SEPTEMBER • 1990

AUTOMATION

THE MAGAZINE FOR MANUFACTURING MANAGEMENT & ENGINEERING

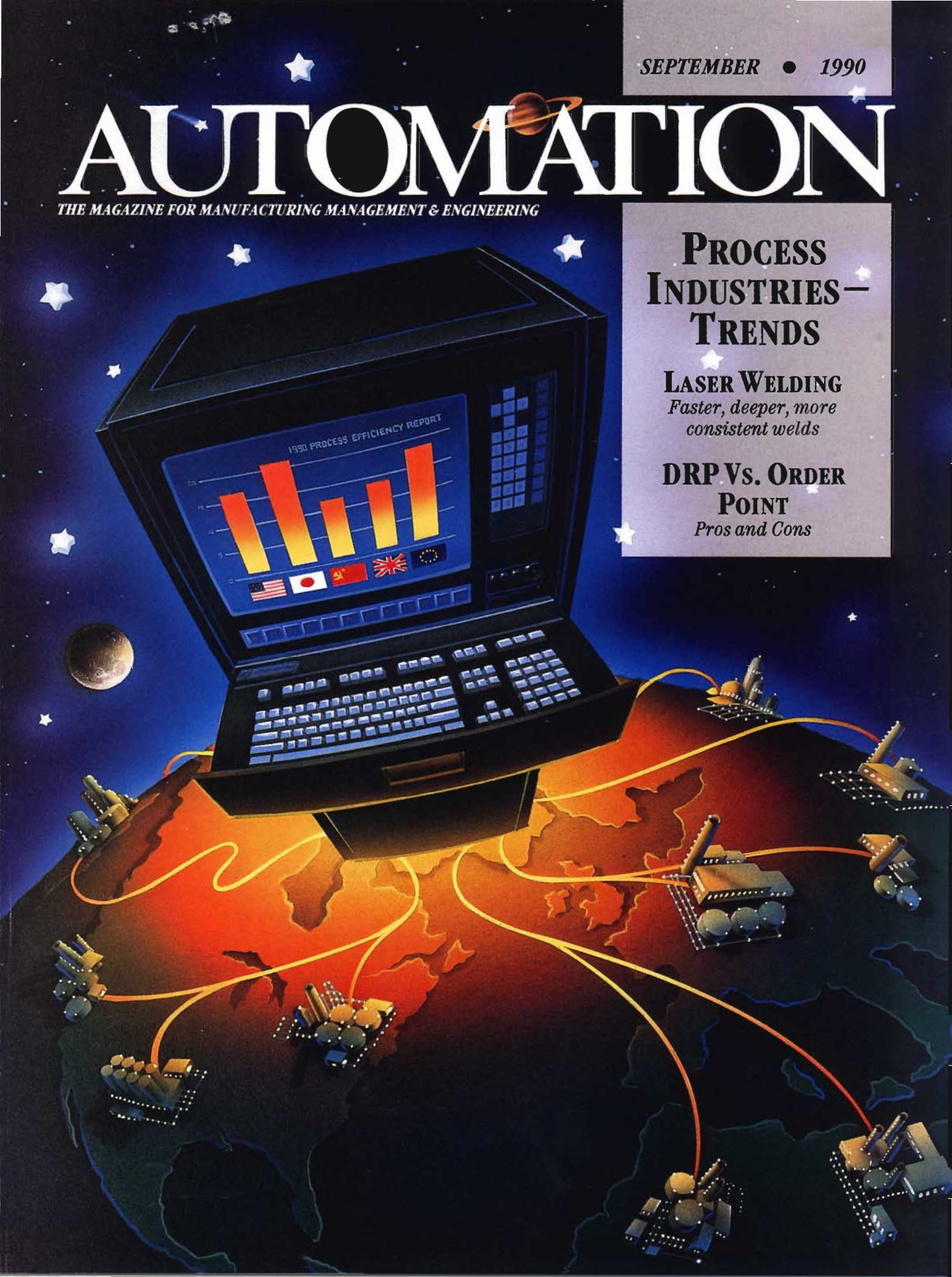
PROCESS INDUSTRIES—TRENDS

LASER WELDING

Faster, deeper, more consistent welds

DRP VS. ORDER POINT

Pros and Cons



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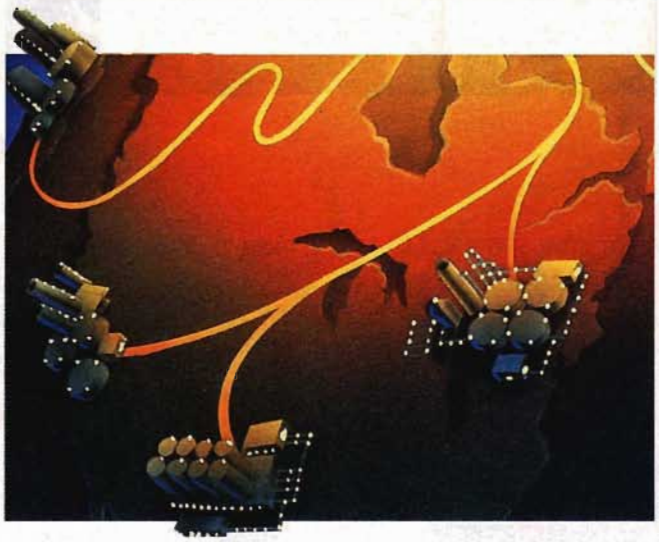

in every issue

coming next month

Our cover feature in October focuses on current research at General Motors Corp. See what exciting manufacturing challenges are inherent in producing the cars of the 21st century. Other articles are on composites for aerospace, machine tools, material handling, and robots. Two reports on systems integration and manufacturing software round out our coverage for this issue.

cover

The September cover depicts technological process control and process management. Artwork by John Webster from graphics provided by Action Instruments Inc., San Diego.

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PROCESS ENGINEERING LOOKS TO THE CHALLENGES AHEAD

BY LINDA G. ALLEN, ASSISTANT EDITOR

Major trends for the process industries? Unique challenges? Several themes resound from our conversations with manufacturers across the country—namely, the need for flexibility, new perspectives on time lags, and the "battle cry for open systems" and integration, as Joe Hurley, vice president and director of advanced manufacturing systems for Corning Inc., Corning, N.Y., aptly puts it. Along with all these themes, the counterpoint we hear accompanying them is a crescendoing emphasis on product quality.

On the need for integration, Richard Seemann, senior business consultant for Fisher Controls International Inc., Marshalltown, Iowa, sums up his customers' requirements. "From the standpoint of the operator's console, which is a key component of a distributed control system, [customers need] the ability to integrate other control systems and business information and [have this information presented] on a single window to the environment. Instead of having multiple devices off of multiple computers that he has to interface with, the customer wants it all consolidated into one console."

According to Ken Kuna, manufacturing and plant engineering manager of the Glass Div., Ford Motor Co., Lincoln Park, Mich., one issue that's being looked at in a new way is that of time. "We typically look at time in terms of cycle time in the operation, but there's a large element of . . . wasted time in many operations, and there is cost associated with that. It could be in cost associated with a lost order or a dissatisfied customer, or cost associated with unnecessary inventory and underutilized floor space. We're focusing on eliminating those time lags, . . . [and] it's a very difficult thing to get at," he contends.

Another area Seemann cites as sine qua non would be flexibility—especially for batch control. "Batch control in the past was pretty much [making] the same product over and over again. But now with JIT concepts and trying to produce product based on customer orders versus forecasts, you're producing different batches in a random fashion, and that's where you have to increase the flexibility of your batch processing to be able to download recipes, sequences, and other information into the control system as opposed to just having some simple configurations to do your batch processing.

"A lot of the instruments that are actually measuring your process variables—your temperature transmitters, your flow transmitters—are now becoming intelligence devices. They have more than just the flow signal. They've got status information, and they may also provide you with a temperature or some other process variable along with the flow, for example. So interfacing with those intelligent subsystems is another influence that is affecting distributed control systems," Seemann indicates.

