

INNOVATORS OF THE FUTURE



As we celebrate the achievements of this year's ICIS Innovation Awards winners, let's also look to the future and ask: "Who will be the innovators of tomorrow?"

For our companies, our industry and our societies to respond to megatrends such as green energy, clean and accessible water, and sustainable urban environments, we will need the engineers, product developers and research scientists of tomorrow to combine technical brilliance with insatiable curiosity, intellectual rigor and a relentless passion for trying new approaches.

Teaching, mentoring and nurturing these future innovators is one of the key priorities for our industry and our society.

At my own company, Dow Corning, we're taking some steps through science days around the world – from China and South Korea to North America and the UK – which give more than 500 children the chance to experience at first hand what it feels like to be an innovator.

We recognize that instilling a spirit of exploration and experimentation at an early age leads to well-educated, skilled and motivated young people in society.

But as we recognize the accomplishments of the innovators of today, we should also challenge ourselves to think how we can do more to help teachers get students excited about science. As companies, we have many opportunities to inspire. We can invite children and students to visit our facilities and we can send our employees out into the classrooms so that young people get the chance to meet with "real life" scientists.

Small steps perhaps – and ones that do require effort. But as the Chinese philosopher Lao-tzu, said: "A journey of a thousand miles begins with a single step."

Dr. Stephanie Burns
Chairman, president and CEO
Dow Corning

DOW CORNING

*We help you
invent the future.™*

Who dares

After a record number of entries and two rounds of intense judging, ICIS now reveals the winners in this year's ICIS Innovation Awards

CONGRATULATIONS TO each of the winning companies in this year's ICIS Innovation Awards. A record number of entries and several close-fought categories mean they can feel doubly proud to have emerged victorious from the 13-strong short list.

The ICIS Innovation Awards, now in its sixth year, continues to be sponsored overall by US silicone and silicon technology specialist Dow Corning. But to demonstrate that the awards themselves are also a source of innovation, this year ICIS welcomed US consultancy CRA International as the sponsor of the Best Product Innovation category.

And, for the first time, the panel of five judges (listed opposite) was asked to nominate an overall winner from among the four

categories. This award will be presented by Dow Corning when the companies gather to celebrate in London in mid-December.

So step forward, the CECA division of French specialty chemical company Arkema. Its entry for the development of a surfactant formulation that makes asphalt production and road laying less energy-intensive and less environmentally harmful won the category for Best Product Innovation and then went on to be judged the best overall entry.

The judges believe this innovation is a significant development in a mature technology area and brings numerous benefits in terms of energy savings, and thus greenhouse gas emissions; volatile organic compound and dust reduction; and better working conditions for road contractors. And, given the potential scale of application – hundreds of millions of tonnes of bitumen/aggregate mix (asphalt) are used each year in Europe alone – the commercial rewards are huge.

Judge Gregg Zank noted: "It is really hard to get innovation in mature areas," while Gernot Klotz appreciated the fact that the innovation can improve health and safety in the road construction area.

CECA, however, had a hard fight on its hands to come out on top in the Best Product Innovation category. All four short-listed entries were impressive, and the judges eventually decided to give UK-based Lucite International a special mention for its development of a completely new route to the manufacture of methylmethacrylate (MMA).

Lucite's *Alpha* technology has many benefits over conventional routes to MMA, and late last year went into commercial use in a new plant in Singapore. The judges said the development, which took 15 years and involved multiple innovations, showed true determination to succeed.

Judge Neil Checker commented that there had been very few examples of this

THE WINNERS THIS YEAR ARE...

OVERALL WINNER

CECA/Arkema

BEST PRODUCT INNOVATION

CECA/Arkema

Formulations for "greener roads"
Special mention

Lucite International

Alpha technology for production of methyl methacrylate (MMA)

BEST INNOVATION BY AN SME

Oxford Catalysts/Velocys

A microchannel reactor for distributed production of third-generation biofuels

BEST BUSINESS INNOVATION

DSM

Moving down the value chain with *claryl*

– the picture glass

BEST INNOVATION IN CSR

Tata Chemicals

Greening of alkali and saline sediments

wins!

type of major process innovation in recent years. "Lucite persevered with this project, showing commitment to solve a number of problems and to pilot and then commercialize the process, which changes MMA economics substantially."

COMPETITIVE SMES

The Best Innovation by a Small or Medium-sized Enterprise (SME) was also closely fought between three of the four short-listed entries. The entry from new technology start-ups Oxford Catalysts, of the UK and US-based Velocys emerged as the judges' choice for its combination of process intensification, using a microchannel reactor, and *Fischer-Tropsch* (F-T) catalyst to turn municipal waste into liquid biofuels on a local scale.

