

THE 7TH INDUSTRIAL GREEN CHEMISTRY WORLD - (IGCW-2023) CONVENTION & ECOSYSTEM

6th - 8th November 2023

The Westin Mumbai Garden City

PROCEEDINGS & REPORT 7th Industrial Green Chemistry World (IGCW-2023) CONVENTION & ECOSYSTEM 6th – 8th November, 2023, The Westin Mumbai Garden City

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Executive Summary

On 6th November 2023, the 7th INDUSTRIAL GREEN CHEMISTRY WORLD (IGCW-2023) CONVENTION & ECOSYSTEM was organised in Mumbai. The IGCW-2023 Convention was organised by Green ChemisTree Foundation (GCF) with support from the Dept. of Chemicals & Petrochemicals, Ministry of Chemicals & Fertilizers, Govt. of India.

The Inauguration ceremony was attended by 100+ leaders of the Indian Chemical Industry and inaugurated by a panel of esteemed dignitaries including:

- **Shri Sustana Kumar Purohit**, Jt. Secretary, Dept. of Chemicals & Petrochemicals, Govt. of India
- **Shri Praveen Darade**, IAS, Principal Secretary, Dept. of Environment, Govt. of Maharashtra.
- **Mr. Anil Jain**, Managing Director, PI Industries Ltd.

And the world-renowned *Father of Green Chemistry*:

- **Prof. Paul Anastas**, Director, Centre for Green Chemistry & Engineering at Yale, USA
- **Dr. John Warner**, Founder & Board of Directors - John C. Warner Green Chemistry, LLC; The Technology Greenhouse, USA

In his welcome address to the Industry, the Joint Secretary, Shri Sustana Kumar Purohit, emphasized on the importance of sustainable growth of chemical industry, while ensuring minimum impact on our environment (quality of air, water and soil), and safeguarding safety of human beings working in our industries and living in and around the manufacturing units.

He further added that for the sustainable growth of chemical industry, it would demand designing inherently “greener” and “safer” products and processes, and in this context “Green Chemistry & Green Engineering”, is now globally recognized as a tool to make Chemical industry environment friendly as well as competitive. From India’s perspective, with the potential expansion of greener technologies in Indian Chemical Industry, we can get back in to manufacturing of all those products which we are currently importing from China. Reduce dependency on China & expand Make in India.

In this view, The Industrial Green Chemistry World Convention is designed to - facilitate learning from global green chemistry leaders and experts, bring together key stakeholders of Indian Chemical Industry including senior Govt. officials, provide a conducive ecosystem that can accelerate the implementation and industrialization of Green & Sustainable Chemistry, enable learning from Industry peers and practitioners of successful case-studies, invite subject-specific solutions and technology providers to showcase at IGCW EXPO, recognise research advancements, initiatives and practices by conferring the IGCW Awards; and encourage collaborative initiatives by offering industrial networking platform to Researchers, Scientists, and Technocrats.

The 7th IGCW-2023 was attended by 400+ “green chemistry” enthusiasts from various sectors of Chemical Industry, with 100+ experts on various topics pertaining to the subject. 30+ Solution Providers in the IGCW EXPO, including a pavilion of the Council of Industrial and Scientific Research Laboratories. The prestigious IGCW Green Chemistry Awards was conferred to Students, Academia / Researchers, MSME, Large, MNC Industry, etc. [Please refer Annexure 01 – List of Attendees – IGCW 2023](#)

About- Green ChemisTree Foundation

Green ChemisTree Foundation (GCF) is a not-for-profit organization, established with the vision to serve the Indian Chemical Industry and the chemical community at-large, in its Green Chemistry and Green Engineering (GC&E) pursuits for ensuring environmental conservation and industrial sustainability.

Green ChemisTree Foundation is the founder and organiser of India’s first and largest Industrial platform titled “**Industrial Green Chemistry World (IGCW)**”, an international Convention being held in India every two years since 2009; and have declared its commitment to facilitate the IGCW Convention series until 2025.

Background, Objectives & Structure of the proposed event

Event Title

7th Industrial Green Chemistry World – Convention & Ecosystem (IGCW 2023)

Date & Venue

6th November Evening (6:00 PM to 9:00 PM): IGCW-2023 Inauguration & IGCW Awards Felicitation Ceremony.

