

Innovative Solutions at Work

Chemical processing plants share their strategies for overcoming today's toughest challenges

Editor's Note: This is the second part of a two-part series examining the top issues in the chemical processing industry.

By Joy LePree

In our first issue of 2007, CHEM.INFO asked industry experts from chemical processing associations across the country about the challenges chemical plants would face in the coming year. Most predicted that the growing energy crisis, plant security concerns, and railroad service issues would be the most problematic. Knowing our readers would not sit by idly, we asked how they're handling what they view as the industry's toughest issues. The stories and solutions we discovered are filled with creativity, proactive action, and the will to survive. They also demonstrate the outstanding ability of chemical engineers to overcome the difficult challenges associated with doing business on today's chemical industry battlefield.

Taming the Energy Monster

The energy crisis may well be the single largest challenge the chemical industry has ever faced. With natural gas and electric prices soaring, many processors find themselves in a very difficult, and costly, predicament. However, chemical manufacturers across the country are finding creative ways to tame the energy monster. Some are changing processes, some are discovering better management is key, and some are turning to renewable energy sources. By confronting the crisis head on, many processors have found a way to help themselves as well as the environment.

Green Power

Green power, electricity generated from environmentally preferable and renewable resources such as solar, wind, geothermal, biogas, biomass, and low-impact hydro resources, is cleaner than conventional fossil fuel-based sources of electricity, which produce carbon dioxide emissions. Purchasing green power helps support the development of renewable energy capacity nationwide, while reducing the burden, and reliance, on traditional utilities. Users of power of the green kind abound in the chemical industry. For example, WhiteWave Foods was named as a 2006 Green Power Leadership Award winner by the EPA and the Department of Energy for using

renewable energy. WhiteWave's Silk and Horizon Organic brands offset 100 percent of the electricity used in manufacturing their products by purchasing wind energy Green Tags from Bonneville Environmental Foundation. Green Tags represent the real savings in carbon dioxide and other pollutants that occur when clean, renewable power replaces power produced from burning fossil fuels, including coal and natural gas, in the national electric grid.

The company further expanded its support of wind last year by offsetting the energy used in its Broomfield, CO, headquarters with renewable energy. These additional Green Tags, coupled with those bought by Silk and Horizon Organic to match each kilowatt-hour of electricity used in production of their products, result in a total of almost 54,000 megawatt-hours of wind energy being added back into the national grid annually. The resulting benefit of the renewable energy is equivalent to the elimination of 35,000 tons of greenhouse gas emissions. That benefit is the same as taking 6,000 cars off the road or planting more than 10,000 acres of trees each year.

WhiteWave is not alone in its use of renewable energy. DuPont was ranked No. 7 on the EPA's list of the nation's Top 25 Green Power Purchasers for its voluntary purchase of 170 million kilowatt-hours of green power. The company is purchasing renewable energy certificates for electricity generated from biomass and wind energy. "Purchasing green power helps us improve our environmental performance, increase demand for renewable resources, and sends a clear message that using cleaner sources of electricity is a sound business decision," says Linda Fisher, DuPont vice president and chief sustainability officer.

The EPA, using national average utility emissions rates, estimates that DuPont's purchase is equivalent to avoiding nearly 237 million pounds of carbon dioxide (CO₂) emissions annually. This is the equivalent of avoiding the CO₂ emissions associated with more than 23,000 passenger cars each year. The company's purchase of 170 million kilowatt hours also represents the same amount of electricity needed to power nearly 14,000 average American homes each year. DuPont has a long-standing tradition of proactively dealing with energy issues. The company has reduced greenhouse gas emissions 72 percent since 1990, and by doing so, DuPont has avoided more than \$3 billion in energy costs. Those energy savings are based on the use of improved process controls, optimization of energy generation and distribution at its facilities, new technologies with lower energy consumption, and one of the most significant factors improved yields from manufacturing processes. DuPont is also reducing the use of fossil fuels by employing renewable energy sources such as landfill gas.

Alternative Ideas

Engineers at Cytec Industries, a producer of specialty chemicals and materials, are thinking outside the box when it comes to finding alternative ways to power up their facilities. First, the company has developed a landfill gas project that collects and pipes gas from a nearby landfill to its sulfuric acid regen plant in Louisiana. The project, which took five years to complete, was a collaborative effort between Cytec, Renovar Energy, the Jefferson Parish Landfill, the Louisiana Department of Environmental Quality, and EPA's Landfill Methane Outreach Project. "This project was a win-win for everyone involved," says David Lilley, chairman, president, and CEO of Cytec. "It helps reduce air emissions, benefits the local communities affected by landfill gas burn-off, promotes conservation of non-renewable energy

sources such as natural gas, and helps offset costs and expenses at the Jefferson Parish Landfill and Cytec."

