Distillation Experts Conclave

VIRTUAL 2021

e-booklet

August 3 - 6

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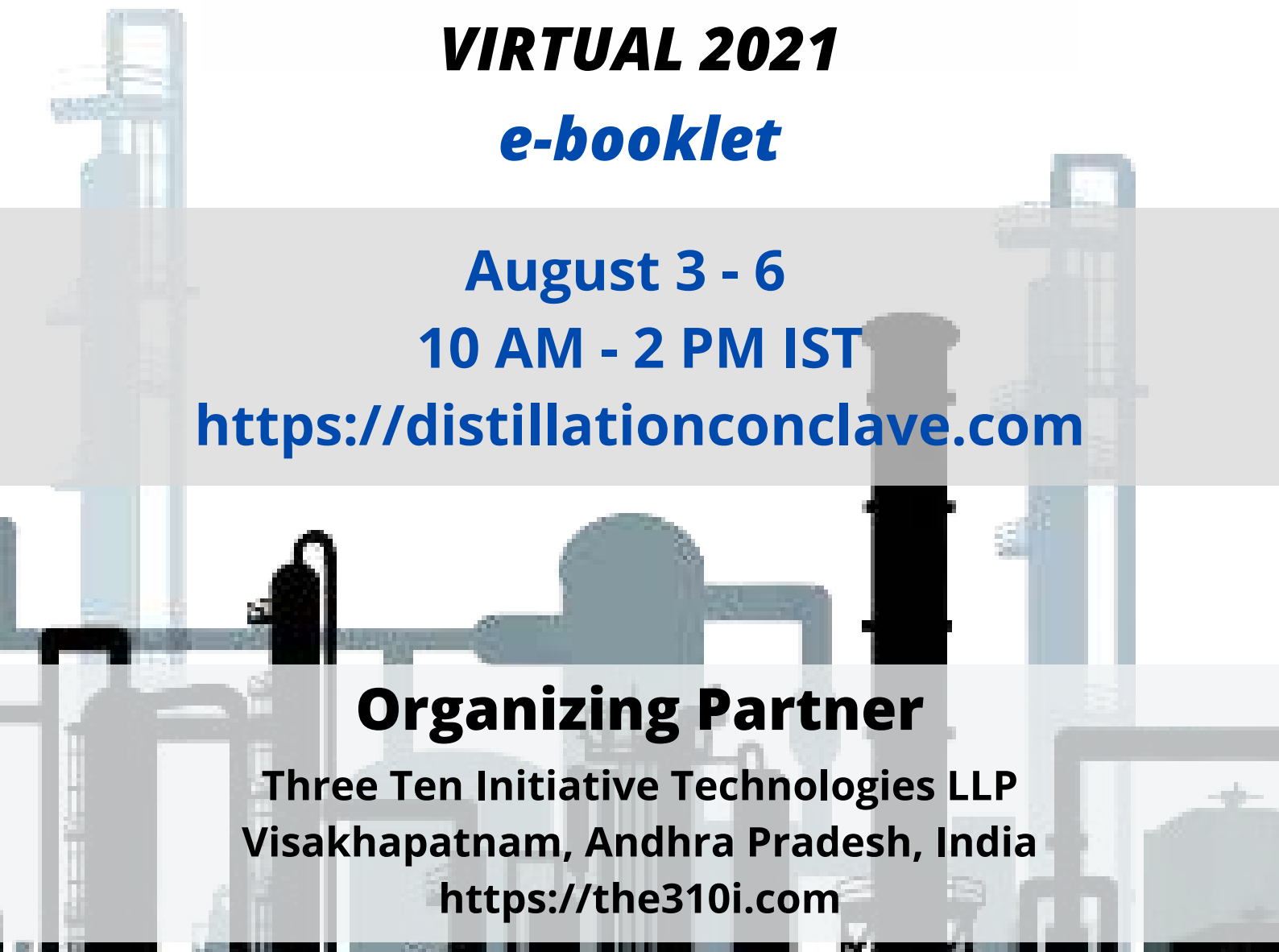
https://distillationconclave.com



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About DEC Virtual 2021

The Distillation Experts Conclave is organized by Three Ten Initiative Technologies LLP. The focus of the event is to bring together the global distillation expertise to the South Asian region, providing platforms for engineering personnel from across the chemical, petrochemical, refining, oil & gas, and pharma industries to interact and gain from collective experience. This is the second edition of the event, after the success of the first edition in 2018 at Mumbai. The conclave will henceforth be an annual feature.

Distillation Experts Conclave brings together all public-sector and private chemical, petrochemical, refining, oil & gas, and pharma plants, licensors, engineering companies, column internals manufacturers, control and instrumentation companies, testing agencies, and research groups. The conclave will focus on issues unique to the South Asian region broadly concerning process design, process optimization, operations, greenfield and brownfield projects, near misses, analytical methods, and failures and success of troubleshooting efforts.

Distillation Experts Conclave is designed to ensure a high level of technical exchange between participants. The importance of the conference stems from the fact that distillation is the most widely used industrial separation technology across a variety of manufacturing industries. Additionally, and perhaps more importantly, distillation units consume a significant part of the energy, with some estimates pegging this at 50% of the total heating energy used in the process industries. Distillation as a separation method has been around for a very long time, and in some sense is also regarded as mature technology. However, 21st century demands to reduce capital costs, energy consumption, improve efficiency and margins, reduce operation and maintenance costs, means that there are many challenges that still remain to be addressed.

On the one hand we see increasing energy and material needs of a growing and aspirational South Asian population, while on the other hand there is an increased focus on reducing the environmental footprint of the manufacturing industry. This has led to a variety of developments including transition to ethanol blended fuel, integrating refining with petrochemicals, and tighter norms for waste disposal from pharmaceutical manufacturing. Therefore, it is quite clear that in the next several decades to come, distillation will remain the primary workhorse for separating mixtures. There is plenty of discussion and work still left to be done, and the conclave aims to be the largest specialized technical platform for distillation in South Asia – a region of the world that houses the bulk of the world's manufacturing sites.

