Kireeti Akkunuri

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Research Interests

Reaction Engineering, Systems Biology, Synthetic Biology, Sustainable Engineering, Process Design

Education

Indian Institute of Technology Bombay (2016 – 2020)
Bachelor of Technology (B. Tech.) with Honors in Chemical Engineering | GPA: **8.71/10** *Mumbai, India*

Intermediate Education (XII) : *Narayana Junior College, Hyderabad, India* | Performance: **98.6%** (2016)
Matriculation (X) : *Dilsukhnagar High School, Hyderabad, India* | GPA: **9.8/10** (2014)

Achievements & Honors

- 1st Position (IIT Bombay), Prof. N.R.Kamath Memorial ChE Quiz by the Indian Institute of Chemical Engineers (2020)
- Recipient of the MITACS Globalink Research Fellowship (Canada) with an internship grant of over $7000 CAD (2019)
- Awarded AP grade for outstanding performance in the course 'Introduction to Paninian Grammar', IIT Bombay (2019)
- Received the DWSIM-FOSSEE Honorarium for open-source flowsheeting on DWSIM Process Simulator (2019)
- Secured a 99.4 percentile in JEE-Advanced Examination out of nearly 200,000 candidates (2016)

Research Experience

Process Optimization of a Liposomal Drug Formulation (Mar '21 – Present)
Guide: Dr. Vikas Jain, Injectables Process Engineering, Dr. Reddy's Laboratories R&D *Hyderabad, India*

- Conducted 20+ experiments involving compounding, HPH, and lyophilization of a complex injectable. Understood the influence of CPPs on CQAs pertaining to liposomal morphology, IVR, aggregation state, lipid degradation, *etc.*
- Optimized 2 CPPs to yield consistent API dissolution, by filtration studies & quantifying degradation products by HPLC
- Upgraded process to reduce VOC by >96% using N_2 sparging. Measured k_La to size the orifices under low-foaming
- Robustly achieved <50ppm in the final product at 1L & 30L scales. Reproducibly scaled up to 120L at production scale

Catalytic Hydrogenation of Sorbic Acid (Aug '19 – Nov '19)
Guides: Profs. Sanjay Mahajani & Rahul Nabar, Dept. of Chemical Engineering, IIT Bombay *Mumbai, India*

- Screened for a novel 'green' hydrogenation route of 100% atom-efficiency to synthesize aroma compound *cis*-3-hexenol from alcoholic sorbic acid using a stereoselective Ru-based catalyst, based on literature review
- Designed an autoclave setup & configured a GC assay to detect reaction components & stereoisomers of cis-3-hexenol
- Experimentally tested chemically safer Pt-C and Pd-C catalysts at different loadings and operating conditions, and concluded that 5% Pd-C at ~100°C, ≥ 50 bar causes non-zero conversion but over-hydrogenation (analyzed in GC-MS)

Continuous Plug-flow Crystallization | Mitacs Globalink Internship, Canada (May '19 – Jul '19)
Guide: Prof. Stevan Dubljevic, Dept. of Chemical & Materials Engineering, University of Alberta *Edmonton, AB*

- Explored crystallization of KNO_3 through batch-cooling and understood the impact of mixing on crystal growth & size
- Designed & fabricated a jacketed tubular crystallizer setup, compatible to modular scale-up, based on literature search
- Identified components to implement feedback control using Arduino-MEGA, & tested their integration with the setup

Modelling and Simulation of Cell-Cycle Networks (May '18 – Jul '18)
Guide: Prof. Sandip Kar, Dept. of Chemistry, IIT Bombay *Mumbai, India*

- Modelled kinetics of cyclin/Cdk feedback networks in the cell-cycle. Identified the onset of bistability & oscillations using bifurcation analysis and generated the deterministic time-evolution to study the behaviour of 20 variables
- Stochastically simulated networks in FUCCI reporter using Gillespie algorithm. Wrote a MATLAB program to extract the mean duration of G_1 & SG_2M phases over ~200 cycles, and compared the variability against experimental data