7th & 8th November (9 AM to 6:00 PM): Technical Sessions

Venue: The Westin Mumbai Garden City

7th IGCW-2023 Convention & Ecosystem Objectives

- ✂ Facilitate learning from global green chemistry leaders and experts
- ✂ Bring together key stakeholders of Indian Chemical Industry including senior Govt. officials
- ✂ Provide a conducive ecosystem that can accelerate the implementation and industrialization of Green & Sustainable Chemistry
- ✂ Enable learning from Industry peers and practitioners of successful case-studies
- ✂ Invite subject-specific solutions and technology providers to showcase at IGCW EXPO
- ✂ Encourage collaborative initiatives by offering industrial networking platform to Researchers, Scientists, and Technocrats.
- ✂ Recognise and acknowledge initiatives in “Green & Sustainable Chemistry” through IGCW-2023 Awards

IGCW 2023 Convention: (10 Technical Sessions, IGCW-2023 AWARDS, IGCW-EXPO)

The 7th IGCW-2023 Convention with its various dimensions incorporated participation from over **300 Chemical companies (500 unique audience across two days)** and over **100 relevant Academic and Research Institutes**. Apart from these, IGCW-2023 was attended by **50+ senior officials from Govt. bodies, Industrial Associations, NGOs & Media**.

The 7th IGCW-2023 Convention and Ecosystem, was designed to serve as a multi-dimensional ecosystem, engaging diverse stakeholders from Industry, Research Institutes, Govt. bodies, Academia, etc., in various subject-specific and sector-specific deliberations across the two-day Convention.

IGCW-2023 TECHNICAL SESSIONS

With the objective to facilitate and expand the technical understanding of implementing “Green & Sustainable Chemistry”, in the IGCW-2023 structure, 10 Technical Sessions on topics that are pertinent for Industry, were concurrently held over two days (7th & 8th Nov.). Each Technical Session was designed and organised by Industry/Academia mentors having domain expertise on the specific session topics.

Below is an overview of all the 10 Technical Sessions and the sub-topics covered in each of the Sessions and the respective Session Mentors.

IGCW-2023 Technical Sessions: - Tuesday, 7th Nov 2023; Hotel Westin Mumbai Garden City			
Sr. No.	Title of the Session	Sub-topics	Academia / Industry Mentors
1	Green Chemistry Tools for Process Research	<ul style="list-style-type: none">• Green Solvent Selection Guide.• Green Reagent Selection Guide.• Green & Sustainable Chemistry Solution Provider’s Website.• PMI Metric Tool, etc.	<ul style="list-style-type: none">• Dr. Rakesh Ganokar, Head - CDMO and R&T, Hikal Ltd.• Dr. Sudhir Nambiar, CSO, Solara Active Pharma Sciences Ltd.

2	Sustainability & Green Chemistry Metrics	<ul style="list-style-type: none"> • Tools & techniques for measuring: Carbon Neutrality. Net Zero. Circular Economy. Life Cycle Assessment (LCA). Process Mass Intensity (PMI). Greenness of Process through DOZN tool, etc. 	<ul style="list-style-type: none"> • Prof. Brijesh Kumar Dubey, Professor - Circular Engineering (Dept. of Civil Engg.) and Chairperson - School of Water Resources, IIT-Kharagpur. • Dr. Anand Sekar, Leader, LCA Global Centre of Excellence, SABIC.
3	Conference on "Facilitating Industrial Sustainability & Pollution Prevention using Green Chemistry" for Pollution Control Board Officers	<ul style="list-style-type: none"> • Pollution Prevention using Green Chemistry. • Balancing role of Regulator & Facilitator - Learnings from US EPA. • Circular Economy, Resource Efficiency. • Hazardous Waste Management Rules. • Innovative Initiatives of State PCBs. 	<ul style="list-style-type: none"> • Dr. Ajay Deshpande, Adjunct Professor, Centre for Policy Studies, IIT-Bombay. • Dr. Atul Vaidya, Director, CSIR-NEERI.
4	Environment, Health & Safety - Tools & Technologies	<ul style="list-style-type: none"> • Safety Leadership & Culture. • Process & Plant Safety. • EHS Management Systems & Frameworks. • Digital Tools for EHS. • Supply Chain Sustainability. • Incident Analysis & Investigation. 	<ul style="list-style-type: none"> • Prof. Anju Singh, Professor Sustainability Management, National Institute of Industrial Engineering, NITIE. • Mr. Mahesh Chandak, Head of HSE - South Asia and HSE Business Partner for Crop Science, Bayer.
5	Renewable Feedstocks for Sustainability	<ul style="list-style-type: none"> • Utilization of all Carbon Components. • Platform molecules from renewable feedstock. • Energy from renewable feedstock. • Key challenges in moving to renewable feedstock. • AI & Digital in Biorefinery. • Bio-fuels & Future Fuels. • Valorization of food waste. 	<ul style="list-style-type: none"> • Dr. Avatar Matharu, Dy. Director, Green Chemistry Centre of Excellence, University of York. • Dr. Sasisanker Padmanabhan, Senior Principal Scientist, Praj Industries Ltd. • Dr. Sangeeta Srivastava, Executive Director, Godavari Biorefineries Ltd.