Judge Rob Kirschbaum commented that the company was smart to focus on using waste to produce biofuels and to look at reactor and catalyst technology that reduces the need to transport waste over long distances to large, centralized processing facilities.

Zank added that the use of microchannel arrays in the reactor was a good approach, and that the use of an F-T catalyst was a "tough place to start." Nevertheless, "the volumes look good and people have been working on the technology for a while – we are now seeing the fruits."

There was no dispute over the winner in the Best Business Innovation category. Here, DSM was a clear winner for the way it took an innovative business approach to commercialize its novel glass coating technology. [Kirschbaum abstained from judging in this category, given his DSM affiliation.]

The Dutch life science and materials company decided that, rather than license the technology and merely supply the coating chemicals, it would retain greater profit margins by entering the retail picture framing market with its own-brand product, *claryl*.

This route also allowed it to take the innovation to market quickly and to prove the technology platform before expanding its applications into areas, such as solar cells.

Judge Paul Hodges applauded the move as one not often found in the chemical industry. "DSM has worked out the value proposi-

tion well here and instead of merely accepting margin on the basis of square meterage of glass sold, has captured more value by going downstream," he commented.

Zank concurred, noting that the volume of coating was minimal, so making good money simply by selling the chemicals would be hard to do. "The question is: where is the real pull in the market and who will drive it through?" And Klotz added that DSM's approach "gives a clear signal of the way the industry needs to go.... It should not just rely on the distribution of materials. It is a good business approach for European industry to keep money flowing back."

The entry from PTT Polymer Marketing, of Thailand, had also gained several plaudits from the judges. The company entered its innovative project to develop a fully electronic system to handle letters of credit and associated export papers and documentation.

INDIAN SUCCESS

And so to the final category – the Best Innovation in Corporate Social Responsibility (CSR). This new category in the ICIS Innovation Awards attracted several good CSR projects, but the clear winner in the end was Indian soda ash producer Tata Chemicals, for its novel approach to reducing dust nuisance to people living near its soda ash solid waste site.

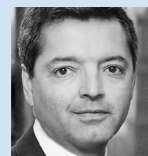
The judges felt the company had taken an innovative and considered approach, involving the local community, not just in the development, but the execution of the project, which involved planting specially chosen and treated plants to create a plantation on the alkaline and saline solid waste.

Kirschbaum commented that "mimicking nature is a good starting point to determine how to solve a problem," and Zank added that the overall solution, including special irrigation techniques "was very neat. The look at nature and concern for the planet is a strong theme."

The judges also commented that the entry from the Agrochemical Intermediates Manufacturers in Europe consortium, part of European trade group Cefic's European Fine Chemicals Group, deserved recognition,

THE JUDGES THIS YEAR ARE...

Dr. Neil Checker
vice president and head of the Europe & Middle East region for chemicals at CRA International



Paul Hodges
chairman of UK-based consultancy International eChem, an adviser to the chemical industry and the financial community



Robert Kirschbaum
vice president of open innovation at DSM, in the office of the chief technology officer



Dr. Gernot Klotz
executive director for research and innovation at Cefic and manager of the SusChem sustainable chemistry platform



Dr. Gregg Zank
vice president, chief technology officer and executive director for science and technology at Dow Corning



bringing together as it did a diverse industry group to work on product stewardship issues along the agrochemical and intermediates supply chain. As Hodges noted: "This is very difficult but worthwhile and even if the discussion is still in the qualitative stage, it has got a lot of people focused on the key issues."

You can read all about the successful entries on the following pages. Each winner has been interviewed and the background to the innovations, the problems overcome and the benefits to be gained outlined and explored.

The winning entries demonstrate that there is plenty of scope for new business, both in mature sectors like road building and emerging areas like biofuels.

» For more on the ICIS Innovation Awards, go to www.icis.com/awards

On the right road

An innovative surfactant technology that reduces the energy input and environmental impact when producing and laying road surfaces earned Arkema's CECA subsidiary the top slot in the Best Product Innovation category

AS INNOVATIONS go, the surfactant formulation developed by CECA for use in asphalt production is huge, even though it is added to the bitumen/aggregate mix in very small amounts. Production of asphalt in Europe stands at around 350m tonnes/year; in the US, it is an even greater 500m tonnes/year.

As the bitumen itself is added to the aggregate in small amounts (the ratio is typically 5:95 by weight) and is highly viscous, the entire aggregate has to be heated to ensure complete wetting by the bitumen during mixing. On a global basis, heating asphalt to 180°C (356°F), as is necessary with traditional "hot mix" techniques, is estimated to use 8m tonnes/year of fuel.

