



### Markets and Companies

China's mid-level chemical market offers opportunities for Western companies

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FOR THE CHEMICAL AND  
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### Chemicals

Ionic liquids from the vantage point of an industrial-scale supplier

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### Newsflow

Solvay, the Belgian drugs, chemicals and plastics maker, said it has bought Egypt's state-controlled Alexandria Sodium Carbonate Company. Solvay was the preferred bidder for the firm after agreeing to pay €100 million for the producer of soda ash, a principal ingredient for glass.

Since the end of September, BASF has reduced its worldwide production of caprolactam to about 65%. The reason for this measure is the high cost of raw materials and energy as well as the unsatisfactory market demand. This decision involves production at the sites in Freeport, Texas; Antwerp, Belgium; and Ludwigshafen, Germany. The company said that this will not affect the number of employees at those locations.

The Linde Group expands gases supply in Ningbo (China) and has entered into two new contracts for the on-site supply of gases to the companies Ningbo Iron & Steel and Hanwha Chemical Corporation (HCC). Under the agreements, Linde will build an additional air separation plant at the emerging industrial site on the Yangtze delta, an investment of around €17 million.

Chemengineering will open a subsidiary in Serbia. Starting from December, the new office in Belgrad offers the whole range of Chemengineering's services, including GMP-consulting, Engineering, qualification and validation etc.

Arkema has successfully doubled the production capacity at its Wujing (Shanghai, China) hydrogen peroxide plant, which increases the capacity to 80,000 t/y.

Lanxess invests around €35 million in its group of facilities for the production of basic chemicals in Leverkusen, Germany. The specialty chemicals group is expanding capacity of cresols and their derivatives and monochlorobenzene for the global market by up to 60%. Work on extending production plants is scheduled for completion by the beginning of 2010.

The Linde Group, via its Swiss subsidiary PanGas, is to build a new air separation plant in Muttens, in the Swiss canton of Basel Land, for around €44 million. The new plant, which will have a capacity of over 500 t of liquefied nitrogen, oxygen and argon per day will come on stream in late autumn 2010.

**Working Together** – Long gone are the images of smoke-filled board rooms, with white-haired men running the businesses of the world. Today's corporate landscape looks much different than what our grandfathers were used to; diversity is a key element to any company's success, particularly in the traditionally male-dominated world of chemicals.

Many companies have recognized this trend and have begun to intensify efforts to diversify their workforces. Underlining the importance of heterogeneity, Henkel established the position of diversity manager in November 2007. Anke Meier – a 12-year Henkel expert with extensive experience abroad – is the first to fill these shoes. Brandi Schuster spoke to her about her first year on the job and about what the word diversity actually means.

*CHEManager Europe: Ms. Meier, how has your first year been as Henkel's first diversity manager?*



Globalization has also become a household term over the last decade, and this is reflected in Henkel's growth strategy.

Anke Meier, Henkel

**A. Meier:** It has been very exciting to bring in external developments in the world into the company. Diversity is not only an internal company program; rather it also reflects society and demographic developments all over the world. Thanks to having more access to education, for example, more and more women are entering the workplace, even in lesser-developed countries. Globalization has also become

a household term over the last decade, and this is reflected in Henkel's growth strategy.

*How do people understand diversity? What are the different things that you heard?*

**A. Meier:** Diversity is often understood as being only a matter of gender. Some people think that diversity is a given once more women are put in man-

agement positions. For others, it means internationalization and training employees from different countries to work together. While diversity does involve these elements, it is also much more than just gender or nationality. We have to respect each individual, and the strengths and potentials they bring into the company. That really unleashes the full power of diversity.

*How has the acceptance been within the company over the last year of having a diversity manager within Henkel?*

**A. Meier:** The response has been overwhelmingly positive; however, there were questions regarding the necessity of diversity and whether Henkel was already international enough.

Communication has really been the key in helping our colleagues overcome any uncertainties.

*What was behind Henkel's 2006 decision to create the Diversity Cockpit?*

**A. Meier:** We use the Diversity Cockpit which helps integrate age, gender and nationality into the company's worldwide management structure, to measure the development of diversity. Of course, we can only measure some elements, such as age, gender and nationality. There are many other aspects that are not measurable, but having the Diversity Cockpit gives us at least a starting point; it also helps me to communicate diversity, to focus people on certain areas and to raise awareness and understanding.

*How has this active effort to diversify Henkel affected the business?*

**A. Meier:** That is something that can't be measured for the time being. However, people have become much more conscious when putting teams together with respect to diversity. Many teams are now cross-cultural, and Henkel offers seminars to ease the communication between cultures.

*While this can be seen as an enrichment, are there also conflicts that arise from such constellations? How are these dealt with?*

**A. Meier:** The most common problem is people not understanding each other, not because they don't speak the same language, but because body language and culture rules differ all over the world. There are people who always speak up on their own, and there are people who want to be asked. Some don't have a problem with conflict, some do. Also, men and women think and act differently. The main task here is to make sure people understand

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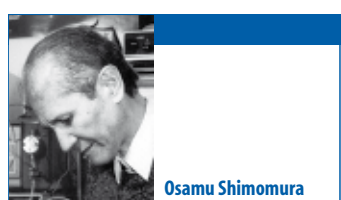
## Americans Share Nobel Prize in Chemistry

### Glowing Proteins – A Guiding Star for Biochemistry

**Bright Idea** – The brightly glowing green fluorescent protein, GFP, was first observed in the jellyfish, *Aequorea victoria* in 1962. Since then, this protein has become one of the most important tools used in contemporary bioscience.

With the aid of GFP, researchers have developed ways to watch processes that were previously invisible, such as the development of nerve cells in the brain or how cancer cells spread.

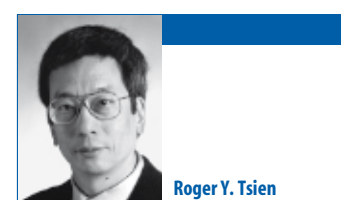
Tens of thousands of different proteins reside in a living organism, controlling important chemical processes in minute detail. If this protein machin-



Osamu Shimomura



Martin Chalfie



Roger Y. Tsien

ery malfunctions, illness and disease often follow. That is why it has been imperative for bioscience to map the role of different proteins in the body.

This year's Nobel Prize in Chemistry rewards the initial discovery of GFP and a series of important developments which have led to its use as a tagging tool in bioscience. By using DNA technology, researchers can now connect GFP to other interesting, but otherwise invisible, proteins. This glowing marker allows them to watch the move-

ments, positions and interactions of the tagged proteins.

Researchers can also follow the fate of various cells with the help of GFP: nerve cell damage during Alzheimer's disease or how insulin-producing beta cells are created in the pancreas of a growing embryo. In one spectacular experiment, researchers succeeded in tagging different nerve cells in the brain of a mouse with a kaleidoscope of colors.

The story behind the discovery of GFP is one with the three

U.S. Nobel Prize Laureates in the leading roles:

Osamu Shimomura first isolated GFP from the jellyfish *Aequorea victoria*, which drifts with the currents off the west coast of North America. He discovered that this protein glowed bright green under ultraviolet light.

Martin Chalfie demonstrated the value of GFP as a luminous genetic tag for various biological phenomena. In one of his first experiments, he colored six individual cells in the transpar-

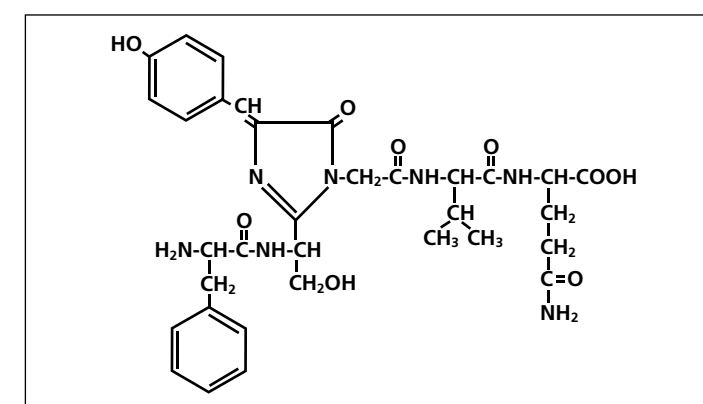


Fig. 1: The fluorescence chromophore formed by amino acid residues 65-67 (Ser-Tyr-Gly) in the primary structure of GFP (From Cody et al., 1993).

ent roundworm *Caenorhabditis elegans* with the aid of GFP.

Roger Y. Tsien contributed to our general understanding of how GFP fluoresces. He also extended the colour palette beyond green allowing research-

ers to give various proteins and cells different colors. This enables scientists to follow several different biological processes at the same time.

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### Altana CEO Plans Future Acquisitions

Altana chief executive Matthias Wolfruber is planning to make further acquisitions in the future. "It is safe to say that we will always make complementary acquisitions," he was quoted as saying. "Of course, we are always looking around in the market and developing concepts," he added. He did not rule out making acquisitions in the billion euros range, but said that size alone is not necessarily the main criteria. "We always emphasise that



acquisitions have to be value-creating. This also refers to the price. If the price is not right, we will not make an acquisition."

### Lanxess to Acquire Pigment Plants in China

Lanxess said it agreed to buy two Chinese construction pigment factories from its cooperation partner Jinzhuo Chemicals Company in order to benefit from Asia's construction boom. The move will increase the company's global production capacity for inorganic pigments of about 300,000 t/y by 5%, the company said in a statement, without disclosing the deal's financial terms. The inorganic pigments produced at the sites in Jinshan near Shanghai are used to colour construction materials such as roofing tiles, paving blocks and concrete but they also go into paints,



coatings, plastics and paper. The German chemical maker said it expects the Asian construction industry to grow by about 5% annually in coming years. Lanxess had already leased one of the plants, Lanxess added.

### Swiss Takeover Board: No Ciba Extension

In a letter, the president of the Swiss Takeover Board has rejected a request from the Bestinvestor investor group to extend the offer period for the public takeover offer to shareholders of Ciba and to supplement the board of directors' report and the fairness opinion (an opinion from an independent expert on the financial adequacy of the offer price).

"We welcome this decision and are very confident that more than the minimum requirement of 66.67% of

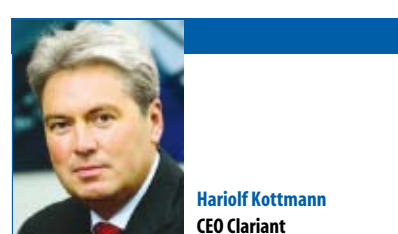
shares will be tendered by the end of the offer period," said BASF spokesman Michael Grabicki.

BASF will pay Ciba shareholders CHF50.00 in cash for each nominal share in Ciba. The offer corresponds to a premium of 32% above the closing price for Ciba's shares on Sept. 12 and a premium of 60% above the volume-weighted average share price for Ciba shares in the 30 days prior to announcement of the public takeover offer on Sept. 15.

### Clariant: Group Must Remain Independent

Swiss specialty chemicals company Clariant must remain independent, the group's new chief executive wrote in a letter to employees obtained by German newspaper FT Deutschland.

"Clariant must remain an independent, listed company based in Switzerland," Hariolf Kottmann wrote, according to a version of the FTD story. "Clariant should be neither broken up nor sold out in pieces. We are also not planning any mergers with a competitor," Kottmann wrote in the letter. In September, Clariant said Kottmann would take over as new CEO in October from Jan Secher,



who only joined the company in 2006. Speculation has swirled that Clariant could be bought after Germany's BASF launched a bid for rival Ciba. Kottmann said the main priority in 2009 and 2010 would be to improve the cashflow.

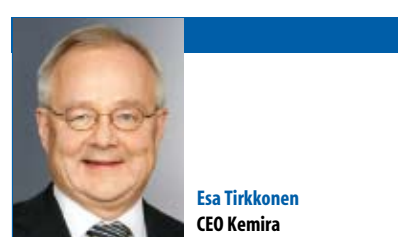
### Arkema Presents Plan to Cut Jobs

Arkema plastics unit Alphacan presented a draft reorganisation plan, proposing 31 job cuts, to its central works council. Arkema said the plan is designed to improve the company's competitiveness by "optimising its structures and reducing its operating costs." The plan involves Alphacan's headquarters in Yvelines

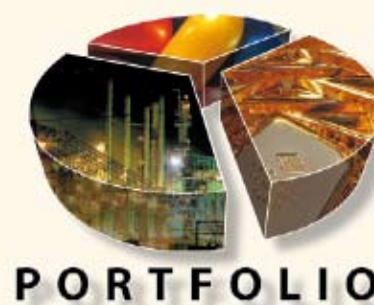
and its plant at Gaillac in the Tarn and "essentially entails the rationalization of support functions at both these sites by streamlining the operation of the teams and adapting their organizational structure accordingly," the company said. Fifteen jobs are expected to be cut at the headquarters and 14 at Gaillac.

### Kemira to Cut 300 Jobs

Kemira's co-determination negotiations, which involved the company's Finnish sites Oulu, Vaasa, Äetsä, Espoo and Helsinki, have been concluded. As result of the negotiations, the net reduction of personnel will be 298 in Finland. Out of these jobs, 191 will be direct lay-offs and 107 people will leave the company through pension schemes and termination of temporary employments. It was estimated in the beginning of the negotiations process that the net reduction would be about 300 people in Finland. It was agreed during the negotiations that a support package would be given



to those affected. The most important parts of the package will include financial support to people moving to other Kemira locations, outplacement services, a new fund for financing re-education, pension arrangements and financial compensation.



## PORTFOLIO

**Akzo Nobel to Acquire Fatty Amine Business in Europe** Akzo Nobel's Surface Chemistry business has signed an agreement to acquire part of Kao Chemicals Europe S.L.'s fatty amine business in Europe. The agreement will be completed during the fourth quarter of this year. "This transaction is in line with our strategy to focus on core markets and optimize the use of our manufacturing capacity," said Tommy Öhlin, general manager of Akzo Nobel's Surface Chemistry Europe business.

**Symrise: Two New Acquisitions** Symrise has announced the acquisition of Intercontinental Fragrances and Manheimer Fragrances as well as plans for a global air care center in the U.S. in 2009. These two moves make Symrise one of the leading fragrance suppliers for air fresheners in North America. The North American market for air care products – which include air fresheners and scented candles – amounts to over \$300 million and comprises 10% of the entire fragrance market in the U.S.. Acquiring Intercontinental Fragrances and Manheimer Fragrances significantly increases Symrise's overall share on the U.S. fragrance market and strengthens the company's position in the air care sector and on the scented candles market in particular. The Manheimer transaction is subject to the approval of the anti-trust authorities. The anticipated combined consideration for the transactions, which is partially contingent on the attainment of certain milestones, will be \$100 million. In 2008, the acquisitions will add \$12 million to group sales.

**Linde Acquires Remaining Elgas Shares** The technology group Linde said it has acquired the remaining 50% of the shares in the Australian LPG company Elgas at an equity value of €126 million. Elgas, established in 1984, was a 50:50 joint venture between BOC, a member of the Linde Group, and AGL Energy (AGL). Elgas is the biggest marketer of LPG (liquefied propane gas) in Australia and operates Australia's largest LPG storage facility at Port Botany in Sydney. The company achieved sales of around €255 million in the financial year 2007 and currently employs about 460 people. In the operating segment South Pacific & Africa, Linde achieved sales of €1.284 billion in the financial year 2007. Within the operating segment, Linde's gases sales in South Pacific increased by 11% to €755 million in 2007.





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# Respecting The Individual

## Henkel's Diversity Manager Strives to Unleash the Full Power of Diversity

◀ Continued Page 1

each other. We put diversity awareness training elements in many of our trainings, which help our employees understand that not everybody is the same and one's personal standard is definitely not the standard that applies for others.

**Does Henkel have a worldwide diversity strategy, or does this differ from country to country?**

**A. Meier:** Diversity is part of our corporate strategy. Henkel's CEO, Kasper Rorsted, has a few focus points that are important: profitability, focus on the customer and global teams. And global teams can be translated into diverse teams. Since the needs and situations vary from country to country, it is not possible to put one strategy in place globally and expect it to work. My task is to make sure that the different diversity topics country by country are identified and addressed and then acted upon.

**How does Henkel go about dealing with different laws that are present in different countries? For example, if the company's internal compliance regulations are stricter than an actual law in a given country, what does Henkel do? Do they follow the country's law in order to avoid maybe competitive disadvantages, or does it stick to its own stricter regulations?**

**A. Meier:** This can best be illustrated with Henkel's environmental policies. If our internal rules are stricter than the local laws, we expect our

employees to follow our policies. The same goes for our diversity policies, which are currently being developed. Here we are planning on specifically addressing certain tasks and targets, and of course we have to make sure that they adhere to local laws. But, as I said, if our policies are stricter, then they must be followed.

**Does that put the company at a disadvantage competitively?**

**A. Meier:** There may be a perceived disadvantage in the short term, but in general a company is much better off in the long term if it stays ahead of the regulations.

**How does Henkel insure diversity within the company without turning to quotas?**

**A. Meier:** We have established something we call the diversity rule. If a vacancy is posted and candidates are selected for the final round of interviews, we ensure that at least one of these candidates is a diverse candidate, either in terms of nationality or gender or age. That does not mean that this person gets the job – competency and potential are the deciding factors at Henkel. However, we make an extra effort to make sure that we consider diverse talents in the last round. This means that more people get more opportunities, and more diversity gets put into the round. But definitely there are no quotas, and if no diverse candidate applies for the position or is the right fit, then we go with the best competency to put the right person on the right job.

**Along these same lines, what does Henkel do to encourage women to apply for jobs in male-dominated areas?**

**A. Meier:** First of all, we have a lot of family and work-life balance programs, which are not only for women. But more importantly, we make it clear to our female employees that they get a fair chance, and our board finds it important that women are able to advance their careers, even in the traditionally male-dominated areas. That doesn't mean that we don't have divisions that are dominated by one sex or the other; and in the female-dominated areas, we also encourage men to apply for jobs there as well.

Another factor in terms of people development at Henkel is that we foster job rotation. In order to enjoy a successful career in our company, employees have to spend time in different positions, in different countries and in different business units. Because of this, we have a natural fluctuation between businesses, which also means we get more diversity, even in the male- or female-dominated areas.