Organizer Profiles

Dr. Anand Govindarajan
Director, Three Ten Initiative Technologies LLP
India

Dr. Anand Govindarajan, received his B. Tech. from Anna University (India), and M.S. and Ph.D. degrees from Oklahoma State University (USA), all in chemical engineering. Anand has diverse experience spread across various organizations and countries in environmental engineering, renewable energy, distillation, gas treating, sulphur recovery, advanced process control, and engineering software development. Dr. Govindarajan has led/conducted trainings on gas treating and Sulphur recovery for dozens of engineers in several countries. Dr. Govindarajan was also Co-Chair of the Fundamental's session of the Separations Division of the American Institute of Chemical Engineers (2015-17), and is also on the panel of the board of studies of department of chemical engineering at SSN College of Engineering-Chennai.

Dr. Anirudh R. Patrachari
Director, Three Ten Initiative Technologies LLP
India

Dr. Anirudh Patrachari specializes in areas of process modeling, transport phenomena, and advanced process control. He received his B.E. in chemical engineering from University of Mumbai. He also holds M.S. and Ph.D. degrees in chemical engineering from Oklahoma State University (OSU). He worked for over five years at Aspen Technology, supporting, designing and implementing APC controllers including model predictive control and adaptive control across various process units.

Dr. Upasana Manimegalai Sridhar,
Director, Three Ten Initiative Technologies LLP
India

Dr. Upasana Manimegalai Sridhar received her B. Tech. (2009) from Anna University (India), and M.S.(2010) and Ph.D.(2014) degrees from Oklahoma State University all in chemical engineering. She joined Covestro (formerly Bayer Material Science) in July 2014 as Process Dynamics and Optimization Specialist where she monitored, and improved existing PID and APC sequences in a production unit. Upasana has diverse experience in process control, modeling, engineering software development, entry-level engineers and technician training.

About organizing partner

Three Ten Initiative Technologies LLP (310i) was incorporated in September 2016 in India. Currently based in Visakhapatnam, India the primary focus areas include:

- Bridging the gap between academia and industry, by improving the skills of engineering graduates and making them more employable.
- Providing high quality technical services, including building custom software solutions to the process industry (Oil & Gas, Refining, Chemical & Petrochemical)
- Process simulation for gas treating and sulphur plants (in alliance with Optimized Gas Treating Inc.).

All the founders hold a Ph.D. degree in chemical engineering from Oklahoma State University (OSU), Stillwater, Oklahoma, USA. Their experience is spread across diverse areas of teaching and professional mentoring, process modelling and simulation, transport phenomena, optimization, advanced process control, engineering software development, and technical training and professional mentoring. The directors of 310i carried out their research from Engineering North Lab 310 at OSU.

For more information you can reach out to:
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Distillation Experts Conclave
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Tridiagonal Solutions is a process consulting company, providing engineering solutions to Fortune 100 Chemical companies across the globe. For over a decade Tridiagonal has maintained a reputation of providing innovative services and solutions for engineering problems for the Oil and Gas, Power and Chemical Industry.

Through its **Maximize Profit** program, Tridiagonal offers a curated mix of services aimed at addressing the pressing needs of the Process Industry namely – improving Throughput, enhancing Profitability, improving Safety and Sustainability. Tridiagonal's proven expertise in implementing state-of-the art engineering solutions such as Advanced Process Control (APC), Asset Performance Management (APM) and AI/ML based optimization solutions has enabled it to deliver sustainable value to its customers.

'Bridge the Gap' program of Tridiagonal supports Data Science and Manufacturing Data Analytics initiatives of the organizations through its Guided Analytics Services & Solutions Framework. **Tridiagonal Solutions** evaluates Digital Transformation Maturity of an organization and provides solutions (as per the maturity curve) with Industry-leading platforms. With strong process domain knowledge, we help companies in codifying process engineering know-how into the decision support applications, which can be extended to business level as well.

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That research includes the only independent commercial scale distillation experimentation program operating with hydrocarbon systems at pressures ranging from deep vacuum to 500psia. The current membership of over 70 companies includes many leading companies in the field of distillation. Over 60% of the membership is international.

FRI's purpose is to execute member-driven, well-planned experimental programs to collect large scale mass transfer hardware performance data with industrially representative chemical systems, and to report such data to its members clearly, in useful formats, and in a timely manner. Our goal is to keep your company on the leading edges of distillation technology.

For more information you can reach out to:
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Website: www.fri.org

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Media Partner

CHEMICAL INDUSTRY DIGEST is India's leading chemical and engineering monthly known for its qualitative content with practical relevance for process industries. It features articles and write-ups on current developments, state-of-the-art technologies, equipment design, plant operations, maintenance, energy management, environment, and safety. Chemical Industry Digest also includes news features, company profiles, and mini directories of equipment manufacturers and service providers making it very engaging. The journal readership includes a very targeted top technical audience who influence decisions; from engineers, scientists and technical personnel in top management to the plant level. Industries covered are oil & gas, refineries, petrochemicals, fertilizers and agrochemicals to drugs & pharma, fine chemicals, colorants, EPC & equipment manufacturers, etc.

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Conference Agenda

**All times in Indian Standard Time*

Moderation: Dr. Anirudh Patrachari & Dr. Anand Govindarajan

3 Aug. 2021 - Tuesday **Focus: Digitization & Safety**

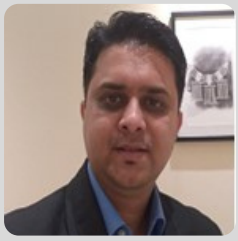
10:00 - 10:05 **Opening Remarks**
310i Technologies LLP, Visakhapatnam, India

10:05 - 11:20 **Distillation performance improvement insights using hybrid (ML + first principles) modeling**
Shardul Shindadkar, *Assistant Manager - Sales & Marketing*
Kaushal Sampat, *Assistant General Manager - Modeling & Analytics*
Nishant Jaiswal, *Senior Engineer - Process Technology*
Ingenero Technologies, Mumbai, India

11: 25 - 12:40 **Process safety, asset integrity & reliability improvement in CDUs**
B. Ravi, *General Manager, R&D*
Hindustan Petroleum Corporation Ltd. (R&D), Bengaluru, India