IGCW-2023 Technical Sessions:- Wednesday, 8th Nov 2023, Hotel Westin Mumbai Garden City

Sr. No.	Title of the Session	Sub-topics	Academia / Industry Mentors
6	Sustainable Metal Catalysis for Sustainability	<ul style="list-style-type: none"> • Catalysis using earth abundant metals. • Reaction in water. • Recent developments in Catalysis. • Catalysis for Carbon Capture. • Catalysis for Air. • Water & Solid Waste Management. 	<ul style="list-style-type: none"> • Prof. Lakshmikantam, Dr. B. P. Godrej Distinguished Professor of Green Chemistry & Sustainability Engg, Institute of Chemical Technology (ICT). • Dr. Rakshvir Jasra, Sr. VP - R&D, Reliance Industries Ltd.

7	Bio-catalysis: A Powerful tool for Green & Sustainable Chemistry	<ul style="list-style-type: none"> •Basics of Biocatalysis •Industrial case studies •Recent developments in Biocatalysis •Challenges in Bio-Catalysis •AI & Digital Tools in Bio-Catalysis 	<ul style="list-style-type: none"> • Prof. Santosh Noronha, Asstt. Professor, Dept.of Chemical Engineering, IIT-Bombay. • Prof. Shamlan Reshamwala, Asstt. Professor, Centre of Energy Biosciences, ICT. • Dr. Muffazal Hussain, Associate Director, Lupin Ltd.
8	Green Engineering for Process Safety & Benign Environment	<ul style="list-style-type: none"> • Process Intensification. • Flow Chemistry. • Flow Reactors. • Energy recovery & optimization. • Mixing & Agitation. • Process Safety. • Scale-up Challenges 	<ul style="list-style-type: none"> • Dr. Amol Kulkarni, Scientist, Chemical Engineering & Process Development, CSIR-NCL. • Dr. Suhas Jawlekar, Associate Director - Process Engineering, Polymorph development & New technology, Dr. Reddy's Laboratories Ltd. • Dr. Sandeep Jain, Sr. Director - Special Technologies - Process R&D, PI Industries.
9	Waste Valorization & Industrial Ecology	<ul style="list-style-type: none"> • Recycle. • Reuse. • Recovery of Chemicals from Wastes. • Zero Liquid Discharge (ZLD). • Use of waste as raw material in other industry. • Valorization of Wastes. • Co-Processing, 	<ul style="list-style-type: none"> •Prof. Anurag Garg, Professor, Environment Science & Engg., IIT-Bombay. • Mr. Ulhas Parlikar, Global Consultant (Waste management, Circular Economy, Policy Advocacy & Co-processing) • Dr. Jyoti Palekar, Founder, STEP Environmental Solutions Pvt. Ltd.
10	Software & Analytical Tools for Green & Sustainable Chemistry	<ul style="list-style-type: none"> • Artificial Intelligence & Machine Learning for optimization. • Process Analytical Tools (PAT). • Computational Chemistry. • Design of Experiments (DOE). • Software tools & Analytical tools like SciFinder-N, SynLED, ASCOC. 	<ul style="list-style-type: none"> • Dr. Kaustav Chakraborty, Team Leader, Laboratory of Advanced Polymer & Organic Chemistry, Solvay Specialities India Pvt. Ltd. • Dr. Rakeshwar Bandichhor, VP & Head of Chemistry - API R&D, Dr. Reddys Laboratories and Vice-Chair, ACS-India Chapter.