**Would you consider Henkel to be a German company?**

**A. Meier:** Yes and no. Henkel is definitely of German origin, but about 80% of our sales are outside of Germany, and also 80% of our employees are working outside of Germany as well. We employ roughly 100 different nationalities and are present in more than 110 countries around the world. While our German roots are reflect-

### Why Diversity Management is Important

Diversity management is not just a nice-to-have add-on for international companies. Here are a few examples of what can go wrong when cross-cultural wires get crossed:

- Managers at one American company were started when they discovered that the brand name of the cooking oil they were marketing in a Latin American country translated into Spanish as "Jackass Oil."
- American Motors tried to market its new car, the Matador, based on the image of courage and strength. However, in Puerto Rico the name means "killer" and was not popular on the hazardous roads in the country.
- A sales manager in Hong Kong tried to control employee's promptness at work. He insisted they come to work on time instead of 15 minutes late. They complied, but then left exactly on time instead of working into the evening as they previously had done. Much work was left unfinished until the manager relented and they returned to their usual time schedule.
- A cologne for men pictured a pastoral scene with a man and his dog. It failed in Islamic countries dogs are considered unclean.
- Procter & Gamble used a television commercial in Japan that was popular in Europe. The ad showed a woman bathing, her husband entering the bathroom and touching her. The Japanese considered this an invasion of privacy, inappropriate behavior, and in very poor taste.
- An American business person refused an offer of a cup of coffee from a Saudi businessman. Such a rejection is considered very rude and the business negotiations became stalled.
- A Japanese manager in an American company was told to give critical feedback to a subordinate during a performance evaluation. Japanese use high context language and are uncomfortable giving direct feedback. It took the manager five tries before he could be direct enough to discuss the poor performance so that the American understood.
- One company printed the "OK" finger sign on each page of its catalogue. In many parts of Latin America that is considered an obscene gesture. Six months of work were lost because they had to reprint all the catalogues.
- A golf ball manufacturing company packaged golf balls in packs of four for convenient purchase in Japan. Unfortunately, pronunciation of the word "four" in Japanese sounds like the word "death" and items packaged in fours are unpopular.
- Federal Express chose to expand overseas when it discovered the domestic market was saturated. However, the centralized or "hub and spoke" delivery system that was so successful domestically was inappropriate for overseas distribution. In addition, they failed to consider cultural differences: In Spain the workers preferred very late office hours, and in Russia the workers took truck cleaning soap home due to consumer shortages. Federal Express finally shut down over 100 European operations after \$1.2 billion in losses.
- Mountain Bell Company tried to promote its telephone and services to Saudis. Its ad portrayed an executive talking on the phone with his feet propped up on the desk, showing the soles of his shoes – something an Arab would never do.

Source: Kwintessential Cross-Cultural Solutions  
[www.kwintessential.co.uk](http://www.kwintessential.co.uk)

ed by the Henkel family, our major shareholder, during a five-minute walk through our headquarters in Düsseldorf, visitors will hear people speaking Spanish, Italian, English and

many other languages. Three of our five board members are not German, and all of these factors have definitely changed the culture within Henkel. In the last 12 years I've been at Henkel,

the change has been tremendous – you can see it from the names on the office doors.

[www.henkel.com](http://www.henkel.com)

# Active Inclusion

## A Business Necessity and an Organizational Challenge

**Diversity And Inclusion – With massive demographic shifts and an increasingly complex business environment, diversity and inclusion (D&I) is at the top of the human resources (HR) agenda for many science and technology companies. However, change does not always come easy when facing a tight labor market externally and breaking cultural paradigms internally.**

To be able to attract, develop and retain diverse talents and to reap the benefits that they promise to bring, companies need an integrated change management strategy that moves D&I from "just another initiative" to "the way they work and do business every day."

### Business Environment And Challenges

Globalization, increased competition and rising raw material costs are just a few factors that have made the business environment in the chemical industry more complex, dynamic and ambiguous. Being successful requires innovation, that is finding new and different approaches to many aspects of doing business: markets, products, customers, business and organizational models, and partnerships. Employees with a wide variety of skills sets, diversity of thought, capability and style are vital to mastering the challenges ahead. Employees' talents and abilities are the key source for competitive advantage. In this context, the ability to fully engage employees and create an environment where they can contribute at their best becomes central and has been shown to impact the bottom line.

At the same time, the science and technology sector is experiencing profound shifts in its workforce. At Dow, up to 35% of



Gabriele Youd  
Dow Europe

the current workforce will be eligible to retire over the next 5–10 years. To be able to replace them it will be necessary to tap into a talent pool that is much more diverse and driven by different needs, values and priorities, than what is available inside of the company today. For the science and technology sector this talent pool is very tight. University graduates in these fields are much sought-after. In addition, the chemical industry may not always be considered the employer of choice, making it even harder to attract the necessary talent.

### The Difficulties

Many science and technology companies understand the problem and have developed strategies to attract a diverse workforce. Often these look rather similar; the same approaches are used everywhere. Competition is therefore fierce; a "war for talent" has broken out.

Internally, companies often encounter resistance to change. The support given to underrepresented groups may be perceived by other employees as a threat to themselves. They may fear that their own chances for development and advancement are diminishing, or that staffing decisions will now be made with other considerations in mind, not primarily based on merit or qualification, fears that are sometimes shared by members of the underrepresented groups receiving the support. In addition, the need to accommodate employees' differing needs and styles may be seen as complicated and potentially getting in the way of achieving necessary business results. For D&I to become "the way work gets done," these notions need to be, and fortunately can be, turned around.

### Key Ingredients For Success

The key ingredients to be able to manage this successfully are the same as in any large scale change initiative.

### Demonstrate The Business Value

While the arguments for D&I outlined are compelling, they are also very generic. Everybody understands them at an abstract level, but what they mean in terms of specific advantages for each business unit, function or department is often not clearly defined, and in many cases incredibly difficult to quantify. Being able to demonstrate the actual impact of D&I will make an important difference in people's commitment.

### Setting the Tone at the Top

At Dow, the vision and objectives for D&I have been set by the CEO and executive leadership team. The vision to enhance the diversity of the workforce is aimed at:

- reflecting the places Dow does business today and tomorrow, and
- ensuring an inclusive work environment that truly embraces the competitive advantage that comes from the diversity of style and thought
- This vision rests on three strategic goal areas that address; becoming an employer of choice; enhancing employee engagement through inclusion; and creating diversity at leadership levels.

These vision and objectives have been shared with all leaders in the company, globally. These leaders are held accountable for achieving key metrics, but also for demonstrating a set of behaviors that create an inclusive environment.

Dow being a global company, the geographies take the primary accountability for implementation, thus allowing for greater flexibility in implementation plans to address specifics of a geographic area. This geographic ownership also helps avoid the "not invented here" syndrome.

### Education And Communication

Not surprisingly, education and communication play a key role. A number of studies have shown that diverse teams in and of themselves do not automatically deliver better results. They need to be managed well to do so. Therefore, leaders and employees alike must strengthen their skills to make positive use of a diverse workforce and teams. Self-awareness,

understanding differences, flexibility and adaptive leadership are key Dow competencies for success. These key concepts are integrated into all employee and leadership development curricula and delivered broadly to the target population. Special themed learning resources allow for these topics to be explored in more depth.

Leaders learn to understand different needs and how to find flexible solutions that consider the needs of both the company and the employee. Employee networks create touch points and platforms for discussion thereby playing a vital role in raising awareness and understanding. An integrated communication strategy focuses on raising awareness and sharing and celebrating successes achieved through D&I by reinforcing the key themes and behaviors.

### Integration Is Key

Raising awareness and building skills are not enough. Ultimately, the ability to drive change drives the ability to succeed. Therefore, Dow has incorporated D&I thinking into all people-related processes, whether that is hiring, succession and staffing planning, leadership identification or pay.

Each of these processes starts by identifying the diversity that will be needed to achieve strategic objectives, followed by defined steps to find this diversity. Every effort is made to access and develop diverse talent pools. This may mean increasing the breadth of sourcing channels, tapping into an increased number of organizations and networks. It also includes making certain accommodation such as adjusting a workplace for a person with a disability, providing opportunities to work flexibly or remotely, offering help for a working spouse/partner when relocating a dual career couple or assessing readiness for international moves and offering support during transition.

### Focusing On Overarching Themes

While understanding the importance of differences, there is also a danger in focusing on differences alone, thus creating many different unique groups rather than one integrated

sum total; women, mature workers, generations X and Y, Asian, Arab or Hispanic employees and the list goes on and on. This can result in fragmentation of an initiative into many different parts. It can also lead to singling out or separating particular groups. The danger with this dynamic is that the engagement efforts now need to focus on multiple groups with different objectives which can lead to efforts becoming fragmented.

At Dow, experiences show that a better approach is to focus on the key underlying themes that matter to all employees and that will include all employees. These underlying themes are flexibility, engagement, development and life long learning. The themes are highlighted in communication, emphasized in skill development workshops and training, integrated into the employee networks, and links are established between organizational groups to further foster understanding and engagement around them. This helps decrease resistance and increases the power with which these themes are pursued.

### Results

With all this in place progress has been made at Dow in all key areas: employee satisfaction with D&I related topics has increased by 7% over the last two years, female representation at leadership levels has grown by 37% within the last three years, and numerous external awards have been won, recognizing Dow's efforts more broadly, including a second place in "Germany's Best Employers 2008" study, with a special award for Diversity. But there is still a long way to go. Achieving active inclusion and embedding it in the very cultural fabric of an organization requires ongoing discipline, energy and commitment to lead to a successful outcome.

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# Accelerating Growth

## China's Mid-level Chemical Market Offers Opportunities for Western Companies

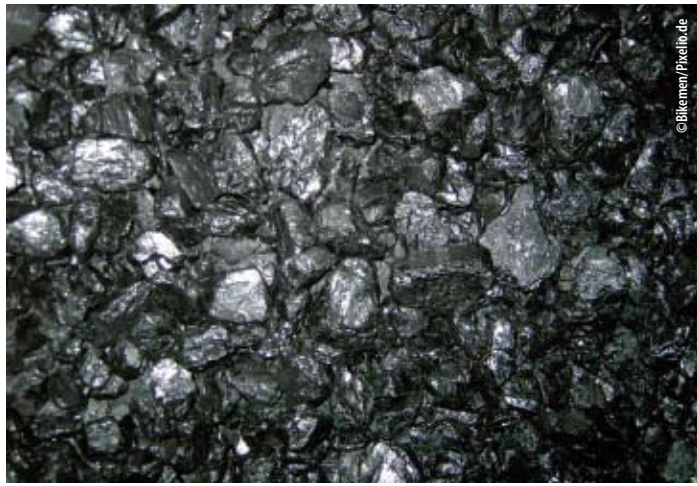
**Going Chinese** – Is there a substantial mid-level chemical market in China? Should multinational companies (MNCs) consider entering it? These are important questions for MNCs in the chemical industry.

Up to now, an important characteristic of the chemicals market in China has been the lack of a substantial market for mid-level chemicals – chemicals which meet basic quality criteria but are not top-end quality. They are different from low-end chemicals in that they are not only bought based on price but also on quality-related properties such as purity or environmental friendliness.

So far, chemicals in China were either produced for local consumption (with low quality demands and high price pressure) or for export (with quality demands basically on a western level). Therefore so far the mid-level market has been limited.

### Growing Demand for Mid-level Chemicals

Given the relatively low average incomes in China, most end consumers cannot afford premium products. In addition, the utilization of high-end chemicals is limited by the available equipment. For instance, the consumption of high-end water-borne overprint varnish is relatively small in China, both because Chinese consumers cannot afford expensive printing products and because the Chinese printers have only a small number of offset printing



Chinese chemical companies tend to have good access to government-controlled natural resources such as coal.

machines capable of using this high-end overprint varnish.

In the past, the local chemical markets were therefore dominated by low-quality chemicals. However, a middle class has started to emerge in China. According to the National Bureau of Statistics, in 2007 there were about 80 million Chinese that qualified as middle class (annual income RMB 60,000 to RMB 500,000, or approximately €6,000 to €50,000), and this number is increasing by about 11% per year. Although this Chinese middle class does not have the purchasing power of their equivalent in Western countries, their consumption habits are already changing. Properties such as product quality, safety and environmental issues are becoming more important. Mid-level chemicals fit the requirements of this class as they are a compromise between price and quality.

The chemicals market is thus getting more similar to the one in the West, with a big mid-level market and smaller markets for low-end and premium chemi-

cals. The fight for this mid-market – particularly between MNCs and local Chinese companies – will be a key market driver in the near future.

### Chinese Companies: Moving Upmarket

Facing intense competition in the low-end market, many Chinese chemical producers have started moving to the more profitable mid-level market. This requires them to provide better products and differentiate themselves from their local peers. In addition, in some industries such as coatings, local players strongly focus on brand building. At the same time, the technological knowledge and the production equipment of Chinese chemical companies is improving, giving them the capability to produce higher-quality chemicals.

Chinese chemical companies tend to have good access to government-controlled natural resources such as coal. Furthermore, the Chinese government often supports them both financially and po-

litically. Chinese companies understand the requirements of Chinese customers well and tend to have good distribution networks in China. In particular, their distribution network is usually not limited to first-tier and second-tier cities (a common limitation of MNCs), giving Chinese companies access to a broader customer base. Finally, Chinese companies have no strict foreign language requirements and can therefore often find staff more easily.

On the other hand, lack of suitable technology is a common problem among Chinese chemical companies. In the past, many Chinese companies gained new technologies via joint ventures with Western peers, but today those are very reluctant to share their intellectual property.

### Multinational Companies: In Search of Size

Since China's opening in 1978, many big chemical companies already have been able to build a long history in this market. So far, most of them have stayed in the premium market, leveraging their quality and brand advantages. However, they are now starting to feel that the premium market may not be big enough to keep their growth rates. An obvious solution is to target the mid-level market. Apart from promising additional growth, this move may also be seen as a pre-emptive attack on Chinese companies that are entering the mid-market now, and are expected to approach the premium market in the future.

MNCs have accumulated substantial management and technological experience. When

approaching the mid-market in China, they can leverage this knowledge. Another advantage is that the MNCs tend to have well-known brands and a good reputation. Given the capital of the MNCs, they are also able to make big investments and thus to outspend local players.

However, in entering the mid-market, MNCs also face the challenge of gathering sufficient local knowledge – in many ways, the mid-market is more dominated by local requirements than the premium market. Also, a lack of local access to feedstock may put MNCs at a disadvantage for the production of basic chemicals.

### Key Issues for Chemical MNCs Entering the Mid-level Market

The premium brands of the MNCs may be jeopardized if they are utilized to enter the mid-level market. Establishing a second brand may therefore be a good option. This new brand must be carefully positioned to avoid cannibalization effects between it and the established brand. One way of doing this is illustrated by Xiameter, an affiliated brand of Dow Corning, a silicones supplier. For this brand, technical service is only given for an additional fee, distinguishing it from the premium offer. The Xiameter brand is successfully used for the mid-level market.

In order to earn money with mid-level chemicals, MNCs need to control their costs. Often this means localization of workforce and production. As there are many qualified Chinese managers and engineers in China today, often mid-level positions can be filled with local Chinese, avoiding expensive expatriates.

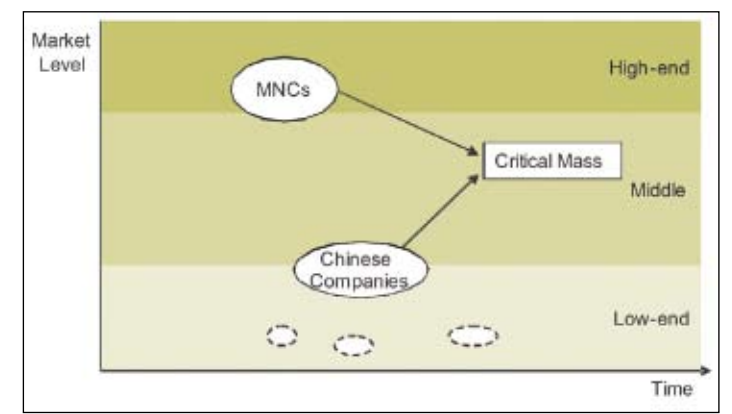


Fig. 1: Multinational and Chinese companies are targeting the mid-level market

Chinese Companies	Multinational Companies
<ul style="list-style-type: none"> <li>Good local access to natural resources (e.g., coal)</li> <li>Government support (political, funding)</li> <li>Cost advantages</li> <li>Local experience</li> </ul>	<ul style="list-style-type: none"> <li>Advanced technology</li> <li>Specialty focus</li> <li>Management expertise</li> <li>Strong brands</li> <li>Abundant funds</li> </ul>
<ul style="list-style-type: none"> <li>Lack of technology</li> <li>Traditionally commodity - focused</li> <li>Resource-intensive processes</li> <li>Rely on western specialty manufacturers for materials</li> </ul>	<ul style="list-style-type: none"> <li>Lack of local expertise</li> <li>High costs</li> <li>Possible cannibalization of own brands</li> <li>Less control of feedstock</li> </ul>

Fig. 2: Advantages and disadvantages of Chinese and multinational companies in targeting the mid-level chemicals market

### No Time To Waste

The mid-level market will be crucial for chemical companies in China. This market is big and growing, but may not be as profitable as the premium market. International chemical companies have to adapt their approach accordingly, and develop a proper strategy for the mid-level market. Consulting companies with a deep understanding of both the global chemical industry and the Chinese specifics can be of great assistance – for example, Strat-

ley has already helped several MNCs in successfully targeting the mid market.

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# Principles Of Heterogeneous Catalysis

## Part IV: Catalyst Development, Bridging Gaps in Heterogeneous Catalysis

**Catalysis** – Parts I to III of this four-part series were published in CHEManager Europe 7-8/2008, 9/2008, and 10/2008, respectively ([www.chemanager-europe.com](http://www.chemanager-europe.com)). This last article in the series focuses on catalyst development, and bridging gaps in heterogeneous catalysis.

Catalyst development typically involves testing a large number of catalysts with a feedback loop, as it is currently difficult to design catalysts a priori. In this respect, catalyst development studies involve examining a large number of catalysts, for which recent advances in high-throughput testing have attracted considerable attention. Catalyst development through the testing of a wide range of materials was first practiced in 1909 by Mittasch at BASF who, according to Timm, issued the following directive to his team who at the time were developing the synthesis of ammonia:

- The search for a suitable catalyst necessitates carrying out experiments with a number of elements, together with numerous additives.
- The catalytic substances must be tested at high pressures and temperatures, just as in the case of Haber's experiments.
- A very large number of tests will be required.