12: 45- 14:00 **Best process safety practices and detailed incident reviews of distillation units**
Hema Divya K, *Process Safety Management Consultant*
Rahul Raman, *Process Safety Management Consultant*
Kaypear Engineering LLP, Chennai, India

Speaker Profiles



Distillation performance improvement insights using hybrid (ML + first principles) modelling

Shardul Shindadkar, ***Assistant Manager - Sales & Marketing***
Ingenero Technologies, India

Shardul has over 13+ years of experience in the refining and petrochemical industry, particularly in Crude Units, Delayed Coking, Fluidized Catalytic Cracking, ethylene. He has hands-on experience in plant operations and technical services. He holds a Bachelor's degree in Chemical Engineering from Mumbai University. Shardul has been a part of several projects related to Capacity Enhancements, Operations Excellence, Plant optimization, MOCs, Digitalization and Automations etc. He currently is a part of the business development team for Ingenero in Middle East and a few other markets. Prior to joining Ingenero, he was Manger in Operations and Technical Services Department at world's largest grass-root refinery by Reliance Industries Limited and also Account Manager at Petronas Melaka Refinery in Malaysia for Dorf Ketal Chemicals Sdn Bhd.

Distillation performance improvement insights using hybrid (ML + first principles) modelling

Kaushal Sampat, ***Assistant General Manager - Modelling & Analytics***
Ingenero Technologies, India

Kaushal has over 17 years of experience in the Refining, Midstream and Petrochemical, particularly in Olefins, Delayed Coking, PTA, Gasification and LNG plants. He has hands-on experience in Modelling, Simulation, OTS, Applied AI and Process Control. He holds a Master's degree in Chemical Engineering from IIT Bombay. Kaushal has been a part of several projects related to Hybrid Modelling, Data Reconciliation, Process Improvement and Debottlenecking. He is currently part of Digital Transformation Projects at Ingenero. Prior to joining Ingenero, he was Manger in Operations and Technical Services Department for PTA plants with Reliance Industries Limited.

Distillation performance improvement insights using hybrid (ML + first principles) modelling

Nishant Jaiswal, ***Senior Engineer - Process Technology***
Ingenero Technologies, India

Nishant has over 8 years of experience in the petrochemical industry and refinery, particularly in Furnaces, Distillation, Compressors, Ethylene crackers of multiple feedstock. He has hands-on experience in plant operations and technical services. He holds a Bachelor's degree in Chemical Engineering from Indian Institute of Technology, Delhi. Nishant has been a part of several projects related to Process Monitoring and Optimization of Crackers, Operations Excellence, Plant optimization, Digitalization and Automations etc. He currently is a part of the Digital Transformation Project at Ingenero. Prior to joining Ingenero, he was Manger in Operations at Gas Cracker plant, Reliance Industries Limited.

Speaker Profiles

Process safety, asset integrity & reliability improvement in CDU's
B. Ravi, *General Manager, R&D*
Hindustan Petroleum Corporation Ltd. (R&D), India

Chemical Engineer by profession and an Alumni of A.C.Tech, Anna University, Chennai and S.P.Jain, Mumbai with more than 30 years of experience in Refining industry and R&D (last 2 years). He started his career as a Technical Services Engineer of Crude Distillation and Fluidized Catalytic Cracking Units at HPCL Visakh Refinery. Subsequently he moved to Operations dept to be part of the team for commissioning Hydrogen and Diesel Hydrodesulphurization units in Y2K. Back in Technical services, he successfully implemented the "Advanced Process Controls" in various process units of the refinery that resulted in improved and optimum performance. Later he moved to Projects dept and successfully implemented the second Hydrogen and Diesel hydrotreating plant projects Before moving to R&D in 2019, he held the portfolio of Operation's Division Head and was responsible for the critical primary and secondary production units. Currently, he is in-charge of Crude & Fuel testing, Analytical & Chemical synthesis and Battery & Nano technology labs as GM-R&D and supervised successful execution and commercialization of several indigenous products.

Best process safety practices and detailed incident reviews of distillation columns
Hema Divya K, *Safety Management Consultant*
Kaypear Engineering LLP, India

Hema Divya works as a Process Safety Management Consultant at Kaypear from 2018. At Kaypear, she provides PSM consultancy services to Oil & Gas and Petrochemical industries. She has worked with both domestic and international clients providing specialized relief system validation that includes risk mitigation services and has strong knowledge of API 520, API 521, and ASME Section VIII Div.1. She is a scribe and assists the PHA facilitator in noding of P&IDs, consolidation of risk register, prioritization of action items, and generation of technical reports. Hema Divya graduated with a Bachelors in Technology in Chemical Engineering from SVCE, Chennai [Anna University] in 2018 and a PG Diploma in Petrochemical Process Safety and Engineering from Bharat Sevak Samaj in 2020.

Best process safety practices and detailed incident reviews of distillation columns
Rahul Raman, *Safety Management Consultant*
Kaypear Engineering LLP, India

Rahul Raman is a PSM consultant and provides PSM consulting services to the oil and Gas, Pharmaceutical, and Petrochemical Industry. He provides technical stewardship, and works as an embedded subject matter expert for pressure relief system. He has extensive experience in PSI audit, changes to relief system due to management of change, re-validation of process units, and two-phase flow analysis. In addition, he is an instructor for an awareness course on Emergency Relief System, specifically for engineers and managers. He has actively participated and contributed in Design Institute for Emergency Relief System (DIERS) and API Sub-Committee for Pressure Relieving Systems.