Detailed Programme Schedule of each of the 10 Technical Sessions is enclosed in Annexure 02.

IGCW-2023 Green & Sustainable Chemistry AWARDS

The Industrial Green Chemistry World (IGCW) Awards are India's first and only dedicated accolade that scientifically consolidates and recognizes Green & Sustainable Chemistry innovations across India. Inventions and Innovations that have created a substantial impact on the level of safety and environmental footprint of chemical products or processes are acknowledged through IGCW Awards.

The IGCW Award acknowledges the commitment demonstrated by individuals & organisations to develop and commercialise Green & Sustainable Chemistry based innovations that make a positive difference to the quality of human health and the environment. IGCW Awards is an appreciation of your technical expertise, thinking out of

the box, and courage to deal with all the hurdles that came on the way for the successful implementation of the idea.

Since its launch in 2009, the IGCW AWARDS has received applications from over 500+ Industry and Academia practitioners, determinedly integrating Green Chemistry / Green Engineering principles into chemistry routes, chemical designs, manufacturing practices, etc. The IGCW Awards are felicitated biennially in Mumbai, India.

For IGCW-2023 AWARDS, there were 103 applications who attempted to apply for the Green Chemistry Awards, of which 59 submitted the case-studies, and out of that 16 nominees were shortlisted within eight categories.

The top 3 nominees in each category have been announced as Winners and felicitated by the dignitaries including the “Fathers of Green Chemistry” – Prof. Paul Anastas and Dr. John Warner on 6th November 2023.

The Winners from the Academia and Students Category were felicitated with a reward of INR 1,00,000 and INR 50,000 respectively as a token of encouragement to further their research project.

Category	Organization
Knowledge Community - Student	Ms. Gunjan Sharma, Research Scholar, Tata Institute of Fundamental Research
	Ms. Divya Dixit, CSIR-NCI, Pune
	Ms. Tanmayee Vedak, Ph. D Scholar, Institute of Chemical Technology
	Ms. Shalaka S. Mohire, PhD research Scholar, Institute of Chemical Technology, Mumbai
Knowledge Community - Researcher	Prof. Sirshendu De, Professor, Indian Institute of Technology Kharagpur
	Dr Anagha Shyamsundar Sabnis, Associate Professor, Institute of Chemical Technology Mumbai
	Dr. Ketan Patel, Scientist, CSIR-Central Salt and Marine Chemicals Research Institute, Bhavanagar, India
Knowledge Community - Solution Provider	Dr. Ninad Gujarathi, Proprietor, Environalgae
	Dr. Vanita Prasad, Founder and CTO, REVY Environmental Solutions Pvt. Ltd.
	Dr. Makarand Pimplapure, Managing Director, MakSpeed Technologies Pvt Ltd
Green Chemistry - Start ups	Mr. Anish Malpani, Founder, WITHOUT by Ashaya
	Mr. Hemant Goyal, Director, Prayas Greentech Private Limited
	Mr. Raj Tanna, Managing Director, SCHUTZEN Care Pvt. Ltd.
Industry - Micro	Texochem Industries
Industry - Small Scale	Banyan Sustainable Waste Management Private Limited
	Sarna Chemicals Pvt Ltd
	CTech Corporation
Industry - Medium Scale	Aquatech Systems Asia Pvt Ltd
	Amines & Plasticizers LTD
Industry - MNC and Large Scale	Anthem Biosciences
	Aragen Life Sciences Limited
	UPL

IGCW-2023 AWARD FINAL WINNERS:

Category	Name	Title
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Knowledge Community - Student	Ms. Gunjan Sharma, Research Scholar, Tata Institute of Fundamental Research	Synthesis a novel plasmonic reduction catalyst in which Pt doped Ru nanoparticles, the hydrogenation sites have been loaded on black gold, a plasmonic light harvester. The catalyst thus synthesised has the ability to selectively hydrogenate acetylene (in excess ethene) to ethene only by shining light.
	Ms. Divya Dixit, CSIR-NCL, Pune	Dual activity cavitation reactors for increased efficacy in degradation of refractory pollutants
Knowledge Community - Researcher	Prof. Sirshendu De, Professor, Indian Institute of Technology Kharagpur	Fluoride Removal Filter from Groundwater using Aluminium substituted Hydroxyapatite Incorporated Wood Charcoal (Al-HApC)
Knowledge Community - Solution Provider	Dr. Ninad Gujarathi, Proprietor, Environalgae	Microalgae-based sustainable effluent treatment technology
Green Chemistry – Start-ups	Mr. Anish Malpani, Founder, WITHOUT by Ashaya	Revolutionary MLP Upcycling: Transforming "impossible-to-recycle" multi-layered plastic packaging (MLP) using chemo-mechanical technology into premium materials and products (world's first recycled sunglasses), driving environmental sustainability and empowering waste-pickers out of poverty.
Industry - Micro	Texochem Industries	'PE Replacement' Water based Barrier Coating The coating provides i) Barrier Properties ii) Water and Oil resistance iii) Heat Sealing ability iv) Enhance strength of paper v) Supports recycling, composting, and degradation of paper naturally vi) Applicable for direct food contact applications
Industry - Small Scale	Banyan Sustainable Waste Management Private Limited	Banyan Nation - Driving circular economy for human-contact applications. Banyan is a vertically integrated plastics recycling company that helps global brands use more recycled plastic instead of virgin plastic. Banyan's technology innovations in rHPDE and rPP recycling have helped major FMCG brands put 1 billion recycled plastic bottles on shelves.
Industry - Medium Scale	Aquatech Systems Asia Pvt Ltd	What is it? A 350m ³ /d zero liquid discharge (ZLD) plant using membrane distillation technology to treat pharmaceutical wastewater at ACG Pharmapack's capsule plant in Dahanu, Maharashtra. Operating in a harsh environment for ZLD regulations, ACG took a proactive stance implementing innovative industrial solutions to the problem of complex wastewater.
Industry - MNC and Large Scale	Anthem Biosciences	Purpose: To run Nitration reaction under safe environment using alternate technology Objective: Shift all our Nitration reactions to Continuous manufacturing Title of the technology: Continuous manufacturing (flow chemistry) >95 % of our nitration reactions are carried out in flow and in majority of the cases we could reduce the effluent

IGCW-2023 – EXPO: Green & Sustainable Chemistry Solution Providers' Exhibition

The IGCW-2023 EXPO was integrated to enable maximum industry interactions with companies and research institutes offering focused Green & Sustainable Chemistry solution providers. There were about 31 solution providers participating in the IGCW-2023 EXPO, including a pavilion of CSIR Labs, Indian start-ups facilitated by International Sustainable Chemistry Collaborative Center (ISC3), Germany; and Academia Institutes such as the Institute of Chemical Technology (ICT).

Below is the complete list of companies and organisations that exhibited in the IGCW-2023 EXPO:

1. MakSpeed Technologies Pvt. Ltd.

2. Sky Life Sciences Pvt. Ltd.
3. SIPL Pvt. Ltd.
4. Lab Guard India Pvt Ltd
5. HEL India Pvt. Ltd.
6. SRICO
7. Institute of Chemical Technology (ICT Mumbai)
8. Newreka Green Synth Technologies Pvt. Ltd.
9. Climate & Conservation Consortium
10. Rhodium Master
11. Environalgae
12. Geist Research Pvt. Ltd.
13. International Sustainable Chemistry Collaborative Center (ISC3)
14. REVY Environmental Solutions Pvt. Ltd.
15. Ashaya Recyclers Pvt. Ltd.
16. Schutzen Care Pvt. Ltd.
17. Bunko Junko
18. We The Recycle Company
19. Pure Water & Veolia
20. Standard Engineers
21. Revity Signals Software Inc
22. Kcat Enzymetic Pvt. Ltd.
23. Proburgeon Pvt. Ltd.
24. Clean Chem Laboratoris LLP
25. Advanced Enzymes Technologies Pvt. Ltd.
26. Excel Industries Ltd.
27. Corning
28. CSIR- NCL, Pune
29. CSIR- CLRI
30. CSIR- CSMCRI
31. CSIR- IIP
32. CSIR-NIIST
33. CSIR-NEERI

Feedback of IGCW-2023 Participants & Exhibitors:

Feedback was collected from participants at the end of both the days through a physical feedback form. About 50% of participants provided their feedback. Below is the summary of their feedback as received.

