to 10%

*Stable solutions of sparingly soluble actives*

2. PCT Application No.: PCT/IB2008/003096
3. US Application No.: US 2011/0020440  
Inventor: **Patravale Vandana**  
**Abstract:** The present invention relates to a stable pharmaceutical composition comprising soft gelatin capsules containing at least one sparingly soluble active drug (singly or in combination with sparingly soluble and/or soluble drugs) and a solvent system.

*Compositions and coatings for implantable medical devices*

4. US Application No.: US2007/0212393
5. European Application No.: EP1832289  
Inventor: **Patravale Vandana**  
**Abstract:** An implantable medical device, comprising a polymer coated on at least a portion of the medical device, and a pharmaceutically active agent covalently bonded to the polymer.

*An implantable medical device, comprising a polymer coated on at least a portion of the medical device, and a pharmaceutically active agent covalently bonded to the polymer*

6. US Application No.: US2007/0212388
7. European Application No.: EP1834636  
Inventor: **Patravale Vandana**  
**Abstract:** A composition comprising a first polymer having pores, nanoparticles

dispersed within the pores of the first polymer, the nanoparticles comprising a second polymer and at least one pharmaceutically active agent dispersed in the second polymer, and heparin covalently bonded to at least one of the first and second polymer

*Coatings for implantable medical devices*

8. US Application No.: US2007/0212387
9. US Application No.: US20070212388
10. European Application No:EP20070103756

Inventor: **Patravale Vandana**

**Abstract:** A composition comprising at least one polymer covalently bonded to heparin, and at least one pharmaceutically active agent other than heparin dispersed within the at least one polymer.

*Novel lipid based carrier*

11. Indian Application No.: 174/MUM/2014

Inventor: **Patravale Vandana**

**Abstract:** The present invention relates to the synthesis of novel amphiphilic lipid or lipid like moiety and applications thereof.

*Nanodrug delivery based on combination therapy for treating parasite infections*

12. Indian Application No: 3567/MUM/2013

Inventor: **Patravale Vandana**

**Abstract:** The invention relates to a drug combination approach delivered via smart nanocarriers for alleviation of infectious diseases.

*Highly porous dosage forms*

13. Indian Application No.: 3441/MUM/2013

Inventor: **Patravale Vandana**

**Abstract:** The invention relates to a pharmaceutical dosage form with highly porous nature developed using freeze drying technology.

*Point-of-care diagnostic test for rapid detection of brucellosis*

14. Indian Application No.: 3183/MUM/2013

Inventor: **Patravale Vandana**

**Abstract:** The invention relates to design and development of a novel, sensitive and specific diagnostic module for early detection of brucellosis.

*Non-invasive vaccine delivery system for immunization against brucellosis using green technology*

15. Indian Application No.: 2920/MUM/2013

Inventor: **Patravale Vandana**

**Abstract:** The invention herein relates to the development of novel nanoparticle based vaccine for nasal immunization using supercritical fluid technology.

*Pharmaceutical composition for combined immunization and therapy against macrophage host related infections*

16. Indian Application No.: 2266/MUM/2012

Inventor: **Patravale Vandana**

**Abstract:** The invention herein relates to a synergistic strategy towards mitigation of macrophage infections.

*Pharmaceutical composition for transdermal application*

17. Indian Application No: 1218/MUM/2012



Inventor: **Patravale Vandana**

**Abstract:** The invention herein refers to the novel nano/micro formulation approach for transdermal delivery of therapeutic actives.

*Pharmaceutical composition for bioenhancement of active agents*

18. Indian Application No.: 1108/MUM/2012

Inventor: **Patravale Vandana**

**Abstract:** The invention relates to hot melt extrusion assisted formulation leading to enhanced bioavailability and stability of pharmaceutical actives.