Conference Agenda

All times in Indian Standard Time

Moderation: Dr. Anirudh Patrachari & Dr. Anand Govindarajan

4 Aug. 2021 - Wednesday **Focus: Operations & Debottlenecking**

10:00 - 10:05 **Opening Remarks**
Fractionation Research Inc., Stillwater, OK, USA

10:05 - 11:20 **Controlling reboilers heated by condensing steam or vapor**
Henry Kister, *Senior Fellow*, *Director of Fractionation Technology*
Fluor Corporation, Aliso Viejo, CA, USA

11: 25 - 12:40 **Eliminate reboiler bottlenecks - Design effective condensate drainage**
Jim Risko, *President*
TLV Corporation, Charlotte, NC, USA

12: 45- 14:00 **Gamma scans - A tool for insights into the problems in distillation columns**
Parag Walinjkar, *Senior Scientist*
Bhabha Atomic Research Centre, Mumbai, India

Speaker Profiles

Controlling reboilers heated by condensing steam or vapor

Henry Kister, *Senior Fellow, Director of Fractionation Technology*
Fluor Corporation, USA

Henry Z. Kister is a Fluor Corp. Senior Fellow and Director of Fractionation Technology. He has over 35 years experience in design, troubleshooting, revamping, field consulting, control and startup of fractionation processes and equipment. He is the author of three books, the distillation equipment chapter in Perry's Handbook, the distillation chapter in the Kirk-Othmer Encyclopedia of Chemical Technology, and over 130 articles. Kister has taught the IChemE-sponsored "Practical Distillation Technology" course over 530 times in 26 countries, and a recent "Troubleshooting Distillation Controls" course, also sponsored by IChemE. He is a recipient of several awards, Fellow of IChemE and AIChE, and Member of the US National Academy of Engineering.

Eliminate reboiler bottlenecks - Design effective condensate drainage

Jim Risko, *President*
TLV Corporation, USA

James R. Risko, CEM, PEM, MBA is president of TLV Corporation, Charlotte, NC, responsible for US and Canadian operations. He has 44 years' steam systems experience, authored more than 60 technical articles, provided webinars to over 2,500 attendees globally, and presented at IETC, AIChE, Kister Distillation Symposium, RefComm, and AFPM conferences. He holds several patents, co-invented the world's first combination pump-traps, and created the "*Extended Stall Chart*," for draining stalled heat exchangers. He is active in FCI, ANSI, and ISO standards. An avid tennis player, he has three energy management certifications.

Gamma scans - A tool for insight into the problems in distillation columns

Parag Walinnjkar, *Senior Scientist*
Bhabha Atomic Research Centre, India

P B Walinjkar is working as a senior scientist in Bhabha Atomic Research Centre - one of the reputed R&D centres of India. He has obtained his master's in electronic engineering. He has about 50 papers on his credit published in various journals, International and National conferences, seminars, and symposiums. He has worked on gamma-based non-destructive testing methods like gamma radiometry, gamma scanning, and gamma tomography for more than 15 years. He is the recipient of 1st prize of Best paper award, for his presentation on 'USB scanner for ICT' in national seminar NDE-2014. Presently he is working on the development of a new method of gamma profile analysis based on Fast Fourier transform.

Conference Agenda

**All times in Indian Standard Time*

Moderation: Dr. Anirudh Patrachari & Dr. Anand Govindarajan

5 Aug. 2021 - Thursday **Focus: Process Intensification & Debottlenecking**

10:00 - 10:05 **Opening Remarks**
310i Technologies LLP, Visakhapatnam, India

10:05 - 11:20 **Debottleneck distillation columns using dividing wall technology**
Manish Bhargava, *Founder & Director*
Anju Patil, *Head of Operations (India)*
DWC Innovations LLC, Houston, TX, USA

11: 25 - 12:40 **The route to high capacity in separations technology**
Ashraf Lakha, *Technical Consultant (Middle East & SE Asia)*
RVT Process Equipment, Singapore

12: 45- 14:00 **Column targeting – a thermodynamic tool for debottlenecking distillation columns – A VCM plant case study**
Supriya Apegaonkar, *General Manager R&D*
Dr. Madhukar Garg, *President - Refining & Petchem R&D*
Reliance Industries Ltd., Mumbai, India

Speaker Profiles

Debottleneck distillation columnsusing dividing wall technology
Manish Bhargava - *Founder & Director*
DWC Innovations LLC, USA

Manish Bhargava is the Founder and Director of DWC Innovations. He has 18 years of experience in the process optimization and distillation techniques currently used in refineries and chemical plants. Prior to DWCI, he led the advanced separation group at GTC Technology (Houston) and he worked at KBR as a principal technical professional for six years. Bhargava's primary area of interest is distillation. He played a pivotal role in technology development and commercialization of dividing-wall columns. He has personally helped commercialize more than 25 dividing-wall columns. His innovative ideas and refinery solutions have been well received through articles and seminars in chemical engineering journals and conferences. He has written several publications and holds several patents on dividing-wall column technology. He has an MS degree in chemical engineering from Illinois Institute of Technology, and a bachelor's degree in chemical engineering from MNIT, Jaipur.

Debottleneck distillation columnsusing dividing wall technology
Anju Patil, *Head of Operations (India)*
DWC Innovations LLC, USA

Anju Patil Sharma earned her graduation in Chemical Engineering from Malviya National Institute of Technology in India. Anju has an overall experience of more than 17 years. She is the Head of India Operations for DWC Innovations. She started her career as Process Engineer at DSCL in India a company involved in manufacturing Fertilizers, Caustic, Carbide and there she was actively involved in plant operations and process optimization. She has hand on experience on process simulators. Distillation, refinery processes and energy conservation has been her areas of interest. Her inclination for energy optimization made her work on newer technologies used in refineries particularly distillation columns. Her interest in dividing wall column technology has made her gain insight in this technology.

The route to high capacity in separations technology
Ashraf Lakha, *Technical Consultant (Middle East & SE Asia)*
RVT Process Equipment, Singapore

30 years of experience in oil and gas industry in both process engineering and managerial function. Excellent technical, analytical and communications skills top up with application knowledge in all aspects of mass transfer and separation processes. Experience in designing (including process modelling) of various refinery fractionators including but not limited to crude columns, FCC, Hydrocracker and Coker. Experience of Olefin plant and downstream derivatives Excellent troubleshooting and debottlenecking knowledge with a focus towards optimization of process units and improving reliability. Recognized as an industry expert within mass transfer industry.

