

ICIS Publications



# INNOVATION AWARDS 2006

**REVEALED! THIS YEAR'S  
WINNING INNOVATORS**

The time has come to reveal the winners of the 2006 ICIS publications Innovation Awards, sponsored by Dow Corning for the third year running. We congratulate the four winning entries for their high degree of innovation and commercial value

## JUDGING THE ICIS publications

Innovation Awards is always a fascinating task, and this year was no exception. The panel of judges (see below) were impressed by the high quality of the science and innovation shown by the entrants and, in particular, the winning entries (see right).

And, as Gregg Zank of Dow Corning commented, many of them have the potential to be "significant in terms of commercial impact". This, the judges agree, is a fundamental part of innovation in the chemicals sector – not merely invention and development, but taking ideas and products successfully to market.

The winning companies and innovations cover a broad spectrum, mirroring the diversity of the chemical industry itself. On the one hand, the product category winner – German chemical major BASF – has come up with a near-classical piece of product development, using sound science and technology to develop a product that meets specific customer needs. That is, a plasticiser for flexible polyvinyl chloride (PVC) with a safer toxicological profile than conventional products.

The winner of the best innovation by a small and medium-sized enterprise (SME) also went to a German company, Sto, but a different type of concern to BASF. Sto specialises in architectural coatings and insulation, but it, too, has used very innovative classical chemistry to develop a

## THE WINNERS

### Best product innovation

- BASF (Germany)  
Hexamol® DINCH PVC plasticiser

### Best process innovation

- Air Liquide Electronics – Balazs  
Analytical Services (US) Practical use of laser ablation for materials analysis

### Best environmental innovation

- Metabolix (US)  
Biodegradable natural polymers

### Best innovation by an SME

- Sto (Germany)  
Photocatalytic pigment for pollution-destroying coatings

photocatalytic pigment that operates in the visible end of the light spectrum, rather than needing ultraviolet wavelengths to operate.

Professor Rodney Townsend commented that: "There is a high quality of science underpinning the technology and the development was challenging." The result of the innovation – a coating that destroys organic pollutants in the atmosphere – has huge potential uptake, given today's concerns over air quality and human health.

On the other hand, the best process category was awarded to the US electronics arm of French industrial gases concern, Air Liquide, for its sophisticated development of laser ablation technology to enable the composition of semiconductor and ceramic materials to be measured to high accuracy. The judges were unanimously impressed by this innovation, especially, as Dr Andrea Tilche pointed out, for its potential impact on the burgeoning area of nanotechnology.

The award for the innovation with the best environmental impact went to Metabolix, a US biotechnology start-up, which specialises in using genetically modified bacteria to produce biodegradable polymers from renewable feedstocks. Dr Alfred Hackenberger acknowledged that Metabolix "is the benchmark in this area, achieving near theoretical yields" from its complex fermentation production. Again, concerns over oil shortages and plastics waste give this innovation a potentially huge market. Gregg Zank added that the development was "significant and impressive".

Paul Hodges noted that all the entries were very good and that many "got back to basic chemistry" for the kernel of the innovation. It was also, he added, difficult in many cases to distinguish between them, as "they all have a high level of commercial potential".

To see whether you agree, or not, the four winning innovations are all profiled in more depth in the following pages. If there is one message that can be drawn from this year's awards competition, it is that good innovation is alive and kicking in the chemical industry. What binds it all together is the quality of the science and the drive to meet customer needs.

» Editor's note: As BASF was shortlisted in the best product innovation category, Dr Alfred Hackenberger withdrew from the judge's discussion of this category.

## THE JUDGES



**Dr Andrea Tilche**  
Head of environmental technologies and pollution prevention unit in DG Research – I.2, European Commission



**Professor Rodney Townsend**  
Director of science and technology, Royal Society of Chemistry and Suschem board member



**Gregg Zank**  
Vice president, chief technology officer and executive director of science and technology, Dow Corning



**Paul Hodges**  
Chairman, International e-Chem



**Dr Alfred Hackenberger**  
President, speciality chemicals research, BASF

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# Innovating innovation

Dow Corning's head of vision takes a holistic view of innovation – and it works

MUCH HAS been said about the importance of innovation in the chemical industry. To the industry as a whole it is essential to ensure a sustainable future; to individual companies, it is vital to their competitiveness and a profitable future. “But innovation is hard,” says Gregg Zank, chief technology officer and executive director of science and technology at Dow Corning. And, he adds: “There is a lot of theory out there, about open innovation and disruptive innovation, but innovation is different for each company and its customers.”