Ten years later, the number of tests conducted had exceeded 10 000, and more than 4000 catalysts had been studied. This extraordinary effort was also extraordinarily successful. What has changed since then, however, is the way in which the systematic search is assisted. Today, armed with an arsenal of principles, concepts, instrumentation and computers, it is possible to identify and to improve new catalytic materials in a much shorter time and



**CATALYST DEVELOPMENT:** Gas chromatography is used to separate the product of a catalytic reaction into its individual components and to analyse whether the catalyst employed has produced the desired chemical product. Photo: BASF

with a smaller number of trial samples, especially with the possibility of advanced characterization methods (especially in-situ techniques) and insights from theoretical calculations (e.g., DFT calculations). The practical merit of this "assisted catalyst design" is clear, while its scientific dividend is the possibility of learning as the design proceeds, with the building of a data bank of rate constants and the formulation of more precise models of active sites. With new theoretical insights or principles, quantitative bases of catalyst preparation and reproducibility of catalyst behavior, the future of heterogeneous catalysis still looks very bright.

The path to the design of an optimal catalytic process would be clear if the activity, selectivity and stability of the catalyst were to move in the same direction upon an increase in a single process variable, such as temperature. However, this simple behavior is not typically observed, and choices must be made in every instance. For example, while the activity of a catalyst may increase with

temperature, its stability usually decreases with temperature. In addition, the relationship between catalytic activity and selectivity is typically very complex, and is not understood in detail until the surface chemistry of the catalytic process has been elucidated. Accordingly, selectivity, stability and activity must be considered together, and trade-offs may have to be negotiated, perhaps by using multi-functional reactors with catalytic distillation or catalytic membranes. Success in heterogeneous catalysis begins with chemistry, but ends with catalytic reaction engineering.

### Bridging Gaps in Heterogeneous Catalysis

The above description of research and development into heterogeneous catalysis as being interdisciplinary in nature, involving studies at the levels of materials, catalyst performance and elucidation, can also be cast in the form of building bridges between various types of studies and different types of material. We often talk about

bringing together the field of surface science (which traditionally is focused on studies of single crystal surfaces at low pressures) with the field of heterogeneous catalysis (which traditionally is focused on studies of high-surface area catalytic materials surfaces under high-pressure reaction conditions). More recently, we have talked about "bridging the materials gap", as we have attempted to use experimental results from studies of well-defined model materials to interpret the performance of more complex, high-surface area catalytic materials. Traditionally, these model materials have been single crystals, cut at various angles to expose surfaces containing different types of sites, such as surfaces with different symmetries and atoms present at terraces, steps, and kinks. More recently, however, these model materials have become highly sophisticated, such as the deposition of nanoparticles with specific sizes and geometries on well-defined support surfaces (e.g., metal nanoparticles supported on thin films of oxides deposited on single crystal metal surfaces, or non-metallic nanoparticles supported directly on single crystal metal surfaces). We also talk about "bridging the pressure gap," as we attempt to

use experimental results from studies conducted at low pressures (less than  $10^{-6}$  Torr) to interpret the performance of catalysts under high-pressure reaction conditions. The origin for this pressure gap comes from the fact that, whereas some spectroscopic techniques can be employed to study the surface and bulk properties of catalysts under high-pressure reaction conditions (e.g., FTIR, Raman, XRD, EXAFS, Mössbauer spectroscopy), other spectroscopic and characterization techniques (e.g., XPS, TEM) are most easily conducted with the sample at low pressures (e.g.,  $<10^{-6}$  Torr). These latter techniques are typically associated with use of electrons to probe the sample, with the electrons interacting strongly with molecules in the gas phase. This pressure gap can be bridged directly by designing advanced instrumentation, such that the distance traversed by the electrons in the gas phase is minimized. In addition, the pressure gap can be bridged indirectly by using molecular-based models (e.g., kinetic Monte Carlo calculations, micro-kinetic models), first to describe the experimental results obtained at low pressures, and then to extrapolate this information to high-pressure reaction conditions.

### BASF Catalysts Introduces New Pharma Solutions at CPhI Worldwide

**PRODUCT** BASF Catalysts introduced two new catalysts at this year's CPhI in Frankfurt at the beginning of October. The two catalysts – Nano Select LF 100 and Nano Select LF 200 – were specifically designed to meet the market requirements of providing a lead-free replacement for Lindlar catalysts, which have long been used in hydrogenation processes. Nano Select LF 100 and LF 200 are characterized by supported well-defined, unimodal nano-sized palladium clusters and show similar activity and selectivity as Lindlar catalysts in selective hydrogenation reactions.



"BASF NanoSelect LF 100 and LF 200 catalysts are an environmentally-friendly alternative for Lindlar catalysts," said Dr. Hans Donkervoort, global product technology manager specialty and fine chemicals catalysts at BASF's Catalyst Division. "They additionally offer significant cost savings by having a markedly lower precious metal content."

### Homogeneous Catalysis: Evonik has Granted Exclusive License to Solvias

Evonik Degussa said it has granted an exclusive license to Solvias to develop, manufacture, and market the Catasium and Catacium ligand product lines. Evonik, a leading supplier of catalytic system solutions, remains active in homogenous catalysis as manufacturer and vendor of Catmetium catalysts for metathesis reactions. Solvias is one of the most capable excellence centers for homogeneous catalysis and high throughput screening (HTS). Catasium is a



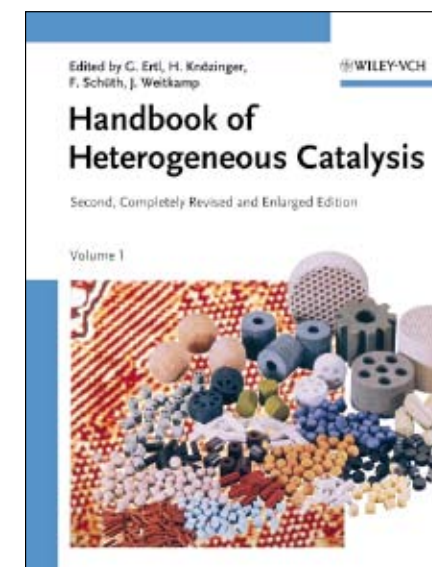
product line of chiral ligands for asymmetric hydrogenations that consists of highly variable chiral ligands and their associated Rh complexes. Catacium is a line of CX coupling ligands with proven success in solving industrial CX coupling problems.

### And the winners are...

At this year's Chemspec Europe in Munich and CPhI Worldwide in Frankfurt, CHEManager Europe readers could enter a drawing of two complete copies of the 8-volume book from Wiley-VCH "Handbook of Heterogeneous Catalysis."

#### Congratulations to:

Dr. Martin Reisinger of Evonik Degussa and  
Dr. Torsten Priester of Grace Europe



First published in 1997, the Handbook of Heterogeneous Catalysis, has become the standard reference on all aspects of the subject, from physicochemical foundations to large-scale industrial applications. Now in this updated and expanded edition, the Handbook of Heterogeneous Catalysis (Wiley-VCH; April 2008; 8 volumes, 4,270 pages with 2,000 figures; Hardcover; Print ISBN: 978-3-527-31241-2) provides coverage of every important topic and development related to the area of heterogeneous catalysis. This eight-volume set has been edited by a world-renowned board of editors including Gerhard Ertl, recipient of the 2007 Nobel Prize in Chemistry.

The past few years have witnessed an explosion in the area of nanotechnology, in which researchers have learned – and are continuing to learn – how to engineer materials at the nanometer length scale. The field of heterogeneous catalysis has been involved in the synthesis of nanomaterials for many years (e.g., the synthesis of zeolites). Indeed, essentially all studies of heterogeneous catalysis begin at the Materials Level. Recent advances in nanotechnology offer new routes for catalyst synthesis (e.g., atomic layer deposition, self-assembly methods) and, importantly, also for catalyst characterization (e.g., techniques such as scanning tunneling microscopy that allow atomic-scale imaging of materials at elevated temperatures and pressures). However, as an increasing number of research groups become involved in nanotechnology, it is possible that an "applications gap" will be created in heterogeneous catalysis, where new materials are formed without clear applications for catalytic processes. Clearly, this gap can be bridged by realizing that

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References available on: [www.interscience.wiley.com/reference/hetcat](http://www.interscience.wiley.com/reference/hetcat)

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### EFCG: Implementation Plans for Voluntary Guidelines

The European Fine Chemicals Group (EFCG) set out the implementation plans for their new, worldwide "Voluntary Guidelines for ISO-regulated Fine Chemical Manufacturers" at the CPhI in Frankfurt at the beginning of October. The voluntary guidelines are a proposed set of minimum requirements for global manufacturers of non-pharma fine chemical intermediates and active ingredients. Based on all nine elements of the guidelines, which were launched at the Chemspec in Munich in June, the EFCG has developed a business integrity evaluation (BIEn) template to evaluate suppliers and help customers reach a purchase/no purchase decision within less than half a day. The implementation plan calls for the Agrochemical Intermediates' Manual manufacturers in Europe (AIME) – a sub-section of EFCG – to pilot test, validate and improve the new BIEn template during the next six months with their sup-



pliers. The workability of the template will then be reviewed before widening its use to the rest of EFCG members during 2009. Allan Laing, Chairman of AIME said, "The initial driver for the voluntary guidelines was the need to better manage the risks in the food supply chain resulting from the globalization of the manufacture and supply of agrochemical intermediates and active ingredients given the increased involvement of players from the emerging markets. Over the next few years, EFCG and AIME plan to engage with national and global chemical manufacturing organisations and stakeholders, including those in China, India, the U.S. and Japan, to help build a network of users worldwide."

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# Chemical Investment Clusters in England

## Real Bottom Line Benefits

**The Right Approach** – In many locations, the benefits of business clusters have not brought the anticipated improvements expected from the guidance received from business gurus. However, in the Northeast of England huge bottom line benefits have been achieved by companies participating in the Northeast Process Industry Cluster (NEPIC), including the pharmaceutical manufacturing units based in that region.

The lack of success of many cluster initiatives arises from the lack of understanding of some basic principles. Firstly, many are too narrow and shallow, illustrating the fact that a handful of companies manufacturing or researching for the same or similar markets do not constitute an economic cluster but rather a trade association. Their interests are too closely related and narrowly focused for an economic cluster. In addition the lack of involvement of up stream and down stream organisations makes them too shallow to steer and create economic impact. Supply chains are and have always been at the heart of a successful economic cluster. An early European Union definition reflects this:

"Clusters are groups of inter-related industries that drive wealth creation in a region. Often they represent the entire value chain of a broadly defined industry from suppliers to end products, and are interconnected by the flow of goods and services throughout this chain."

Interestingly the most important phrase may be "inter-related industries" this has often been interpreted too narrowly by local development agencies and governments.

Many regions might separate their pharmaceutical, chemical, petrochemical, polymer or bioprocessing companies into cluster initiatives. However, such companies, with bases in the Northeast of England, have found that closer interaction between these process industry sub sectors brings much more benefit. They also discovered that they are in fact sharing the many supply chain companies

in engineering, logistics, process and product analytics, legal, health, safety and environmental businesses.

Companies from all these sectors for example have very similar needs in the scientific and engineering training of their staff. Through working together university and vocational training provision has improved. Indeed the Northeast region of England became so organised and strategically aligned that it became the driving force for the establishment of a UK National Skills Academy for the Process Industry which has been created by the UK government at the University of Teesside. This was only achieved by the collective "voice of the Industry" created through a truly engaged and broadly defined industrial cluster organisation. Clustering is ultimately about developing competitiveness and economic development with clear benefits in productivity and innovation, and the provision of skilled and focussed resources is undoubtedly a key economic success factor.

### How Was Such an Example of Success Achieved?

It is clear from the NEPIC model that without engagement and commitment at the highest level in companies, clusters and trade associations for that matter, become talking shops for industry enthusiasts. In these circumstances there is little direction and no recognition that there is any value in their work. Perhaps even more importantly engagement through a trusted intermediary body such as NEPIC has subsequently been shown to be a key success factor. The recently published work of the group of Cluster Guru Porter of Harvard noted that when a strong business environment is created to attract individual companies it is best achieved by a sustained agglomeration process and engagement with the top local executives. This has been at the core of the NEPIC strategy. In fact more than 120 senior executives have regularly given their input to the cluster's activities through specially created teams that focus on the issues that the industry leaders themselves have identified as critical to the future sustainability of their businesses.

■ **Marketing, Communication & Network** – Growing the activity to



achieve regional spread, UK and global recognition and the involvement of all sectors

- **Skills and Education** – Expanding targeted activities in the adult skills and science education to deliver a better trained workforce across all sectors
- **GDP Growth and Investment** – Focusing regional resources to increase investment opportunities and indigenous growth
- **Trade Growth** – Establishing a greater understanding of region, industry and company capability enabling companies to find and fulfill new business opportunities
- **Innovation, Research and Development** – Creating Collaborative mechanisms to build projects between industrial and academic partners
- **Manufacturing & Productivity** – Leveraging regional providers to drive performance and take up improvement programs

The value of the trusted intermediary is particularly clear in the area of productivity and efficiency improvement. How can companies understand what world class manufacturing or other business processes look like without interacting externally? Harvard's Porter is clear on this, they must overcome the tendency to view productivity improvements coming from internal innovation. This is where NEPIC and its members have made outstanding strides by interacting across a wider cluster base, looking for best practice even beyond the obviously related industries.

### Sharing Know How

One of the main advantages of manufacturing pharmaceuticals in the Northeast of England region is that this is one of the world's leading locations for lean manufacturing as applied within and beyond the conventional automotive and engineering fields. Nissan has their only European car manufacturing

facility based at Sunderland and this has repeatedly won the accolade of Europe's most productive car manufacturing plant. The plant has also attracted over 100 Japanese and supply chain companies of other nationalities to the region. This injection of know-how on productive working techniques has led to the formation of the Northeast Productivity Alliance (NEPA) through which lean manufacturing techniques have been injected and developed in both traditional and new industry sectors.

This focus on productivity has resulted in the region's pharmaceutical facilities becoming some of the most productive units in the world. Companies such as Glaxosmithkline, Sanofi-aventis, Merck Sharp & Dohme, SSL International, Nicholas Piramal, Aesica Pharmaceuticals

and Avecia are among those to have benefited from applying continuous improvement techniques introduced by NEPIC and its partners. Moreover, delivery of these techniques into chemical and polymer companies, by the same team of experts, has brought millions of pounds to their bottom lines. These efforts are hugely appreciated by companies such as Johnson Matthey, Sabic, Lucite International, Thermo Fisher Scientific, Ineos (Hydro Polymers), Avecia, Evonik Degussa, Chemson, Rohm & Haas and many more.

Very significant productivity and performance improvements have been reported by the companies that have tapped into this regional expertise. This includes 30% reduction in product changeover times, additional capacity created with over 50 more batches produced in a year, overall operational efficiency increasing from 45% to 70%, a 50% reduction in cycle times on key products, 20% increase in batch size, 14% reduction in total tablet cost, and tablets per employee increasing by 14%. All of these improvements were achieved within a few months of the initial intervention. One pharmaceutical company has reported that they were able to capture

two new blockbuster products in their existing processing equipment with little or no additional capital investment.

An independent review of NEPIC's work on behalf of the regions Economic Development Agency said "Overall our conclusion is that NEPIC has made a strong and invaluable contribution to the continuing success of the process industries in the Northeast, to an extent well beyond what could have been achieved in the absence of such an organisation or by private sector initiative alone. It represents excellent value for the core public funds invested in it to date." The cluster has been credited with generating almost £200m of gross added value for the local economy including attracting more than 10 businesses to the region, influencing 1,500 job decisions and some very significant bottom line savings from more than 30 companies.

### Conclusions

As the Harvard Cluster Group points out; to be successful there must be a context for a strategic cluster intervention and that they can be successfully achieved even when rivalry is present. Clusters are most effective

when there are external demands and business conditions that impact across sectors. They can be particularly successful when related and supporting industries are present which will widen the economic and social impact. This is very much the case within NEPIC where companies from a spectrum of life science based businesses – chemicals, pharmaceuticals and biotechnology – are working so closely together.

If companies are to create a successful cluster then companies must be brave, broaden their perspective and agenda to the upgrading of all relevant parts of their business. Companies certainly must become more outward facing to remove internal bottlenecks. Engagement through a cluster organisation built on the growing of trust and shared information can be the platform through which private and public organisations can address the industrial needs of companies in a sector.

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## SAFC Pharma Completes Ireland Expansion

SAFC Pharma, a focus area within SAFC, a member of the Sigma-Aldrich Group recently announced that a new reactor at its Arklow, Ireland, manufacturing site has begun operation, expanding the facility's capacity for large-scale active pharmaceutical ingredient (API) manufacturing by approximately 15%. The new reactor is the latest in a series of investments designed to enhance production capacity and expand capabilities at the Arklow site, which is the company's global center for the production of commercial and

late-stage APIs and advanced intermediates.

The \$4 million project involved the installation and start-up of a 6,000 l Hastalloy reactor for large-scale API manufacturing, increasing the total capacity at the site to 96,000 l, with a reactor range from 250 to 8,000 l. This latest investment adds capacity for both large- and small-scale manufacturing and improves upon the site's award-winning environmental performance.

This latest investment complements two additional expansion projects at the Arklow site:



The building of a \$2.25-million, 15 kg capacity pilot-scale filter dryer designed to double the facility's current capacity for small-scale (10 kg-150 kg) manufacturing of APIs, due for commission in third-quarter 2009; and a \$1.8-million expansion of the site's cGMP warehouse capacity, also scheduled for completion in 2009.

## 30 Years Wacker Spain

Wacker Química Ibérica, a wholly-owned Wacker Chemie subsidiary, recently celebrated its 30<sup>th</sup> anniversary. Established in 1978, the Barcelona-based sales subsidiary now serves customers in Spain, Portugal and Morocco. In 2007, Wacker Química Ibérica and its employees generated sales of over €75 million. Key markets include the construction, automotive, textiles, paper and chemical industries. As part of Wacker's European



sales network, Wacker Química Ibérica is responsible for all sales and distribution activities on the Iberian Peninsula. Over the last few years, the subsidi-

ary has achieved above-average growth. In 2007 alone, sales grew by 16% to over €75 million. Wacker Química's managing director, Thomas Funke, is expecting good results in 2008, too. "Even though some sectors, such as the Spanish construction industry, have for months been affected by extremely difficult business conditions, I'm very confident we'll be able to boost our total sales this year, too."

# 50 $\frac{t}{a}$

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# Ionic Liquids

## Unique Materials with Multiple Prospects

**Unanswered Questions** – There is hardly anyone who has never come across the concept of ionic liquids, yet more often than not, certain questions remain unanswered, as they did in the Neil Winterton's article "Ionic Liquids – Help or Hype?" (CHEManager Europe 5/2008). The question is certainly justified, and this article deals with it from the vantage point of an industrial-scale supplier of ionic liquids.