What's simmering in food processing? Mexican entrees offer but a sampling of the spicy variety tempting today's consumer palate. But providing that variety to accommodate today's consumer means special challenges for manufacturers. Take tortillas. When a leading manufacturer introduced its Mexican line, it really had to start from scratch. According to one of the managers in the engineering department, "It was very difficult for us, but we built the equipment . . . ourselves [to make the tortillas]." The staff took a standard piece of equipment, modified it considerably, and then designed and built the peripherals for the machine.

Because the Mexican line has proven a success, the company would like to investigate automating its equipment. But according to its equipment-development manager, the company's not sure the needed equipment is out there—equipment for "rolling tortillas, putting stuffings in them, automating the grills to cook the shells, automating the loading of the tortillas into the package. Right now we're doing most of it by hand [in terms of loading the equipment and rolling the tortillas]," he explains. "[The automated equipment] is available right now," he adds, "but it's not big enough to produce our volumes [at the speed we need]."

Finding sophisticated equipment to handle large-volume production of specialty-menu items is merely a taste of the challenge presented by today's consumer demands. The rapidly changing market defies predicting just what the customer really does want, so companies have to try a new item for a while before they can even consider automating. Then . . . justifying the cost of equipment for producing what are for the most part relatively low-cost items and finding floor space to accommodate this variety of demands make for a tall order on the manufacturer's plate.

A major seasonal fruit-and-vegetable producer discusses his need for cost containment on interface devices from the standpoint of a producer of low-cost foods. "I think that the industry needs to be working in that area a little more diligently, trying to provide lower-cost

ways of sensing what's actually happening on the manufacturing floor and then feeding that back into either programmable logic controllers or to mainframe computers that may ultimately be running our factories," he states. "I think that the challenge . . . from this industry's point of view—because of all the problems of seasonality and basically low-valued items—is the need for cost reduction in the way of automation."

Nor is the consumer asking simply for more variety; he's also more quality conscious than ever. The director of engineering for a major food manufacturer observes, "As customers become more and more quality conscious, the challenge to improve our quality is ever with us."

In more ways than one, however, inspection for the food industry is something less than duck soup. He goes on to point out "that the human inspector quite frankly at this current time is probably our best bet. . . . The problem with seasonal fruits and vegetables is that there is no consistency with, for example, an ear of sweet corn or green peas or with carrots. They're all somewhat dissimilar, and so it's very difficult to talk about automation support and where we've got machine vision." The engineering director believes, "One of the things that is going to have to happen for our industry over the next 10 or 20 years would be the bringing on of machine vision coupled with some sort of artificial intelligence so that we could take a look at certain products and have the computer try to make a decision for us as to whether it's acceptable or not within a range of acceptabilities."