Dubbed *CECABASE RT*, the product is heralded by CECA as a formulation "for greener roads." Its use, it says, can cut energy consumption by up to 50%, by lowering the hot mix temperature from 180°C to 140°C, while notably improving working conditions and environmental impact, in terms of lower generation of

dust, greenhouse gases and volatile organic compounds (VOCs).

Moreover, its use allows night work and a quicker reopening to traffic, thus reducing the disturbances and pollution created by road works.

Its use, in what has come to be called "warm mix" asphalt, can also increase the

CECABASE RT contains 60% renewables and the search is on to increase this further

proportion of Reclaimed Asphalt Pavement (RAP) that can be incorporated in the new asphalt surface being laid. Levels of 50% of RAP can be achieved at normal heating temperatures.

These benefits, explains Franck Charrier, asphalt additives manager at CECA, are

achieved while at the same time keeping the properties of the asphalt mix constant – or even improving them – and without the need for investment in additional or special equipment. Furthermore, productivity in asphalt mixing can be increased by up to 30%.

The key to the innovation is the way the surfactant controls the bitumen/aggregate interface structure. This greatly reduces internal friction, which translates into the major reduction in the required application temperature of the bitumen mix. In practice, road surfaces can now be laid with the asphalt mix at just 120°C, 40°C lower than previously.

Charrier explains that CECA is a part of Arkema that is dedicated to specialty chemicals, both mineral and organic, which are usually tailor-made for specific uses and bring added value to the customer.

CECA has been active in the road additives sector for many years, offering emulsifiers that help create bitumen/water emulsions.

A WORD FROM BEST PRODUCT INNOVATION SPONSOR



CRA has been proud to participate as a sponsor and panel judge of the ICIS Innovation Awards 2009. We are particularly encouraged by the unprecedented number of high-quality submissions in the Best Product Innovation category, a fact that reinforces our view that innovation remains vibrant in the chemical industry, despite the current industry environment.

We would like to thank all of the companies and individuals that participated. In particular, we would like to extend our congratulations to the Best Product Innovation category winner, CECA/Arkema. CECA's surfactants

for "greener roads" are an innovation, built on sound commercial and environmental advantages, which brings extensive collaborative technology developments to market.

Congratulations to all of the 2009 winners.

Dr. Neil Checker, vice president, CRA International

CRA
International



It is a major player here, but the emulsion technology accounts for only around 10–15% of the road surfacing market. The main bulk of the market uses hot mix technology, but because of the high energy and environmental impacts, road builders have been looking for improvements in the technology.

“We saw the time was right to propose new products and decided to look at this problem in 2003,” says Charrier. “So we carried out research at Arkema’s research center (Centre de Recherche Rhone-Alpes) in Lyon.” Here, CECA has a group dedicated to the bitumen business, led by new research manager Gilles Barreto, but it had to set up new expertise, train people and develop new skills for this emerging technology.

Today CECA employs about 10 people in this area, which forms a significant part of the company’s surfactant research and development effort.

CECA already had a range of surfactant products in its portfolio on which to base development, including oil field additives, and fertilizer additives. It set about screening these and also developing new formulations using its core knowledge in fatty acids and fatty amines.

A key part of the development requirement was Arkema’s insistence that new products have a high content of raw materials obtained from renewable sources. Charrier points out that *CECABASE RT* contains 60% renewables and the search is on to increase this further. There were also stringent conditions on the formulation in terms of toxicity and eco-toxicity and safety in environmental terms.

Since the product’s launch in 2006, there has been a significant uptake of the technology, and many road contractors are carrying out field trials in a variety of climatic conditions and geographies, including Europe, Russia, North America and Australia. In 2008, some 400,000 tonnes of warm mix asphalt was laid.

If the entire West European market shifted to warm mix, says CECA, it would save the equivalent energy consumption of 55 New York-London daily flights every year, with a drop in associated carbon dioxide emissions of more than 2m tonnes/year. Surely that is something worthy for the road construction industry to aim for. ■

▶ For more information on CECA, go to www.arkema.com/sites/group/en/products/business_units/ceca.page



...and road laying are both improved in environmental terms with CECA’s innovative additive

LUCITE INTERNATIONAL GAINS A SPECIAL MENTION

In the hotly contested Best Product Innovation category, Lucite International received a special mention for its development of a new route to methyl methacrylate (MMA). Late last year, Lucite successfully started up its first commercial MMA plant using novel *Alpha* technology. The 120,000 tonne/year unit, built in Singapore, “worked like a dream,” says David Johnson, senior monomer chemist at the UK-based company.

The plant is the culmination of 15 years of intense innovation and development work, during which time Lucite researchers and academic collaborators developed two highly active and selective catalysts for the main reaction steps and a novel separation technology using complex distillation. “It has been one of the biggest research projects in heavy chemicals in the past 10 years,” notes Johnson.

