

# Dhiraj Kumar Garg

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[https://www.researchgate.net/profile/Dhiraj\\_Garg](https://www.researchgate.net/profile/Dhiraj_Garg)

<http://scholar.google.co.in/citations?user=uXy0iCUAAAAJ&hl=en>



## Education

- **PhD** (Process Engineering/ Process simulation), **University of Strasbourg, France**, Mar'2014. Thesis Title: **Numerical Modeling and Simulation of Polymerization Reactions in Coiled Flow Inverters.**
- **M.Tech.** (Chem. Engg.), **Indian Institute of Technology Delhi, India**, May'2010, (CGPA- 8.2/10).
- **B.Tech.** (Chem. Engg.), **Guru Gobind Singh Indraprastha University, Delhi, India**, Jun'2003, (%age– 83.1%).
- **10+2** (A-Level), **CBSE**, Greenfields Public School, Delhi, (88%), Physics, Chemistry, Maths, Biology, English.
- **10<sup>th</sup>** (O-Level), **CBSE**, Dayanand Model School, Delhi (89%), Science, Social Sc., Maths, Hindi, English, Sanskrit

## Technical Skills

- **Programming languages:** C, C++, Ladder programming for PLC, MATLAB with SIMULINK
- **Software:** HYSYS, COMSOL, ANSYS, CFD-ACE+

## Areas of Interest/ Expertise

- Computational Fluid Dynamics, Numerical Methods, Chemical Engineering, Process Engineering, Process Control and Dynamics, Process Safety, Heat Transfer, Mass Transfer, Process Intensification.

## Courses Teaching

- Numerical Methods, Computational Fluid Dynamics, Process Engineering, Process Equipment Design, Chemical Engineering Thermodynamics.

## Awards/Achievements

- **Project grant (Rs.17.6 lakh) under Young Scientist Scheme (No. YSS/2015/002088) in 2015** for three years.
- **International Travel Grant for young scientist awarded by DST** for attending conference Pacifichem 2015 (15<sup>th</sup> -20<sup>th</sup> Dec'2015) in Honolulu, Hawaii, USA.
- Got Travel Support Grant from Shiv Nadar University of Rs.1.5 Lakh for attending conference Pacifichem 2015 (15th -20th Dec'2015) in Honolulu, Hawaii, USA.
- Got Research Grant from Shiv Nadar University to the tune of around Rs.4.25 Lakh for purchasing workstation and CFD software for my research work.
- **ISCRE Poster Award** for poster titled, "*Improvement of the control of polymer architectures by means of a coil flow inverter microreactor*" authored by D. Parida, C.A. Serra, Y. Hoarau, **D.K. Garg**, at ISCRE 22, 22<sup>nd</sup> International Symposium on Chemical Reaction Engineering, 02-05 Sep 2012, Maastricht, The Netherlands.
- Got an **outstanding promotion to SO-D** in 2006 during work tenure in NPCIL.
- **University Topper** in B.Tech. (Chemical Engineering), 2003.
- Scored **100% marks in Applied Mathematics** in 3<sup>rd</sup> semester of B.Tech. (Chem. Engg.), 2000.

## Professional Affiliation

- **Life Member** of Indian Institute of Chemical Engineers (**IChE**) No. LM-55005
- **Member** of American Institute of Chemical Engineers (**AIChE**) No. 9901139184
- **Member** of American Chemical Society (**ACS**) No. 30819652

## Professional Experience

- **Present- Assistant Professor, Dept. Of Chemical Engineering, School of Engineering, Shiv Nadar University, UP, India** – 05 Jan'15 - till date.
- Involved in teaching various UG courses to the tune of two courses per semester.
- Worked as departmental library coordinator for one year.
- Currently heading Departmental Student Activities Charge.
- Member of departmental recruitment committee.

## Achievements during current employment

- **Setup various departmental labs from scratch** - Chemical Reaction Engineering Lab, Computational Lab and Process Control Lab.
- **Opened Departmental Student Technical Society** nicknamed H2O in 2016.
- **Opened IChE Student Chapter** in 2016.
- **Organized several talks** by external experts from academia and industry
- **Organized one full day talk** by external experts from academia and industry participated by around 200 students and faculty members from 4 universities and institutes around Delhi-NCR.
- **Organized two industrial visits** (NPCIL plant at Narora, and NFL, Panipat) for the students as well as Faculty
- **Purchased all semester departmental text-books and almost standard chemical engineering reference books/ handbooks and encyclopedias** in one year itself as library coordinator.
- **Attended QIP program at IIT Roorkee twice.**
  
- **Past- Scientific Officer-D, Nuclear Power Corporation of India Ltd.** – 01 Sep'2003 to 12 Jul'2008 (~5 yrs)
- **Commissioning, Field & control room operation** during general and shift duty and **Technical Services.**
- **Nuclear and conventional power plant technology** including water treatment plant, cooling towers: induced and forced type, D<sub>2</sub>O upgrading column, various advance control strategies, PLCs, SCADA etc.
- **Operational details and thorough knowledge** of various types of mechanical, electrical, process control and instrumentation equipment like heat exchangers, pumps, motors, control valves etc.
- **Nuclear radiation** detection, measurement, protection and planning.