- 99% of participants were highly satisfied with the interactions during the Convention.
- 95% of participants found the IGCW-EXPO useful.
- 99% of participants found the Speakers and presentations to be highly engaging.
- 99% of participants very happy with Overall Experience.
- 96% of participants accepted that IGCW-2023 Conference led to new ideas and possibilities.
- The participants primary objectives for participation in IGCW-2023 was (96% Technical sessions, 26% to meet domain experts; and 15% to network with solution providers in IGCWEXPO)
- 70% of participants felt that the structure of the Convention met the objectives of their participation.
- 73% of participants attended IGCW Convention for the first time.
- 86% Exhibitors were satisfied with their overall experience of interacting with the IGCW-2023 participants.
- 95% Exhibitors found people visiting their booth were right level of decision makers.
- 99% Exhibitors accepted they got ample opportunity to interact with business potentials.

- 68% Exhibitors are first time exhibited in IGCW-2023
- 89% Exhibitors experience much better compare to other tradeshow.

Overall Outcome

Platforms such as the “Industrial Green Chemistry World” are the need-of-the-hour for providing a conducive ecosystem for the Indian Chemical Industry to adopt “greener” alternatives for meeting their SDGs.

Since its launch in 2009, the IGCW ecosystem has been expanded both qualitatively as well as quantitatively over the years. Apart from increasing number of participants from Industry, Academia, Research institutes and Govt. bodies (refer graph titled IGCW Ecosystem since 2009); more than 100 global leaders from the green chemistry community (Academia & Industry) have contributed as Speakers and experts. There has been an enthusiastic increase in number of focused solution providers (from Industry and Research Institutes globally) showcasing their GC&E relevant technologies at the IGCW EXPO; and most importantly there has been a remarkable increase in number and quality of case-studies received over the last five IGCW Conventions for the IGCW Green Chemistry Awards.

Various Government bodies too have realized the importance of this subject for driving sustainable growth of the Industry, and have now initiated focused interactions to create a road-map for accelerating the implementation of GC&E in India.

All the above emphatically indicates that India is witnessing a paradigm shift in its level of adoption and implementation of Green Chemistry and Green Engineering based practices; and that our consistent efforts in this direction are poised to create India an Asian leader in Green Chemistry based practices by 2025.

Over the years, the IGCW Convention & Ecosystem is emerging as a robust platform for engaging diverse stakeholders to come together to collectively work towards accelerating the implementation of green chemistry practices in India.

The 7th IGCW-2023 Convention & Ecosystem witnessed the following tangible and intangible outcomes:

- Active participation of 500+ Indian Chemical Companies’ senior representatives from Management, R&D chiefs, Managers Production / Operations, in various capacities of the two-day Convention
- Brought together global thought leaders, GC&E experts, industry stalwarts and relevant solution providers on a common platform.
- Facilitated engaging involvement of key drivers and stakeholders such as policy enablers (Ministry of Chemicals & Petrochemicals, Ministry of Environment & Forests), Regulators (CPCB and State PCBs), Govt. facilitators (DST, CSIR Labs, etc.), Multi-National consortiums such as ACS-GCIPR and ISC3
- Offered subject-specific events (10 Technical Sessions) which enabled customized participation for the Industry and thereby facilitated maximize take-aways and technical insights from the two-day Convention.
- Facilitated focused interactions and exchange of learning amongst Industry peers and practitioners of successful case-studies
- Apart from recognizing outstanding initiatives, the IGCW-2023 Awards continued to serve as a resourceful tool to collect, document and track GC&E trends, implementation case-studies and initiatives from across India at various Industry and non-Industry levels.

Conclusion

The 7th IGCW-2023 concluded with the promise to facilitate the implementation of Green & Sustainable Chemistry by the Indian Chemical Industry.

One of the key deliverables post IGCW 2023 is the creation of a dedicated web-portal on “Green & Sustainable Chemistry Solution Providers Global Database’ which aims to further accelerate the implementation of Green & Sustainable Chemistry in India.

In addition to the above, series of Customized Workshops on “Green Chemistry Tools and Techniques for Corporate R&D personnel” will be conducted with the objective to accelerate Green Chemistry adoption amongst chemical companies.

Annexures

1. Programme Agenda of 10 Technical Sessions
2. List of Attendees
3. Post-event Media Reports
4. Photo Report