At first sight, it is fairly easy to say what ionic liquids are: salts that are liquid already at low temperatures due to their chemical structure, which comprises mostly rather voluminous, organic cations and a wide range of different anions. And they only consist of these cations and anions; they do not contain any solvents like water. This does not sound very exciting on the face of it, but it results in a combination of unique properties that cannot be achieved with any other material. In a way, these liquid salts combine the properties of solids and liquids in a single material. This paves the way to many innovative solutions like new products or processes.



Dr. Uwe Vagt  
BASF

To date, ionic liquids are often considered to be "lab curios" that are virtually unaffordable. People tend to overlook that it is not the price that tilts the balance in favor of ionic liquids but the cost at which a kilogram of final product can be manufactured. This cost is usually low because in many cases, a major part of the ionic liquid can be recycled. Moreover, ionic liquids are available nowadays at the ton scale and in high quality from a variety of suppliers. BASF, e.g., offers a portfolio of products that are being manufactured by standard processes on a fairly large scale and cover a wide range of application options.

From the early days, ionic liquids were assumed to merit approval for being "green solvents." This was based on the absence of vapor pressure and has proven to be little help. As with many other chemicals, you can find the entire range from highly toxic to absolutely safe among ionic liquids. So there will never be an across-the-board toxicology or eco-



toxicology rating that applies to all ionic liquids alike. Having said that, as in all other cases professional and sustainable management of chemicals is what really makes the difference.

However, the many toxicological studies on ionic liquids that are available today show some clear trends and point the way to toxicologically safe materials. They suggest, e.g., that long-chain alkyl groups should be avoided irrespective of the cation involved in order to achieve lowest possible toxicity levels. 1-ethyl-3-methyl-imidazolium-ethylsulfate is an ionic liquid available today in BASF's portfolio that shows no signs

of acute toxicity has been registered in keeping with the law on chemicals and opens up a broad range of applications.

Starting from the original idea that ionic liquids should be used as alternative reaction media for chemical reactions, promising applications today span a wide array of uses. Ionic liquid applications that have actually been put into practice successfully are often distinguished by the fact that they could not have been realized at all if it had not been for the specific properties of these materials, as can be seen from the three examples given below:

The best testimony to the innovative power of Merck, its reliability and close understanding of local and global markets is the sheer diversity of its products. The Merck portfolio currently encompasses more than 15,000 chemicals and reagents, active ingredients, test kits and analytical systems. Every day, new products join the fold, the result of purposeful research projects, specifically

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### Linde – Operating Medium for New Gas Compression Technology

In gas compression, heating the gas to be compressed causes considerable loss of efficiency that translates into increased input of energy. This effect is illustrated clearly by the case of hydrogen, which needs to be compressed to pressures exceeding 400 bar for efficient storage. Linde recently presented a novel compressor technology that has the ionic liquid doing the work of compression as a "liquid piston." This technology, launched by Linde as the "ionic compressor," has obvious benefits: It requires less maintenance as there are significantly less moving parts, and it cuts energy input by about 20%. This is achieved by cooling the operating medium externally, which makes nearly isothermal compression possible.

It is only by means of ionic liquids that this compression technology could be realized, because only ionic liquids offer the combination of physical properties needed here: a liquid that flows relatively freely at temperatures from  $-20$  to  $+200$  °C, virtually no vapor pressure and very low solubility for gases. However, not all ionic liquids meet these requirements equally well. The properties of the ionic liquid must instead be tailored to suit exactly the profile required in this application and other constraints need to be taken into account as well. Linde already operates a number of these compressors for hydrogen and natural gas in a beta test phase in cooperation with selected customers, and general commercial launch of its imminent.

### G24i – Electrolyte in Dye-sensitized Solar Cells

The exploitation of solar energy currently represents one of the most promising options for the use of renewable energy. The most widespread technology and also the most advanced in terms of efficiency is the crystalline silicon solar cell. However, the comparatively high cost of this type of cell still poses a major challenge. Dye-sensitized solar cells that can be produced at a much lower cost therefore offer a promising alternative. In addition they are sensitive to far more of the visible spectrum of light, so that they can operate even at relatively low levels of light intensity as for example in diffuse light.

Along with the dye and the electrode materials, the electrolyte used in these dye-sensitized solar cells is crucial. Ionic liquids are the only materials that will produce the desired functionality and long-term stability in these cells. In this case, too, the technology makes use of various properties: the low melting point and negligibly low vapor pressure allow the cells to be used across a broad range of temperatures, from  $-20$  °C to  $+80$  °C; the conductivity of the ionic liquid ensures the charge transfer required, and its electrochemical stability produces the required stability. In addition to that, the ionic liquid stabilizes the dye that is applied over a titanium dioxide layer, and it acts as a solvent in the I-/I<sup>3+</sup>-redox process. This is another case where ionic liquids are the only materials that meet the complex range of requirements.

G24i of Cardiff, Wales, is the first company making commercial use of this dye-sensitized solar cell technology. The technology allows for an extremely favorable roll-to-roll manufacturing process and also gives flexible cells that can be used in many fields. The market launch mainly aims at portable applications such as mobile phone chargers in regions that do not have a universal power supply grid.

### BASF – Dissolution and Processing of Cellulose

With 75x10<sup>9</sup> t regrowing each year, cellulose represents the largest source of carbon available on our planet. Only a very small fraction of that, about 200x10<sup>6</sup> t, is actually being used nowadays, above all to make paper and pulp. Out of that, the negligible volume of 5x10<sup>6</sup> t only is used to produce materials in the narrower sense – mainly viscose fibers. Cellulose has not been used more widely to date mainly because there have been no suitable solvents that can be han-

dled easily. Ionic liquids are the first products that can step into this gap.

Based on pioneering work by Professor Robin Rogers of the University of Alabama and in cooperation with additional partners, BASF has developed processes for dissolving and shaping cellulose. Taking things further, the chemical modification of cellulose dissolved in ionic liquids opens up a wide array of potential ways to produce materials based on regenerative raw materials. BASF is cooperating with a number of partners to commercialize these processes and products.

### Would-be Limits

Some publications surmise that ionic liquids have come up against certain limits in their applications, or that their potential is being overestimated. This applies in particular to the much publicized use of ionic liquids as reaction media in chemical reactions. Yet that "apparent lack of success" is often due to the approach chosen for the venture. The mere fact that ionic liquids do not have vapor pressure won't be sufficient to make a process more efficient. Applications in this segment that have been implemented successfully are always marked by the fact that the ionic liquid has at least one more very positive influence, in addition to being free of vapor pressure. The following examples of successful applications, which do not claim to be exhaustive, demonstrate that ionic liquids by all means continue to hold great promise as reaction media in chemical reactions, if their specific properties are employed purposefully to optimize these reactions.

In the fluorination process described by Arkema and realized in a pilot plant, the ionic liquid enhances reaction selectivity and prolongs the life of the catalyst. In this process, the ionic liquid supports the catalysis as such, just as it does in the hydrosilylation reactions described by Degussa and Wacker. The beneficial influence of ionic liquids is even more obvious in the processes published e.g. by IFP and Chevron where the ionic liquid itself acts as a catalyst. In the Basil process practiced by BASF, the first ever chemical process to use an ionic liquid, the reaction medium speeds up the reaction dramatically, which makes a totally novel jet reactor concept possible.

### Potential Of Ionic Liquids

What has been said with respect to chemical reactions applies in the same way to all other potential applications of ionic liquids: The most promising are those that employ more than one of the properties typical of ionic liquids. Ionic liquids should be seen less as "chemicals" but rather as "system innovations" that make certain products and processes possible for the first time.

Although a broad range of ionic liquids is now available, there is obviously no denying the fact that more work is needed to keep optimizing the properties of these materials. Current research focuses on developing ionic liquids that feature still lower viscosity, higher conductivity while they retain their high electrochemical stability, and improved thermal stability.

Applications that continue to offer major potential for ionic liquids include electrolytes for energy storage media like capacitors or lithium-ion batteries; the deposition of non-noble metals; the transformation of biomass into regenerative energy sources; and the wide area of engineering liquids, which includes applications as interesting as lubricants, hydraulic liquids or sorbents for cold production. Suppliers of ionic liquids, academic researchers and potential customers will definitely have to cooperate closely across their disciplines if we want to tap the full potential available.

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## UNDER CONSTRUCTION

**Lanxess Plans to Build Synthetic Rubber Plant in China** Lanxess is looking into building a synthetic rubber plant in China, roughly comparable in size to a €400 million factory it will start to build in Singapore next year, the head of the company's Chinese business said. Lanxess also aims for greater China, which includes Hong Kong and Taiwan, to account for more than 10% of the group's total revenues in five years, up from almost 6% in 2007, said Wang Yongli, who is in charge of the company's business in the region. Sales in greater China are set to continue to grow at double-digit percentage rates, following a 21% gain in 2007, media reports cited Wang as saying in remarks that were later confirmed by Lanxess spokesman Rudolf Eickeler.

Plans to bolster Lanxess' global rubber business further across the globe are in "very early" stages and the company is looking both into acquisitions and own investments, Eickeler said, adding a new Chinese plant is one of several options. The company bought Brazil's Petroflex for €200 million in December to boost its rubber business in Latin America. In February, Lanxess announced its largest investment to date, a new 400 million-euro synthetic-rubber plant in Singapore, catering to major tyre makers that are rushing to Asia to serve the region's burgeoning car industry. Lanxess generated almost €2.7 billion in revenues from synthetic rubber last year, mainly selling to tyre makers. Last year, the company invested €284 million in new plants, equipment, rights and licences, but the amount was offset by depreciation and writedowns on assets. ■

**Bayer to Invest €100 Million in Brazil Through 2009** Bayer said it plans to invest €100 million in Brazil until the end of next year to capitalise on Latin America's economic growth. About €40 million of the amount is earmarked for upgrading an existing chemical site in Belford Roxo near Rio de Janeiro, which makes plastics precursors and ingredients for pesticides, the German chemical and drug company said in a statement. ■

**Bayer Strengthens Presence in China** Bayer Materials science has successfully started production at its new 350,000 t/y diphenylmethane diisocyanate (MDI) complex at the Bayer Integrated Site Shanghai (BISS). The new world-scale plant is the largest MDI facility of its kind in the world, according to the company. Furthermore, the company has now broken ground for a 250,000 t/y toluene diisocyanate (TDI) plant at BISS that is scheduled to come on stream in 2010.

The new TDI facility in Shanghai features the modern gas phase process. This enables energy savings of up to 60% compared with a conventional plant of the same size. The new process technology uses up to 80% less solvent, and cuts investment costs for this type of large-scale facility by some 20%. In addition, the oxygen depolarized cathode (ODC) technology used to recycle chlorine at BISS yields 30% savings in energy use compared with conventional technology. ■

**BASF Completes Capacity Expansion in Spain** BASF Catalysts said it has completed a significant debottlenecking project that has increased capacity at its production facility in Tarragona, Spain. The 25% capacity increase will help meet growing global demand for polypropylene catalysts. The expansion was completed as projected, on time in the third quarter 2008, and is already on line and in use to serve customers. The Tarragona plant produces custom catalysts for BASF's partner, Novolen Technology, and BASF's own proprietary polyolefin catalysts. "The global polyolefin catalysts market is expected to grow 4-5% per year through 2015," said George Vann, BASF Polyolefin Catalysts global business manager. ■

**Technip Awarded Contract in Russia** Technip has been awarded a lump sum engineering and procurement contract, worth about €45 million by Sibur Neftchim (a Sibur Moscow Holding subsidiary) to expand an ethylene plant in Kstovo, Russia. Technip's operating center in Zoetermeer, the Netherlands, will execute the contract, which follows the basic engineering contract already carried out by Technip. It covers detailed engineering, procurement and supply of main equipment and materials. Technip will also provide technical assistance during construction, commissioning and start-up. The plant will be based on Technip's proprietary technology. During a first phase, it will be expanded to a capacity of 360,000 t/y. In a second phase, it would be further expanded to a capacity of 450,000 t/y. ■

**BASF Strengthens Position in Chinese Automotive Industry** A new BASF plant for the manufacture of automotive spring aids made of Cellasto for approximately five million vehicles per year is to be built in Shanghai by early 2010. The move allows BASF to create a base for close-to-the-customer supplies for the growing automotive market in China, according to the company. After Nansha, also located in China, and Shinshiro in Japan, Shanghai will be the third production and development site for these polyurethane (PU) based car components in Asia. ■

**Safety, Reliability And Efficiency – Honeywell is the sponsor of this year's Namur general session which is taking place in Lahnstein, Germany, Nov. 6 – 7 and will highlight advanced process automation, including the design of production processes.**



Jack Bolick  
Honeywell

information and enables collaboration by sending it to the right people in the plant and across the enterprise. The result is unified business and manufacturing intelligence – truly a smart plant and optimized business.

*The chemical industry is coming to terms with the rising price of raw materials. How is Honeywell helping customers deal with this issue?*

**J. Bolick:** It'd be nice if technology existed that could magically reduce the price of raw materials. Of course that's not realistic, but what we can do is develop technology that reduces the impact of these costs. There are four technological elements that can achieve this. The first is process efficiency. By closely monitoring and controlling manufacturing processes, you can increase effective unit capacity, maximize yield, and reduce lost product by staying on spec. Put all of this together and you've just reduced the need for higher quantities of raw materials. Next is material management. You can reduce material losses by applying tighter control and automation to work process related to materials handling and manual addition. The third area where we're helping our customers is real-time inventory tracking. By integrating production data with business systems, you reduce material inventories. Finally, energy management is probably one of the most talked-about and efficient ways to manage the cost of these raw materials. Take simulation software: here's a tool that many of our customers buy to train their operators. But another key benefit is the ability to design efficient processes. By more closely monitoring the energy flows around the process, customers can balance supply and demand and determine the most cost-effective feedstock to purchase.

*If we look back 10-20 years and compare the automation industry to how it is now in terms of productivity and energy efficiency, what would you say were the main influences to drive the evolution of the industry?*

**J. Bolick:** Over the last two decades, the name of the game for maximizing business performance has been global growth. Every process industry can point to a global demand for its products. To be truly competitive, many of Honeywell's customers have tried to strengthen their businesses by becoming world-leading enterprises. Global growth is a big enough challenge on its own. Now think about trying to expand globally while your existing facilities are plodding along with aging automation systems. Think about global

expansion when there's a shortage of skilled workers and your best people are inching closer to retirement. Factor the emerging environmental regulations and the multiplying dangers of the job, and it's easy to see why trying to achieve global growth is a monumental proposition. All of these topics have influenced the technology we vendors created to serve our customers.

*What can be done to help customers overcome the roadblocks ahead?*

**J. Bolick:** In Honeywell's case, we believe we can help our customers overcome these challenges by improving three core aspects of manufacturing facilities: safety, reliability and efficiency. These drivers have led to an unprecedented move toward open systems, which will bring a whole new set of challenges that will influence the direction of our industry. One of those main challenges is the development of standards, including wireless standards. Wireless will undoubtedly enable exciting changes in our plants of the future. It will allow operators to more efficiently monitor how their plant assets perform while improving worker safety in the process.

*What is your outlook on Honeywell's growth in other geographies?*

**J. Bolick:** We're still seeing solid growth opportunities in emerging regions like India, China, Eastern Europe and the Middle East, as well as established regions like North America and Western Europe. There are several factors working in our favor for attaining this growth, not the least of which is our extensive installed base across the globe. We tell our sales staff to never forget that our existing customers have evolving needs, and it's our job to consistently take their pulse and not just have an "install-and-you're-done" approach. And our strategic mergers and acquisitions have helped widen an already solid portfolio. This has put Honeywell in a great position to serve as a single-source provider for everything from instrumentation like gauge readers to advanced applications like process simulators. Honeywell will continue to look for similar opportunities in the future that will further strengthen our ability to help our customers improve overall plant safety, reliability and efficiency.

*A big problem in the industry is the decreasing workforce. How is Honeywell combating this issue?*

**J. Bolick:** The decreasing workforce is, without a doubt, a very serious issue facing our industry, especially considering that plant operators are now expected to handle more complex processes and make better decisions on behalf of the business. We're not seeing enough people with the right skills eager to step in and readily replace the retiring

workforce. And the new people entering the field are simply being handed the keys to run aging automation systems. It's a snowball effect that could have serious implications for manufacturing facilities. It would be wonderful if we could create technology that could persuade more people to enter the engineering fields and become process operators – but that's not realistic. The next best thing is to produce technology that retains the process know-how. Honeywell's Experion PKS was designed to capture the knowledge and best practices of the operators who have been driving these processes for decades. This knowledge is captured through solutions such as procedural operations, which gives manufacturers the ability to encode these best practices into the control system itself. We offer a clear migration path that allows plants to use their existing control infrastructure with some of our newest technology. We have customers still using our TotalPlant Solution with our newest Experion interface. This is a much more cost-effective approach that provides the efficiencies of the latest tools on the market.

*What should every CEO be aware of in terms of process automation solutions?*

**J. Bolick:** As the five layers of automation collapse, it's imperative that C-level executives recognize that automation is more than just a tool to help your operators execute processes. When engineered effectively, an integrated process automation and control system is a strategic investment that can link demand variability to raw material variability, adding value to your business enterprise-wide. The automation system is the central cog to your operation, and its design is arguably the single most important influence on whether the plant operates profitably with minimal downtime, or fails during startup and breeds unsafe working conditions. It all boils down to what I've said several times already: Is your automation system making your plant safer, more reliable and more efficient? If it isn't, you're unnecessarily wasting raw materials and energy, you're opening the door to expensive and dangerous process upsets, and you're ultimately losing money and making it harder to meet your business objectives.

*What does the future hold for the industry?*

**J. Bolick:** How the industry fares in reaching its potential will really be answered over the next decade. That's because in the next 10 years we will continue to see the lines between the five layers of automation increasingly blur. In the past, plants functioned well despite operating these layers in silos. Workers on the plant floor didn't need to worry about control strategies, operators never really needed to think beyond

instrumentation and control, and your C-level executives focused on business performance and metrics. But all of this is changing as manufacturers start to move toward integrated systems.

*On a personal note, you have just passed the six-year mark as being President of Honeywell Process Solutions. In that time, what do you count as some of your most significant achievements?*

**J. Bolick:** When I first came here, a lot of industry observers regarded Honeywell as "the DCS box" provider. You need someone to install a control system? Call Honeywell. Helping to erase that perception has been one of the most gratifying accomplishments of the past six years. Our customers are now looking at Honeywell as a total solution provider. Listening to our customers and understanding their needs has been a key factor in changing the DCS-only perception. So it's been very gratifying to see first-hand how our company has been rewarded for adopting a customer-centric approach. By making it a point to sit down with our customers and seriously listen to what they have to say, we have been able to make great strides in developing our next-generation products and ultimately improving customer satisfaction.