At Dow Corning, the goal has been to make innovation a pervasive part of the company culture and drive its importance home to all employees. As Zank explains: “It is a journey we are all on and I believe we are well down the line on getting our people and infrastructure in place.”

The company, a joint venture between Dow Chemical and Corning, specialises in silicon and silicone chemistry, and spends an above-industry average of around 5–6% of sales on research and development. It has developed the concept of innovation so that it embraces all its operations and all its employees. It has espoused the doctrine of “10 ways to innovate”, promulgated by consultancy Doblin, which seeks to drive innovation throughout the company.

The effort is working. A recent survey of Dow Corning employees, asking who is responsible for innovation, came back with the result “everyone”. “At least,” jokes Zank, “it is not all seen as down to me!”

The result is that Dow Corning is able to provide solutions to customers’ needs, as sales and marketing personnel are equally concerned about solving these problems and driving innovation. “We have taught people to ask questions and listen to customer needs, which can be difficult when we want to talk to them about science. The art of listening and asking to find out where the pain is is important and can bring new products or services.” It can even, adds Zank, lead Dow Corning to help its customers expand into new markets or geographies.

But alongside the infrastructure building

## GREGG ZANK AT A GLANCE

- He is responsible for providing the vision for science and technology at Dow Corning and leading the company to realise that vision.
- He has a PhD in inorganic chemistry from the University of Illinois at Urbana, and a BA in chemistry from the University of Wisconsin-Superior.
- He holds 30 patents for innovations such as advanced monolithic and composite ceramics, rechargeable batteries and high-temperature thermosetting plastics.
- He was previously director of new ventures research and development (R&D) at Dow Corning. He developed the R&D organisational strategy for new ventures, including an internal new business and technology incubator for Dow.
- He continues to direct the evolving portfolio of activities for New Ventures.

and the soft people issues, Dow Corning takes a rigorous approach to metrics, to ensure it is getting the requisite innovation from its R&D budget. Like many companies, it has targets for the proportion of sales coming from newly introduced products, but it also has targets for the proportion of new products that earn more than a certain threshold of sales.

“We have this added hurdle to keep the pipeline balanced between major

Another way of looking at this is to see how the innovation projects map on to a three-by-three matrix, plotting products on one axis and customers on another. “In the bottom corner you have innovation with current customers and current products, which is low-risk and easy to calculate the outcomes of R&D investment. In the top corner you have far more risky projects, with new projects and new customers, where the return on investment is much more uncertain.”



**“We have so many ideas these days of where we could go... it’s a tough decision on what to fund and what not to fund. We wish we could do it all”**

Gregg Zank, chief technology officer and executive director of science and technology, Dow Corning

innovations and smaller ones. If you are not careful you can get a lot of incremental products coming along, but do they really add a lot of value? We want to make sure we have the right balance and keep an eye on the big opportunities.”

In some way, admits Zank, “we have too many metrics”, although it is an issue he is working on. He views the metrics as being in three buckets: impact – where there is a measure of revenues and margins delivered; the return on investment for a project; and the success rate of portfolio development – “are we delivering what we said we would?”

Once again, Zank stresses that getting the balance right is important, so that the company is running a portfolio of innovations right across the grid. “The pendulum is swinging in the right direction and things are looking pretty good,” he declares. “We have so many ideas these days of where we could go – in technologies or geographies – that it’s a tough decision on what to fund and what not to fund. We wish we could do it all.”