The process enables MMA to be made from the readily available feedstocks ethylene, methanol and carbon monoxide and has a series of key benefits over traditional process routes. It eliminates inventories of toxic and corrosive materials; minimizes by-products and thus waste treatment; has good conversion rates and can be easily scaled up in size.

As a result, says Johnson, the *Alpha* process has the capability to realize cost savings of more than 40% compared with conventional processes. “The process is not derivative – it is a completely new process with no ties to anything in the past,” explains Johnson.

Lucite, recently acquired by Japanese fibers producer Mitsubishi Rayon, is now planning a second, much larger unit in Saudi Arabia, with Saudi chemical giant SABIC as partner, and later on a third addition. Work is now underway to improve the technology by studying the Singapore unit in operation. This is already performing better than expected from the pilot scale operation because of beneficial scale effects but, adds Johnson, some technology issues were missed that can be put right in the next plant.

He also indicates that Lucite is continuing to perform novel research to improve some of the higher cost, higher waste areas in the technology. Improvements here, he indicates, could further cut costs in capital, utilities and raw materials. “We have two or three ongoing projects, with one very promising for early stage implementation.”

Riding the mega trends

2008 ARTISTS RIGHTS SOCIETY (ARS), NEW YORK/DADGP, PARIS

Dow Corning's Jean-Marc Gilson explains the company's approach to innovation and the importance of macro trends in its strategic thinking

Project success: Beijing's National Grand Theater

IN THE world of silicones and silicon-based technology, opportunities for innovation abound almost without limit. And, with a strategy firmly anchored on growth through innovation, Dow Corning believes it is well positioned to reap the rewards on offer.

But you need a vigorous process for selecting the markets in which to innovate, explains Jean-Marc Gilson, executive vice president and general manager for specialty chemicals and president for Asia at Dow Corning. "You have to decide where the biggest needs of customers are and where the most commercial prospects are."

Taking a broad overview, Dow Corning is directing its innovation energies into areas that sit within a number of emerging societal macro trends. The most important of these, says Gilson, are the global trends towards urbanization, the use of renewable energy and the aging world population.

MACRO TRENDS SHOW THE WAY

These macro trends, also called mega trends, are opening up a wide vista of opportunities in sectors as diverse as construction and water management, solar energy and electronics,

personal care products and health care.

"We are investing in many segments, but we have a very strong focus on some key areas," Gilson explains. In construction, for example, Dow Corning is developing more efficient foam insulation products and glazing technologies that will help improve the energy efficiency of new buildings.

In the solar energy sector, it has introduced a novel polycrystalline silicon, as well as new ultraviolet-resistant encapsulation technology (see side panel), both of which lower the cost of energy production using solar cells.

In electronics, Dow Corning is developing new materials with a high refractive index that will support the introduction of light-emitting diodes into the lighting sector, and is looking to develop compound semiconductors of silicon carbide and gallium

nitride to enable miniaturization of high-power devices such as transmitters. These may find uses, for example, in hybrid cars.

In the area of skin care, Dow Corning plans to introduce silicone naturals into the marketplace, based on hybrid molecules containing siloxanes and sugars. Called sugar siloxanes, these materials are produced by reacting sugar-like molecules (saccharides) with silicones, creating interesting new properties.

For example, liquid silicone can be converted into solids such as powders, waxes and gums. Dow Corning scientists have evaluated these new sugar functional siloxanes and see great promise for their use in diverse applications, including hair conditioning, anti-wrinkling fabric care, liquid bandages and other health and personal care applications. Dow Corning is working closely with key personal



"You have to decide where the biggest needs of customers are and where the most commercial prospects are"

Jean-Marc Gilson, executive vice president and general manager, specialty chemicals, Asia president, Dow Corning

care firms towards future commercialization.

All of these innovations, explains Gilson, can be seen as arising from the main macro-trends that Dow Corning has identified as relevant to its innovation effort, given its existing core expertise and product portfolio. Many of them have been developed through Dow Corning's focus on longer-term innovation, designed to drive it into major new technology areas and platforms. In some instances, development projects have been underway since early in this decade.

As Gilson explains, Dow Corning splits its innovation effort into three broad areas, characterized by different time horizons – short term, over one to three years; medium term, over three to five years; and longer term, generally five to 10 years.

Projects in the first horizon are typically focused on product commercialization, while in the medium term, the company is looking to bring novel products through its technology incubator unit. The third horizon – encompassing both business and technology innovation – gives Dow Corning the time to develop new platform technologies in major new areas, such as polycrystalline silicon and the silicone-sugar hybrids.