*How have your customers shaped Honeywell's offerings?*

**J. Bolick:** For example, our customers told us for years that they wanted a universal wireless network that could simultaneously accommodate multiple devices. We listened to those needs and developed OneWireless, which not only handles thousands of devices on one network, but it communicates with non-Honeywell devices.

*How has this approach affected business?*

**J. Bolick:** I say we've been rewarded for this customer-centric approach because our sales revenues have doubled during my tenure. That's proof that it really does pay to listen to your customers. And we've made sure to listen to customers from all around the world through events like our Users Group Symposia, which were held this year in five countries. When I first came on board, one of our company goals was to become more global and help our international customers become more competitive on the world market. Today, 70% of our business is outside the U.S. That further validates that our customer-first approach has truly become ingrained in our global company culture. As long as we keep that customer-centric mentality, I feel very confident in our abilities to continue growing the business and helping manufacturers succeed.



# Operational Excellence

## Six Sigma Process Improvements

**Process Industry – Operational Excellence initiatives to improve business and production processes are being launched in many companies, usually including management tools to drive the initiative and improvement tools to implement projects.**

Six Sigma is an established methodology, supporting process improvements which originated from manufacturing industries with a strong focus on statistical methods. Its general applicability in other industries, in particular production processes in process industries is, due to the limited prevalence, not obvious.

### Operational Excellence Initiatives

Operational excellence is a goal for conducting business in a manner that improves quality, obtains higher yields, faster throughput and less waste. Based on this rather general definition, operational excellence initiatives have been started in many process industry companies. These initiatives usually encompass management tools needed to steer an operational excellence initiative, create an operational excellence culture, prioritize areas for improvement and control the project outcome by selected business key performance indicators (KPI's). In process industries, these KPI's could be, prioritized depending on the type of business, raw material and energy, availability and capacity. Having no time for improvement in addition to the daily business can no longer be an excuse in companies with a strong operational excellence culture. Nevertheless, the way from the definition of operational excellence to a specific operational excellence initiative in a production environment is rather fuzzy, and there is certainly no general consensus on what exactly operational excellence encompasses. There are for example more than 10

million google hits on 'Operational Excellence' focussing on different aspects of this general definition.

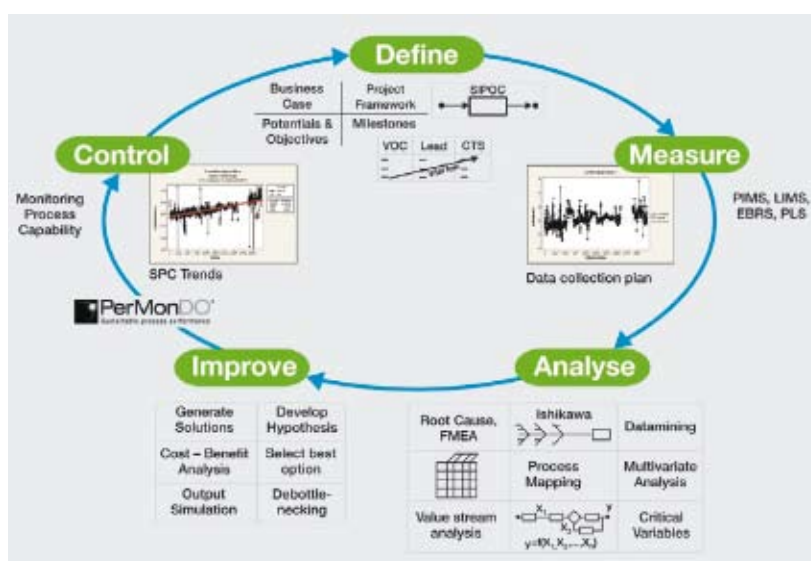
Characteristics of continuous improvement projects within an operational excellence framework are improvements to be obtained in rather limited time, with limited resources and relatively short payback time, therefore usually based on existing technologies and little focus on research and development. After having defined areas for improvement, suitable methodologies to conduct the improvement projects are the last and crucial part of any operational excellence initiative. Irrespective of business or production processes, Six Sigma is a common choice for the methodology used.

### Six Sigma Process Improvements

Six Sigma is a formalised improvement methodology initiated by Motorola that combines project philosophy and cost control with proven methods derived from quality and project management. It has been proven to be one of the most suitable methods for improvement projects where decisions in a formalized project management system are always taken based on data, and not on the preferences of the dominant project team members – measurements instead of opinions.

The Six Sigma philosophy is divided into a guideline for project management and continuous improvement culture, leveraging the philosophy from shop floor personnel to top management – speaking a common language. The qualification levels from yellow via black to master black belts enforce a continuous and extensive training in the methodology. Six Sigma can also be applied solely as a project philosophy, particularly for the initial projects, and when continuous improvement tools are already well established.

Six Sigma methodology aims to reduce process variation and thereby



improve process capability. The five phases of the DMAIC cycle – Define, Measure, Analyse, Improve and Control – force standardized deliverables at each of the project phases. The tools applied are mainly well established parts of the industrial statistics toolbox, where each of the formally qualified Six Sigma experts is trained in their application.

### Six Sigma Project Selection

Six Sigma projects can be identified by simple and concise checklist:

- The improvement is based on reducing process variation: The project goal is to stabilise the process performance towards a demonstrated best practise. Opposed to these projects are development activities improving the theoretical process performance.
- The technical solution is not known from the beginning: The first phases of the project are used to prioritize potential root causes and to define technical means to reduce variation in these. Opposed to these projects are prior known dedicated technical changes by e.g. replacing equipment with known weaknesses.
- The improvement has significant business impact: The targeted im-

provement should be in order of magnitude justifying the effort for setting up a formal improvement project. Opposed to these projects are small improvements in the day-to-day work.

- The process parameters need to be measurable: The process characteristics need to be measurable to be able to make decisions based on data. Opposed to this are processes (either business or production processes) where hardly any measurement is available or feasible.

### Success Stories and Critical Factors

The numerous examples for Six Sigma improvement projects conducted by Bayer Technology Services illustrate the applicability in various areas (Six Sigma Projects). Common to most of these projects is that the identified and finally eliminated root causes for variation where often not the expected ones. Often the technical solutions for process improvements seem rather simple afterwards, but were not implemented before.

Based on the project experience, some critical success factors for the execution of Six Sigma projects can be given. First, especially in chemi-

Six Sigma Projects	
<b>Chemical Processes:</b>	<ul style="list-style-type: none"> <li>■ Minimize cooling water consumption of a large scale monomer unit</li> <li>■ Reduce fouling in several different monomer units to increase availability</li> <li>■ Improve and stabilize color and color stability for basic chemicals</li> <li>■ Capacity increase and reduction of quality variation for a multiproduct batch polymerization unit</li> <li>■ Reduce quality variation in batch polymer production</li> <li>...</li> </ul>
<b>Regulated Industry:</b>	<ul style="list-style-type: none"> <li>■ Yield improvement for fermentation process</li> <li>■ Yield improvement for biotechnological purification process</li> <li>■ Various yield improvement projects for chemical API's and intermediates</li> <li>...</li> </ul>
<b>Supply Chain and Logistics:</b>	<ul style="list-style-type: none"> <li>■ Reduction of duration for ERP business process</li> <li>■ Various projects for the optimization of freight costs</li> <li>...</li> </ul>

cal processes, a strong process engineering oriented process know how is required for the correct interpretation of process data, usually only obtainable by an interdisciplinary team. Second, to handle the usually abundant amount of process data in production processes efficiently, a strong knowledge on database handling and data processing is required. Third, workflows on the production shop floor are to be considered in the sustainable implementation of improvement, which can be achieved by strongly integrating resources from there into the project team.

### Conclusions

The requirements of process industry from time-to-time require some extensions of the standard Six Sigma toolbox. For example:

- Supplementary methods and tools for the correct handling of compressed and autocorrelated data
- Multi-variate statistics for the effective handling of large numbers of measurements

- Use of existing process models during the different phases of the project

None of the project examples are from a Six Sigma company, but success was achieved despite this limitation. This proves that Six Sigma can also be applied solely as a project philosophy, particularly where continuous improvement activities are already accepted within an operational excellence culture.

Example projects with a smaller scope and/or saving potential (< €250,000) and longer duration (9–12 months) can also be successfully realised with a higher success rate using this methodology than with conventional approaches.

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# Ready-To-Run Wireless

## First Products to be Presented at 2009 Hanover Fair

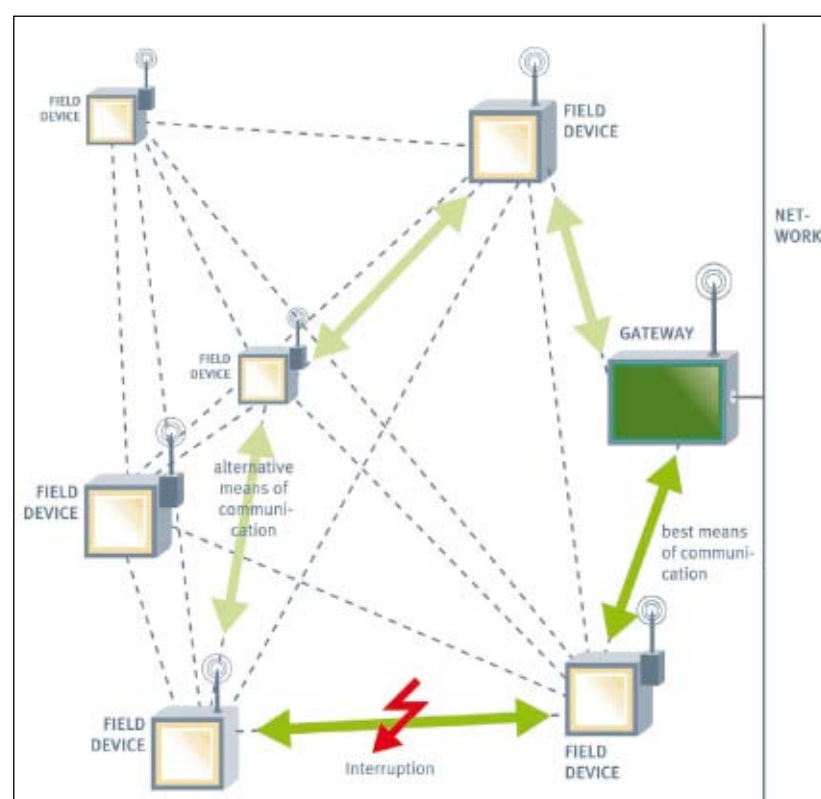
**Full Speed Ahead – Preparations to introduce Wireless-Hart enabled products are proceeding at full speed. By the beginning of next year already, first prototypes of products supporting this new standard should be available. Global introduction of products for wireless data communication are planned for the 2009 Hanover Fair.**

Pepperl+Fuchs has driven the development of Wireless-Hart right from the start and will be among the first companies to offer ready-to-run products on the basis of this communication standard. Primary focus will be the extension of already existing process plants with additional monitoring functions that are simply not possible without the use of wireless communications.

After wireless communication has become a standard feature of internet communication in private homes, it was only a matter of time before the respective technologies also reached the highly sensitive area of process automation and open up a wealth of new opportunities. The introduction of the wireless version of the Hart protocol has provided the process world with a vital standard to enable all wireless field devices to communicate in the same language.

### Wireless-Hart – A New Standard

Generally speaking, Wireless-Hart is an extension of the existing Hart communications protocol. This means this new standard is based upon a proven technology with an installed base of more than 20 million field devices worldwide. With first prototypes and product studies, Pepperl+Fuchs has accompanied the development of this standard from the start. When it was



By means of alternative and redundant transmission channels, Wireless-Hart networks offer a high level of safety

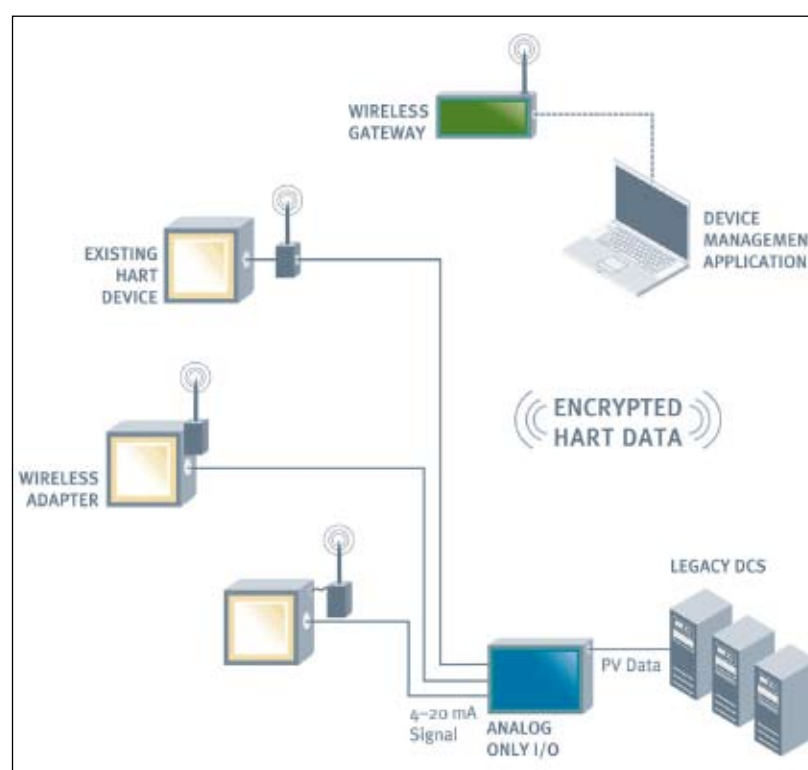
first presented by the Hart Communication Foundation (HCF) at the ISA 2006 in Houston, TX, U.S., the company was the only vendor to offer a prototype of Wireless-Hart gateway. It is therefore not surprising that Pepperl+Fuchs will also be among the first companies to offer first products when this new technology will be officially introduced to the global process market at the 2009 Hanover Fair. According to the state of development, first beta products and prototypes for demonstration purposes will be available by the end of this year.

### Less Wiring, Lower Costs

Typical applications for Wireless Hart are parameter setting of field devices and monitoring of uncritical

process values and environment data. In this field, wireless communication is the enabling technology of a completely new range of applications, for example for performance monitoring, environment management and effective asset management with preventive maintenance strategies.

Comparable to traditional wire-based Hart communication, Wireless-Hart allows the integration of fixed process instruments, mobile field devices, temporary installations, and remote sections of a process plant into the very same communications infrastructure. One major advantage is that Wireless-Hart communication does not require any costly cable installations and allows monitoring specific process parameters at locations where it was simply not possible before.



Wireless-Hart fully integrated into an existing communications infrastructure

### New Products in the Pipeline

Principally, a Wireless-Hart network consists of a gateway and one or several field devices. Pepperl+Fuchs

is presently developing a robust Wireless-Hart gateway designed for the demanding operating conditions typical of the process industry. It will comply with the special requirements

for operation in the Ex zone and offer a RS485 interface, as well as an Ethernet interface for digital Hart signals. Configuration will be possible via DTM, DD or built-in web server connectivity. Models for Profibus and Foundation Fieldbus will be available at a later date.

Another interesting product in the company's pipeline is a versatile Wireless-Hart adaptor. It is designed to add wireless functionality to any conventional field device. This adaptor will be able to obtain the real-time signals from a measuring device or sensor at adjustable time intervals and transfer them to the control system via wireless communication. Another new product will be a self-contained Wireless-Hart temperature sensor. It can be positioned at any location within the plant and is able to transfer up to two temperature values to the process control system.

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## Fieldbus Foundation and ISA Wireless Collaboration

The Fieldbus Foundation and ISA have announced an agreement to facilitate the implementation of wireless backhaul transport networks. This technology initiative is based on shared interests in serving the needs of end users and suppliers of wireless systems in industrial automation. Representatives from both organizations discussed the wireless project at ISA EXPO 2008 in Houston, TX, U.S.. At an ISA100 meeting in June,

ISA100 leaders established a new working group, ISA100.15-Wireless Backhaul Networks Working Group, to develop and maintain a standard to address one or more dedicated or shared wireless backhaul(s) is to support technologies running multiple applications. The first of these backbones will be the Fieldbus Foundation's High Speed Ethernet (HSE) implementation. To expedite the work, the Fieldbus Foundation and ISA

have entered into a cross-licensing agreement allowing the two organizations to collaborate on wireless networks. ISA will publish the technical documents as a standard within the ISA100 family of standards, and the standard will be jointly owned by the two organizations and used accordingly in the marketplace.

www.fieldbus.org  
www.isa.org



# Accurate Flow Measurement Improves Profit

## Two-wire Coriolis Flowmeter for Loop Powered Applications

**Rough Economic Seas** – The current economic climate means that many managers are taking a keen interest in the selection of their flow-measuring devices. Today's decision makers understand the benefits of different flow technologies and accept that when migrating to higher performing technologies, there may be cost implications resulting from, for example, increased wiring and associated installation costs. In a new installation, these extra costs can usually be minimized through good engineering practices.

The chemical and life science industries, like many other process industries, are facing challenging times. Over the past decade, the various market sectors have seen greater competition from other world areas, an abundance of new legislation, increasing raw material costs and an increase in energy costs. This is driving manufacturing companies to improve the efficiency of their processes with better and more reliable measurement technologies. Whereas 15 years ago "repeatability" was the magic word, what really counts today is what is dosed into the reactor, or transferred to the crystalliser, and how well we control temperature in the fermentation vessel to optimise the process.

To address these challenges and to remain competitive, the managers and engineers in charge of plant processes have been looking for ways to optimize their assets, maximizing product quality, plant throughput and availability, while minimizing operations and maintenance costs, reducing waste and rework, cutting the cost of utilities and cutting the cost of complying with safety health and environmental legislation without increasing risk.

One of the areas attracting special attention is that of flow measurement, as this often has a direct impact on the profitability of the plant. Get it right, and the plant is more efficient, produces less waste, minimizes rework and lowers maintenance costs. Get it wrong and the consequences can be significant.

Inaccurate measurement in fiscal applications can lead to a plant being overcharged for raw materials or effectively giving away the product. Inaccurate meters used to measure utilities can also add to costs. Meters used to provide a mass balance across the plant need to be accurate or technicians will either spend time chasing product losses that aren't there, or they will set the tolerance so wide that product losses are not identified early enough.