Speaker Profiles

Column targeting - a thermodynamic tool for debottlenecking distillation columns. A VCM plant case study

Dr. Madhukar Garg- *President - Refining & Petrochem R&D*
Reliance Industries Ltd., India

Dr Madhukar Garg is an acknowledged expert in petroleum refining and petrochemicals and has been instrumental in developing and commercializing large number of technologies in the Indian refineries. A graduate from Nagpur University and a post graduate from IIT Kanpur, he did his Ph.D. with Prof H R C Pratt at University of Melbourne in Solvent Extraction. He served Engineers India Limited in the Research and Development Centre for 18 years until 1994 and then Technip KTI for four years before joining CSIR-Indian Institute of Petroleum in 1998. He has been the Director of the Indian Institute of Petroleum for 13 years from 2003 to 2016 and officiated as the Director General of CSIR during the year 2015. His areas of specialization include solvent extraction, process integration, advanced control, simulation and modeling, besides the ability to conceive research ideas and take them to commercialization. He has won several awards. Some of most prestigious are: MOPNG Innovation Award (2016), TDB Technology Day Award (2017 and 2019), ICC Life time Achievement Award (2013), Vasvik Award (2017), besides several CSIR Technology as well as Innovation awards from 1998 to 2016. He has published more than 300 papers in refereed journals and is the inventor in 44 national and 22 international patents. He is the elected Fellow of the Indian National Academy of Engineers. He is currently President, Refining and Petrochemicals R & D of Reliance Industries Limited.

Column targeting - a thermodynamic tool for debottlenecking distillation columns. A VCM plant case study

Supriya Apegaonkar - *General Manager R&D*
Reliance Industries Ltd., India

Supriya Apegaonkar is a Chemical engineer with 25+ year experience in Process Design and Developmental Research. As Process Engineer served across manufacturing divisions of Reliance on different process technologies, new 'In-house' process developments as well as debottlenecking existing facilities. Design experience includes Process Simulation, Energy optimisation/Site integration, Distillation column sequencing and PINCH analysis, Heat exchanger network (HEN) design with PINCH analysis and Utility Network analysis. She has been part of special task force-Algae to Oil research program aiming to produce 'Energy for the future'. She has been focal point between RIL and U.S Department of Energy (DOE) steering bio-fuels production and upgradation technology development and scale up. Developmental research experience includes design of experiments, Pilot scale trials, mitigating technology and scale up issues, design and scale up to technology demonstration / commercial units. She is currently General Manager - Refining and Petrochemicals R & D of Reliance Industries Limited.

Conference Agenda

**All times in Indian Standard Time*

Moderation: Dr. Anirudh Patrachari & Dr. Anand Govindarajan

6 Aug. 2021 - Friday **Focus: Advancements in Separations**

10:00 - 10:05	**Opening Remarks** **310i Technologies LLP, Visakhapatnam, India**
10:05 - 11:20	**DWC technology application for naptha separation to improve gasoline yield** Srinivasulu Kaalva, *Sr. Manager Process Development & Optimization* **Bharat Petroleum Corporation Ltd. (R&D), Noida, India**
11: 25 - 12:40	**Conceptualization and evaluation of an energy-efficient method for crude petroleum oil processing in crude distillation unit** Dr. Sunil Kumar, *Principal Scientist* **CSIR - Indian Institute of Petroleum, Dehradun, India**
12: 45- 14:00	**Cyclic distillation: A new challenger for intensified fluid separations** Dr. Anton A. Kiss, *Professor - Chemical Engineering* **University of Manchester, Manchester, UK**

Speaker Profiles

DWC technology application for naptha separation to improve gasoline yield

Srinivasulu Kaalva, ***Senior Manager - Process Development & Optimization***
Bharat Petroleum Corporation Ltd. (R&D), India

Kaalva Srinivasulu is Senior Manager (R&D) – Process Development & Optimization for Bharat Petroleum Corporation. With over 14 years of experience in the process industry, he extensively worked in the areas of process development, process optimization and design of pilot plants. He is instrumental in the design and implementation of BPCL's DWC technology. He lead the development of process technologies that includes, Co-processing of vegetable oil in hydroprocessing units, Lube oil base catalyst development, Cross-flow hydroprocessing technology and Furfural hydrogenation technology. He acquired good knowledge in the refinery process by virtue of working in the areas of catalyst development, process optimization and energy efficiency studies. He holds a master's degree in chemical engineering from IIT Guwahati. Presently actively working on Divided Wall Column (DWC) and selective Hydrogenation technologies for Refining and Petrochemicals applications.

Conceptualization and evaluation of an energy - efficient method for crude petroleum oil processing in crude distillation method

Dr. Sunil Kumar - ***Principal Scientist***
CSIR - Indian Institute of Petroleum, India

Dr Sunil Kumar received M.Tech. in Chemical Engineering from IIT Kanpur and PhD Degree in Chemical Engineering from IIT Roorkee. He is presently working in CSIR Indian Institute of Petroleum, Dehradun as a principal Scientist. He has 12 years of experience in the refining and chemical industries.
His professional interests include- synthesis, simulation, design, and scale-up of chemical and refining processes, Pinch analysis, Process integration, separation processes development. He has been involved in the development of many technologies and processes. Few commercialized are NMP based food grade hexane, CPCL, Chennai, Benzene recovery from FCC gasoline-Reliance Jamnagar, De-oiling Technology for wax production- Numaligarh Refinery (NRL), Assam. He has completed more than 40 sponsored aimed at technology and process development, energy conservation and process modifications. He has published 16 journal papers and 15 conference papers. He holds 17 international patents (US: 05; Indian 07; other countries: 05), and his 03 filed Indian patents are under evaluation. He received IEI Young Engineers Award in 2017, Certificate of Merit for Academic Excellence, Chemical Engineering Department, IIT Kanpur, 2009, Ambuja's Young Researchers Awards in 2009, M H Shukla second prize, 2008. He also received two CSIR Technology Award, 2014,2016, one MoP&NG and CHT best innovation in R&D, 2015 award, two National Technology Development Board (TDB) Awards, 2017 and 2019, as a core team member.