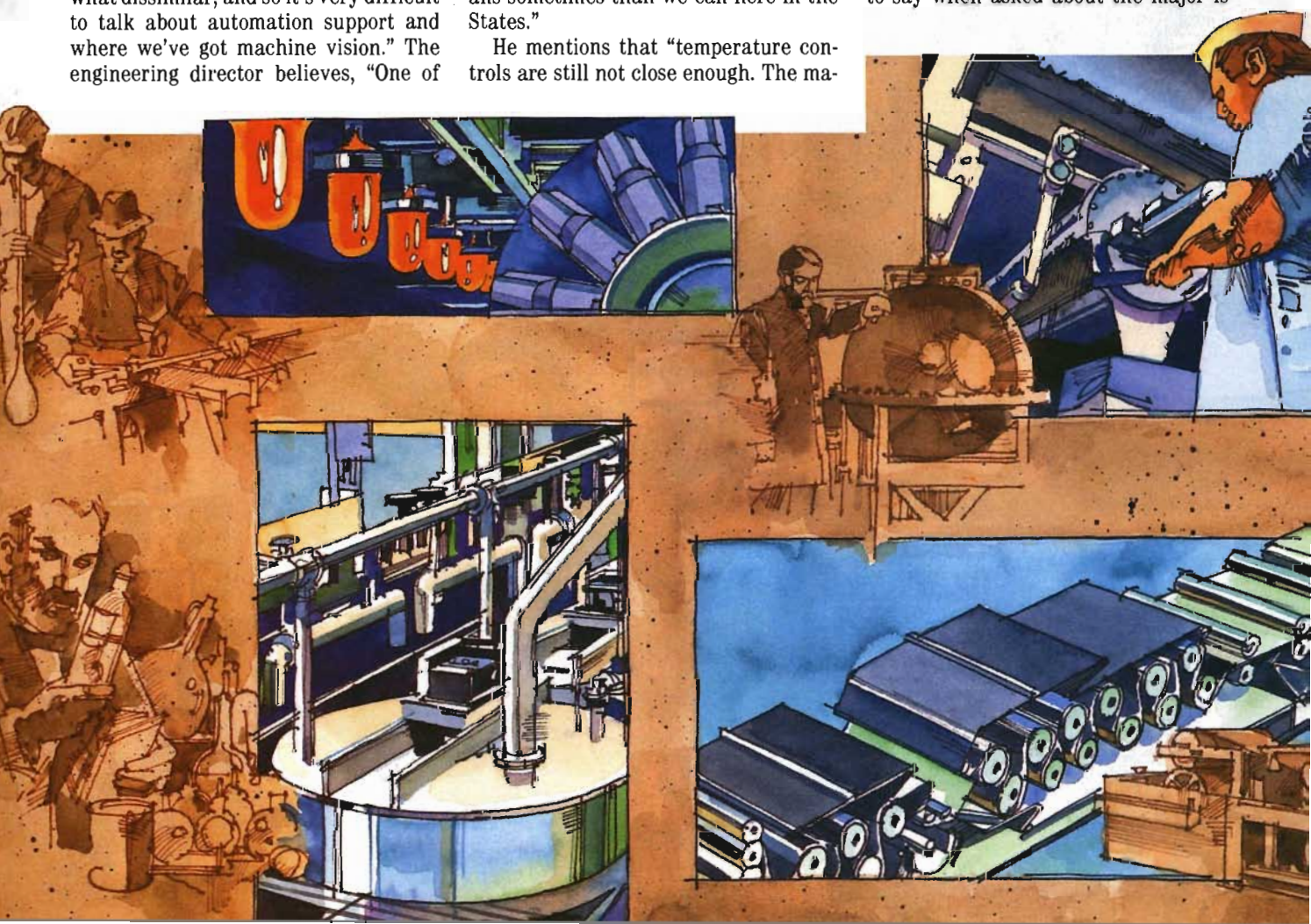
Metal detection remains a "sore spot" for the industry, according to one leading foods processor. A manager on the engineering staff reveals, "There is not a metal detector built to detect some of the buckshot that arrives in some of the animals. It's small enough that you cannot detect it. The only way we usually find it is when it starts damaging our equipment."

He also concedes that "the Europeans are far ahead of the Americans in the metal detection and checkweighers right now. . . . We're starting to buy more and more European-type equipment for process, for measuring devices, and so forth, because they are superior to our own," he acknowledges. "I hate to admit that. It's hard to believe, but we can get better service out of the Europeans sometimes than we can here in the States."

He mentions that "temperature controls are still not close enough. The majority of the temperature controls probably range still up around 4 F. And that's not sufficient." As far as checkweighers are concerned, he points out that the company "checkweighs each package that's produced. Our checkweighers are still ± 2 g, so depending on where you set it, it's possible—it doesn't really happen, but it's possible—that 50% of the packages [we] send out could be 2% underweight. The government doesn't care as long as [the] average averages [the] labor weight. They don't care; we do. So we still feel that checkweighers have a long way to go yet."

Checkweighers, temperature controls, metal detectors and other types of vision equipment, and automated machines for processing large volumes of a variety of items at high speeds—these represent a few of the concerns for food processors. As one manufacturer put it, "I believe that this industry is definitely ready and has an absolute utter need for automation."