In addition to the problems associated with meter accuracy and repeatability, many flowmeter technologies require regular maintenance and calibration to maintain their accuracy. This adds cost to the maintenance budget and also has cost implications with regards to record keeping.

### Flowmeter Designs

There are several technologies available to measure flow, many of which are interchangeable for any flow application. The choice of technology depends on several factors, including cost, required accuracy, the unit to be measured and the understanding of the overall return on investment.

Volumetric flow rates can be inferred by measuring the differential pressure across a restriction in the pipe. The mass flow rate will vary depending on temperature and pressure and so some form of calculation has to be performed in the transmitter or the controller in order to give an accurate measurement. The accuracy of this calculation is dependent on the density of the fluid remaining constant. One of the disadvantages of dif-



Coriolis meters are accurate and reliable. Because there are no moving parts, maintenance is reduced to a minimum.

ferential pressure (DP) flow measurement is that it requires a good flow profile to work properly, so installation needs to be in a relatively long length of straight pipe. In addition, the technology does not offer a wide flow range and accuracy is limited. A further drawback is that the pipe restriction, whether this is an orifice plate, a venturi or any other device, may wear, meaning that regular calibration checks will be necessary to ensure accuracy.

Another means of measuring volumetric flow is by using some form of positive displacement (PD) meter where a mechanical device is caused to rotate by the flow passing over or around it. PD meters include turbine meters and oval gear meters. Because these devices have moving components they require regular calibration checks and regular maintenance, especially when being used with non-lubricating fluids. In addition, and in common with DP measurement, PD meters add a restriction to the line causing a pressure drop.

Other flow measurement techniques include ultrasonic flow measurement, which uses sound waves to determine the velocity of the media, and vortex flow measurement which measures the frequency of vortices created by inserting an obstruction in the pipeline. Both techniques have their place but are limited in their application.

Finally there is Coriolis mass flow metering. Coriolis measurement is based on the principle that when fluid is moving through an oscillating tube, forces are induced which causes the tube to twist. The amount of twist is directly proportional to the mass flow rate of the fluid flowing through the tube. Coriolis flow meters have been in existence since the 1970s, when pioneering companies such as Micro Motion first introduced commercial meters based on this technology.

### The Benefits of Coriolis Flowmeters

Coriolis meters have become acknowledged as the meter of choice when high accuracy is required. On-going development has led to improved accuracies and also the introduction of predictive diagnostics to warn when calibration or maintenance is necessary. In addition to the higher accuracy characteristics, a further benefit is that there are no moving parts. By selecting the right

materials for an application, the effects of erosion and wear can be avoided and maintenance reduced to virtually zero. These advantages have resulted in a growing market for Coriolis meters as they are increasingly specified for new applications and retrofits.

One limitation when applying Coriolis measurement, particularly in retrofit applications, is the need for between four and nine wires for operation (depending on the manufacturer). Two wires have always been necessary to power the device with an additional two wires required for the instrument signal. Coriolis manufacturers have been challenged by the energy needs of the sensor to oscillate and the energy available from loop power instrument wiring. Many users have indicated that the applications for Coriolis flow and density meters would be greatly expanded if a two-wire version was available.

While the need for four wires can easily be accommodated in new installations when changing out an existing two wire device, the cost of running an additional cable versus the benefits from the installation can mean that it is not a viable option. However this has now changed with the introduction by Emerson Process Management of a two-wire Micro Motion Coriolis mass flow and density meter.

### Two-wire Coriolis Mass Flow Meters

Over the last 31 years, the Micro Motion division of Emerson Process Management has made significant investments in Coriolis technology and

has recently addressed challenges in applications where entrained gas is present and the need for customers to understand if the metering tubes maintain their integrity by means of in-line meter verification. One of the major enablers for these features is the total energy management of the metering system which comprises the sensor and transmitter.

This provided a platform for the development of a two-wire Coriolis metering solution which allows users to install Coriolis metering, with all its inherent benefits which include direct mass, no moving parts, on-line density measurements, low pressure drop and more, in applications where at present a two-wire traditional flow metering device is installed.

Having benefitted from Coriolis technology in the past, process engineers and managers wanted a meter they could use more broadly. The new two-wire meter provides a perfect solution for loop-powered flow points throughout the plant, delivering measurement accuracy, repeatability and operational savings on a level not previously possible for flow loops with older flow measurement technologies. The new meter delivers +0.10% liquid flow and +0.0005 g/cm<sup>3</sup> liquid density accuracy in continuous process and mass balance applications.

The new Micro Motion two-wire Coriolis is ideally suited for use in the chemical, petrochemical and refining industries, and for continuous process and mass balance applications.

### Coriolis Meters Can Now Be Installed Virtually Anywhere

The introduction of two-wire Coriolis flowmeters means that accurate and reliable Coriolis technology can be used to upgrade older loop-powered technologies without adding more power or installing new cabling. The new two-wire meter delivers measurement accuracy, repeatability and operational savings on a level not previously possible for flow loops with older flow measurement technologies.

The loop-powered design makes for seamless integration into existing control systems and is ideal for long wiring runs and applications in hazardous areas. It has no moving parts and requires no maintenance.

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Emerson's new two-wire Coriolis meters are especially valuable for upgrading older loop-powered technologies without adding more power or installing new cabling.



# Demanding Applications

## Type-specific Pump Advantages and Disadvantages

**Solving Riddles – The different types of pumps available on the market offer specific advantages and disadvantages, which in the end define the field of application for these conveying units. In the case of gear pumps, their field of application covers especially combinations of high viscous media, high pressures and high temperatures.**

Recently, Maag Pump Systems has solved a complex pumping problem involving high viscosity food additives through the development of a special pump for this application. Centrifugal pumps cover the majority of pump applications in the chemical industry. This type of pump offers the specific advantage of being able to pump large liquid quantities using relatively small and cost-effective pumps. The field of application of centrifugal pumps is, however, limited due to the pumping characteristics of the centrifugal pump. Thus, only relatively low viscous fluids can be pumped and the attainable discharge pressures are limited. Moreover, the quantities pumped by these pumps change with the operating point. Thus, these pumps are not suited for metering purposes.

Should it not be possible to solve a pumping problem through a centrifugal pump, then commonly a positive displacement pump will be selected as the alternative. In the case of these units, many different types with specific use limitations exist. For example, reciprocating positive displacement pumps like piston or diaphragm pumps are deployed where the medium needs to be pumped against high pressures or where metering accuracy requirements are high. However, also in the case of these pump types, the viscosity of the pumped medium is limited due to the valves at the inlet and discharge of the pumps. Moreover, pulsations, which are characteristic for these pumps, cannot be accepted in many applications.

### The Strength of Gear Pumps

The second type of positive displacement pumps are the rotating positive displacement pumps. A representative of this family is the gear pump. A characteristic of gear pumps is their simple, valveless design, allowing cost-effective, reliable and high-precision pump solutions.

Beginning with lubricating oil pumps for gears and other machinery, these solutions include hydraulic pumps and metering pumps for chemicals and additives. Through suitable design measures the pumps may, moreover, be also used in connection with highly demanding conditions. For example, gear pumps are capable of pumping liquids exhibiting viscosities up to 20 Mio mPas and at pressures up to 1,000 bar. Also, these pumps can handle high temperatures up to 350 °C and corrosive applications. In addition, gear pumps offer the advantage of being able to operate reliably at very low feed-in pressures.

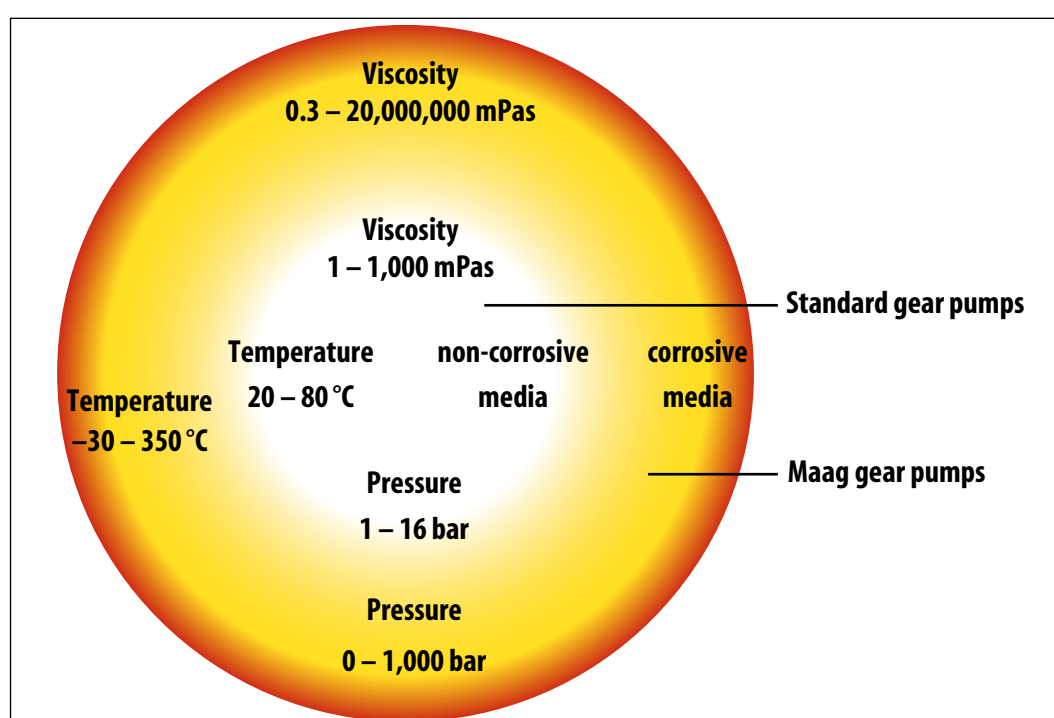
### Demanding Applications

Some examples for such demanding applications can be found in the manufacture of polymers. In these applications, gear pumps are used to extract high viscous and very hot polymer melts from reactors and other apparatus, thereby supplying the material to the downstream processing stage. For these pumps – besides the capability of being able to handle the demanding operating conditions – reliable operation is of utmost importance. Should a discharge pump in such a factory fail, then the entire production process will come to a standstill, resulting in significant financial losses to the operating company.

Gear pumps are also used when it comes to processing polymers. There they are used as pressure build-up units between extruder and die. They relieve the extruder from the pressure build-up thereby allowing gentle and economic processing of the melts thus also improving product quality. Of course, there are numerous applications in the chemical process industry that can benefit from the advantages of the gear pumps. For example, the pumps are also used as discharge units on thin-film evaporators where the viscosity levels are not as high as in the synthetic materials industry but where also very low feed-in pressures at the pump's inlet are present. Also, in connection with such applications, the requirements can be high regarding the chemical resistance of the pump's materials.

### Extraction Pump for Sugar Esters

A current example for a combination of these requirements comes from the food industry. An Asian manufacturer of food



Field of application for gear pumps

additives required a pump for discharging high viscosity sugar esters (emulsifiers) from a thin-film evaporator. This manufacturer was already using some gear pumps for discharging low viscosity liquids from thin-film evaporators and knew also about the pumps for high-viscosity melts in the polymer industry. For this reason, he

turned to Maag Pump Systems hoping for a solution.

This application is special above all through the high viscosity of the pumped medium. The results of viscosity measurements in the laboratory of Maag Pump Systems indicated that the viscosity of the sugar ester exhibits a strong non-Newtonian characteristic.

Thus, the viscosity does not only change with temperature but also with shear rate. In the case of low shear rate, as is the case in the vessel upstream of the pump, the viscosity of the sugar ester amounts to several million mPas. This means that in the resting condition the liquid is almost solid. The process temperature amounts to ap-

proximately 100 °C. This temperature is needed to maintain the sugar ester such that it is capable of flowing to a certain extent. The pressure in the thin-film evaporator amounts to a few millibars only. The available feed-in pressure is thus limited to the static liquid column above the pump.

In consideration of these findings, a pump exhibiting a special feed-in geometry is needed where net pressure suction head required (NPSHr) is as low as possible. This value describes the minimum inlet pressure that must be present at the pump's flange so that the pumped medium can be pumped without cavitation. After having analyzed the situation, it was decided to develop a tailor-made pump for this application based on the existing line of products.

This tailor-made pump is a pump with a heatable casing made of food-grade steel. In order to attain a low NPSHr value the casing was designed so that the gear wheels are located only a few millimeters below the surface of the flange connecting the thin-film evaporator. Thus, the liquid comes to "rest" directly on the teeth, so that in spite of the very low

vacuum and due to a special inlet geometry with a static liquid column of only approximately 200 mm, the liquid can be discharged from the high vacuum in the container. Sintered silicon carbide (SSiC) was used as the bearing material, which is food grade with good emergency operation properties and can also be used in connection with thin media needed for possible cleaning cycles. A double mechanical seal is used for sealing which guarantees reliable operation also at low vacuum pressures and high viscosities.

### Other Gear Pump Applications

This application from the food industry is only one example for the type of demanding application that can be solved through the deployment of gear pumps. Further examples for high-viscous media from the industrial or chemical area, which can be conveyed using gear pumps, are resins, silicone materials, polyurethane materials, adhesives, bitumen and greases. Besides these, many media with other demanding properties can be reliably conveyed. In view of the tremendous number of different bearing, shaft and casing materials as well as a wide selection of different sealing types, which can be combined specifically for each customer, standardized solutions, are common.

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Vacorex discharge pump for synthetic material melts



Special discharge pump for sugar esters



Thermoinox gear pump for chemical applications

# Catalyzing The Chemical Industry?

## Overview of Wireless Adoption in the Chemical Industry

**Current Scenario – The chemical industry is characterized by stiff competition, which necessitates plants to constantly strive for higher efficiency and production levels. With well established processes and regulations that govern safety in place, it is important that the automation systems operate continuously with great reliability and flexibility to achieve higher overall plant performance. Wireless devices could prove to be greatly beneficial in many aspects of operation in a chemical plant with the numerous benefits they offer.**

There is a huge amount of data that is being continuously transmitted and that is waiting to be tapped in a chemical plant. Providing invaluable information



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about the state and performance of various processes on a regular basis. Wireless sensors and other devices like routers, modems or access points could greatly help in capturing and transmitting this information successfully. Measurements from remote areas within the plant such as tank farms are made possible by the use of wireless. There are also inaccessible or rotating measurement points where using cables could be challenging. Wireless devices offer the possibility of extending measurements to such areas with ease. In addition, the use of wireless devices greatly reduces cabling costs and offers convenient installation and maintenance proposition. Above all, wireless devices

enable greater workforce mobility and flexibility, empowering the workers to have access to and to control numerous applications which earlier required greater human effort and time.

### Challenges

There are numerous challenges for wireless adoption in the chemical industry. End users, who are traditionally conservative towards new technology, are concerned over various aspects of wireless equipment, the most important among these being safety, reliability and security of data transmitted. The presence of hazardous areas within a chemical plant poses a high barrier for wireless device adoption as it raises safety concerns. Though there are explosion proof (EX Proof) wireless devices available, their use in the chemical industry is still minimal, indicating the end users reluctance to take risk. The possibility of data loss due to interference from other machines

within the plant, robustness of operation in harsh environments and misuse of information due to security breach are also discouraging end users from adopting wireless devices. This assumes higher significance as a chemical plant cannot afford to have a stoppage time owing to unreliable devices as it may have a direct impact on the profit.

For smooth operation of the plant, a seamless integration of wireless devices with existing automation systems and fieldbus is required and end users are skeptical about the interoperability of wireless devices. Battery life and high initial cost of investment associated with wireless devices are among the other end user concerns which are currently stalling wireless adoption in chemical industry.

### Current and Future Adoption Trends

The current level of adoption of wireless devices in the chemical industry is low. Short-range

devices like sensors to measure temperature, level and conductivity as well as medium-range devices such as access points and personal digital assistants (PDAs) are currently being used. Predominant application areas include monitoring and alerts as end users are far more comfortable to use wireless in these less critical applications in comparison to actual control applications.

The use of wireless devices in the chemical industries is expected to increase as more and more end users become convinced about the technology and its feasibility to work in the process environment. This also depends on how soon the wireless device vendors address some of the concerns raised by end users. Pilot testing and product trials could greatly expedite the process of convincing the end users of the reliability of wireless devices. The emergence of uniform standards for wireless communication such as wireless Hart and SP100.11a is expected to drive wireless adoption. Overall, the adoption in chemical industry is expected to increase gradually with significant adoption likely in a time frame of five years.

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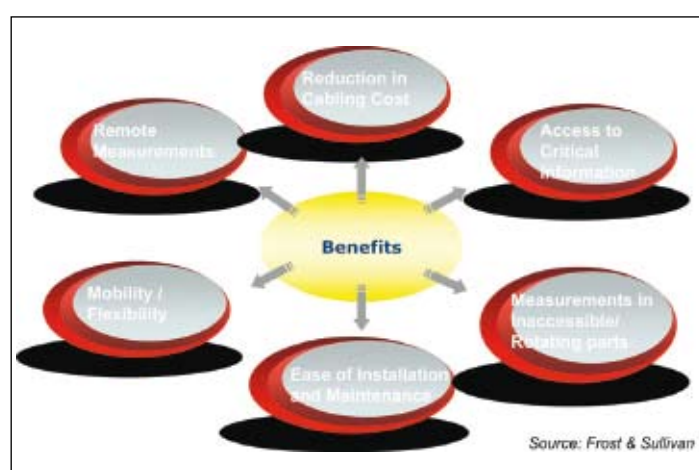


Fig. 1: Key Benefits of Wireless

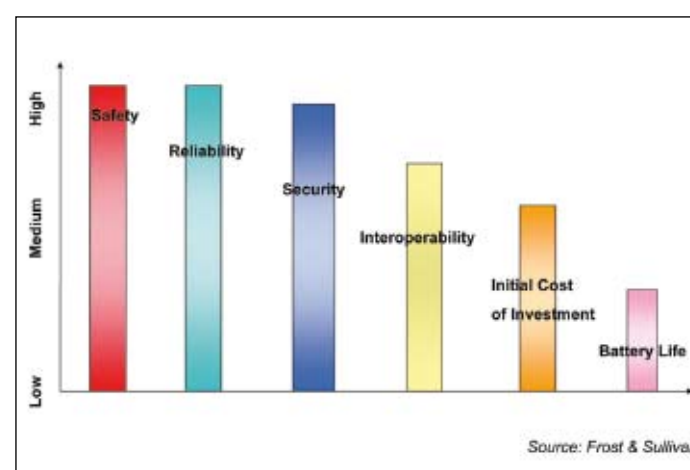


Fig. 2: Challenges to Wireless Adoption



# Gains From Industrial BPM

## Digitizing Work Processes with SOA-Based Workflow Execution

**Streamline Production – business process management (BPM) and service oriented architecture (SOA) are well known at the enterprise IT layer. However, when used in a real time capacity and industrialized, these technologies can bring the immense gains seen in the enterprise to production operations. Industrial BPM digitizes and streamlines production – from work instructions and compliance monitoring to corrective action. Teams can integrate processes across systems and departments for reliable, repeatable execution.**

Every production environment contains a mix of automated and manual interactions between equipment and personnel. Often, these production processes are not fully documented and include extra steps and resources. As such, they are difficult to adapt to changing business needs. Additionally, as workforces age and retire, organizations are losing the knowledge that is gained from years of experience on the plant floor – as the information has not been captured electronically and put into formal processes.