*Microparticles preparation and process thereof: process optimization and equipment design*

19. Indian Application No: 652/MUM/2010

Inventor: **Vandana Patravale**

**Abstract:** The invention relates to a process of generation of microparticles using in-house designed equipment.

*Polymeric nanoparticles of curcumin for improved delivery*

20. Indian Application No.: 103/MUM/2008

Inventor: **Patravale Vandana**

**Abstract:** The invention refers to polymeric nanoparticle development approach for curcumin, aimed to enhance pharmacokinetic properties of curcumin with improved stability.

*Stable solutions of poorly soluble actives*

21. Indian Application No.: 2281/MUM/2007

Inventor: **Patravale Vandana**

**Abstract:** The invention relates to a formulation strategy towards solubility, stability and bioavailability enhancement of pharmaceutical actives.

*Nanoparticles for wound healing*

22. Indian Application No.: 256/MUM/2007

Inventor: **Patravale Vandana**

**Abstract:** The invention relates to a new wound healing strategy via development of 3-D structured pharmaceutical composition.

*Biosurfactants from natural source*

23. Indian Application No.: 1945/MUM/2006

Inventor: **Patravale Vandana**

**Abstract:** The invention relates to identification of novel biosurfactants from natural source and applications thereof.

*Solid solutions of pharmaceutical actives*

24. Indian Application No.: 1872/MUM/2006

Inventor: **Patravale Vandana**

**Abstract:** The invention relates to novel formulation technique towards stability and bioavailability enhancement of pharmaceutical actives.

*Novel targeted lipid bioconjugates and delivery system thereof*

25. Indian Application No.: 2822/MUM/2015

Inventor: **Patravale Vandana**

**Abstract:** The present invention refers to novel lipid bioconjugates exhibiting a special ability to cross biological membranes.

***Stable atovaquone nanoparticles with increased bioavailability and pharmaceutical composition of the same***

26. Indian Patent No.: 201621020162 A

Inventor: **Patravale Vandana**

**Abstract:** The invention relates to process for preparation of nano particles of atovaquone, a poorly water soluble drug to increase their solubility and dissolution rate and thereby increased bioavailability.

***Novel dendrimer and application thereof***

27. Indian Patent No.: 201621034246

Inventor: **Patravale Vandana**

**Abstract:** The present invention is directed to novel dendrimer compound comprising of at least one metal and dendritic polymer, and a process of synthesis of said compound. The present invention also relates to properties of said compound as wound care (tissue engineering), anti-acne, anti-scarring, anti-infective and formulation comprising same.

**Trademarks**

1. Registered Trademark "DO-SOL" for pulmonary delivery of therapeutics (No. 2700724, Dated 18 March 2014)
2. Registered Trademark "NANOTARG" for targeting diagnostic nanoparticles (No. 1529980, Dated 12 February 2007)
3. Registered Trademark SMETS®- for Self Micro-Emulsifying Tablets, a new drug delivery system. (No. 1250909, Dated 21 November 2003)

**Industrial Design**

1. **Industrial design for Inhaler device** (No. 261054, Dated 18 March 2014)

**Industrial Consultancy till date**

- |  |                                      |
|--|--------------------------------------|
| 1. Cadila Pharma Pvt. Ltd.                       | 2. Piscium Health Sciences Pvt. Ltd. |
| 3. Quantimmune solutions pvt. Ltd.               | 4. Emami Ltd.                        |
| 5. FDC Ltd.                                      | 6. CavinKare Pvt. Ltd.               |
| 7. Alkem Industries Pvt. Ltd.                    | 8. AJ Organica Pvt. Ltd              |
| 9. Jubilant life Sciences Pvt. Ltd               | 10. Perrigo API India Pvt. Ltd.      |
| 11. Neopharma Ltd.                               | 12. Sulphur Mills Ltd.               |
| 13. Synthite Limited                             | 14. Novartis Enterprises Pvt. Ltd.   |
| 15. Healers Nutraceuticals                       | 16. Charbhujia Agencies Pvt. Ltd.    |
| 17. Amber International Pvt. Ltd.                | 18. Kamani Oils Pvt. Ltd.            |
| 19. Pharmaceutical Coatings Pvt. Ltd.            | 20. Rubicon Research Private Limited |
| 21. Yuva Cosmetics Pvt. Ltd.                     | 22. Piramal Healthcare Ltd.          |
| 23. Famycare Ltd.                                | 24. Mankind Pharmaceuticals          |
| 25. Sahajananad Medical Technologies Pvt. Ltd    |                                      |
| 26. Boehringer Ingelheim Sunder Medical agencies |                                      |