## Achievements during past employment

- **Implemented and proposed various engineering changes** to some existing systems which improved their efficiency, reliability and safety aspects.
- Worked in **6 different nuclear power plants (NPPs) at 4 different sites** throughout India.
- Worked in NPPs based on PHWR technology **from oldest (RAPS-1&2) to latest (RAPP-5) and smallest (RAPS-1&2) to largest (TAPP-3) NPP** till that time.
- After getting **outstanding promotion**, worked as **Scientific Officer-D (SO-D)** at the time of leaving the job from NPCIL (DAE).

## Academic Project/ Research

- **PhD Thesis** titled– **Numerical Modeling and Simulation of Polymerization Reactions in Coiled Flow Inverters**, under supervision of Prof. Christophe A. Cerra (Supervisor) and Prof. Yannick Hoarau (Co-Supervisor), University of Strasbourg, Strasbourg, France, Mar'2014.  
**Abstract:** This thesis aimed at improving the modeling and simulation of free radical polymerization (FRP) in batch as well as in flow reactors. A generalized explicit analytical solution (AS) was obtained in case of variable volume, bulk/solution polymerization, homogeneous and isothermal batch reactor. The reaction steps included initiation, propagation, transfer to monomer, transfer to solvent, transfer to chain transfer agent (CTA), termination by combination and disproportionation. Different models of gel, glass and cage effects

were also implemented explicitly. AS was validated against numerical solutions as well as published experimental data and was found in good agreement. Furthermore, its applicability was extended to conditions for which AS was not derived, i.e. non-isothermal conditions. The versatility and flexibility of AS over the complete range of monomer conversion were thus demonstrated. Then, to broaden its applications range even more, AS was used in CFD simulations. A new and simple transformation was proposed to make kinetic rate coefficients dimensionless in terms of concentration. This enabled chemical data to be fed in molar form to CFD modeling. It also enabled easy coding and debugging by keeping the original form of generation terms intact. The results were found to be improved after validation against experimental data. This transformation was then used for evaluating three tubular microreactor geometries, namely straight tube reactor (STR), coiled tube reactor (CTR) and coil flow inverter reactor (CFIR), under different feed conditions (unmixed or perfectly mixed) at very low Reynolds numbers ( $<1$ ). The modeling for FRP was performed with constant or variable fluid physical parameters (density, viscosity and thermal conductivity) along with discrete variation of diffusion coefficients. Their effects on simulation results were observed and compared with published experimental data for 4 different monomers and were found to match perfectly. Results for mixed feed condition were found to be independent of microreactor geometry. CFIR seems to be the most promising reactor design under microreaction investigated conditions as it allowed the best control over polymer characteristics.

- **M.Tech. major project thesis** titled "Modelling of Droplet Coalescence using Level Set Method," under the guidance of Prof. Shantanu Roy, IIT Delhi, 2010.

**Nature of work:** The complex process of oil drop in water approaching various types of interfaces (characterized by viscosity ratio of dispersed to continuous phase), their coalescence and then complete merging is being modelled successfully. The problem is modelled with Finite Element Method using COMSOL software. The boundary was tracked using Level Set Method. Equation of continuity and incompressible Navier-Stokes equations are used for fluids. The modelling is of general nature and thus can be used for other purposes.

- **B.Tech. final year project** titled "Optimization of Distillation Sequencing in Cold Section of Ethylene Plant," done under the guidance of Prof. D. V. Gupta, GGSIP University, Delhi, 2003.

**Nature of work:** The actual data of an ethylene plant was taken and optimum sequencing of distillation columns of cold section was worked out.

- **Two months industrial training** at UPPC complex, GAIL, Pata, Uttar Pradesh, India on project titled "Quantitative & Qualitative Analysis of Ethylene Losses in the Gas Cracker Unit" after B.Tech., 3<sup>rd</sup> year, 2002.

**Nature of work:** Extensive material balance was done in cold section of the ethylene plant and gained good understanding of gas based plant.

#### **Other minor academic projects**

- "Multicomponent Distillation Column Design" program for stage column, random packed column and structured packed column in MATLAB was written and executed successfully in M.Tech., IITD, 2009.
- "Rigorous Dew Point Temperature and Composition Calculation for any Number of Components (Multicomponent System)" program written and executed in MATLAB successfully in M.Tech., IITD, 2009.
- "Root Cause Analysis of Load Limiting Gear of Turbine System in RAPS-1&2" at RAPS-1&2 (NPCIL), 2004.