Paper quality—nothing run of the mill. "Quality, quality, and quality." That's what Barclay Wallace of Measurex Corp., Cupertino, Calif., had to say when asked about the major is-



'. . .'Cause it's gonna be big, big, big dollars'

Environmental legislation poses serious concerns for process industries. Companies see public opinion as being distorted by the media, and worry that increasingly stringent regulations pushed through by pressure from a misinformed public could impair U.S. competitiveness.

* * *

The chemical industry continues to get bad press from the rest of the world on our safety record, even though if you really compare the stats, we aren't that bad. There's the record—the stats, and then there's the perception the public has of chemical companies, which are flamed by the press. I just heard some comedian making a remark about Earth Day and saying that we wouldn't need an Earth Day if it wasn't for Dow Chemical, and those kinds of remarks absolutely inflame me. You've got an audience of millions of people watching shows like that and listening to this kind of bunk, and it's totally uninformed information; but nevertheless the public has a perception that chemical companies are not safe. So I think the chief issue of the nineties is going to be safety. I think it's an absolute survival issue that we have to improve safety and also inform the public of what's really going on here. *David Leach*
Air Products and Chemicals Inc.

Recycling is the way the industry seems to be going, rather than the development of biodegradable materials. *Richard Ferren*
Atochem N.A., a div. of Atochem

Because of increased sensitivity to what plant operations can be doing to the environment, there already is a much greater call for the producing companies to meet more and more stringent environmental regulations in terms of waste that needs to be disposed of, or perhaps emissions into the atmosphere through combustion operations. . . . Because of some of these activities in the environmental area, certain capital projects are being held up, pending approval by the environmental legislation. . . . [Approval of those] projects may affect capital spending, obviously. The environmental issue will be a very, very important one for the coming decade. *Chris Reid*
Industrial Automation and Control Div.
Honeywell Inc.

The environment is definitely a consideration on everything we do. Every one of us is involved in protecting the environment in every way we know how. We have been able to significantly reduce emissions and effluents in the last few decades, and it remains a very highly stressed point with the corporation. It will continue to be. We have the support of our upper management to pursue those things and to endeavor to do our very best.
Parke Brown
The Dow Chemical Co.

I think it's been a fairly significant impact [in terms of money spent to meet the requirements of environmental legislation]. I think in the

sues for his customers. "Quality is very big. The industry is going toward using many more sensors," the company's paper-industry spokesman continues. "There are many quality parameters in paper that make up the overall quality of the end product. Historically we focused on just the key parameters—the basis, weight, and moisture, and possibly caliper. What we see happening now is the end users applying many more of those measurements in a routine fashion to get a much better picture of the quality of their product as it's being manufactured and to use that information to reduce the variations in those quality parameters," he explains.

Loren Forrister, an engineer with Specialty Paperboard Inc., Brattleboro, Vt., talks about that need for a "better picture of the quality of their product" as well as the need for reliability and service. "I would imagine all the systems available and all the people that sell them are basically using the same kind of field devices—temperature probes, level probes. It's what they do with that information when they get it that differentiates them. How do they massage it? How do they record it? How do they manipulate it? Those are where the companies split in their different directions. Temperature is temperature. If somebody takes a temperature, there's not a whole lot you can do to it. But it's what they do when they get the temperature that's different. So reliability, service, getting back on-line—I would say most folks would tell you that these have got to be the single biggest things they're concerned with," he says.

Another trend Mr. Wallace sees is "closing the loop on control on the higher-frequency variations. . . . Process control in the paper industry historically has focused and has attacked primarily the longer-term variations—that being variations that are longer than five to ten minutes. When you're dealing with a feedback-control system on a paper machine, generally variations that are shorter than that we have not tried to address in the past," he tells us. "Today, it's quite common that we're measuring and analyzing variations from 200 Hz on out through the long-term variations that we've historically measured that can be as long as several hours. So we see that much more of the variations—a wider range—are going to be attacked and are going to be addressed with the newer technologies, and again, in support of the thrust toward our customers striving to produce a higher-quality product."