## **Technology Commercialization**

1. **Name of Technology:** Biodegradable Polymeric Stents  
**Name of Industry:** Sahajanand Medical Technology Pvt. Ltd.  
**Area of Invention:** Fabrication of Novel Stent
2. **Name of Technology:** Infinnuim (Paclitaxel elution coronary stent)  
**Name of Industry:** Sahajanand Medical Technology Pvt. Ltd.  
**Area of Invention:** Fabrication of Novel Stent
3. **Name of Technology:** Supralimus<sup>®</sup>, Supralimus-Core<sup>®</sup>  
**Name of Industry:** Sahajanand Medical Technology Pvt. Ltd.  
**Area of Invention:** Fabrication of Novel Stent
4. **Name of Technology:** S-LINK, SUPRAFLEX  
**Name of Industry:** Sahajanand Medical Technology Pvt. Ltd.  
**Area of Invention:** Fabrication of Novel Stent
5. **Name of Technology:** Everoflex<sup>TM</sup>  
**Name of Industry:** Sahajanand Medical Technology Pvt. Ltd.  
**Area of Invention:** Fabrication of Novel Stent
6. **Name of Technology:** Tetrilimus<sup>TM</sup>  
**Name of Industry:** Sahajanand Medical Technology Pvt. Ltd.  
**Area of Invention:** Fabrication of Novel Stent
7. **Name of Technology:** Cadisome (Amphotericin B Liposomes)  
**Name of Industry:** Cadila Pharmaceuticals Ltd.  
**Area of Invention:** Nanotechnology
8. **Name of Technology:** Zillion (Taste masked ondansetron tablets)  
**Name of Industry:** Cadila Pharmaceuticals Ltd.  
**Area of Invention:** Taste masked tablet
9. **Name of Technology:** O-lit (Mouth dissolving tablets Omeprazole HCl)  
**Name of Industry:** Cadila Pharmaceuticals Ltd.  
**Area of Invention:** Modified release tablet for faster onset
10. **Name of Product/Process/Technology:** Imuvac (Immunomodulator)  
**Name of Industry:** Cadila Pharmaceuticals Ltd.  
**Area of Invention:** Nanotechnology
11. **Name of Technology:** Ranx (Ranolazine Tablets)  
**Name of Industry:** Cadila Pharmaceuticals Ltd.  
**Area of Invention:** Modified release tablets
12. **Name of Technology:** Paclitaxel Soft Gelatin Capsules  
**Name of Industry:** Cadila Pharmaceuticals Ltd.  
**Area of Invention:** Novel drug delivery system

13. **Name of Technology:** Valdone® (Curcumin Soft Gelatin Capsules)  
**Name of Industry:** Cadila Pharmaceuticals Ltd.  
**Area of Invention:** Novel drug delivery system
14. **Name of Technology:** Curcumin Soft Gelatin Capsules  
**Name of Industry:** Cadila Pharmaceuticals Ltd.  
**Area of Invention:** Novel drug delivery system
15. **Name of Technology:** Calcirol (Cholecalciferol soft gelatin capsules)  
**Name of Industry:** Cadila Pharmaceuticals Ltd.  
**Area of Invention:** Novel drug delivery system
16. **Name of Technology:** ACILOC (Ranitidine Oral Suspension and Syrup)  
**Name of Industry:** Cadila Pharmaceuticals Ltd.  
**Area of Invention:** Novel drug delivery system
17. **Name of Technology:** Intrauterine Contraceptive Device (Product Profile similar to Innovators Intra Uterine device Mirena®)  
**Name of Industry:** Famy Care Ltd.  
**Area of Invention:** Contraceptive Device
18. **Name of Technology:** SKINEASI antichafing gel  
**Name of Industry:** Amaterasu Lifesciences LLP  
**Area of Invention:** Personal care