Speaker Profiles

Cyclic distillation: A new challenger for intensified fluid separations

Dr. Anton A. Kiss - *Professor - Chemical Engineering*
University of Manchester, USA

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Introductory Excerpts

(Detailed presentations/paper are made available post conference)

Distillation Performance Improvement Insights Using Hybrid (ML + First Principles) Modeling

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Ingenero Technologies, India

Availability of an equipment/ asset in any manufacturing unit is an important factor that determines the Overall Manufacturing Asset Effectiveness. Any unforeseen plant activity (process failures, product off-specs etc) or unplanned plant shutdown normally occurs due to some issue in the plant operations. Retro analysis of such issues have often shown that the root cause these issues almost always exhibits symptoms way before the actual event. Hence, capturing such symptoms before it is too late and proactively addressing the issues becomes critical to avoid such plant downtimes. It is common knowledge that the advantages realized from process optimization and advanced controls, get wiped out by such unplanned plant shutdowns causing costly delays in plant maintenance, overall production schedules, and even have impacts on process safety.

The symptomatic indicators reside in the large volumes of a variety of data that are measured on a continuous basis from the plant operation and archived. It would need a rigorous, and time consuming exercise to review these wide variety of millions of data points - collected at minute wise or even higher frequencies – to identify such symptoms and this is difficult for an unaided human mind, unless it shows up obviously on a commonly monitored parameter. Several of these parameters measured are non-linearly related to one another, further complicated by different types of errors in the collected data.

Big Data Analytical techniques can be utilized to help effectively analyze hundreds of minute wise tag data for a process equipment, in real time, to help “find problems before they find you”. This paper describes how Machine Learning Techniques have been applied to Distillation Column operation in an Ethylene Manufacturing unit to provide useful, non-intuitive insights that are usually hidden in the large volumes of data collected. This paper covers the below 3 case studies covering applied machine learning techniques for troubleshooting and improving Distillation Column performance.

Process Safety, Asset integrity & Reliability Improvement in CDUs

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Crude Distillation Unit (CDU) is the primary unit which drives the overall refining process by distributing feedstock to all the downstream units that create high value products. Hence, ensuring process safety, asset integrity and reliability of CDUs has direct impact on the profitability of the refinery. In the current scenario where refiners are forced to process discounted opportunity crudes for economic viability, reliability of CDU operations is of serious concern. It is a challenge to ensure safe and reliable operation while maintaining the competitive edge. Most of the existing crude/vacuum distillation units are not designed to process opportunity crudes or blends. Operational problems such as severe exchanger fouling affecting preheat and increasing load on heaters, poor desalting and column overhead corrosion leads to process safety, integrity and reliability issues which in turn affect profitability.

To ensure process safety, integrity and reliability of operation, addressing all the above operational problems of crude distillation unit end to end is essential. For example, if water is not drained to the maximum extent from crude during tank farm operations, slugs of water can enter the CDUs and cause major plant upsets resulting in damage to column internals and safety issues associated with possible over-pressurization of process equipment. Similarly, optimum desalter operation is essential to ensure maximum dehydration of crude and low levels of chloride salts in the desalted crude to minimize potential corrosion in CDU column overheads. Fouling in preheat exchanger trains and combustion scale deposits on furnace tubes externals can lead to poor heat transfer and increased energy consumption often affecting sustained throughput of CDUs.

Best Process Safety Practices and Detailed Incident Reviews of Distillation Units

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Kaypear Engineering LLP, India

Distillation columns are widely used in many chemical process industries, especially in oil and gas processing. Accidents related to operations of a distillation columns have resulted in loss of human lives, assets, business interruptions, and has negative reputation of the company. The paper is going to highlight how deficiency in compliance audit, technical design, and asset integrity can lead to catastrophic incidents. Process Safety Management program is a performance standard and the paper will summarize the recognized best practice for performing safety reviews in a distillation column. Relief systems offer a last layer of protection and DiERS recommended heat and material balance across the column is the preferred way for addressing relief system design. Steady state or dynamic simulation can also be a preferred method to evaluate complex relief system scenarios. Furthermore, the paper will provide additional guidance on scenarios described in API 521 which can be used for both risk assessment and relief system design. Finally, the paper will dissect three major incidents: (1) BP Texas City Incident (2) Chevron Richmond Refinery Fire and (3) Williams Geismar BLEVE.

Controlling Reboilers Heated by Condensing Steam or Vapor

Henry Z. Kister
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Good control of the tower heat input is central to stable, trouble-free operation of distillation towers. While the control of reboilers heated by sensible heat is usually not troublesome, the control of those heated by condensing vapor, which is the majority of reboilers, is often troublesome and can destabilize the whole tower. Typical examples of reboilers heated by condensing vapors are steam reboilers, refrigeration vapor reboilers, and heat-integrated reboilers that condense overhead vapor from same or a different tower.

For these reboilers, the control valve can be located either in the steam (or vapor) inlet line or in the condensate outlet line. The two methods are different in principle and operation, have different strengths and weaknesses, each of these methods can be troublesome in different ways, and each requires different measures to achieve trouble-free operation.

The selected method, as well as the features added to overcome its weaknesses, is central for good reboiler operation, performance, and tower stability. The literature has some excellent reviews on this subject, but these reviews have last been updated three decades ago. Recent excellent sources have only partially addressed some of the key considerations. This presentation aims to fill in the gaps, combining the old knowledge with the recent experiences into a detailed updated guide to the key considerations, features, and practices that can help solve today's problems, avoid tomorrow's, and improve reboiler control and operation.

Eliminate Reboiler Bottlenecks - Design Effective Condensate Drainage

Jim Risko
TLV Corporation, USA

Reboilers using an inlet steam control valve (ISC) arrangement can provide significant economic and control benefits to certain distillation tower installations. By exposing the full surface area of a reboiler to steam for effective heat transfer, the steam pressure can be lowered - which can reduce the fouling that can occur with higher pressure steam and the corrosion that can follow from flooding a tube bundle. Control can improve because steam can adjust to process demand changes much more rapidly than by the alternative of varying the condensate liquid level and exposed area of the tube bundle - such as occurs with an outlet condensate control valve (OCC) arrangement.