As with other industries, the trend for the paper sector is also toward more integration of "the PLC systems, the DCS systems, and the supervisory systems, as well as newer uses of computers for better management of information. Those different control systems [have] developed from different backgrounds, . . . and it was not uncommon up until a few years ago that . . . on a fairly new paper machine with modern process control, you'd literally have

future—or now—it'll put more demand on our needs for process control. They're tightening up, . . . and we find that some of our equipment is not performing to that level, and it either requires replacement or improvement of controls. *Tom McGurk*
Schering-Plough Corp.

It's a mixed bag. There are some things on process work after glass itself is made—adding value to the product—where stack emissions have entered into it, and vapors that are produced enter into it. Where they have not yet found ways to reduce the emissions, they have to put in scrubbers and [similar] things. The trouble with scrubbers is that you end up with some trash that nobody wants to take in a landfill. Don't ask me about that; ask the people at the power plants that are burning coal. They run the stack emissions from a coal-fired power plant through crushed limestone. They end up with a sludge there that's just a terrible thing. Nobody wants it. *Risher Hall*
Glass Industry Consultant

[The environmental issue is affecting pharmaceutical companies] tremendously here in New Jersey. Basically, we have to deal with stricter and stricter discharge requirements for any kind of air or water discharges or effluents in the plant, and that impacts us in that we have to design and build into our systems very sophisticated pollution-control systems. And that influences us greatly on products we can run and not run. If we don't have the proper pollution-control equipment in place, we can't develop certain products. So it affects us quite a bit from a capital-expense point of view."
William Cokeley
Schering-Plough Corp.

[The environmental issue is affecting the petrochemicals people] quite a bit. . . . One of the best things you can do there is not create waste or environmentally damaging products or by-products in the first place. That's one area of control-systems automation that perhaps has an opportunity for some development, because if you could control your process better to make the things you did want and not make the things that you don't want, that would be the most direct way to address the environmental problem; i.e., don't do it in the first place. So there could be a significant opportunity there in terms of automation—both in terms of sensors that could tell you what it is you are or aren't making, and then in terms of automation equipment to help you move your process away from making a lot of waste product. Certainly that's a paramount issue in general—not just in control.
Richard Schmotzer
BP America

The state of Maine I believe just passed some legislation where they have some really stringent things on color—emitting color and chemicals in the rivers. And it seems that there are other folks who are going to follow suit. Big controversy now. Big, big—'cause it's gonna be big, big, big dollars to do the things that the legislature wants to do.
Loren Forrister
Specialty Paperboard Inc.

four or five different vendors all having different control systems controlling that process. The industry and the vendors themselves recognized that a better solution to that is to integrate all necessary interactions that do occur on the process and tie together your continuous and discrete actions in one system," Wallace concludes.

Chemicals, petrochemicals—still looking for solutions. "There has always been and continues to be in my estimation a gap between those who have the problem and those who are producing equipment to solve a problem." So says Parke Brown, director of process control for The Dow Chemical Co., Midland, Mich. "It really requires an intimate knowledge of the process itself to determine the optimum control scheme. Many of the vendors are challenged with providing a tool that is usable across a broad band [of industries]. It's pretty hard to encapsulate all the things that happen on the plant floor for a vendor and expect him to develop a custom solution to what you're trying to solve. . . . That's one reason we're in the business of designing our own systems—we're very close to the problems."

Richard Schmotzer, group leader of control engineering at BP America, Cleveland, sees eye to eye with Brown. "I think one of the things we'd like for them to address is—more the problems we have, as opposed to the technology per se. If you look at expert systems, for example, what we really need is [to know] how you apply expert systems to better control a petrochemical plant—not just [about] the technology of the expert system. What we're interested in is running the plant more efficiently. We don't really care whether it's expert systems or whatever. I think a lot of times what the suppliers provide is technology that hasn't really been fit to the specific problem, and that's really where the payoff is—when you apply the technology to a problem. So rather than looking strictly at the technology, I think there's a big opportunity to look more at solutions to the problem, using the technology."