**Dr. Sadhana Sathaye**

Associate Professor, Pharmaceutical Sciences and Technology

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### **Patent Applications Filed**

*Development and evaluation of wedelolactone for antiepileptic activity by using nasal formulation for improved efficacy*

1. Patent application No: 201621023432

Inventors: **Sathaye Sadhana**; Muke Suraj; Chaturbhuj Ganesh; Khatri Chetankumar

**Abstract:** The present invention includes synythesis of wedelolactone for treating or preventing seizures or epilepsy by using nasal formulation. The invention discloses method of synthesis of wedelolactone and preparation of nasal formulation. The invention is specially related to three step cost effective synthesis of wedelolactone and nasal formulation of it for treatment or cure of seizures or epilepsy.

# Department of Physics

## Research Areas:

Structure property relationships of polymer composites and nanocomposite

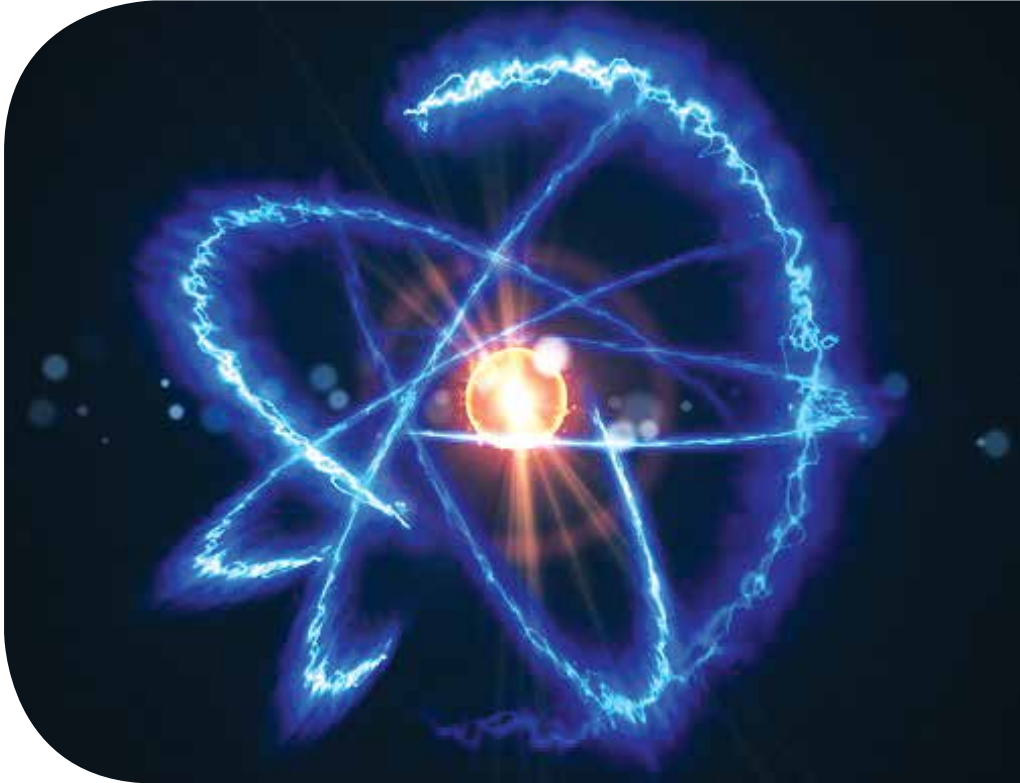
Crystallization kinetics of /polymercomposites