Selected Academic Projects

Process Design Project - Ethylene Dichloride (EDC) | *Profs. K. Moudgalya & L. Hattiangadi, IIT Bombay* (Jan '20 – Mar '20)

- Determined a 1-MMTPA capacity based on market analysis. Identified the commercial process, designed the detailed flowsheet and generated a PFD. Performed stage-wise & overall mass balances for the case of 95% selectivity
- Simulated the end-to-end process with recycle on DWSIM, and detailed simulation of by-product quench column

Life Cycle Analysis of Denim Manufacture | *Sustainable Engineering Principles, Prof. Y. Shastri, IIT Bombay* (Aug '19 – Nov '19)

- Evaluated carbon footprint per pair of blue jeans (10.6 kg CO_2eq of GHG emissions) from LCA Scopes - 1&2 using a cradle-to-gate approach (cotton farming to final manufacture) & calculated the minimum value of carbon tax

Profitability of Energy-Integration in Distillation | *Process Economics, Prof. R. K. Malik, IIT Bombay* (Aug '19 – Nov '19)

- Comparatively evaluated the investments & operating expenditures for 11 heat-integrated column designs. Graphically analyzed their economic feasibility and recommended the operating parameters for the most profitable design.

Work & Industrial Experience

Pharmaceutical Manufacturing & Project Execution | *Dr. Reddy's Laboratories, Vizag, India* (Aug '20 – Mar '21)

- Coordinated the installation & qualification of >30 equipment modules for a 100-TPA continuous API production unit in a greenfield project, through management of stakeholders, timelines, documentation; and on-site technical inspections
- Assessed an impact-based Equipment Criticality Rating. Estimated the savings on RMCs & utility costs compared to existing batch production. Quantified the hours of manual intervention & manpower needed in the continuous plant.

Overview of Indian Chemical Industry | *Prof. S. Mahajani, IIT Bombay* (Nov '18 – Dec '18)

- Gained exposure to manufacturing processes & equipment in 10+ industries spanning the entire chemical value chain
- Detailed a techno-commercial report on Atul Industries, & simulated their DCDA process for sulfuric acid on DWSIM

Technical Skills

Programming	C/C++, Python, MATLAB / Simulink
Software	Aspen Plus, DWSIM, OpenFOAM, ANSYS, Oscill8, AutoCAD, SolidWorks, ImageJ, PowerBI
Publishing	LaTeX, Microsoft Office, HTML

Training & Coursework

Good Manufacturing Practices	Industrial Revolution 4.0	Sustainable Engineering Principles
Advanced Transport Phenomena	Advanced Reaction Engineering	Non-linear Dynamics
Cellular & Molecular Biology	Genetics & Evolution	Metabolism & Bioenergetics

Mentoring & Extracurricular Activities

- **Placement Mentor '20**: Mentored 2 senior students on job & interview preparation for IITB's placement season
- **Mentor, Summer of Science '18**: Guided 4 freshmen at IITB on technical reading projects on the topics NLD/Chaos & special relativity through resource suggestions, query & feedback sessions, and overseeing project documentation

Editorial Board Member | *Insight, IIT Bombay's official student media body* (Apr '18 – Mar '19)

- Ideated and published content in a team of 20 for Insight's student newsletters, with a campus readership of 10,000+
- Mentored a panel of 7 undergraduate freshmen for an article on identifying & overcoming academic challenges
- Spearheaded special issues on mental health awareness in IITB & investigating biodiversity loss on-campus

Volunteering - National Service Scheme | *IIT Bombay's Social Outreach Wing* (Aug '16 – Apr '17)

- Dedicated 80 hours of community service in a 66-member team focussed on societal and environmental issues
- Educated small vendors on e-transactions & tackling demonetization in the Cashless Awareness Drive

Miscellaneous

- Received the Institute Journalism Award (Special Mention) for outstanding contribution to journalism at IITB (2019)
- Secured 1st place in the Institute-level Creative Writing General Championship at IITB (2018)
- Worked as a convener in a 5-member team in IITB's Biotech Club to promote bioengineering (2018)