## List of Publications

### Books and Chapters (1)

1. C. A. Serra, D. Parida, F. Bally, **D.K. Garg**, Y. Hoarau, V. Hessel, **Micro-Chemical Plants**, Chapter in *Encyclopedia of Polymer Science and Technology*; 4th ed., **06 Sep'2013**, Wiley-VCH, Weinheim (Germany), DOI: 10.1002/0471440264.pst612. Citations- 2.

### Scientific Articles (10)

#### **Published (10)**

1. **D.K. Garg**, C.A. Serra, Y. Hoarau, D. Parida, M. Bouquey, R. Muller, **New Transformation Proposed for Improving CFD Simulation of Free Radical Polymerization Reactions in Microreactors**. *Microfluid Nanofluid*, **14 Dec'2014**, 18 (5-6), 1287-1297. DOI: 10.1007/s10404-014-1527-3. Impact factor- 2.344. Citations- 1.
2. **D.K. Garg**, C.A. Serra, Y. Hoarau, D. Parida, M. Bouquey, R. Muller, **Analytical Solution of Free Radical Polymerization: Applications- Implementing Non-isothermal Effect**. *Macromolecules*, **02 Dec'2014**, 47 (24), 8514-8523. DOI: 10.1021/ma501964h. Impact factor-5.835. Citations- 2.
3. **D.K. Garg**, C.A. Serra, Y. Hoarau, D. Parida, M. Bouquey, R. Muller, **Analytical Solution of Free Radical Polymerization: Applications- Implementing Gel Effect Using CCS Model**. *Macromolecules*, **18 Nov'2014**, 47 (23), 8178-8189. DOI: 10.1021/ma501251j. Impact factor-5.835. Citations- 7.
4. **D.K. Garg**, C.A. Serra, Y. Hoarau, D. Parida, M. Bouquey, R. Muller, **Analytical Solution of Free Radical Polymerization: Applications- Implementing Gel Effect Using AK Model**. *Macromolecules*, **27 Oct'2014**, 47 (21), 7370-7377. Impact factor-5.835. Citations- 5.
5. **D.K. Garg**, C.A. Serra, Y. Hoarau, D. Parida, M. Bouquey, R. Muller, **Analytical Solution of Free Radical Polymerization: Derivation and Validation**. *Macromolecules*, **01 Jul'2014**, 47 (14), 4567-4586. Impact factor-5.835. Citations- 11.
6. D. Parida, C.A. Serra, **D.K. Garg**, Y. Hoarau, R. Muller, M. Bouquey, **Flow Inversion: an Effective Means to Scale-up Controlled Radical Polymerization Tubular Microreactors**, *Macromolecular Reaction Engineering*, **09 May'2014**, 8 (8), 597-603. Impact factor-1.543. Citations- 14.
7. D. Parida, C.A. Serra, F. Bally, **D.K. Garg**, Y. Hoarau, F. Bally, R. Muller, M. Bouquey, **Coil Flow Inversion as a Route to Control Polymerization in Microreactors**, *Macromolecules*, **06 May'2014**, 47 (10), 3282-3287. Impact factor-5.835. Citations- 21.
8. D. Parida, C.A. Serra, R.I. Gómez, **D.K. Garg**, Y. Hoarau, M. Bouquey, R. Muller, **Atom Transfer Radical Polymerization in Continuous-Microflow: Effect of Process Parameters**, *Journal of Flow Chemistry*, **28 Apr'2014**, 4 (2), 92-96. Impact factor-1.768. Citations- 3.
9. D. Parida, C.A. Serra, F. Bally, **D.K. Garg**, Y. Hoarau, **Intensifying The ATRP Synthesis of Statistical Copolymers by Continuous Micromixing Flow Techniques**. *Green Processing and Synthesis*, **21 Nov'2012**, 1 (6), 525-532. Impact factor-0.782. Citations- 7.
10. F. Bally, **D.K. Garg**, C.A. Serra, Y. Hoarau, C. Brochon, D. Parida, T. Vandamme, G. Hadziioannou, N. Anton, **Improved Size-Tunable Preparation of Polymeric Nanoparticles by Microfluidic Nanoprecipitation**. *Polymer*, **12 Oct'2012**, 53 (22), 5045-5051. Impact factor-3.364. Citations- 37.

#### **To be communicated (4)**

1. **D.K. Garg**, C.A. Serra, Y. Hoarau, D. Parida, M. Bouquey, R. Muller, **Numerical Investigations of Different Tubular Microreactor Geometries for The Synthesis of Polymers Under Unmixed Feed Condition**. **2017**, to be submitted.

