

“There are no barriers at all in implementing Green Chemistry; all you need to do is to invent it”

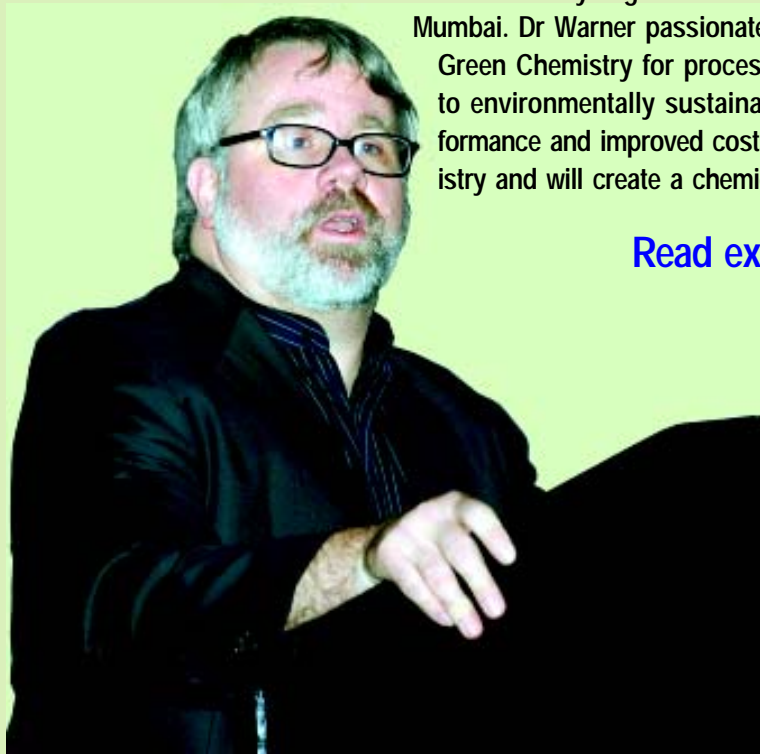
– Dr John Warner

From 4th Dec to 6th Dec'09, India witnessed the first international Industrial Green Chemistry Workshop (IGCW) in Mumbai. Dr John C Warner, alongwith Prof Paul Anastas, was actively involved with this event and delivered interesting discourses on Green Chemistry in Mumbai for IGCW.

Dr Warner is the President and CTO of The Warner Babcock Institute, USA, an independent initiative, he launched recently to provide green chemistry technologies for industry. Dr Warner is widely recognized as one of the world's leading experts in designing of safer products and processes. John received his BS in Chemistry from the University of Massachusetts, Boston and his MS & PhD in Medicinal Chemistry from Princeton University. He then led a research group at the Polaroid Corporation for 9 years before returning to the University of Massachusetts as an academic where he spent 9 years educating the next generation of professionals in green chemistry. He won the 2004 Presidential award in science mentoring amongst numerous other awards he has received. He holds numerous patents for Green Chemistry technologies with applications ranging from electronic and polymeric materials to pharmaceuticals and cosmetics.

Chemical Industry Digest interviewed Dr Warner at the sidelines of the IGCW'09 in Mumbai. Dr Warner passionately believes in the application of the 12 principles of Green Chemistry for process and product development which he says will lead to environmentally sustainable products and processes with far improved performance and improved costs. Green chemistry is good chemistry; its safer chemistry and will create a chemical industry with a benign, friendly public face.

[Read excerpts from this interview.](#)



Chemical Industry Digest (CID): What would drive green chemistry practices in industry? Would it be intrinsically driven or through extrinsic pressures like regulations?

Dr John Warner (JW): I think both intrinsic and extrinsic factors will contribute. Regulatory pressures are only going to increase in the long term. The opportunity and advantage will be for industries to come up with greener processes through innovation and invention before regulatory pressures increase. Those com-

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CID: If you look at the research that is going on for greener processes, are we looking at more of chemistry or engineering or both?

JW: The whole point is that its impossible to separate chemistry and engineering. Greener processes need an entire systems approach in R&D and manufacturing. You can't do good chemistry without good engineering and vice versa. It could vary depending on the specific situation: in some cases more chemistry may be needed and less of engineering and in other cases more of engineering and less of chemistry.

CID: Would you suggest that a step by step approach is taken where, in the first instance, reexamine existing products and processes and rework them based on principles of green chemistry and engineering and then get into absolutely new products and processes?

JW: Both are required based on what is viable and feasible. What I have seen is that many a times making changes in existing products and processes is more difficult and costly than going in for entirely new. Introducing a new product based on green principles will be cost beneficial and more of a success in the market place. However there are times when it makes sense to redo an existing product.

CID: From your experience in the US what are the barriers in implementing green chemistry?