» For more details go to [www.dowcorning.com/innovation](http://www.dowcorning.com/innovation)



# Grand designs

BASF's latest invention, *Hexamoll* DINCH, has been carefully designed, guaranteeing its smooth and successful entry into the market

INCREASING DEMAND for non-phthalate-based plasticisers for use in flexible polyvinyl chloride (PVC), especially in toys and medical devices, spurred BASF into developing the novel plasticiser. As Klaus Halbritter, head of intermediates research at the German major, explains, BASF addressed concerns over the toxicology of conventional phthalate early, through the development of an alternative using its core competencies in R&D.

The key to avoiding the issues surrounding those concerns has been to hydrogenate the aromatic ring in di-isononyl phthalate (DNIP) to produce a cyclohexane ring system, di-isononyl-cyclohexane dicarboxylic ester, or *Hexamoll* DINCH as BASF calls it.

It is now marketing the product as *Hexamoll* DINCH after building a 25,000 tonnes/year production unit in Ludwigshafen, Germany, in 2002. Halbritter points out that the plant is integrated into BASF's Verbund structure, based on existing value chains. Just last week, BASF revealed it will increase capacity to 100,000 tonnes/year by the second quarter of 2007.

Halbritter says: "Selective hydrogenation of aromatic rings is a core competency at BASF and we were able to develop *Hexamoll* DINCH using a reaction with a very high conversion rate and high yields." The reaction takes place by means of a noble metal catalyst. The development was carried out in close cooperation with BASF's application laboratories, marketing operations and



BASF's winning innovation satisfies concerns over PVC toys

customers, to come up with a suitable, near drop-in replacement for phthalates, but one with an excellent toxicological profile.

BASF has spent more than €5m (\$6.4m) putting *Hexamoll* DINCH through regulatory testing and, explains Friedrich Seitz, European business head for plasticisers and solvents: "Taking all the evidence into account, we have shown that *Hexamoll* DINCH does not pose a threat to human



**"Innovation can bring new life to old products"**

Dr Klaus Halbritter, head of intermediates research, BASF

health or the environment."

But the big advantage for customers, is that the product is essentially a drop-in solution for compounders and users of conventional plasticisers. "Some reformulation might be necessary – because of the change in fusion temperature – but it is possible to make these changes on existing equipment, by merely changing parameters a little," says Seitz.

He adds that BASF is seeing increasing interest from makers of medical products such as blood and saline drip bags, enteral tubes and gloves, as well as from toy makers, for use in balls, dolls and inflatable toys, for instance. "We are now also seeing interest in food packaging, such as wrapping film and

closures – including cork replacement in wine bottles and caps for carbonated drinks." Developments here will be spurred as the product has just received European Food Safety Authority approval for use in a wide range of food contact applications.

The product is viewed by BASF as a premium offering in its plasticiser range, where it continues to offer its conventional product offerings into the market. These are often viewed in the market as commodity products, says Halbritter, who is keen to point out that the development of *Hexamoll* DINCH shows just how innovation "can bring new life to old products".

Halbritter points to a number of success factors behind the projects, which has also just won one of BASF's own internal innovation awards. First, it aligned very closely with one of BASF's strategic guidelines, "to help customers to be more successful". Second, the new product was already closely integrated with BASF's value chain. And third, it represents a step along sustainable development for BASF in the plasticisers market.

Seitz agrees, adding that "early coordination with customers and timely testing within our development labs were key to our success. Today, we are happy with the development of the product." With the growing public concerns over product toxicity, there is plenty of interest in this premium product to drive growth.

» For more details go to [www.basf.com](http://www.basf.com)

# Exceeding its own expectations

Air Liquide's US subsidiary, Balazs, has developed a novel process of materials analysis using laser ablation, combining innovative technology with what their customers want

IT IS always rather satisfying when one plus one equals more than two. And this has been the case for Balazs Analytical Services' development of its laser ablation ICP-MS analytical technique.

Balazs, the analytical arm of Air Liquide Electronics, has taken laser ablation technology and successfully coupled it with inductively coupled plasma-mass spectroscopy (ICP-MS) to create a technique

use in rock, soil and artefact analysis, where quantitative data were not required.

What Li and his colleagues at Balazs have done is develop an extensive calibration matrix, which can provide quantitative data from a wide range of samples. The resulting matrix-matched standards give data for materials in the 100ppb to 100ppm range.