Offering a similar viewpoint, Richard Carlson, director of process research for The Dow Chemical Co., affirms the need for solutions that target problems and offer expert-system knowledge. "I think the challenge is understanding the chemical-reaction kinetics and the heat and mass-transfer phenomena, and being able through the use of expert systems to bring in the heuristic knowledge and have that programmed in your process-control computer, so that in addition to picking up the signals from temperature and pressure and flow instruments that come into a computer and then controlling the operation of the plant, you have the fundamentals of the chemistry and all the process knowledge built in," he maintains. [That way] you can optimize from a safety point of view, from a quality point of view, and from a cost point of view. I think the challenge is for the manufac-

Control system hits the mark for gaging dough viscosity

BY RAYMOND A. GECKLE

When the U.S. Navy needed to reduce variability in its solvent-melt, batch-process manufacture of nitramine gun propellants, it turned to a new control system. And it got results.

Now the Navy gages dough viscosity as the dough is mixed in a horizontal sigma-blade mixer—similar to what is used in a bakery or in chemical applications. This propellant dough is then extruded and cut to desired dimensions in order to meet specific ballistic-performance criteria relating to the velocity of the projectile and its accuracy in hitting the target (i.e., dispersion). Since implementing the system, the manufacturing facility has reduced the standard deviations of the ballistic-performance criteria and has thereby seen substantial quality improvements in the more than 80,000 lb of gun propellant produced under control of the new system.

The Micromax process-management system, from Leeds & Northrup, a Unit of General Signal, North Wales, Pa., forms the backbone of the system and comprises two major components:

- A management station located in the engineering office, providing a window on the manufacturing process.
- Two Local Processing Units (LPUs) installed behind the instrument panel in the manufacturing control house, which directly monitors the manufacturing operation.

Highlights of system functions include the following:

- Uses programmable logic to monitor numerous system temperature and pressure-alarm set points and notifies operators of hazardous operating conditions.
- Monitors motor current and voltage inputs and calculates motor power and total work performed by a mixer motor. That data is then used as a process-control parameter by the operator.
- Provides averaging of various quickly fluctuating analog inputs to provide an averaged steady-output signal.
- Continuously calculates the vapor pressure and rate of evaporation of processing solvents based on operating temperature of the system. These values are then used to control processing parameters.
- Monitors and records all processing conditions and control-panel switch positions on a streaming magnetic tape for future recall and analysis.

For more information on the process-management system,

CIRCLE 439

Raymond A. Geckle is a Project Engineer at the Naval Ordnance Station in Indian Head, Md.

turer to be able to capture his knowledge in a useful way so that we can take another advance in the control of a plant," he suggests.

Chemical manufacturers will quickly tell you the challenges they face in their rapidly changing and ever-more-competitive market are myriad. "There's a whole raft of those," avers Parke Brown of The Dow Chemical Co. "Certainly the application of expert systems is one. Advanced control is another. Automatically tuned loops, for example, is certainly an area that everybody is interested in. Certain other phenomena—such as modeling and model-building simulations, and operating plants based on model-based control [are other opportunities]. . . . Certainly quality is pretty important to us. Reproducibility is another one. Consistency. It goes on and on. There's no limit to the opportunity that I can foresee in the challenges we are facing."

All of those areas highlight the increased focus on product quality, which, according to Chuck Pisciotta, a partner with Andersen Consulting in Columbus, is one of the biggest trends for the chemicals industry. And it's "forcing a lot of automation," attests Pisciotta, who specializes in analyzing the process industries.

"The industry is a spectrum of people who are still using 100% manual-control operations all the way up to people who are using computerized and integrated systems," observes Stan Whitman, chemical industry marketing manager for Fischer & Porter Co., Warminster, Pa. "It depends on the specific customer, the location, [and] whether or not the product that the facility is producing is profitable [as to] whether or not that company will spend money to automate it," he notes.