These three time lines need to be kept strictly separate, says Gilson. “The worst thing you can do is start on a long-term innovation and then begin to mix the cycles. We have a commitment within Dow Corning to maintain the three-horizon time lines and to be patient for results.” If there is pressure from the market to introduce lots of new products quickly, he adds, there is a tendency to forget the longer-term innovation. But then, he warns: “The pipeline will soon dry up.”

ACROSS THE HORIZONS

Innovation in horizon requires a slightly different setup for maximum effectiveness. Short-term, largely product-based innovation is carried out globally by Dow Corning, with facilities close to customers in all major markets. In Asia, this means research and development and technical centers in Japan, South Korea, China, India and also Thailand.

For the medium-term innovation, argues Gilson, although fewer people are involved, critical mass is important and so the effort is concentrated in the US, Europe and Japan. Longer-term innovation is based mainly in the US, with some activity in Asia. In terms of manpower and financial commitment, the near-horizon innovation accounts for 70% of resources, medium-term innovation 20% and long-range innovation about 10%.



Dow Corning focuses on longer-term innovation

In Asia, Gilson identifies several different approaches to innovation across the region. In Japan, for instance, because of the structure and maturity of the market, innovation is much more incremental than in other developed economies. It is also more customer centric, he says, “and mostly driven by what customers are asking you to do.” This is different to the US and Europe, Gilson adds, where you can take a step back, innovate and actually bring new offerings to your customers.

In China, by contrast, there has been a strong emphasis on new product commercialization, usually with a one-year focus. But this is changing rapidly. “Industry here is still nascent but developing quickly and we are now seeing an [innovation] approach closer to that in the US and Europe.”

Gilson points to construction and electronics as the two main sectors that are driving the change and maturing rapidly in China. “We have to provide the right solutions to the market,” notes Gilson: “You don’t succeed [here] if you don’t innovate and we are adding people now and bringing in our best technology.”

Dow Corning has invested in an applied technology service center in Shanghai and the business plan is to expand its technical footprint in China as it will soon be a major market. “It will become the single largest market for silicon materials within the next five to 10 years and one of the biggest producers too.” In the future, he warns: “You won’t win if you can’t succeed in China.” ■

» For more information on Dow Corning, go to www.dowcorning.com

SOLAR CELL ENCAPSULANTS

Dow Corning executive vice president and general manager, specialty chemicals, and Asia president Jean-Marc Gilson regards the company's development of silicone-based encapsulant technology for solar cells as a prime example of its longer-term innovation effort. The materials and associated application technology are claimed to improve the performance of solar cells, effectively lowering the cost per kilowatt-hour of solar power.

The Dow PV-6100 encapsulant series relies on the ultra-violet stability of the silicone molecule to deliver improved durability and increased efficiency for crystalline modules compared with the conventional organic products.

In addition, the new processing platform, being developed in close cooperation with customers, offers lower capital costs and higher manufacturing throughput, thus lowering the total cost of production.

Gilson notes that the Dow Corning PV-6100 encapsulant series delivers a 1% relative efficiency gain over the commonly used ethyl vinyl acetate resin. The new technology can be used to encapsulate both crystalline and amorphous silicon thin-film modules, providing an ultra-transparent layer of protection for the solar cells assembled in a solar panel.

Think big!



Chemical companies are increasingly basing their longer-term thinking on where to place their innovation efforts around the mega trends in today's global society

PACE-SETTING INNOVATORS in the chemical industry are increasingly focusing on emerging social and economic mega-trends to decide where to place innovation efforts and budgets. This calls for a strategy focused on the longer term, and not just the short and medium-term developments that enable firms to compete in existing markets.

Neil Checker, vice president in the chemicals practice of US consultancy CRA

now if they can do anything else or anything better," explains Checker.

But to create a sustainable innovation pipeline and business, mega trends offer the best potential. Checker cites opportunities to address diverse areas such as energy efficiency, transportation, and water and food scarcity. And these are indeed being taken up by the major innovators in the industry.

Last year, Dow Chemical detailed how

"perfect fit" with its corporate portfolio priorities. And, importantly, it believes they will "generate multiple business opportunities and have a positive impact on DSM's profile."

Another example is German chemical group Evonik Industries, which has been establishing innovative science-to-business centers focused on major platform developments around emerging mega trends. These include its Bio-center, designed to develop biotechnology products from natural raw materials, its Nanotronics center, which aims to develop systems solutions based on nano-scale materials for electronics applications, and a process intensification project house to work on process strategies and reactor concepts for more flexible production facilities for specialty chemicals.