2. **D.K. Garg, C.A. Serra, Y. Hoarau, D. Parida, M. Bouquey, R. Muller, Numerical Investigations of Perfectly Mixed Condition at The Inlet of Free Radical Polymerization Tubular Microreactors of Different Geometries. 2017, to be submitted.**
3. **D.K. Garg, C.A. Serra, Y. Hoarau, Numerical Modelling and Simulation of Semi-Batch Free Radical Polymerization Reactor Operation Using Analytical Solution with AK Gel Model, 2017, to be submitted.**
4. **D.K. Garg, C.A. Serra, Y. Hoarau, Algorithm to Deal With Very Large and Very Small Numbers to Enable Utilization of Analytical Solution of Free Radical Polymerization During Gel Effect, 2017, to be submitted.**

## **Conferences**

### **Oral Communications (9)**

1. **D.K. Garg, C.A. Serra, Y. Hoarau, Semi-Batch Free Radical Polymerization Reactor Modelling and Simulation Using Analytical Solution, Advancements in Polymeric Materials APM 2017, 11-13 Feb'2017, Bengaluru, India.**
2. **D.K. Garg, C.A. Serra, Y. Hoarau, D. Parida, M. Bouquey, R. Muller, Analytical solution of free radical polymerization: Application to the numerical modeling and simulation of polymerization reactions in coiled flow inverters, Pacifichem 2015, 13th – 20th Dec 2015, Honolulu, Hawaii, USA.**
3. **D.K. Garg, Y. Hoarau, C.A. Serra, D. Parida, Derivation of analytical solution for the Free Radical Polymerization reaction conducted in a constant volume, isothermal, well mixed batch reactor and its applications to CFD modelling, WCCE9, 9th World Congress of Chemical Engineering, 18-23 Aug 2013, Seoul, South Korea.**
4. **D.K. Garg, Y. Hoarau, C.A. Serra, D. Parida, Analytical solution of FRP for constant volume, isothermal, well mixed batch reactor and its application, WPPRE 2013, 2<sup>nd</sup> Working Party on Polymer Reaction Engineering, 24-26 May 2013, Hamburg, Germany.**
5. **D.K. Garg, Y. Hoarau, C.A. Serra, D. Parida, Numerical simulation of polymerization reactions in tubular microsystems: effect of reactor geometry, WPPRE 2012, 1<sup>st</sup> Working Party on Polymer Reaction Engineering, 11-13 Oct 2012, Lyon, France.**
6. **D.K. Garg, Y. Hoarau, C.A. Serra, D. Parida, Flow improving polymerization reactions in coil flow inverter, EFMC9, 9<sup>th</sup> European Fluid Mechanics Conference, 09-13 Sep 2012, Rome, Italy.**
7. **D.K. Garg, Y. Hoarau, C.A. Serra, D. Parida, Numerical modelling of polymerization reactions in different tubular microreactor geometries, ISCRE22, 22<sup>nd</sup> International Symposium on Chemical Reaction Engineering, 02-05 Sep 2012, Maastricht, The Netherlands.**
8. **D.K. Garg, Y. Hoarau, C.A. Serra, D. Parida, Numerical investigations of different microreactor geometries for the synthesis of polymers, CHISA 2012, 20th International Congress of Chemical and Process Engineering, 25-29 Aug 2012, Prague, Czech Republic.**
9. **D.K. Garg, Y. Hoarau, C.A. Serra, Numerical modeling of polymerization reaction in CFI, CFM 2011, XX<sup>ème</sup> Congrès Français de Mécanique, 28 Aug-02 Sep 2011, Besançon, France.**

### **Posters (3)**

1. **D.K. Garg, Y. Hoarau, C.A. Serra, D. Parida, Analytical solution of FRP for constant volume, isothermal, well mixed batch reactor and its application, 11<sup>th</sup> Workshop on Polymer Reaction Engineering, 21-24 May 2013, Hamburg, Germany.**
2. **D. Parida, C.A. Serra, Y. Hoarau, D.K. Garg, Improvement of the control of polymer architectures by means of a coil flow inverter microreactor, ISCRE22, 22<sup>nd</sup> International Symposium on Chemical**

*Reaction Engineering, 02-05 Sep 2012, Maastricht, The Netherlands.*

3. **D.K. Garg**, Y. Hoarau, C.A. Serra, D. Parida, ***Numerical modeling of polymerization reactions in straight tube and coiled flow inverter (CFI) Reactors***, SoMaS 2011, Summer school in soft matter, 10-15 July 2011 Mittelwihr, France.

**Workshop Attended**

- **Chevron Sponsored AIChE's Center for Chemical Process Safety (CCPS) Faculty Workshop August 13-16, 2017 · Richmond, CA**