Renovar Energy designed and constructed a gas compressor system and the four-mile pipeline that transfers the gas from the landfill to Cytec's manufacturing unit. Renovar compresses the gas, filters it to remove the particles, chills it to condense water, and pipes it to Cytec. The pipeline was complete in late 2005 and the startup of the project began in mid-January 2006.

The project captures approximately 1,700 standard cubic feet per minute of landfill gas and transports it via underground pipelines to Cytec for use as a fuel in a process heater. The annual reduction of greenhouse gases attributed to this project has the same effect as removing emissions equivalent to 4,100 vehicles, reducing oil consumption by 49,700 barrels, or planting 5,800 acres of forest. And, according to Greg Deis, process engineer and energy gatekeeper with Cytec, it has created substantial energy savings for the company. He also discussed an earlier project, the Liquid Carbon Dioxide Vaporizer project, which won Cytec's acid and melamine production teams an Energy Efficiency Award from the ACC. The project was based on the idea of using cooling water, instead of steam, as the heat source to vaporize liquid carbon dioxide used in the urea process. Because carbon dioxide is stored as a liquid at -4°F, the challenge was to design a unit that would not freeze up while vaporizing the sub-zero liquid carbon dioxide. Design engineers devised a plan that successfully reduced the steam load by 5,000 pounds per hour. Using cooling water instead of steam resulted in cooler carbon dioxide gas, which reduced the work of the compressors by 115 kilowatts. Annualized energy savings are 1.3 percent per pound of production, equivalent to 55,000 MMBtu per year, with an associated carbon dioxide emission reduction of 3,250 tons.

The melamine team was also recognized for a project called Modified Baffles in Acid Regen boiler. The project grew out of an engineering study that showed that more heat could be recovered in the waste heat boiler if the boiler could be made more efficient. The team used an advanced computer design method to point out specific locations where baffles could be added to the boiler, without adding additional boiler tubes. The baffles were installed and, as predicted by the computer model, increased the amount of 600 PSIG steam produced by the waste heat boiler, which in turn reduced the amount of natural gas burned in the utilities boilers. Annualized energy savings have amounted to 2.75 percent per unit of production, which is equivalent to 38,042 MMBtu, with associated carbon dioxide emissions reduction of 2,206 tons.

What can be expected from such a creative company in the future? According to Dies, a lot. "We are looking at a mechanical co-generation project where we would make electricity using mechanical energy and we have a lot of other plans in the works," explains Dies. "We have to because energy is one of the things we have to get our hands around in order to maintain a viable business."

Hiring Expert Help

Carmeuse, the largest lime producer in North America with 14 plants spread between Alabama and Ontario, Canada, knew they weren't doing the best job possible managing the energy beast, so they turned for help to Summit Energy, a

company that provides energy management services. Summit helped Carmeuse create a strategic energy plan — a multi-leveled plan for dealing with energy purchasing, management, and budgeting. "They helped us devise a strategy that focused on planning for our energy needs and helped us sell it to all the locations," says Jack Fahler, vice president of supply chain with Carmeuse.

"If I had to pinpoint the single most important thing, it would be the Corporate Hedge Program they initiated," says Fahler. "The reason it helped us is because instead of Carmeuse being a market buyer of natural gas and dealing with the wild price swings, we now proactively create a budget for ourselves with Summit's help and we manage our natural gas not to beat the market but to beat our own budget."

He says the company now creates a business plan for its natural gas use and uses the program as a tool to facilitate what is spent on gas. "This program instilled the discipline of proactive layering of gas purchases in line with a budgeted number that we develop," says Fahler. "It allows us to plan and takes those spikes out of gas prices that could hurt us since we aren't able to pass increases along to our customers."

Besides helping with its planning and budgeting, the company's decision to turn to outside energy support has helped when it comes to purchasing power. "If we were in the marketplace buying gas and power on our own, we would have to have a staff of people managing it," says Fahler. "It involves different contracts with utilities and transporters and that becomes part of the overall cost of getting your gas and power. Summit has people that have expertise in all the areas of the marketplace. We also assume that because they are a big purchaser, they are getting results we wouldn't be able to get on our own because it stands to reason that if you have more volume behind you, you are getting a better bid package."

In addition to saving the legwork and headaches associated with bidding on power packages, the service provider handles the administrative aspects of managing Carmeuse's contracts. "They know when our contracts are up and the various laws and rules in different market areas. And, they audit every one of our bills. When they catch provider mistakes, which do happen, they help us recover the dollars." Like Carmeuse, more chemical manufacturers are outsourcing the management of energy — for good reason. Says Steve Wilhite, president and CEO of Summit Energy: "Energy users need to get in front of the energy snowball because if they don't, energy is managing them versus them managing it." He continues: "Many companies are challenged by what they are spending and have no idea how to get their hands around the information. Information is necessary because if you are finding out that your consumption has risen three months after the fact, that's too late. Energy service providers can help get information in a timely fashion, in addition to knowing the marketplace and helping users prepare for anticipated changes. Service providers also know how to budget, forecast, and save money when it comes to energy."