Digitizing work processes offers a way to evolve production – leveraging the methods and technologies that BPM brought to the enterprise. By documenting, leaning and digitizing production work processes or workflows, companies can achieve greater agility and long-term sustainability.

The benefits of digitizing production processes include:

- Leaner processes through improving, eliminating and automating steps
- Managing by exception
- Automating information flow from plant-to-enterprise and enterprise-to-enterprise
- Integrating people and their roles/functions
- Customizing to individuals' work styles and decision making
- Managing and auditing production processes more effectively and consistently
- Sharing production best practices and collaborating on processes

Unlike traditional systems, industrial BPM or industrial workflow allows production teams to mix automated and manual

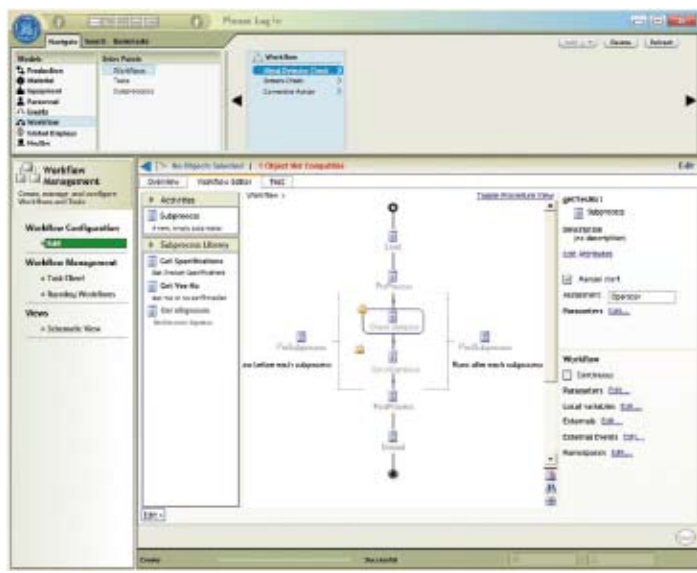


Fig. 1: A graphical authoring environment permits drag-and-drop construction of workflow diagrams or the execution process.

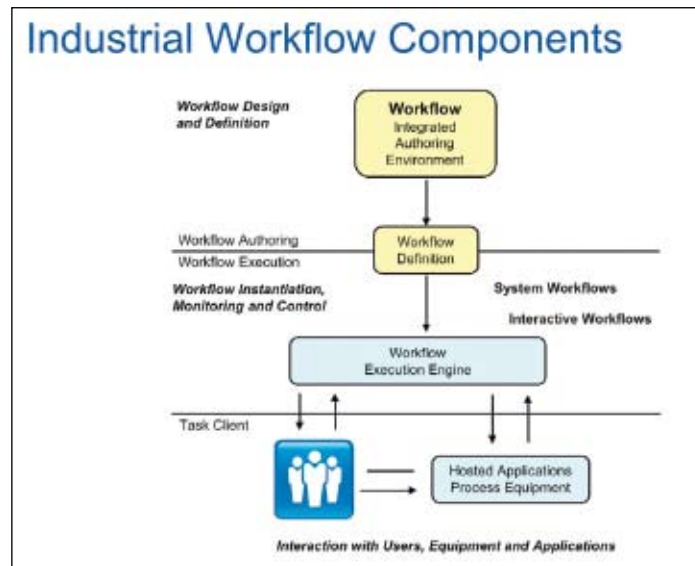


Fig. 2: Following definition, the workflow moves to the execution engine.

tasks. A simple workflow to process a production order could take place as follows:

- **Set Up Machine and Download Recipe:** The enterprise resource planning (ERP) triggers an event that a work order is passing down to the manufacturing execution system (MES), and a workflow begins and pushes out steps to different places or stations within the plant for execution. As an example, task 1 could be pushed out to a particular production machine and provide set up instructions to the operator in the form of attached documents. Once the machine is successfully set up, the workflow system could communicate to a supervisory control and data acquisition (SCADA) system or human-machine interface (HMI) system – or it could download the recipe directly. The workflow system has access to real-time data sources such as PLCs, OPC servers, custom process equipment, and more. With completion of these first two steps, the operator finished set up, downloaded the reci-

pe, and put the machine into production.

- **Visually Inspect Product:** As the product moves through the production line or from cell to cell, the operator receives a task to do visual inspection for that particular production order. The system provides work instruction for how to perform the visual inspection. Within that task step, the system requires manual data entry, as the operator inspects the product. The operator enters the information into an easy-to-use form, which is set up specifically for that task. The system pushes the inspection data into other systems – such as MES, laboratory information management system (LIMS), and HMI.
- **Package Product:** With the visual inspection completed, the product moves to packaging. At that station, the packaging operator receives instructions on how to package the product and moves through a workflow that even includes printing the package labels.
- **Pallet and Ship:** Once packaging is completed, the product moves to pallet and ship. The opera-

tor receives more instructions on what packages to use as well as materials and other information. The workflow system automatically pushes information back up into the ERP, so the ERP now contains the completed order information – including which pallets, which exact products and other details.

### Industrial BPM Across Production

Usage of industrial BPM vary from company to company. However, many organizations face common production challenges. In addition to orchestrating high-level processes and managing data between systems, common cases for industrial workflow include:

- **Leaning Production Processes:** Document and execute processes – digitizing production workflows to streamline steps. Additionally, record date/time and who performed the work, closing the loop for process improvement with factual data.
- **Managing Production Specifications:** Changes to specifications can trigger a workflow that will route the changes through a number of approvers, such as the quality control manager and then to the production manager for final approval and notification.

industrial workflow to create and document procedures – and build the corrective actions that are necessary if there is a negative response to one of those procedures. As companies execute on a procedure, teams need to collect the data on corrective actions – when they are taken, how, and what the response to the corrective action was. Industrial workflow provides a full closed loop for production.

- **Evaluating Reasons For Downtime:** As plant systems generate downtime events, industrial workflow can evaluate the conditions at that moment in time and infer downtime reason codes, then write the downtime reasons back to those systems.

With use cases reaching across production and driving critical production operations, industrial BPM must provide ease of use for quick response across teams and roles.

### Industrial BPM Across Roles

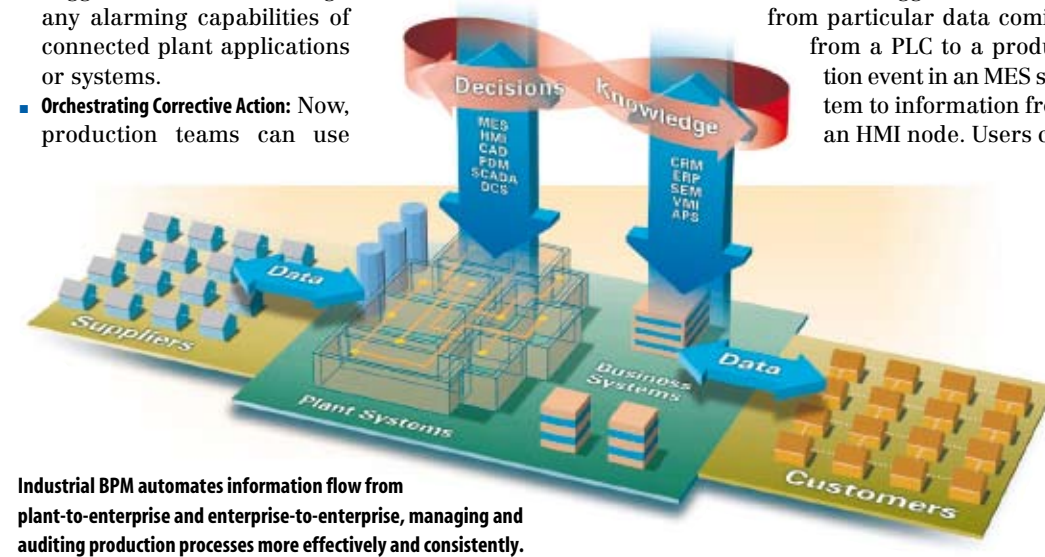
Unlike many enterprise-level systems, industrial BPM typically does not require IT resources, and power users are able to make changes to the system to immediately improve production. A graphical authoring environment permits drag-

### As workforces age and retire, organizations are losing the knowledge that is gained from years of experience on the plant floor.

- **Coordinating Sample Requests:** When a certain condition arises – such as a combination of variables outside a limit, or a time window lapses, an industrial workflow system can send a request to quality assurance (QA) to perform tests or take samples. Likewise, teams can trigger a workflow through any alarming capabilities of connected plant applications or systems.
- **Orchestrating Corrective Action:** Now, production teams can use

and-drop construction of workflow diagrams or the execution process. (fig. 1.)

Following definition, the workflow moves to the execution engine (fig. 2). A typical plant could have 60–100 workflows executing at the



Industrial BPM automates information flow from plant-to-enterprise and enterprise-to-enterprise, managing and auditing production processes more effectively and consistently.

## Lanxess Plant Accident-free for over 16 Years

Accident insurance companies would give a policy holder like this one a discount: The hydrogenation plant in Uerdingen, Germany belonging to Lanxess's Basic Chemicals business unit has gone 6,000 days without a notifiable accident, which is the equivalent of around 16 years and 5 months.

"We're very proud of this anniversary," said Reinhold Brink, plant manager of the hydrogenation plant, "but we are well aware that this achievement is primarily due to the careful work procedures of our staff in the plant and the laboratory." A high standard of safety maintained by all involved together with a degree of luck have brought about this positive result.

"Nonetheless, there is no doubt that we need to continue rigorously working on our health and safety practices, because routine is the natural enemy of occupational safety,"



said head of department Christoph Mannheims at the celebrations recently.

The hydrogenation facility, belonging to specialty chemicals group Lanxess, manufactures almost 50,000 mt of hydrogenated amines and alcohols every

year. These basic chemicals are important building blocks which are absolutely vital for the production of an immense number of wide-ranging chemical products such as rubber and plastics, pharmaceuticals, dyestuffs, coatings and agrochemicals. ■

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# Enhancing For Sustainability

## The New Responsible Care Ethic

**Adapting** – Twenty five years ago, when the leaders of the Canadian Chemical Producers' Association (CCPA) member companies pioneered Responsible Care, they saw as mission-critical the need for a radical shift in the ethic – or belief system – of our industry. Their "licence to operate" was in real and present danger of being revoked if they clung to a credo that continued to evoke public distrust and fear.

Company lawyers were initially aghast at the leaders' new commitment to this ethic of "do the right thing, and be seen to do the right thing," guided by principles of openness, public accountability, precaution, lifecycle stewardship, exceeding requirements and constructively engaging in public policy advancement with governments and our critics.

Pretty revolutionary stuff for the 1980s in Canada. Unthinkable in many other countries. Amazingly this ethic has prevailed and has spread to the chemical industry in 53 countries around the world. Some might say it has become the new norm.

This has the current leaders of the Canadian chemical industry wondering if the Responsible Care ethic needs to move to

even higher ground. Is Responsible Care up to the task of guiding the industry to adequately address society's increasingly dominant concerns such as health, climate change, water supply and globalization? Do we need to rethink how we can be, and be seen as, contributors to sustainability rather than its enemies – providers of solutions rather than compounders of problems?

### Investments Shifting East

The sustainability of the Canadian industry is also under threat. Investments have significantly shifted to the Middle East, India and China. Chemical imports to Canada and the U.S.

from these regions are growing at the expense of domestic production. Economies of scale can work against our generally smaller Canadian production facilities. Our previous feedstock and energy availability and cost advantages are eroding. Public policy does not always encourage investment here.

Do we need to work together under Responsible Care to find innovative ways of meeting these challenges and turning them into opportunities?

### The Answer Is Yes

After several soul-searching meetings last fall involving the CCPA Board, membership, activist panel and various committees, as well as sustainability experts, we have concluded that Responsible Care must indeed move to a higher level to better address both aspects of sustainability.

We're starting with the ethic and guiding principles. Subsequently, revisions and additions to the current Responsible Care policies, codes of practice and our public-peer verification process will likely also be needed, but these must flow from the ethic and principles – truly an evolutionary process.

- Precaution
- Solutions to sustainability challenges
- Security
- Innovation
- Economic contribution
- Social responsibility
- Proactive improvement of public policy.

It has also been agreed that we will maintain the ethic statement "do the right thing and be seen to do the right thing," as well as the essence of the current principles related to lifecycle stewardship, accountability, safety, respect and continuous improvement.

A high level task force of stakeholders has been formed to take a look at the whole "ar-

**Responsible Care**  
Our commitment to sustainability.



**Gestion responsable**  
Notre engagement envers le développement durable.

It has been agreed that any new principles, or rewording of existing ones, must drive behaviour change and lead to measurable outcomes. They should be inspiring and seen as cutting edge.

Some aspects of sustainability that emerged as possible additions in a new version of the ethic statement include:

- Sustainable or green chemistry
- Reduction in footprint of operations and products

### Contact:

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Responsible Care for the Canadian Chemical Producers' Association  
bwastle@ccpa.ca

### New And Approved

Below is the version of the new "Responsible Care Ethic & Principles for Sustainability" that has resulted from several rounds of discussion on earlier drafts by CCPA's Leadership Groups, National Advisory Panel, policy committees and Board of Directors. It was endorsed by the Board in June 2008:

We are committed to do the right thing, and be seen to do the right thing.

We dedicate ourselves, our technology and our business practices to sustainability – the betterment of society, the environment and the economy. The principles of Responsible Care are key to our business success, and compel us to:

- work for the improvement of people's lives and the environment, while striving to do no harm;
- be accountable and responsive to the public, especially our local communities, who have the right to understand the risks and benefits of what we do;
- take preventative action to protect health and the environment;
- innovate for safer products and processes that conserve resources and provide enhanced value;
- engage with our business partners to ensure the stewardship and security of our products, services and raw materials throughout their life-cycles;
- understand and meet expectations for social responsibility;
- work with all stakeholders for public policy and standards that enhance sustainability, act to advance legal requirements and meet or exceed their letter and spirit;
- promote awareness of Responsible Care, and inspire others to commit to these principles.

## Pfizer Selects Prosonix Technology

Prosonix announced that Pfizer Global Manufacturing will implement its Prosonitron reactor and sonocrystallization process technology at Pfizer's manufacturing facilities in Ireland. The Prosonitron technology will be used in the controlled crystallization and production of a number of Pfizer products and follows an extended period of collaboration and testing with Pfizer Global Research and Development in Sandwich, UK.

The Prosonitron technology is proven across scale, facilitating the complete crystallization control of many aspects of complex pharmaceutical crystallization processes, including control of crystal size, shape, and purity, the selective production of polymorphs, enhancing both manufacturing productivity and ultimate formulation performance of drug product. The technology is increasingly being recognized as an impor-

tant new option in active pharmaceutical ingredient (API) crystallization.

Commenting on the deal, Simon Davidson, new product team leader, Pfizer Global Manufacturing said, "Sono-crystallization technology offers an additional tool to augment existing techniques for API crystallization and in-situ selection of specific API physical characteristics."

## Survey: French Biotechs Set to Lure Drugmakers

French biotechnology companies' progress developing potential medicines should lead to several alliances or mergers with drugmakers in coming months, a report by the country's industry body showed recently. The global financial crisis has put the brakes on initial public offerings (IPO) but alliances with pharmaceutical companies should still give biotech access to cash, it said.

"While awaiting the next opening of the stock market window, it is to be hoped that the financial deficits registered within the large pharmaceutical groups... will push them towards our biotech companies," France Biotech said in

its annual survey of the French sector. "Such a development could lead to a number of strategic alliances or mergers over the coming months," it said.

The French biotech industry is approaching maturity in developing possible medicines, the survey showed, with 73 products entering the research phase and 98 experimental drugs being tested on humans in clinical development phases. That compares with 57 drugs the pharmaceutical industry has in development as it grapples with patent expiries and a dire need for new treatments, the survey showed. Marketing approval is pending for 10 biotech products with four available to patients.

In the first half of the year, the French biotechnology sector chiefly raised cash from venture capitalists which invested €98 million, France Biotech said. While opportunities for biotech IPOs – 15 in 2007 – were very slim due to the financial crisis, France Biotech expected the creation of Euronext's Next Biotech European stock market index last April to "ensure greater visibility for the sector resulting in greater attractiveness." The Next Biotech is the only European index dedicated to the biotechnology industry and comprises the 26 companies, located in France, Belgium and the Netherlands, listed on Euronext or Alternext.

## Univar Launches Chlorohexidine Gluconate with CEP

At the CPhI in Frankfurt at the beginning of October, Univar announced the launch of chlorohexidine gluconate (manufactured by R.N. Pharmaceuticals) fully certified by the European Directorate for the Quality of Medicines (EDQM). The EDQM's Certificate of Suitability certifies compliance of a material with the requirements stipulated in the relevant monograph of the European Pharmacopoeia. The CEP for chlorohexidine gluconate was issued in July and con-

firms the good manufacturing practices (GMP) quality standard under which the product is manufactured and supplied. There is also a drug master file (DMF) available.

Chlorohexidine gluconate is an important disinfectant and antiseptic used in oral care, skin care, cosmetics and pharmaceutical products, commonly used in mouth washes, surgical scrubs, hand washes and teat dips. It is a highly effective preservative in cosmetic preparations. As

demand for improved hygiene increase, volumes continue to grow in Europe as well as globally. Many chlorohexidine products, especially those with pharmaceutical uses, are licensed by regulatory authorities so an assurance of quality for the raw material is imperative.

## Pfizer Creates 3 Units as Realignment Continues

Pfizer is forming focused business units in primary care, specialty care and emerging markets as part of an ongoing realignment to streamline its operations. The new units build on moves announced by the world's largest drug maker earlier this year that created units focused on off-patent products and oncology. The realignment involves development, market-

ing, sales and other functions. Pfizer recently alerted employees to the changes in an internal memo, said company spokesman Ray Kerins. Kerins said no jobs would be affected by the changes.