Hugh Gotts, Balazs' R&D director, says that samples can be analysed in 15–30

(€425,000) and selling the technique as a service. Customers send samples to the company and are charged per sample or for the time it takes to conduct the analysis. "We provide customers [with] a written report giving technical information as to what the technology sees."

One of the applications Saris has been successfully used for is the analysis of ceramics for the semiconductor industry. This has been difficult in the past because as an insulating material, the ceramic has a charging effect on an ion or electron beam. Traditionally, scanning electron microscope energy dispersive X-ray (SEM-EDX) techniques could be used to detect high concentration contaminants, but could not detail trace levels or provide depth analysis.

"This information allows customers to build products that are much cleaner and understand why parts break," says Gotts. "The information we provide can also help our customers select suppliers – assessment of a number of polymers can tell them which is the cleaner or most like a material



**"Academia took a look at laser ablation as part of a study into laser-matter interaction mechanisms"**

Fuhe Li, research scientist, Balazs

that can effectively look inside materials. As such, it can provide an elemental survey or material identification – much more than any previous analytical technique.

Called Saris, the technology can provide qualitative analysis for up to 85 elements, with a detection level of 0.0001% (w/w), and quantitative analysis for up to 25 elements, with a detection level of 0.1–100ppm. One of the main advantages of the approach is that quantitative failure analysis can be performed without sample pre-treatment – allowing companies to get a quick analysis for major, minor and trace constituents in solid materials.

Another major advantage is the wide range of materials that can be analysed. These include conductive, nonconductive, homogeneous, heterogeneous, organic, inorganic, transparent and nontransparent materials. It can also be used to analyse materials that have proved difficult to crack using conventional techniques, such as insulating and refractory materials.

Fuhe Li, a Balazs research scientist, has been working on the project since its inception in 1997. He notes that originally, academia took a look at laser ablation as part of a study into laser-matter interaction mechanisms. The technique found some

minutes – a fraction of the time taken by traditional methods. "Some materials are difficult to prepare for analysis. For example, they do not dissolve or are lost when the sample is heated, so they cannot be analysed



**"We provide customers a [with] written report giving technical information as to what the technology sees"**

Hugh Gotts, R&D director, Balazs

by traditional techniques. With Saris, the laser prepares the sample for you."

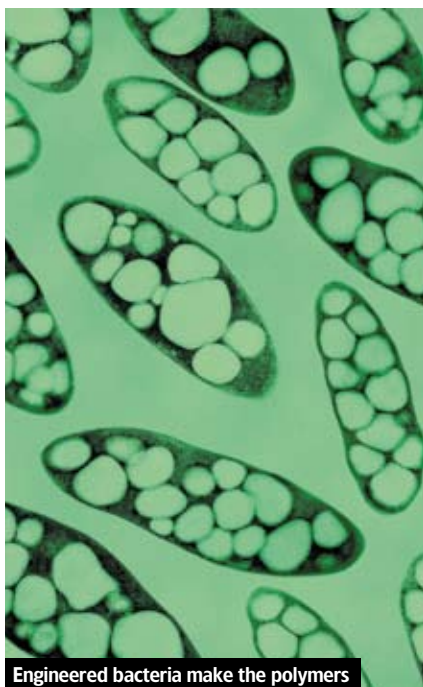
He adds: "We were getting so many unusual requests from customers looking to analyse non-routine substances or wanting depth information. We knew we could supply the answers. What we have done is interface what the technology does with what the customers want. The biggest hurdle to development was calibration – without good calibration you can not use the technology."

Between 2000 and 2001, Balazs started to commercialise the process. This involved building the equipment, which cost \$530,000

used previously." Applications are diverse. Customers use the technology to monitor clean air, develop advanced semiconductor precursors and determine diamond impurities, say Gotts and Li.

Now Balazs is looking to develop laser ablation ICP-MS into an accepted approach industry wide. "This means we need to educate people on how it works and where it can be applied," says Gotts. The company is also expanding into new areas, including medical and nanotechnology.