Evaluation of nanodrug delivery

Theoretical polymer physics solar thermal technology

Electro-optical properties of polymer dispersed liquid crystals

Mathematical modelling of biological pigment





**Dr. Neetu Jha**  
UGC Assistant Professor, Physics

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### **Patent Applications Filed**

#### ***Novel nanocomposites of $\gamma$ -MnO<sub>2</sub> supported on graphene oxide used as a catalyst***

1. Indian Application No.: 473/MUM/2014

Inventors: **Jha Neetu**; Nemade P. R.; Gaikar V. G.; Dhopte K. B.; Kadam M. M.

**Abstract:** The invention relates to graphene oxide supported  $\gamma$ -MnO<sub>2</sub> catalyst, which is more than twice as active other MnO<sub>2</sub> based catalysts reported for oxidation of benzyl alcohol using air at low temperatures.

#### ***Modified Solar Still for efficient water purification***

2. Indian Application No.: 201721001222

Inventors: **Jha Neetu**

**Abstract:** This invention describes the modification of solar still using carbon fabric to increase the rate of steam generation which ultimately leads to pure water post distillation.





Dr. (Mrs.) V. D. Deshpande  
Professor, Physics

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### Patent Applications Filed

#### *Pharmaceutical compositions for bioenhancement of active agents*

1. Indian Application No.:1108/MUM/2012

Inventors: Patravale Vandana B.; Desair PreshitaP.; **Deshpande V. D.**

**Abstract:** The present invention relates to the amorphous, solid, stable pharmaceutical composition for bioenhancement of curcuminoids. The composition described herein comprises of an active and pharmaceutical excipients processed by melt mixing that result in a solid solution which achieves improved solubility and/or improved availability at site of activity and/or improved oral bioavailability of an active.

# Department of Polymer and Surface Engineering

## Research Areas:

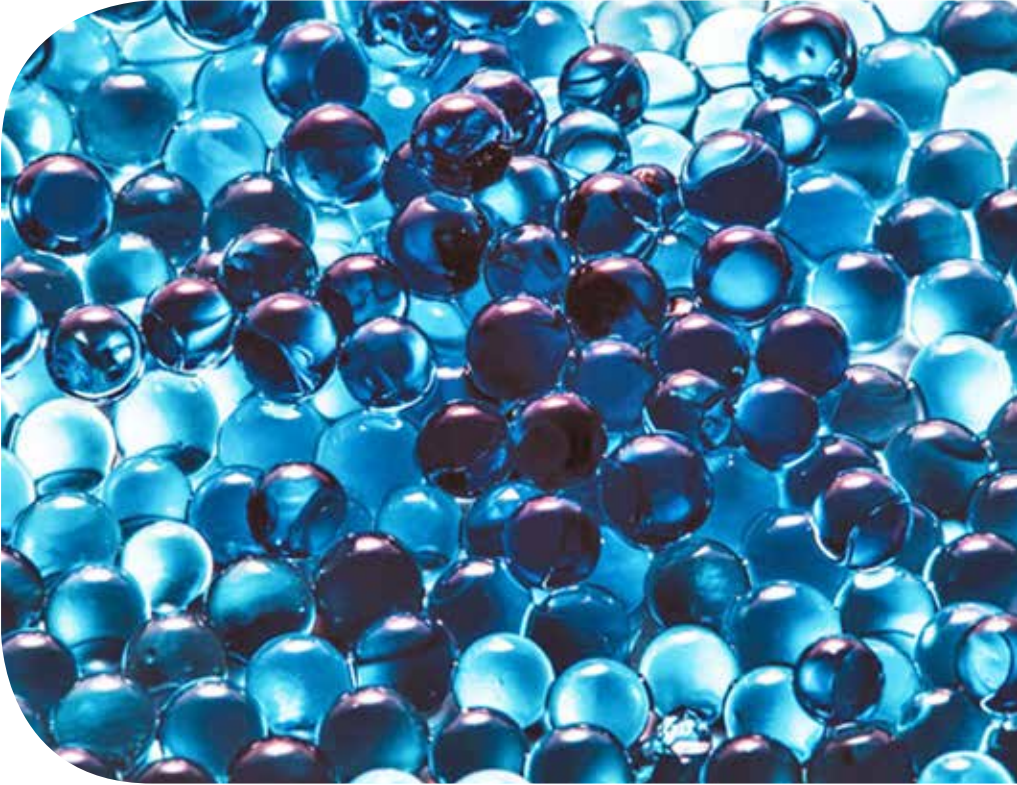
Synthesis and Characterization of speciality polymers for controlled release