But companies face several challenges in successfully adopting this longer-term, strategic approach. Identifying which mega-trends are appropriate to a company's core technology capabilities and overall business strategy is one thing. Turning the potential into commercial innovations is another.

"Companies have to work out how to manage the process of bringing high-level thinking down to the practical level for implementation," notes Checker. "On a practical level, do they have the technology solutions in house or do they need to develop, joint venture or acquire technology – and what implications does this have for intellectual property rights [and so on]?"

Checker explains that there has to be a vital link between business and technology strategy. "Putting the right technology management systems in place ensures businesses get the maximum leverage... and understanding your competitive position in those technologies that are vital for success ensures your technology portfolio remains healthy."



"Companies have to work out how to manage the process of bringing high-level thinking down to the practical level for implementation"

Neil Checker, vice president, CRA International

International, sees many companies beginning to think longer term about strategy and innovation and how to build new capabilities and technology platforms with the potential to generate significant new revenues.

It is not just European and US companies that are adopting this route. CRA is seeing similar government-sponsored approaches in the Middle East. He adds: "There is no set cut-off period for this [longer-term thinking] but, in general, companies need to be looking ahead 10 years and more and asking what are the major trends in and around society and industry. They then need to redesign their innovation pipeline to take advantage of these opportunities."

This approach differs from short-term, tactical thinking, largely driven by process improvements to increase efficiencies and reduce costs, and the medium term, say four-five years, where new product development for existing end-use markets is the norm.

Today's trends in coatings, automobiles and electronics, for example, will have an impact on a company's products and processes in five years. "They need to be asking

it would be focusing its organic growth on four global mega trends: energy, transportation and infrastructure, health and nutrition, and consumerism. Within each of these areas, it has identified key themes. For example, in energy, it expects moves to higher energy efficiency standards in buildings and increased use of renewable energy.

Similar thinking is apparent at Dow Corning, which has identified urbanization, renewable energy and the aging population as three key mega trends relevant to its business (see pages 22-23). These are driving longer-term innovation in the construction, photovoltaics and personal care areas, for example. So too, at Dutch life science and materials company DSM, which is focusing innovation on four emerging business areas, driven by global mega and technology trends: biomedical materials, specialty packaging, personalized nutrition and white (or industrial) biotechnology.

In selecting these areas for innovation focus, says DSM, it has taken into account that they build on its existing capabilities in terms of market and technology, and are a

» For more on CRA, go to www.crai.com/chemicals

One small step...

Carefully combining two innovations brought Oxford Catalysts and Velocys success in the category for Best Innovation by an SME

PRODUCTION OF liquid biofuels such as diesel and jet fuel from organic materials including municipal waste, is an attractive proposition. But using conventional large-scale plants requires bulky waste to be transported, often over long distances, negating some, if not all, of the environmental benefits.

An alternative being developed by UK-based Oxford Catalysts and its US subsidiary Velocys is distributed production based on the use of small-scale, high-intensity plants located close to the source of the waste. Microchannel reactors, combined with highly reactive *Fischer-Tropsch* (*F-T*) catalysts optimized for use in them are central to the distributed production approach.

The plants will work by converting synthesis gas (syngas – a mixture of carbon monoxide and hydrogen produced by gasifying the biomass waste) into the liquid fuels. A wide variety of carbon-containing materials, such as plant biomass-like crop residues and lignocellulose waste from trees, animal-derived waste, and municipal solid waste can be used as feedstocks.

"In contrast to conventional *F-T* biomass-to-liquid (BTL) plants, which are designed to process at least 10,000 tonnes/day of feedstock, the microchannel reactors can operate

economically when handling just 500–2,000 tonnes/day, and achieve productivities that are orders of magnitude greater than for conventional *F-T* reactors," explains Derek Atkinson, business development director at Oxford Catalysts. Depending on the gate fee for the feedstock, the process could be economical at oil prices as low as \$60/bbl.

The *F-T* catalysts arose from pioneering work carried out 15 years ago by Malcolm

oped by Velocys, based in Plain City, Ohio, and acquired by Oxford Catalysts from US nonprofit organization the Battelle Memorial Institute last year. In recent trials, a pilot-scale microchannel *F-T* reactor system was operated successfully for 4,000 hours. The volumetric productivity of the test reactor, defined in terms of kg of product per cubic meter of catalysts per hour, was 10–15 times greater than current *F-T* reactors.



"Microchannel reactors can operate economically when handling just 500–2,000 tonnes/day [of biomass feedstock]"

Derek Atkinson, business development director, Oxford Catalysts

Green at the inorganic chemistry department of the UK's University of Oxford. Oxford Catalysts was spun off in 2004 to commercialize this and other technologies.