» For more details go to [www.balazs.com](http://www.balazs.com)



Engineered bacteria make the polymers

# Plastics: keeping it green

Metabolix's use of biotechnology to produce plastics from renewable resources has already been widely praised

US-BASED Metabolix is a leader in using biotechnology to produce plastics. It has two platform technologies to produce what it brands as *Natural Plastics* – the first, now being commercialised, converts sugars or vegetable oils via microbial fermentation, while the second, which is still under development, uses direct production in non-food crop plants. This combines the production of polymers with biomass that can be converted into biofuels.

The first technology platform, microbial conversion of sugars or vegetable oils to *Natural Plastics* (technically PHAs, polyhydroxyalkanoates, a kind of polyester), generates plastics that are more environmentally sustainable than traditional polymers that are based on fossil-fuel feedstocks. Not only are the new products based on renewable resources, but they also biodegrade benignly after use. Metabolix's proprietary polymers can be processed in existing plastics conversion equipment.

Metabolix's research in this area has mirrored that of pharmaceutical companies. The company has harnessed microorganisms to convert sugars or vegetable oils through several intermediate steps into fully formed *Natural Plastics*, all within the biological cell. The organisms control polymerisation and produce different plastics, ranging from rigid to elastic. This technology extends the range of uses that can be served by bioplastics,

which are traditionally polymerised from bio-based monomers using conventional chemical processes.

At present, the company operates a pilot plant to produce sufficient material for applications development and trials with select customers. A broad range of *Natural Plastics* has been generated, from rigid thermoplastics, suitable for moulded and thermoformed



**“[The award] is a validation of the work we do.”**

Jim Barber, president and CEO, Metabolix

goods, to grades suitable for flexible film, to highly elastic grades, to those suitable for adhesives and coatings. In some cases, Metabolix *Natural Plastics* offers combinations of properties that are not available in synthetic materials. One example combines good water resistance with biodegradability, which could be used in flushable personal hygiene products.

The applications work is in preparation for commercial-scale production. Metabolix and Archer Daniels Midland (ADM) have formed a joint venture to commercialise the polymers and a 50,000 tonnes/year plant in Clinton, Iowa, is due to come on stream

in 2008. The event will mark the next step in the commercialisation of the innovative technology, pioneered by two of Metabolix's founders, Anthony Sinskey and Oliver Peoples, at The Massachusetts Institute of Technology (MIT) in the late 1980s.

Peoples and Sinskey developed the concept of using advanced molecular biology techniques to introduce a series of genes into a cell that would provide the coding for individual enzymes. These enzymes control the generation of a specific molecule of interest. Instead of targeting one gene to make one protein, the team incorporated genes for each step in a multi-step pathway, where the final product was a small molecule, a protein, or, in the case of Metabolix, a biopolymer.

Metabolix was founded in 1992 to further develop the technology, which it licensed from MIT. Initially, the focus was developing the right strain of microbes and developing the process. Key points along the path to innovation have been: the influx of government grants and finance from private investors; acquisition of Monsanto's *Biopol* technology, which consolidated Metabolix's intellectual property position; demonstration of a commercial-scale process in 2002, with a large-scale fermentation unit; and linking with ADM, one of the largest agricultural processors and fermentation companies. Metabolix now employs 55 people.

Commercialisation of Metabolix's second technology platform, the development of plants – switchgrass in particular – that directly produce plastics, is expected to be viable in about five years. The trick is to get the plant to produce both what is wanted commercially, and what it needs to grow. The development process is inherently slow because it takes plants a long time to grow.

While Metabolix has won numerous accolades for its technology, including the prestigious Presidential Green Chemistry Award in 2005, Marcia Miller, director of marketing communications, says the ICIS award is meaningful to the company because it is recognition from industry: “It is a validation of the work we do.” Jim Barber, president and CEO, added: “We're delighted that ICIS has chosen to recognise Metabolix and our innovative *Natural Plastics*. It reflects the growing worldwide trend in concern for the environment, and the role that *Natural Plastics* will have in making it cleaner and greener.”

» For more details go to [www.metabolix.com](http://www.metabolix.com)

# The sweet smell of success

A successful scientific collaboration has enabled Sto to develop a paint that removes odours from rooms, activated merely by ambient lighting conditions

IMAGINE A paint that can remove odours from the air in a room, destroying them to produce just water and carbon dioxide. The innovation that Sto has commercialised does just that, and it is already gaining recognition in the market.

