

GREEN CHEMISTRY

Collaborations needed to tackle challenges & overcome hurdles to implementation

Sustainability was the buzzword at the recently concluded IGCW 2013 summit in Mumbai, with convergence of academia, industry and government agencies, to identify, assess and analyze the future road map for sustainability in the chemical value chain. It also sent the message that green chemistry is alive and kicking in India. Global experts in green chemistry and technology, industry practitioners and researchers went through a comprehensive assessment of the present state of green chemistry practices while reflecting on emerging future challenges and prospects.

Setting the framework for the summit's agenda, Prof. M.M. Sharma, Emeritus Professor of Eminence Institute of Chemical Technology (ICT), Mumbai outlined the multiple chemistry and technology dimensions of the chemical industry, in his address on the theme 'Cleaner and Greener is Smarter;

Conversion of Liabilities into Assets.' (see following feature)

Prof. Paul Aanstas, University of Yale (USA), joined in the deliberations through video and discussed the broad framework for the chemical industry in the long term.

A panel debate chaired by Dr. R. Rajagopal and including panelists Dr. Martin Vollmer, Dr. Rafael Cayuela, Mr. Manish Panchal and Mr. Rajeev Pandia deliberated on a wide range of issues related to the business case for investing in green chemistry; challenges of taking sustainable innovations to markets; shifting pace of regulations and its impacts; need for industry academia interactions; and, in particular, barriers to implementing green chemistry practices at commercial levels.

Need for sustainability kits

Dr. David J.C. Constable, Director,

American Chemical Society, Green Chemistry Institute (USA), addressed the diverse issues in taking green chemistry to commercial level. He emphasized the criticality of supply of key elements – including zinc, nickel, platinum and rhodium – and how depletion of these resources will impact various sectors of the economy.

Touching on some of the key green chemistry challenges, he said chemists still resort to ancient chemistries, which are defined by process inefficiencies, risky chemistries and inappropriate process controls. He stressed the need for chemists to adopt 3R's sustainability kits that involve renewables (reactants, reagents), reactions, reaction spaces and for chemical engineers to adopt 3S's sustainability kits that involve separations, set up (flexibility) and scale.

He discussed how, in the last decade, government policies were based on industry initiatives. For instance, elimination of the use of toxic and hazardous substances led to policies like EU REACH legislation, TSCA reauthorization in the US etc. He also referred to voluntary initiatives like Energy Star, Green Energy Leaders, etc.

Dr. Constable also described how industry collaborations like the ACS GCI Pharmaceutical and Formulator roundtables led to the development of several tools like solvent & ingredient guides, PMI-LCA tools etc.

He stressed the need for systems-level thinking and user-led research; advocated multidisciplinary approaches in education and sustainability



Dignitaries at the inaugural session of the IGCW 2013 conference



Prof. M.M. Sharma inaugurating the IGCW 2013 expo

research; and identified key research gaps for focus. (see Box)

Exploring opportunities from bio-based sources

New supply chain based on renewables and new technologies was the focus of the third keynote theme talk, delivered by Prof. James Clark, Green Chemistry Centre of Excellence, University of York, UK. Explaining the present status of waste valorization he said it offers immense opportunities while posing numerable technological challenges due to future regulations and standards. These, he felt, will pose far greater challenges for the industry in the pursuit for sustainability.

Agreeing with Dr. Constable he said that depleting elemental resources and their present management poses complexities that need well thought out initiatives. He called for improved understanding of elemental lifecycles. Touching upon present sustainability criteria like bio-based content, life cycle analysis (LCA) etc., he emphasized that future standards will go far beyond just carbon content and product measurements, into domains wherein industry will have to develop improved knowledge base. He advocated the use of non-food quality feedstocks and the

opportunities from the food supply chain to generate high value chemicals, including from polysaccharides. Discussing the commercial significance of extracting specialties like cosmetics, surface coatings etc. from biomass he cited the development of eco-waxes by companies like Croda, L'Oreal and others. He also described the present status of waste valorization from organic peels and waste biomass.

Prof. Clark also brought forth recent developments in the development of greener solvents and tools needed to make right choice of solvents, including the importance of Sustainable Solvent Polarity Map.