In these catalysts, the crystal size is tightly controlled by means of a patented preparation technique known as organic matrix combustion. This results in a highly active and very stable *F-T* catalyst, which is characterized by stable performance and long life in the reactor before replacement is required.

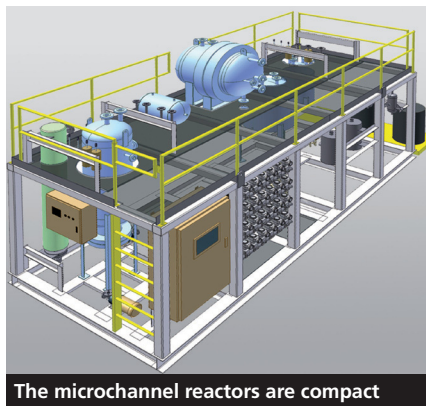
The microchannel reactors are based on the use of microchannel process technology, a developing field of chemical processing that exploits rapid reaction rates by minimizing heat and mass transport limitations. Microchannel reactors are made up of individual modules, each just 2ft³ (0.6m³) in size and capable of producing 25bbl/day of liquid fuel. In the modules, the key process steps take place in parallel arrays of microchannels, each with diameters in the range 0.1–5mm. Plant size can be increased by adding additional modules, reducing capital and operating costs.

The microchannel reactors were devel-

A number of commercial-scale demonstration units will be commissioned during 2009 and 2010, leading to full commercialization in 2011, he adds. One of the demonstration trials is being carried out in the town of Güssing, Austria – a leader in the use of alternative technologies that is determined to be a true carbon-neutral community. There, a small skid-mounted 26gal/day (100 liter/day) *F-T* unit will be installed alongside a wood chip-fired gasifier that produces heat and power for the town, and a synthetic natural gas facility. The facility is expected to be operational in January.

The microchannel reactors show potential in other areas, too, says Atkinson. They offer a convenient route to hydrogenation of *F-T* waxes to produce the diesel and jet fuel, without the use of high-pressure hydrogen. In addition, they are very useful in situations where either the reactants or intermediates are hazardous and therefore safety concerns are an issue.

» For more information on Oxford Catalysts, go to www.oxfordcatalysts.com



The microchannel reactors are compact

Market clarity

It is unusual for chemical producers to capture the value of innovation by creating their own consumer brands, but this approach by DSM put it first in the Best Business Innovation category

WHEN THE functional coatings platform within the DSM Innovation Center realized it had developed the basis of a viable technology for coating sheet glass, it sat down to consider the best way to take it to market as quickly as possible.

Had it followed the conventional route for the chemical industry, it would have sold the coating formulation to glass manufacturers. But the Dutch life science and materials company decided to enter the market directly, with its own consumer brand for picture framing glass, *claryl*.

The results have been rapid. Within three years from concept, the product was intro-

duced to the picture framing market. It is now sold in 1,500 framing shops in 15 European countries. Next year, it will enter the US market. The approach has meant DSM has had to

invest in its own sheet glass coating facility in the Netherlands. This was expanded by 50% in September 2008 because of high demand. Nicolaas Viets, platform director for functional coatings, says that a key success factor in this business innovation was the in-depth market research DSM conducted among the different players in the value chain, both through consumer surveys and focus groups. These helped it understand the drivers of the different players in the market. It clearly showed that consumers were willing to pay a significant premium for this type of glass.

Inge Massen, branding and communications manager, adds that this was in strong

contrast to the picture framers, who were hesitant to promote the product actively, as they perceived the customer was unwilling to pay the premium for the added functionality. As a result, DSM opted to go directly to market with *claryl* and focused its marketing efforts not only on advertising directly to the public, but also on convincing the distributors of the glass and the frame shops of *claryl*'s merits.

RETAIL SECTOR ADVANTAGE

The benefits of targeting the retail sector picture glass application, explains Goudappel, is that it could be deployed quickly into the market, without lengthy certification.

Nicolaas Viets explains further that starting from expertise in organic hard coatings and optical coatings for polymeric substrates at DSM's Desotech unit in the US, DSM decided to look at expanding the application to glass substrates. It went back to the drawing board and came up with an inorganic coating that performed well. In line with DSM's open innovation philosophy, the company also licensed technology from a UK university to speed up the development.

"The next target," says Viets, "is in coating glass for use in solar modules. The anti-reflective coating can increase transmission by 3–5%, leading to similar increases in energy yield." In this case, DSM will license the technology to producers of the specialist glass.

It is now seeking to increase the application throughput rate and move from a batch dipping of glass to an online coating process for larger sheets of glass, as it enters the higher-volume solar modules market.