Where Pfizer previously had been more structured by geographic region, the drug maker would now focus on customer segments, Kerins said. The goal

of the changes is "to build upon the experience of the units we announced earlier this year, and to enhance innovation and accountability that brings us closer to the customer," Kerins said. The new units come after Pfizer recently said it was ending research efforts into heart disease, obesity and bone health as it focuses on cancer and five other areas.

## ISP Introduces New Addition

International Specialty Products (ISP) has expanded its Advantia line of coating systems with the addition of Advantia Preferred HS coatings. The new coatings are based on innovative combinations of polymers and plasticizers for immediate-release film coating of oral solid dosage forms not only for pharmaceutical products but also for dietary supplements.

Moreover, as demonstrated in both laboratory and production-scale coating trials, Advantia Preferred HS coatings can be applied in up to 25% high-solids suspensions. High-solids coating formulations reduce coating process time, thereby increasing productivity and reducing manufacturing costs. In addition, comparative film roughness data from the trials indicate that

Advantia Preferred HS coatings have less surface roughness than other high-solids coating systems, which translates into tablets with a smoother, more elegant appearance.

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## PEOPLE



Christian Jourquin

**Solvay CEO Christian Jourquin Elected President of Cefic** Solvay announces that its CEO, Christian Jourquin, was elected to a two-year term as president of Cefic by the trade association's general assembly. In his speech, Jourquin highlighted that the coming years would be crucial for the European chemical industry, which will have to respond to unprecedented challenges and opportunities created by climate change. ■



John van Osch

**Univar Names Group Senior Vice President Europe** Univar has appointed John van Osch as group senior vice president Europe, effective Jan. 1. Osch is currently president and general manager of DSM Composite Resins in Schaffhausen, Switzerland. Prior to joining DSM in 2006, he enjoyed a career of nearly 20 years with General Electric, primarily with GE Plastics. ■

**Dow Izolan Announces New Leadership** Dow Izolan, the joint venture company between Dow and Izolan, announced that Mikhail Tsarfin has been named Dow Izolan general manager, effective Nov. 1. Since the JV formation in 2006, Tsarfin has been the company's sales and marketing director and first deputy general manager. Tsarfin succeeds Aldo de Santi, who will assume expanded business responsibilities while keeping his current role of commercial director for Northern Europe for the Dow Polyurethane Systems business. De Santi will continue to offer his experience to the joint venture after relocating to Italy in January. Sergey Anikin, currently sales and marketing manager for Dow Base and Performance Chemicals in Russia and the Former Soviet Union, has been named Dow Izolan sales and marketing director and will be located in Vladimir. ■



Alan Burns

**Sartorius Stedim Biotech Appoints VP of Global Quality Systems** Stedim Biotech has announced the appointment of Alan Burns as vice president of Global Quality Systems. Based in Concord, Calif. (U.S.), Burns is responsible for Sartorius Stedim's worldwide Quality Systems and leads a newly formed centralized quality function at the company. He reports to Volker Niebel, executive vice president of operations. ■



Heinz-Werner Meier

**Sanofi-Aventis' German Head to Quit** The head of Sanofi-Aventis' German operations Heinz-Werner Meier will leave his post at the end of the year, Financial Times Deutschland reported, citing the company. Meier, a long-time executive at German drugs and chemicals maker Hoechst, which is now part of Sanofi-Aventis, will also resign from his role as the French group's personnel chief on Sept. 1, the paper said. Meier informed staff of his decision in a letter, which was obtained by Financial Times Deutschland, the paper said. ■



Egil Hogna

**Yara Makes New Appointments** Yara International ASA said it has appointed internal candidate Egil Hogna as its new chief financial officer. Hogna replaces previous incumbent Sven Ombudstvedt, who announced his resignation last week. The company has also appointed Siemens executive Jorgen Ole Haslestad as its new chief executive after a year-long search to find a replacement for the retiring Thorleif Enger. Haslestad currently

heads the German conglomerate's Industry Solutions Division and will take up his new post in September. ■



Dr. Lester Mills

**Bachem Enlarges Corporate Executive Committee** Bachem announced that Dr. Lester Mills will become the fourth member of the company's corporate executive committee on Jan. 1. Mills will be responsible for global marketing and sales and will strengthen the existing team of Rolf Nyfeler, CEO, Daniel Erne, CTO, and Michael Hülsler, CFO. Mills has extensive international industrial experience from his previous work in the U.S. and Switzerland, having started his career at Lonza, then moving on to Genzyme and Roche Vitamins, which is now DSM Nutritional Products. He is currently director of sales at DSM Nutritional Products Europe, Birsfelden, Switzerland. ■



Bernard Poussot

**Wyeth Names President, CEO Poussot to Added Post of Chairman** Wyeth said it named Bernard Poussot, the company's president and chief executive, to the additional position of chairman, effective immediately. Poussot replaces Robert Essner, who in April announced his plans to retire. ■



Alessandro Banchi

**Boehringer Ingelheim CEO Banchi Retires** Boehringer Ingelheim, Germany's second-largest drug company, said its chief executive officer Alessandro Banchi will retire from his post at the end of the year and that Andreas Barner, currently deputy CEO, is to replace him. Banchi has been with the family-owned company for 35 years, Boehringer said in a statement. His successor Barner is currently responsible for research and development.

The company, which was founded in 1885, also said that Hubertus von Baumbach will replace Marbod Muff as CFO from the beginning of next year, a decision first announced in 2006. ■

## BASF: European Award for Carbon Balance

BASF was awarded the European Responsible Care Award by the European chemical industry association Cefic for its carbon balance. The judges commemorated the project as a highly innovative measurement approach that allows BASF to present a comprehensive carbon balance for its operations.

In February, BASF became the first company in the world to present a comprehensive carbon balance covering its entire chemicals business. The results show that BASF products can save three times more greenhouse gas emissions than the entire amount caused by the production and disposal of all the company's products. BASF products enable global savings of more than 250 million mt of CO<sub>2</sub> in areas as diverse as construction, the



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automotive industry, and industrial production. This is three times more than emitted in the production and disposal of all BASF products. The total emissions from the sourcing of raw materials and precursors, the manufacture of BASF's products, and disposal of all products amount to about 87 million mt of CO<sub>2</sub> equivalents. In short: the greenhouse gas emissions that customers save by using innovative BASF products are three times higher than the total emissions from the manufacture and disposal of all BASF products. An independent third party, the Öko-Institut in Freiburg, has reviewed and confirmed BASF's calculations. ■

## EPA Honors Pfizer for Reducing Emissions

The U.S. Environmental Protection Agency (EPA) honored Pfizer in recognition of the company's award-winning Energy and Climate Change Program, which reduced total greenhouse gas emissions by 43% per million dollars of revenue from 2000 to 2007.

These reductions, which exceeded Pfizer's original goal of 35%, were achieved in partnership with the EPA's Climate Leaders Program. Climate Leaders is a public-private initiative in which the EPA works with companies to develop comprehensive climate change strategies.

Pfizer exceeded its GHG reduction goals by implementing more than

1,000 projects during the duration of the goal. The projects included installing a combined heating and power system at its Singapore facility; a geothermal system at its Freiburg, Germany, site; a photovoltaic (solar panel) system at its Lajolla, Calif., U.S. facility; and boiler efficiency upgrades at its Kalamazoo, Mich., U.S. site, as well as many smaller projects. Pfizer has also taken steps to improve the fuel efficiency in its sales fleet through several approaches including raising driver awareness of efficient driving methods and increased use of fuel cards, dual-fuel, and hybrid vehicles in certain markets. ■



## EVENTS

**GHS Seminars and Information Sessions** Following the adoption of the Reach regulation, the next big challenge for European industry will be the Globally Harmonized System (GHS). Just to what extent the announced system becomes reality, cannot be accurately predicted at the present time. It's not only a matter of taking into account changes in classification and labeling use, but also applying both the old and the new regulations in parallel during the different transition periods.

The Academy Modern Management is organizing one practical workshop (Dec. 2-3) as well as two information meetings (April 28, 2009, and Nov. 10, 2009) about GHS. Participants will be provided with general highlights and compliance updates of the consequences of switching over to the new laws and regulations for handling dangerous materials and workplace safety as well as valuable references to the conversion, resulting from the introduction of GHS.

## ▶ Sabine Noll

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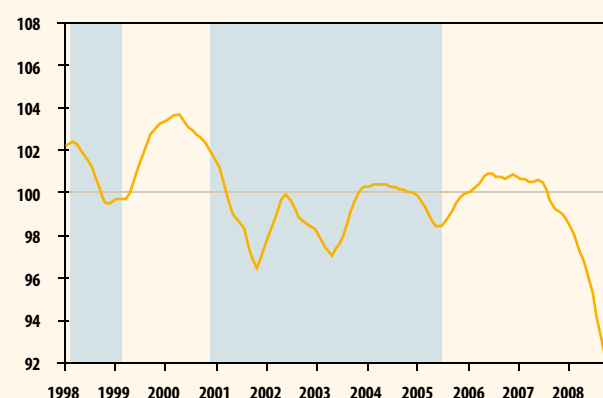
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## Financial Turbulence

## CLIs signal slowdown



Source: OECD

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OECD composite leading indicators (CLIs) for August 2008 indicate a continued weakening outlook for all the major seven economies. The Euro area's CLI decreased by 1.0 point in August and stood 6.4 points lower than a year ago. The above graph shows the Euro area's growth cycle outlook based on the CLI, which attempts to indicate turning points in economic activity approximately six months in advance. Shaded areas represent observed growth cycle downswings in the reference series.

## Second Quarter European GDP Growth rates in volume (based on seasonally adjusted data)

	Percentage change compared to the previous quarter				Percentage change compared to the same quarter of the previous year			
	2007	2008	2007	2008	2007	2008	2007	2008
EU15	0.6	0.4	0.7	-0.2	2.6	2.1	2.1	1.4
EU27	0.6	0.5	0.6	-0.1	2.9	2.5	2.3	1.6
United States	1.2	0.0	0.2	0.8	2.8	2.3	2.5	2.2
Japan	0.2	0.6	0.8	-0.6	1.8	1.4	1.2	1.0

Source: Eurostat

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Euro area (EU15) GDP declined by 0.2% and EU27 GDP by 0.1% in the second quarter of 2008, compared with the previous quarter. In the first quarter of 2008, growth rates were +0.7% in the euro area and +0.6% in the EU27. Compared with the second quarter of 2007, seasonally adjusted GDP rose by 1.4% in the euro area and by 1.6% in the EU27, after +2.1% and +2.3% respectively for the previous quarter. Investments fell by 1.2% in the euro area and by 1.6% in the EU27.

## Researchers Find Easier Way to Make Stem Cells

Researchers trying to find ways to transform ordinary skin cells into powerful stem cells said they found a shortcut by "sprinkling" a chemical onto the cells. Adding the chemical allowed the team at the Harvard Stem Cell Institute in Massachusetts to use just two genes to transform ordinary human skin cells into more powerful induced pluripotent stem cells or iPS cells.

"This study demonstrates there's a possibility that instead of using genes and viruses to reprogram cells, one can use chemicals," said Dr. Doug Melton, who directed the study published in the journal Nature Biotechnology. Melton said Danwei Huangfu, a postdoctoral researcher in his lab, developed the new method. "The exciting thing about Danwei's work is you can see for the first time that you could sprinkle chemicals on cells and make stem cells," Melton, a Howard Hughes Medical Institute Investigator, said in a statement. Stem cells are the body's master cells, giving rise to all the tissues, organs and blood. Embryonic stem cells are considered the most powerful kinds of stem cells, as they have the potential to give rise to any type of tissue. Doctors hope to someday use them to transform medicine. Melton, for instance, wants to find a way to regenerate the pancreatic cells destroyed in type 1 diabetes and perhaps cure that disease.

## Inserting Genes

But pluripotent stem cells such as the embryonic cells are dif-



icult to make, requiring the use of an embryo or cloning technology. Many people also object to their use, and several countries, including the U.S., limit funding for such experiments. In the past year, several teams of scientists have reported finding a handful of genes that can transform ordinary skin cells into iPS cells, which look and act like embryonic stem cells. To get these genes into the cells, they have had to use retroviruses, which integrate their own genetic material into the cells they infect. This can be dangerous and can cause tumors and perhaps other effects.

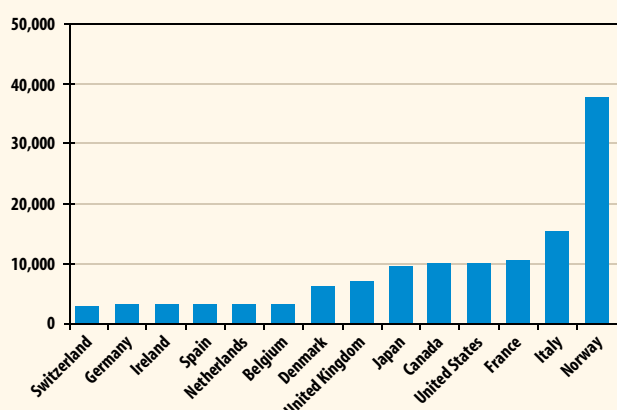
Last month U.S. researchers did the same thing using a harmless virus called an adenovirus, but the method was not efficient. Recently, Shinya Yamanaka of Kyoto University in Japan, who discovered iPS cells in mice, used a loop of genetic material called a plasmid to reformat the cells. Huangfu tried treating the cells first with valproic

acid. After she did this, it only took two of the four usual genes to reprogram the cells into iPS cells, she reported. This is good because the other two genes usually needed can promote cancer. The Melton team used retroviruses to carry the two genes in, but suggest they might not be necessary. "These results support the possibility of reprogramming through purely chemical means, which would make therapeutic use of reprogrammed cells safer and more practical," they wrote in their report. Huangfu said the valproic acid unraveled the chromatin - the physical structure of the chromosomes - making it possible to get in and alter the DNA more easily. "We may need two types of chemicals, one to loosen the chromatin structure, and one to reprogram. We are looking for that reprogramming chemical, and it should be possible to find it eventually," she said.

► www.hsci.harvard.edu

## Deposit Protection

## Explicit deposit insurance coverage limits USD equivalents, as of early 2008

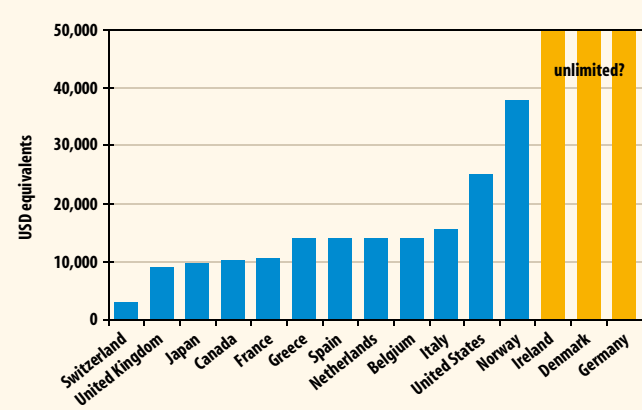


Source: Financial Market Trends No. 94 July 2008

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Until the latest statements suggesting unlimited guarantees, equal coverage was highest in Norway, France, Italy and Mexico. In the U.S. the amount covered has been raised temporarily to 250,000 from 100,000 US dollars per account. The graphs show coverage in early 2008 and the position as of Oct. 8, based on government statements. For a savings insurance system to be effective in preventing bank runs in times of crisis, coverage must be set at adequate levels.

## New temporary deposit insurance coverage limits Based on government statements as of 8th of October 2008\*

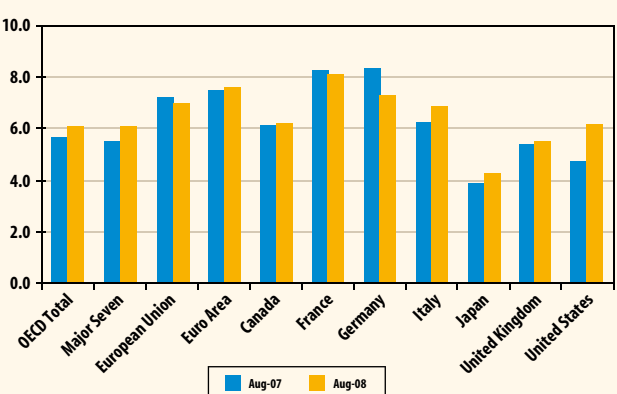


Source: Financial Market Trends No. 94 July 2008

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Critics of deposit insurance schemes suggest they encourage extreme risk-taking by banks as the institutions are protected by a public safety net if things go wrong. Financial safety nets consist of three interrelated elements: prudential regulation and supervision, a lender of last resort and deposit insurance. If a country has developed mechanisms in only one or two of these three areas, it is still likely to face difficulties in preventing or resolving serious problems in its banking system.

## Unemployment Rate Rises

Selected Standardized Unemployment Rates August 2007 - August 2008<sup>(1)</sup>

1) Italy and United Kingdom: June-07 - June-08

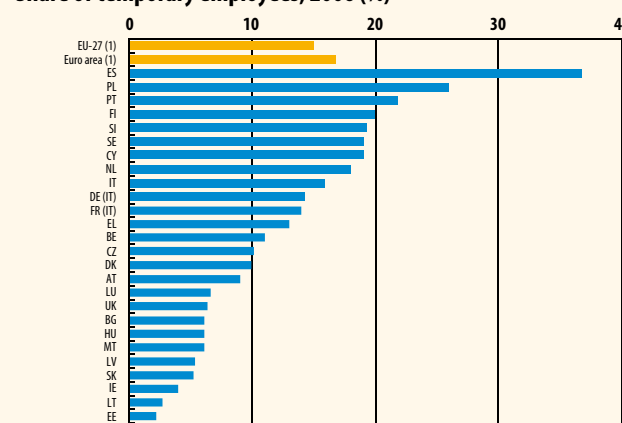
Source: OECD

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The standardized unemployment rate for the OECD area was 6.0% in August 2008, 0.2% higher than the previous month and 0.4% higher than a year earlier. In the Euro area, the unemployment rate was 7.5% in August 2008, 0.1% higher than the previous month and 0.1% higher than a year earlier.

## Temporary Employment

## Share of temporary employees, 2006 (%)



(1) Provisional data

Source: Eurostat

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Labor market flexibility can be seen as a way of encouraging employers to increase employment and raise participation in the labor force. The graph illustrates the results of the EU labor force survey, and covers persons aged 15 to 64. Personnel with temporary contracts are those who declare themselves as having a fixed term employment contract or a job which will terminate if certain objective criteria are met.

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