JW: I do not believe that there are any barriers at all in implementing green chemistry. Processes that are environmentally benign will be based on technologies that are superior to what are existing. They will be cost competitive too. People will implement whatever is superior and better, technology wise and cost wise. I will quote the famous American author

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who said that if you make a better rat trap people will beat a path to your door, irrespective of where you are. The only barrier to green chemistry is that it has to be invented.

CID: What about the process of doing R&D? Do we need to change the methodology of research? Does this get impacted by the principles of green chemistry ?

JW: Discovery research, particularly in fine chemicals and pharmaceuticals, is based on the assumption that most of the examples to be tested will not succeed. So we have a mindset to accept that kind of wastefulness in research, because of which we are not critical on research methodologies. I think the intelligent approach is to change our mindset into assuming that we anticipate success the first time we make it – in which case we will make attempts to do it right the first time. I believe it is important to assume that everything we do in research is manufacturable one day. This will make researchers more innovative and practical. This is the faster way to the market. I believe that the principles of green chemistry will accelerate research.

CID: Experts like you are advocating understanding chemical phenomena at the molecular level which needs an indepth understanding of thermodynamics and physical chemistry areas, normally shunned by chemists.

JW: This is quite true and perhaps this has to do with how chemistry is taught. In my research laboratory even though I am an out and out synthetic organic chemist, the first thing I do is to make phase diagrams.

It is this compartmentalization into organic chemistry, physical chemistry, analytical, engineering etc which is inhibiting – and also creating the need for green chemistry. We need to look at chemistry, holistically.

CID: From our experience in India there are always conflicting perspectives between chemists and chemical engineers which affect the outcome of research. How can this be resolved?

JW: In my philosophy there is no difference between chemistry and chemical engineering or between chemists and chemical engineers. Some say that one synthesizes a molecule while the other formulates a product. These are artificial compartmentalization created by humans. We need to break down these barriers. While it may be a good idea for chemists to learn some chemical engineering and vice versa, due to the vastness of knowledge it will be difficult for anyone to learn everything. So the differences in learning and functions should not lead to conflicts.

At the very beginning of a project, chemists and engineers need to speak to each other and keep up the communication to ensure that the innovation or invention is proceeding in the right direction. Organisations should ensure that this happens for success. Chemists and chemical engineers should be required to collaborate during their educational careers so that they learn to understand and communicate with each other from the very beginning.

CID: How can we in India fast forward green chemistry practices in industry?

JW: Step one is to ensure that academic organizations initiate green chemistry and teach the principles and practices to students so that the next generation of

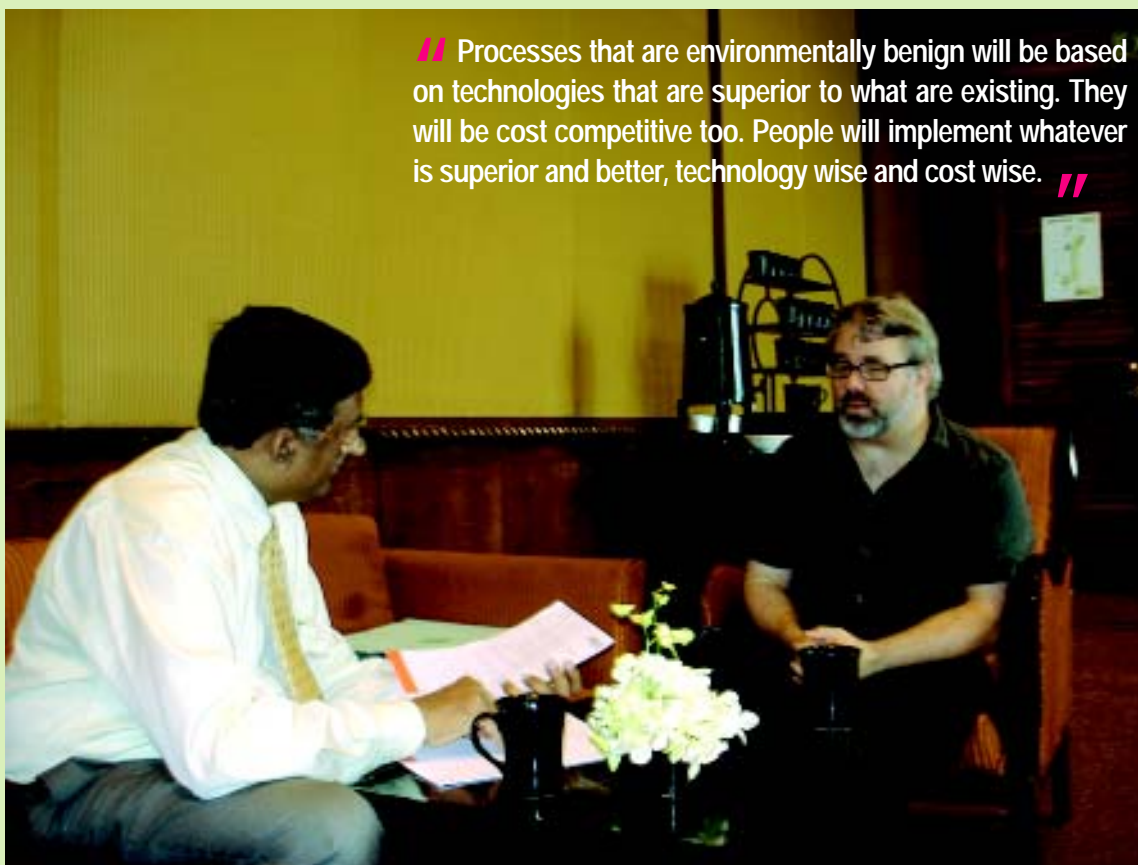
chemists and engineers start working, utilizing green chemistry and green engineering principles from the very beginning. Industry won't have to retrain them.