From just two to three researchers in the functional coating group at first, there are now more than 30 employed in the functional coatings business, in research and development, on the plant, in customer support and business development. The innovative approach in this case has paid off handsomely. ■



"The next target market is in coating glass for use in solar modules. The anti-reflective coating can increase transmission by 3–5%"

Nicolaas Viets, platform director for functional coatings, DSM



DSM's *claryl* framing glass has found a niche

Also key to its success is the fact that it fits comfortably in the market at a price between existing high-end antireflective and ultraviolet protection glass, and the plain float glass product at the low end of the market. Central to its cost effectiveness is the fact that the coating is applied in a simple one-stage, wet dipping process, rather than using conventional multistep processes, often involving vacuum deposition.

The coating technology, explains Remko Goudappel, business director for functional

» For more on DSM innovation, go to www.dsm.com/en_US/html/innovation/DSM_Innovation_home.htm

Dust-free future

Tata Chemicals' solution to environmental problems at a soda ash facility has earned it the award for Best Innovation in Corporate Social Responsibility

IMAGINE HAVING to remediate up to 30 acres (12ha) of highly alkaline and saline land in a drought-prone area on the north-west coast of India – not an easy problem to tackle, but an essential one to solve.

Tata Chemicals, the world's second-largest producer of soda ash, began its journey as a synthetic soda ash manufacturer in Mithapur, Gujarat, on India's west coast.

As operations here expanded, so did the local population. Over the years, housing has come closer to the site and dust fly-up has become a growing nuisance.

Indeed, solid waste disposal is one of Tata's biggest concerns. Before setting up a facility

acreage was possible. To assist, it enlisted the services of The Energy & Resources Institute (TERI – the erstwhile Tata Energy Resources Institute copromoted by Tata Chemicals about 30 years ago), in New Delhi.

TERI has expertise in plant selection and also the identification and isolation of special microorganisms that help plants survive in lifeless soils by extracting nutrients that are normally not available. Working together, Tata and TERI identified compatible bacterial and mycorrhizal mixtures and inoculated the plants' roots when the plants were still young. They also treated the sediments with the microorganisms on site.



"Nature was the best teacher.... There is no more dust and the surrounding community is very happy"

Neti Satya Subrahmanyam, project manager

to convert solid wastes, such as limestone fines and fly ash into cement in 1993, and expanding this plant in 1999–2000 to use effluent solids as raw materials, all the solid waste generated was stored at a corner of the site called Malara.

The conventional approach of wetting the wastes with seawater, practiced for some 20 years, was deemed no longer suitable or sustainable. So the firm began to look at an alternative approach and a permanent solution.

The answer, amazingly, given the nature of the land, was to cover it with a plantation of specially selected plants and grasses. Neti Satya Subrahmanyam, who has managed the project for the past eight years, explains that in this case, "Nature was the best teacher."

Tata had already observed that certain types of shrubs and grasses were eking out a living in such harsh conditions, so the team decided to see if cultivation of the waste

"It was a challenging project," says Subrahmanyam. "The alkalinity and salinity were very high and it proved difficult to cultivate the plantation."

SUCCESS STORY

The project is a success and 22 out of the 30 acres have been converted to lush green plantation. "There is no more dust and the surrounding community is very happy," says Subrahmanyam. Besides solving the dust problem, he says, the project has created 12–15 jobs locally – with workers employed in the nursery to raise the saplings before planting and to maintain the plantation.

In a key parallel initiative, Tata has developed patented technology to separate solids from the liquid effluent streams of the soda ash plant. It uses the solid waste to manufacture cement, so the soda ash effluent no longer has to be dumped into the settling ponds.



Cultivation program has yielded results

Tata Chemicals vice president Jacob Mammen says the Malara project is a good example of Tata Group's CSR policy to improve the quality of life of the communities it serves. In 1980, the firm set up the Tata Chemicals Society for Rural Development, which works to protect and nurture rural populations in and around Tata Chemicals' facilities, and helps the community achieve self-sufficiency in natural resource management, livelihood support and the building of health and education infrastructure.

He points to many other community initiatives around Tata's facility, including the construction of check dams to help store monsoon waters for the 14 villages nearby, building schools and medical facilities, and provision of technical training.

Mammen highlights two other important CSR initiatives. One has stimulated self-help groups in villages and encouraged the women to produce handicrafts (which are sold under brand name *Okhai*), which Tata Chemicals then buys from them.

The other is in establishing a fund to finance children's education. For every bag of table salt or soda ash it sells, Tata makes a contribution to the fund. In the case of table salt, this is 10 paise (\$0.002) for each 1kg bag.

It is our philosophy, Mammen adds, that at all our manufacturing sites "we hope to grow alongside the growth of the community." ■

» For more information on Tata Chemicals, go to www.tatachemicals.com