Furthermore, unlike OCC, it is generally not possible to lose the condensate seal/reboiler duty when the proper drainage design is implemented. Other potential benefits include mitigation of the stratification that can plague channel head gasketing in horizontal designs and enable the use of "long" low pressure steam to improve the steam balance or reduce generation requirements for medium pressure steam.

However, the reliability of ISC (and OCC) reboilers requires effective condensate drainage from the steam space, and there are multiple instances of reboilers experiencing shock-related issues such as channel head gasket and tube bundle damage or the sewering of condensate. These issues may be more commonly experienced with horizontal type reboilers.

Many of these problems can be avoided/mitigated with a proper condensate drainage design, but it often occurs that the reboiler system experiencing difficulty had improper original design or installation and requires correction for improvement. As an example, it is typical that a level pot/control valve arrangement may be improperly balanced, or a stall condition may not be recognized and mitigated. Additionally, some reboiler operations result in the need to discharge colder, non-flashing condensate into headers containing flash steam-a process that can produce violent water hammer.

Gamma Scan of Distillation Column – a Tool to Insight the Problems of the Column

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Bhabha Atomic Research Centre, India

Distillation columns are the heart of any petrochemical industry. It is widely used in refineries to produce petroleum products from crude oil. Enormous research in chemical engineering has brought out highly complex and very efficient column designs and their hardware. The columns are operated at high temperature and pressure, thus subject to damage during its operation. The trouble in the column operation degrades the quality of the final product. Periodic maintenance is key to improve the operational life of the column. Carrying out the column maintenance in a minimal period is a dream of every maintenance engineer. To achieve it, beforehand knowledge on column internal damages or possible problems in specific sections of the column is required. This helps the engineer in planning the maintenance operation judiciously and complete it in record time. Shorter maintenance days mean reduced shutdown time. This reduces loss due to shut down and increases the annual profit of refineries indirectly. Gamma Scanning is a matured technique, used regularly by refineries all over the world. It is used to see inside the operational column and predict/understand the problems it is facing. The topics included in the talk are the fundamental principle of gamma scanning, its methods, advantages, and disadvantages, and discuss one/two case studies.

Debottleneck Distillation Columns Using Dividing Wall Technology

Manish Bhargava, Anju Patil
DWC Innovations LLC, USA

Background: Each refinery has its own unique arrangement which is determined by the refinery location, desired products and economic considerations. Refineries still use distillation as the main unit operation for separating various fractions. Distillation columns are one of the most expensive units in operations because they consume large amount of energy. Energy reduction in the distillation process can be very effective in lowering the refinery margins drastically and in the current scenario wherein an increasing trend is seen in energy prices refineries look forward such revamps. When taking about debottlenecking and optimizing the distillation columns dividing wall columns have lot to offer. The technology of dividing wall columns comes with the benefits of energy savings along with improvement in product specifications and capacity augmentation. The retrofits are simpler and robust hence once the benefits of this technology in any area of operation is justified, time and budget constraint should not hold back the revamps. Dividing wall columns are great retrofits when its comes to debottlenecking any downstream columns such as Naphtha splitters or reformate splitters. Depending on their areas of applications and the feed handled they are broadly classified as top, middle or bottom dividing wall columns.

The Route to High Capacity in Separations Technology

Ashraf Lakha
RVT Process Equipment, Singapore

Process intensification nowadays is considered one of the most important trends in Chemical engineering. For mass transfer applications, this typically translates into increased separation efficiency and/or higher capacity in the same or lower column dimensions.

At the same time, more volatile markets in the chemical industry call for more flexibility in column operation. As such balancing capacity, efficiency and acceptable turndown is key to designing new mass transfer equipment. These two, sometimes counter-intuitive requirements, have led to various developments in designing high capacity equipment.

The typical performance of RVT's high capacity devices, validated in both pilot plant studies and reputed Separation Research institute, are presented. It will be shown that capacity gains of at least 20% can be achieved without significant reductions in efficiency or compromising. Typical results of high capacity designs are compared against limitations in flexibility of operation, invest and operating cost.

Column Targeting – a Thermodynamic Tool for Debottlenecking Distillation Columns - A VCM Plant Case Study

Supriya Apegaonkar, Dr. Madhukar Garg
Reliance Industries Limited, India

A Vinyl Chloride monomer (VCM) plant has two energy intensive distillation columns for separation of HCl, VCM and EDC; each with stringent purity specification of 99 + wt%. The first distillation column separates HCL from VCM and EDC using high end cooling utility such as Propylene Refrigerant for overhead condensation, while the second column utilizes high end heating utility such as High pressure steam for bottom re-boiling. Column targeting – an advanced PINCH analysis technique which provides column thermal insights, can be systematically applied to improve energy efficiency of such distillation columns leading to debottlenecking of such units for enhanced throughput.

We first carried out the design (base) case simulation of these two distillation columns to validate the thermodynamics by matching the stream yields and composition. The base case simulation was then used to generate the Column Grand Composite Curves (CGCC) - a minimum thermodynamic construction which provides excess / deficit energy curves along the column length. For the HCL column, the CGCC clearly indicated scope for reflux optimization and an opportunity for a side condenser. For the VCM column the CGCC analysis indicated scope for feed preheating.

The above simulation model (tuned for the base case) was then used to simulate the actual operating data. Plant data for about a month of stable and steady state operation was collected and reconciled to ensure closure of overall and component mass balances. The operating case simulation was fine-tuned by a close match between simulated and reconciled plant data. This simulation was next used to generate the Column Grand Composite Curves (CGCC) to identify energy improvement opportunities. In the case of the HCL column, opportunity for side condensing/ vapor feed cooling was identified coupled with reflux reduction. The side condenser helped to shift part of the refrigeration duty to a lower cost cold utility such as chilled water. On the other hand, in the VCM column, the CGCC presented a scope for feed preheating with a lower cost hot utility such as Medium pressure steam, or alternatively, to preheat the feed with the column bottom using a feed-bottoms heat exchanger. Feed preheating also led to reduction of liquid load in stripping section thus debottlenecking the VCM column.