Surface coating, nanocomposites and bionanocomposites

Polymer processing and coloration and colour matching

Synthesis of resin from renewable resources

Water borne coating, insulating varnishes, conductive coatings, anticorrosive coating





**Dr. Shashank T. Mhaske**

Head, Department of Polymer and Surface Engineering

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### Patent Applications Filed

#### *Microwave synthesis of polyamide hot melt adhesive*

1. Indian Application No.: 3305/MUM/2014  
Inventors: **Mhaske Shashank Tejrao**; Kadam Pravin Gopal; Kelkal Sunder Tukaram; Savvashe Prashant Bhairavnath  
**Abstract:** The present invention describes the efficient synthesis of polyamide hot melt adhesive in a microwave process with precise temperature control.

#### *Novel poly(ester-amide) hot melt adhesive using castor oil*

2. Indian Application No.: 128/MUM/2015  
Inventors: **Mhaske Shashank Tejrao**; Kadam Pravin Gopal; Vaidya Parth Nitin Savvashe Prashant Bhairavnath.  
**Abstract:** In the present invention, novel poly (ester-amide) hot melt adhesives are prepared from condensation of sebacic acid with the equivalent proportion of a mixture of castor oil and ethylenediamine.

#### *Novel poly(ester-amide) hot melt adhesive using ricinoleic acid*

3. Indian Application No.: 127/MUM/2015  
Inventors: **Mhaske Shashank Tejrao**; Kadam Pravin Gopal; Vaidya Parth Nitin Savvashe Prashant Bhairavnath  
**Abstract:** The present invention describes a process for preparation of novel poly(ester-amide) hot melt adhesives from condensation of sebacic acid with the equivalent proportion of a mixture of ricinoleic acid and ethylenediamine.



**Prof. R. N. Jagtap**  
Professor, Department of  
Polymer and Surface Engineering

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**Technology Commercialisation**

**Name of Technology:** Cool Coatings for Green Building

**Patent:** US 20130216832 A1

**Revenue Generated:** 6, 00,000/- INR

**Area of Invention:** Heat reflective dry-mix/paint



## Dr. Anagha Sabnis

Assistant Professor, Department of  
Polymer and Surface Engineering

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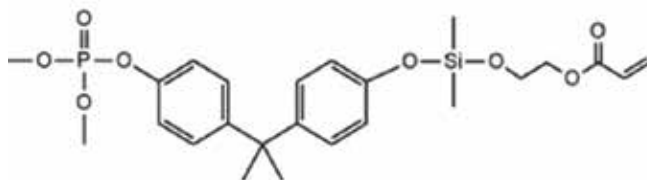
### Patent Applications Filed

#### *Novel phosphorus and silicon containing reactive flame retardant*

1. Indian Application No.: 20171011834

Inventors: **Anagha Sabnis**

**Abstract:** Present invention describes novel phosphorus and silicon containing reactive flame retardant



This compound enhances flame retardancy of UV coating formulations. It acts as a cross-linker as well as flame retardant to epoxy acrylate and urethane acrylate based formulations. Along with flame retardancy, it also improves mechanical properties of the coatings. The synergistic effect of phosphorus and silicon is responsible for excellent flame retardant properties.