Imperatives for collaborative approaches

Explaining some collaborative initiatives in sustainability in the Indian pharmaceutical industry, Mr. Satish Khanna, the Chief Architect of the LAZORR initiative, described the genesis and progress made in implementing novel initiatives for API manufacture. He discussed the need for deploying green chemistry tools like green solvents, bio-transformations, green catalysts and green engineering etc., to design improved and more elegant processes.

Key Research Challenges Identified by ACS GCIPR

Current Reactions: Amide Formation, OH activation, Amide Reduction, Green Mitsunobu reactions, Oxidation/Epoxidations

More Aspirational Reactions: C-H activation of aromatics, chiral amine synthesis, Asymmetric Hydrogenation, Green Fluorination Methods, N-Centred Chemistry

Key Ideas outside the reaction theme: Solventless reactor cleaning, green alternatives to polar aprotic solvents.

Sustainability goals: the road ahead

Mr. Rafael Cayuela, Author of the book, 'The future of the Chemical Industry by 2050' gave a birds-eye view of the mega-trends shaping the chemical industry and how the industry will evolve through the next three decades. He projected world GDP to quadruple from 2010 levels, with China and India emerging as the largest chemical and pharmaceutical markets and the growing middle class driving these markets.

He cautioned that meeting the goals of sustainability from energy and emissions angles will be major challenge. According to him, climate change and resource management will drive the third industrial revolution, as the industry shifts from an operational efficiency to innovation platform.

Indian corporate sustainable initiatives

Mr. Samir Somaiya, Managing Director, Godavari Biorefineries Ltd., described how his company adopted a value creation strategy based on diversification of not only markets but also

feedstocks and manufacturing locations, investing in start-ups, innovating in internal and external processes involving customers and communities. Mr. Ashwin Shroff, Managing Director, Excel Industries Ltd., described the process adopted in his organization in sustainability management and how the company adopted diverse models to bring about a change.

Innovations to drive industry sustainability

Projecting a doubling of the chemical markets by 2030, Dr. Martin Vollmer, Chief Technology Officer, Clariant International Ltd., projected that by 2030 the share of specialty chemicals in total chemicals will significantly increase and bio-based chemicals will account for 20% of sales. He described the various innovation initiatives at Clariant and how its Competence Centres for surfactants, catalysts and biotechnology develop innovative products for crop protection and for carbon capture through a strategic alliance with TU Munich iC4 Project Cluster.

Dr. Surendra Kulkarni, Research Director, SABIC Technology Centre, Bangaluru, described some of the key innovations at SABIC including chemically recycled polybutylene terephthalate (PBT), improved carbon dioxide sequestration initiatives and development of second-generation biofuels. He described how light weighting strategies have enabled significant fuel optimization in the automotive industry. Touching upon innovations in packaging, he explained the concept of multilayer packaging systems. Collaboration in innovations allowed for faster implementation of sustainability initiatives, he added.

Sustainability practices in fine & specialty chemicals

Describing the evolution of sustainability practices in the fine and specialty

chemicals industry, Dr. R. Rajagopal, KnowGenix, discussed the changing landscape in the global fine and specialty chemicals industry driven by sustainability forces. He elaborated on the diverse sustainability models within the industry and how managing sustainability programmes proved to be a very challenging task. He discussed how the industry could create value amidst diverse challenges from feedstocks, technology platforms, shifting markets, stringent regulations and customer preferences. New oppor-

tunities continue to arise from such challenges and the industry needs to devise radically newer approaches, he added.

Dr. Rajagopal touched on the need for collaborative innovations, the challenges of taking innovation to markets and how the present state of low competitiveness in several segments need to be matched by innovative business and operational models. He delineated options for the specialty chemicals industry to initiate and plan its sustainability programs

AWARDS

IGCW recognizes green chemistry accomplishments

The green chemistry awards were presented to winning nominees in recognition of outstanding work in the development and adoption of green chemistry and engineering principles.



The 2013 award winners were:
 • Ms. Sujata Pramanik – University of Tezpur, Assam (student);

- Dr. Prabhavathi Devi, Indian Institute of Chemical Technology (IICT), Hyderabad (academia);
- Dr. Taher Dakorwala, Gharda Institute of Research & Technology;
- Dr. Rakeshwar Bandichhor, Director API-R&D, Dr. Reddy's Laboratories Ltd. (MNC); and
- Dr. Alok Pandit & Dr. Sanjiv Bachal, Founder Directors, Equinox Software Solutions P. Ltd. (Most Promising Technology).