Working on Railroads

Many rail customers maintain that partial deregulation, which began with the 1980 Staggers Act and ended with the rail industry no longer subjected to Sherman Anti-

Trust laws, unintentionally resulted in the railroad industry having monopolistic control over thousands of miles of rail routes. Industries, including chemical processing, that rely on these routes to ship their goods are considered captive because they have no option but to use a single railroad, and, as a result of the lack of competition, often face high rail rates and poor and unreliable service.

"The chemical industry moves 170 million tons of chemical products each year via the rails and unfortunately two-thirds of our facilities are captive rail customers," says Jack Gerard, president of the ACC. "This means that only one rail line services a particular plant or area."

Obviously, the railroad issue is one that is not going to go away overnight, and it is one that most likely needs legislative assistance to correct. However, that doesn't mean the chemical industry must sit by and wait for the next train. Many processors are becoming active in groups such as CURE, a coalition of rail customers, which has been not so gently nudging Congress to take action. Others are also taking matters into their own hands to help rectify the situation in their neck of the woods. And some are hedging their bets by taking both approaches.

For example, key employees at Total Petrochemicals USA Inc. in Houston, TX, are taking active roles in CURE while the company looks for opportunities to join forces with rail service providers to improve the local infrastructure. Alan Cramer, administrative manager at Total's Bayport HDPE plant, was recently elected as secretary and treasurer of CURE. He says his company actively participates in CURE because the railroads are critical to the chemical industry. "We need a healthy railroad system, and by that I mean we need a national rail system that provides reliable transportation at a reasonable rate," says Cramer. "Reliability, for us, is a key issue because rail transportation is often anything but reliable. From the chemical industry perspective, that's a problem. We strive to make our processes and businesses as efficient as possible. We put our products out there every day for the railroads to transport and that often becomes the most inefficient part of our supply chain." He continues: "We absolutely rely on the national rail system and we need it to concentrate on becoming more reliable. If the railroad says a delivery is going to take seven days, we need it to take seven days, not 17."

To combat the inefficiencies, Total's Bayport facility worked in a high-profile partnership with a Class 1 railroad to relieve the rail situation in the Bayport area of Houston. Cramer says the partnership was a little "odd" at the start. "It's like any other joint venture, there's a little cat-and-mouse in the beginning until the parties become comfortable working with each other. Initially, one party is going to come up with an idea and the other will be cautious. Once you can prove that there's a win-win situation and that by being open and working together, you can help each other with reliability and economics, you find you are willing to work together for a common goal." He says while initially the project was intended to add new capacity, a trackage rights agreement was struck between the two area railroads at the urging of Tom Delay, who was the House majority leader at the time. "The end result of the project," says Cramer, "was competitive access on the same tracks that Total was previously captive on." While he considers the project a success because it helped the Bayport facility, he adds that it didn't help the overall Houston infrastructure as much as he would have liked.

While he has worked on projects through his company to help with efficiency, Cramer says joining CURE was done to help his company get relief from the high rates. "CURE is focused on reasonable rates and has taken a legislative approach,"

says Cramer. "CURE can't push for legislation that says you must be more reliable, but they can devise remedies to make the Surface Transportation Board [this is the agency that has authority over the railroads] take a look at what's fair, equitable, and reasonable."

And according to Bob Szabo, executive director and council for CURE, the group is working toward doing just that. "Through CURE, the railroad customer community has united to take on an effort in the Congress," says Szabo. "There are several legislative initiatives that will focus on the railroad and give us some relief if they are passed." The issues currently being prepared for Congress include railroad safety related to shipping hazardous materials, anti-trust legislation that will eliminate the railroad's current exempt status, new directives on how the STB should enforce its authority over the railroads, and investment tax credits for railroads when they invest in infrastructure improvements.

"Congress is going to be hearing a lot about the railroads before this session is over," says Szabo. "CURE is most interested in the economic regulatory concerns. Passage of either the anti-trust bill or the commerce committee bill that tells the STB what to do would be most effective for CURE's needs. Both being passed would be great, but even one would help us address some problems."

Moving Safely Along

While members of the chemical industry are concerned with reliability and rate hikes, many are also taking action to increase safety when transporting goods via the rails. Dow Chemical Co. has joined the Union Pacific and Union Tank Car and the Department of Transportation's Federal Railroad Administration to promote safe and secure transportation of highly hazardous chemicals. Known as the Next-Generation Rail Tank Car Project, the joint initiative focuses on the design and implementation of a next-generation rail tank car with the enhanced ability to safely transport hazardous chemicals.