Step two is to provide professional training in green practices to the existing engineers and scientists already in industry. In this respect workshops like the recently concluded IGCW will go along way in disseminating knowledge on green chemistry. Industry and professional organizations should also get involved and hold workshops at local levels at regular and more frequent intervals. Internal and external collaborations are equally important.

CID: What should government and regulatory authorities do to promote green chemistry?

JW: I don't foresee any role for regulatory bodies since green chemistry is non-regulatory. Government agencies can provide grants, incentives, identify and promote research projects. They can mandate that educational courses should teach toxicology and green chemistry among other things.

One point about regulatory bodies is in terms of what they should not do. Regulatory bodies are more interested in maintaining the status quo and this accidentally inhibits people coming up with new chem-



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istries. They also make it unnecessarily more expensive to introduce new materials even when its environmentally benign.

CID: What do you expect from the media?

JW: It is through the media that we communicate with the general public. Historically, there's been a disconnect between science and the general public, because of poor communications. Science, and chemistry in particular, impacts so many crucial issues from developments for our well being and material comforts to environment, toxicity, global warming etc. More and more scientists are coming on public platforms and I feel it is important that they are coached on how to interact with the media and thru them to the general public. Otherwise it could be disastrous.

Media must also recognize that scientists are not typically accustomed to speaking to the public at large and should not try to capitalize by sensationalising only the problems and mistakes - particularly as it could create fear and apprehensions in the uninitiated public who do not have the scientific background to understand many happenings. So the media should try and educate the public instead of scaring them. Media people most often don't have a science background; so they try to look only at the political and social aspects of scientific developments. Many a times when I want to talk about solutions, the media want to talk about the problems. Media should try and help society to do the right things.

CID: There is a feeling that omnibus and stringent regulations like REACH will choke the chemical industry rather than help it. What are your views?

JW: The goals of REACH are important notwithstanding the debates on its pros and cons and the way of going about it. My concern is that the enormous amount of information that is being generated and gathered by the REACH organization is not being channelled back to the researchers or the process/product designers. Most of this data is related to harmfulness and toxicity of chemicals/products which information in the hands of the design community would have been wonderful to invent better material. Hope REACH closes this loop so that society can be better served.

CID: What about the US? Would the US be following on the same lines, adopt REACH or something similar?

JW: Yes, I think the US will also adopt something similar to the REACH once we sort out the aspect of economic unfairness in this. You see the big companies already have all the required information that a regulation like REACH requires. A mid size company has to expend some money to obtain additional information required while small companies will find it very difficult generating all these data, as they may even go out of business. So we got to settle this economic unfairness. The other point is that innovation comes from small companies and we got to be careful that we don't accidentally stifle innovation.

CID: What is the work that your Institute, Warner Babcock does?

JW: Warner Babcock is a small 35 person research facility. We work with companies to develop environmentally sustainable alternatives. We don't go about telling people upfront that we are going to make your process green. We offer to help solve the process/product problems. We do good chemistry, we improve the performance and we improve the costs of products and processes. In the past 18 months we already have 4 novel products in the market: One is in the pharma field which increases the medicine's bio availability; we have a solvent that is environmentally benign which strips the photo resist of silicon wafers; we have an additive in a paint which improves the physical performance of latex by making it harder and more chemically resistant and an environmentally benign hair colorant system, which literally recreates the natural pigment in hair.

We work with companies and give them exclusive control of the intellectual property. They pay us to develop the technology and give us royalties once they hit the market.

We are open to collaborating with Indian companies. ♻️

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