Gerd Stotmeister, technical director at the company, based in Stuhlingen, Germany, relates one story from the market that illustrates the success of the product, which it is marketing as *StoClimasan Color*. A cafe in Vienna, Austria, had painted its walls with the special paint during a renovation. The manager was surprised shortly afterwards when the cleaners came to him to ask when he had made the cafe a non-smoking establishment. He had not, he replied, surprised at the question. But then, he realised the cleaners were missing the smell of stale tobacco because of the paint.

The key to the paint's action is the catalytic effect of a specially developed titanium dioxide ( $\text{TiO}_2$ ) pigment in the formulation. Peter Grochal, innovation director at Sto, had heard of the photocatalytic effect of  $\text{TiO}_2$  in outdoor applications, mostly from Japanese sources. But, he wondered whether the same effect could be achieved inside buildings, where smells and other pollutants are more of a problem because they can linger.

The problem was that existing catalytically active  $\text{TiO}_2$  required the ultraviolet wavelengths in direct sunlight to trigger the destruction of the adsorbed organic pollutants. Could it be made to work in ambient indoor lighting or diffused



Function and design meet at Sto

daylight, with wavelengths above 400nm?

Grochal realised that he had an interesting project, and Sto, which specialises in architectural coatings and facade insulation systems, began a collaboration with Professor Horst Kisch at the institute for inorganic chemistry at the University of Erlangen-Nuremberg. Kisch's department specialises in photocatalytic pigments and, together, the

two came up with a  $\text{TiO}_2$  pigment that not only destroys organic pollutants in the visible wavelength, but also retains its white colour and is stable in paint formulations.

The answer turned out to be carefully doping the  $\text{TiO}_2$  with carbon atoms to create what Sto calls a visible light catalyst (VLC). The dopant reduces the energy gap between the  $\text{TiO}_2$ 's valence and conductivity bands, so that longer wavelength light can activate the promotion of an electron into the conductivity band, where it is available to oxidise the adsorbed pollutants.

After finding the right VLC, Sto turned its efforts to finding a commercial producer of  $\text{TiO}_2$  that was interested in developing the innovation further, especially the commercial-scale manufacturing process. This, notes Stotmeister, was one of the main hurdles in the whole development process.

But a producer was found and, with larger volumes now available, Sto moved finally to launch *StoClimasan Color* in April 2005, after a two-year development process. It has applied for patents on the product, which it claims is the only catalyst of its type to work in the visible part of the light spectrum.

Sto claims the pigment can oxidise compound such as formaldehyde, solvents, plasticisers and other odorous substances. It is also effective on nitrogen oxides sulphur dioxide, carbon monoxide and ozone. Sto is now studying the effects of the pigment on bacteria and its use outdoors, where it says it can play a role in improving air quality in traffic-congested urban centres.

With the paint used in buildings such as schools and hospitals in Europe, Stotmeister says Sto is now in talks with a major US coatings producer to license its use in North America. Stotmeister points to the need to train Sto's own sales people so they can explain the new concept convincingly to the market, proving once again that innovation is not just about new products, but about commercialising them.



**"The cleaners were missing the smell of stale tobacco because of the action of the paint!"**

Gerd Stotmeister, technical director, Sto

## ACCOLADES FLOW IN FOR STO

Sto has already received accolades for its invention in Germany. Last year it received the Top 100 seal of approval for excellent innovation management. In this regard, Professor Nikolaus Franke, from the University of Economics in Vienna, examined the innovative power of medium-sized companies and honoured the top 100, irrespective of the sector in which they operate. The judges were particularly impressed by the use of the photocatalytic principle to produce paints that reduce pollutants in the air using standard interior lighting. Jochen Stotmeister, Sto CEO, was very pleased: "Research and development is supported by all colleagues, e.g. through the employee suggestion scheme. Consequently, this prize is the result of a combined effort on the part of all Sto employees."

» For more details go to [www.sto.com](http://www.sto.com)