Education:

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<th>Examination</th>
<th>University</th>
<th>Institute</th>
<th>Year</th>
<th>CPI/%</th>
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<tr>
<td>Doctorate</td>
<td>IIT Bombay/Monash University</td>
<td>IITB-Monash Research Academy</td>
<td>2017</td>
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<tr>
<td>Graduation</td>
<td>BITS Pilani</td>
<td>BITS Pilani K.K. Birla, Goa Campus</td>
<td>2011</td>
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<td>Intermediate/+2</td>
<td>CBSE</td>
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<td>2007</td>
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<td>Sachdeva Public School, Delhi</td>
<td>2005</td>
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Areas of Interests:

- Techno-enviro-economic assessment.
- Multi-scale modelling and process integration.
- Renewable energy systems.
- Biofuels and bio-energy.
- Process modelling, simulation and optimisation.
- Computational Fluid Dynamics (CFD).
- Life Cycle Assessment (LCA).
- Sustainable chemicals.

PhD Problem Statement:

Registered at IITB-Monash Research Academy—a joint venture between IIT Bombay, India, and Monash University, Australia

Supervisors: Prof. Sanjay Mahajani. Department of Chemical Engineering, IIT Bombay, Mumbai, India; Prof. Anuradda Ganesh. Department of Energy Science and Engineering, IIT Bombay, Mumbai, India; and Prof. Andrew Hoadley. Department of Chemical Engineering, Monash University, Clayton, Australia

Abstract:

Ammonia is often regarded as a chemical that changed the course of the 20th century. As a fertiliser, it has sustained global agriculture, and as an explosive, it has become indispensable to the mining industry. On the flipside, conventional ammonia production continues to have a significant environmental footprint by consuming 1.2% of the global primary energy and contributing to 0.93% of worldwide Greenhouse Gas (GHG) emissions. This stems from the fact that natural gas has remained the preferred feedstock due to its low price and wide availability. Biomass, with its wide availability and carbon neutrality, stands as a strong candidate for the replacement of fossil fuels. The present study tries to establish the viability of small-scale ammonia production from biomass. A scale of 70 tpd of ammonia production was selected to buffer the sporadic biomass supply, while the local demand for ammonia was simultaneously accommodated. The scale is much smaller when compared to conventional ammonia plants, and the effect of the economies of scale is expected to make the plant less appealing. To overcome these effects, the design incorporated features from the ICI Leading Concept Ammonia® process. This small-scale process, which was developed in the early 1990s, incorporated significant changes in terms of heat integration and process flow in order to suit small-scale ammonia plants.

The use of the dual fluidised bed gasifier technology also contributed to a cleaner syngas and easier energy integration. In order to predict and optimise the operation of the dual fluidised bed gasifier effectively, a compartment-based semi-detailed kinetic approach was used to model the gasifier. A Computational Fluid Dynamics (CFD) model was developed in ANSYS Fluent® for the gasifier in order to validate the assumptions. The CFD model was then used to carry out a Residence Time Distribution (RTD) analysis, which formed the basis for the compartment model. The gasifier model and the downstream gas conditioning that led to ammonia production were modelled in the ASPEN Plus® simulation software.

The output of ASPEN Plus® simulations was fed into an MS Excel®-based framework, which performs Life Cycle Costing (LCC) and Life Cycle Assessment (LCA) for the simulated flowsheet. Finally, these outputs are utilised by an MS Excel®/VB-based Multi-Objective Optimisation (MOO) framework to optimise both LCC and LCA for changing flowsheet configurations as well as for different biomass feedstocks grown at different locations worldwide. Apart from establishing the viability of a small-scale biomass-to-ammonia plant, this study also establishes the advantages of process modelling and simulation at different levels, namely, the phase level, the process unit level, the plant level and the environmental effects level. The project has been funded by Orica Mining Services.
Technical Skills:
I bring to the table a unique blend of a clear theoretical background, excellence in using a variety of simulation tools at different scales, and experience in operation and maintenance of lab-scale plants.

- ASPEN Plus®, HYSYS® and DWSIM® simulation software.
- ANSYS Fluent® and COMSOL® CFD software.
- Multi-Objective Optimisation (MOO) using genetic algorithms.
- SIMAPRO® LCA software.

Among other abilities, the skill that was honed the most during the course of my PhD is problem identification and problem solving.

Work Experience:
3. Research Fellow, Department of Chemical Engineering, IIT Delhi, with Prof. D.P. Rao. (Jan–May 2011).

List of Publications:

Publications in SCI-indexed and Scopus-indexed Journals (Published/Communicated):


Book Chapter

Conference Publications

Conference Presentations


### Research Projects:

1. **Design and Development of GHG Calculator for Distributed Rooftop Solar PV Projects** (Mar-Jun 2018), sponsored by International Finance Corporation (IFC), World bank. Grant Amount: Rs 45,00,000/-. Worked on development of online tool for rooftop solar PV potential and GHG emission reduction potential for textile sector in Bangladesh.

2. **Feasibility Study for Potential Applications of Waste Generated from the Katha industry** (Aug-Dec 2017), sponsored by Indian Wood Products (IWP). Grant Amount: Rs 3,30,000/-. Feasibility study to identify from technical and economic perspective the most viable process for converting Gambier extract (wastes) to useful chemical/fuel/energy products.


5. **Design of a viable hybrid fuel supply system for villages** (Aug–Nov 2010) with Prof. Krishnaswami Ponnani, Chemical Engineering Department, BITS Pilani Goa: The project aimed to propose a sustainable fuel-supply system for villages by incorporating LPG, biogas and biomass gasification syngas.

6. **Designing a PSA Plant for Removal of Carbon Dioxide from Biogas** (May–July 2010) with Prof. V.K. Vijay, Centre for Rural Development and Technology, IIT Delhi: Proposed an algorithm for the designing of an adsorber column to be used in the enrichment of biogas.

### Awards and Achievements:

1. Received the 2019 *Processes Travel Awards* for attending the FO CAPD conference.


5. Outstanding reviewer for the Journal of Cleaner Production by Elsevier.

6. Won the *Paper Presentation competition* in Quark-08 - annual techfest of BITS Pilani, Goa Campus.

7. Stood second in the event ‘*Conwallz*’ at Quark-10. The contest required the making of a wall that could maximise heat transfer under given conditions.

8. Recipient of prestigious *merit-cum-need scholarship* by BITS Pilani.

### Position of Responsibility and Extra-Curricular Activities

1. Member of *Technology Need Assessment (TNA)* committee for the Transport Sector at TIFAC.


3. Member of the organising committee for the International Conference on Advances in Energy Research (ICAER 2015).

4. Core-member of the organising committee of the *ReDx MIT Health Tech Workshop* held at IIT Bombay in Jan. 2014.

5. Member of the organizing committee of the 3rd *Global Tech Workshop* that was held in IIT Bombay in Dec. 2011.

6. Event manager of *Paper Presentation Competition*, the largest event in Quark-09, with more than 1000 participants from throughout the country.

7. Member of the academic committee of Alchemista, Chemical Engineering Students Association of BITS Pilani, Goa.

8. Practised *Taekwondo* up to yellow belt level.

9. Orchestrated *group meditation sessions* in the Goa campus of BITS Pilani.
References:

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Online profile

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