These energy saving schemes can easily be leveraged for potential increase in throughput.
The Column Grand Composite Study as described above, identified opportunity to shift more than 15% of the high cost cold utility i.e Propylene refrigerant to Chilled water in the HCL column. Similarly, a partial replacement of high cost hot utility i.e High pressure steam in VCM reboiler by feed-bottoms heat exchange can lead to potential reduction of more than 20% in HP steam in the VCM column. The feed preheating scheme also debottlenecks stripping section of the VCM column by reducing liquid load by >10 % and vapor load by > 25%. The proposed two heat exchangers are planned to be added in next plant turndown opportunity.

DWC Technology Application for Naphtha Separation to Improve Gasoline Yield

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Bharat Petroleum Corporation Limited, India

Two most important challenges today's refinery and petrochemical industries are facing from sustainability point of view are to increase in value added products yields and to reduce energy consumption. Improved separation efficiency plays a key role in increasing product yields and also to produce value added products. Divided Wall Column (DWC) concept is an advanced separation technique which help improving the energy efficiency in the range of 10-30 % while reducing capital expenditure and space requirement.

DWC is of two types one is mid divided wall column and another one is top divided wall column. In mid divided wall columns, middle product is the target product for improving the purity with optimum energy usage. In the current application of naphtha separation, the objective is to maximize the C5 and C6 paraffins in Side cut-1 and benzene and C6 cyclic compounds in Side cut-2. Further, the Side cut-1 flow to be maximized and Side cut-2 to be minimized. To meet the required design, BPCL developed new 4 cut design based on mid DWC concept and named this technology as BHARAT DWC (B-DWC). In B-DWC column, mid wall section location, vapor split and liquid splits are intelligently used to produce high purity products with highly flexible operation, while minimizing the naphtha production.

To demonstrate the "B-DWC" technology at commercial scale, BPCL R&D along with Kochi Refinery, modified the existing conventional column into "B-DWC column" for naphtha splitting application. B-DWC column has four products viz; top product, rich in isoparaffin compounds is directly routed to Motor Spirit (MS) pool, Side cut-1 rich in C5 and C6 normal paraffins is routed to ISOM unit to produce Isomerate, while the benzene rich Side cut-2 is blended with naphtha product or routed to aromatics recovery unit. Bottom product which contains all C7+ compounds are routed to CCR for producing high octane reformate.

High quality ISOM feed with minimum undesirable components (<9 wt%) benefited ISOM unit to reduce RVP of Isomerate while maintaining same RON. This reduction helped refinery to absorb more naphtha (>2TPH) in Motor Spirit pool. Additionally, increase in Isomerate yield and decrease in LPG production observed. Overall, improvement in Isomerate yield and RVP reduction helped refinery to produce additional MS. This in turn decreased the overall naphtha production by 2 wt%.

Conceptualization and Evaluation of an Energy-efficient Method for Crude Petroleum Oil Processing in Crude Distillation Unit

Dr. Sunil Kumar, Dr. Avinash Mhetre, Dr. Anjan Ray
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The crude distillation unit (CDU) is the first-highest throughput processing unit in the refinery. CDU fractionates the whole crude in desired boiling range fractions. The conventional processing of crude petroleum oil in CDU consumes enormous thermal energy and stripping steam. A slight improvement in energy efficiency can affect the gross margin of the refinery significantly. The quantitative requirement of energy and stripping steam for crude oil processing depends on the CDU design configuration, which, in turn, depends on the method used of crude oil processing in CDU. Refineries are looking for a suitable crude oil processing method to reduce thermal energy and steam consumption, increase their profit margin, and make the crude oil processing greener and cleaner. Integration of flash drum (FD) in CDU has been explored and implemented in commercial plants to reduce thermal energy consumption.

Two prominent FD based designs of CDU are in practice in commercial units. In one method, the heated crude is separated into liquid and vapour streams using the FD. FD vapour is routed to the atmospheric distillation column (ADC) at a location adjacent to the kerosene draw stage. In the second design, FD vapour is routed to the flash zone of ADC. However, the heavies' carryover with kerosene product stream happened due to fluctuation in flash drum operation in the first FD based CDU design. Thus, a second FD based design is preferred. CSIR-Indian Institute of Petroleum (CSIR-IIP) has developed a novel method for crude oil processing in CDU for a significant reduction in thermal energy and stripping steam requirement without compromising the yield and quality of desired products. Three cases (Case 1, Case 2 and Case 3) were conceptualized to evaluate the energetic and economic benefits of the proposed method over existing crude processing methods.

Cyclic Distillation: A New Challenger for Intensified Fluid Separations

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Cyclic distillation is an emerging process intensification technology that significantly improves the separation efficiency as compared to conventional distillation, in a cost effective way. This study provides a scientific and industrial perspective on cyclic distillation, which is an innovative technology that holds tremendous promise for hydrocarbon processing industry. The cyclic mode of operation relies on separate phase movement, which is achieved with specific internals. This leads to major advantages, such as: increased column throughput, lower equipment cost, 30-50% lower operating costs, reduced energy requirements, and better separation performance.[1-5] The application range of cyclic distillation is expanding rapidly to other areas: oil refining, chemistry, petro-chemistry, pharmaceutics, biofuels and others. The use of cyclic distillation for the downstream processing of bioethanol is considered here as a representative industrial application for several reasons. The downstream processing of bioethanol employs several distillation columns, the first one being the beer column that performs the pre-concentration step. This work focuses on modelling and simulation of the beer column and also the rectification column that follows, in a cyclic mode of operation. The results show that by increasing the separation efficiency (at the same steam usage and ethanol concentration), the number of theoretical stages for cyclic distillation is reduced by 50% compared to the traditional operation. Also, for a decrease in beer concentration to 3%, the number of cyclic distillation stages is reduced by a factor 3.5. Moreover, the steam savings for a beer column operated in cyclic mode can be up to 20%. The bioethanol from the beer column needs further purification by distillation in another rectification column. The modelling of this rectification column using cyclic distillation trays shows a significant reduction of the reflux rate by 30%, along with a smaller number of trays (50% less than conventional ones). In addition, cyclic distillation provides also opportunities for removing unwanted odours from bioethanol, without additional costs for utilities.

Notes

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