The trio began collaborating in early 2006 to create a process for the development of a next-generation rail tank car with step-change improvements in safety and security performance. While current rail tank cars have a strong record of performance in accident situations — 99.997 percent of hazmat arrives safely by rails — the project team wishes to reach the next level of safety and security performance. The group plans to implement the new rail tank car design in the shortest timeline possible with an initial tank car prototype projected for 2008. "This alliance demonstrates our mutual recognition that the safe and secure transportation of chemicals and hazardous materials is a shared responsibility between shippers, railroads, and governments," says David Kepler, senior vice president, shared services, environment health and safety, and chief information officer with the Dow Chemical Co.

Securing the Home Front

For obvious reasons, chemical processors were unable to share the steps they have taken to batten down the hatches at their facilities. However, there is some news to

report on the security home front. Following the Department of Homeland Security's recent release of draft chemical security regulations, the ACC asked for clarifications of the draft policy in the interest of its chemical processing members. ACC, which has maintained being in favor of national chemical plant security legislation, also explained some segments of the policy in a recent statement.

"The draft rule is clearly a step in the right direction to secure the nation's essential chemical industry, but we are concerned about the lack of clarity in several key areas," says ACC's Senior Vice President of Advocacy Tom Gibson. "ACC supports the comprehensive approach taken by DHS to ensure that all relevant chemical facilities are included in the initial screening process. However, DHS has not really explained how it will use this screening data to choose the 'high-risk' facilities that will need to take additional action. Business certainty is crucial. We want to ensure that all 'high-risk' facilities clearly know their status and obligations early on so that they can take the necessary steps to demonstrate compliance.

"These new regulations will complement the significant security enhancements already undertaken by our members to protect the chemical industry and the nation. In addition to leading the charge to pass chemical security legislation, our members have voluntarily invested over \$3.5 billion upgrading security as part of the ACC's Responsible Care Security Code since 9/11.

"DHS has taken a thoughtful approach in drafting some 20 risk-based performance standards that our members should be able to implement quickly and produce results. DHS is wisely allowing facilities to establish layered security measures tailored to their site-specific risk profile.

"In addition, DHS has accurately stated existing laws regarding conflict pre-emption, correctly noting that it is the default anytime Congress passes a law that is silent on the topic. That said, ACC does not believe existing state chemical facility security programs — as currently implemented — conflict with the draft federal program."

Dipping into the Talent Pool

While it hasn't received the same amount of media attention as other issues, the shortage of young chemical engineers is a growing concern to maintaining a healthy industry. To combat the problem, some processors are collaborating with universities to develop scholarships and programs centered on engineering disciplines. Others offer professional development programs to attract university students to the field.

University Connection

The Dow Chemical Co. Foundation in Midland, MI, recently gave \$500,000 to the Kansas State University Foundation Changing Lives Campaign to establish nine funds supporting diversity and mechanical and chemical engineering programs at the university from 2006 to 2011. The Dow Chemical Recruitment Program will support recruitment in Project IMPACT, which is administered by the Office of Diversity and Dual Career Development. Project IMPACT is a multi-dimensional program at K-State that serves as a pipeline for the cultivation, recruitment, retention, and graduation of multicultural students. Dow's gift for engineering

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includes funds for the Dow Outstanding Junior Award in Chemical Engineering and the Dow Chemical Co. Foundation Scholars for the Kansas State University Department of Chemical Engineering, among others.

The company says these programs will help increase diversity in the College of Engineering and enhance target academic disciplines related to Dow's global business operations. Thus far, Dow has invested more than \$2 million in its corporate partnership with K-State, supporting a variety of multicultural programs and scholarships at the university since 1999. "Dow Chemical and Kansas State University have had a strong relationship for decades," says Dana Mathes, director of logistics operations for Dow Chemical. "This newest program reinforces this relationship and the commitment of both parties to developing great engineering talent and diversity."

Professional Development

BASF's Professional Development Program (PDP) was created to recruit recent college grads to join BASF Corp. Participants are provided with opportunities to develop professional skills needed within the company. Through a series of real-world rotational assignments at different sites throughout the U.S., participants explore career options and develop technical and professional decision-making skills while fulfilling specific business needs.

The program offers career options in chemistry and chemical engineering as well as accounting and MBA positions. The chemistry segment of the program, dubbed the PhD. PDP, allows participants to develop technical expertise, network at senior levels throughout BASF, and explore possible career tracks within the company. Two nine-month assignments in the participant's field of expertise are designed and planned to enhance career development and deliver immediate value to BASF. At the conclusion of the 18-month program, participants are eligible to apply for open positions. Placement can lead to opportunities in materials research, product development, organic chemical research, polymer and fiber research, quality improvement, biotechnology, ecology, or product/process support.

Summer internships are also available. Junior chemical engineering students are provided the opportunity to spend a summer working at a North American BASF site or BASF AG's international headquarters in Germany.

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