As a key driver of this product-quality emphasis, stiff worldwide competition also serves as a catalyst to precipitate the move of domestic chemical companies toward the specialty-chemicals market. "You could say that globalization is causing companies to decide whether they're a commodity or a specialty," comments Andersen Consulting's Pisciotta. "It's forcing them off the fence," he declares.

David Leach, an engineering associate with Air Products and Chemicals Inc., Allentown, Pa., concurs with Pisciotta. "I think the market is very much changing, and all chemical companies are feeling the global competition these days. Japan, for example, can produce a lot of chemicals more cheaply than we can. . . . So we are becoming a higher technology-based industry, and I expect that's going to continue," he predicts. "People aren't going to be selling the same commodity chemicals 10 years from now that we are today. I see our specialty-chemicals business really growing."

Another part of the chain reaction as global competition heats up will be an intensified need to "transfer information and data from one place to another and to get global access to data from various off-site locations, as well," states Fischer & Porter's Stan Whitman, and that means "a big push on integrating different types of computer-based equipment."

As BP America's Richard Schmotzer puts it, "If you have two different hardware vendors' pieces of equipment, you don't want to have two panels or two CRT screens; you want to have a single consistent display of information to the operator. The problem here in some cases is you have very good pieces of automation equipment that you're not quite sure how to really fit into your overall picture. . . . It's the idea of stan-

DCS keeps cement plant on solid foundation

BY W. JOE WILLIAMS

Almost since the day the first settlers arrived in Demopolis, Ala., in 1817, "selma chalk," a soft, white limestone has been quarried in and around the area. Today the material serves as the main ingredient in portlant cement.

But making the cement is a complex process. That coupled with keen competition within the industry made advanced controls a must for the Demopolis Lafarge cement plant.

After quarrying and transport to the mill via conveyor, the limestone is ground and blended with white (silica) sand and iron oxide ("brown sand"). The resulting mixture goes to special holding silos that circulate the mixture to ensure complete blending, then preheated and fed into a 230-ft-long, 16-ft-diam rotary kiln, where it is subjected to temperatures as high as 2,600 F for a precise time period that depends mainly on kiln rotational speed and material feed rate. Maximum rotational speed for the 109-ton/h capacity kiln is 2.5 rpm.

The resulting calcined material, called "clinker," is conveyed to ball mills for final blending and finish grinding to achieve a fine, uniform particle size, then transported to holding areas until shipment.

When the company chose to automate the process, it went with a Network 90 distributed system from Bailey Controls Co., Wickliffe, Ohio. To lessen disruption of plant operations, the engineers brought the system on-line in stages, taking portions of the old system out of commission at each step.

Six Process Control Unit (PCU) cabinets, each containing redundant Multifunction Controller (MFC) modules, power supplies, slave modules, and I/O connections, constitute the heart of the system. The microprocessor-based MFCs, which handle 2,300 digital I/O points and almost 500 analog I/O, allow the system to replace all the special process calculation and control functions previously performed by a separate process computer.

PCU cabinets connect to each other and to a central control room via a redundant data highway. The control room contains three Management Command System consoles that give operators a window to monitor and control the process or to oversee the entire system.

Lafarge control engineers wanted an operator interface that was easy to learn and use and required little training. They achieved their goal by combining touch-sensitive CRT screens with custom graphics displays modeled after the mechanical switch panels of the old control system.

Other features? Ease of configuration, for one. All control strategies are configured off-line using PC-based Bailey Engineering Work Station software and predefined control algorithms. The new strategies are then downloaded to the controller modules at a convenient time.

The system controls the flow of coal and waste-derived fuels to maintain steady combustion rates and temperature, and ensures efficient combustion by monitoring and controlling temperature, oxygen, and carbon monoxide.

To find out more about the DCS,

CIRCLE 440

W. Joe Williams is Instrument Supervisor, Lafarge Corp., Demopolis, Ala.

dardization—at least more than we have now," he says.

Standardization, integration—certainly domestic chemical manufacturers know they need to see more of it happening in the near future if they're to keep their equilibrium while global competition steams ahead. But there will also need to be more source-level and second-level control, too, and that's a whole different set of equations as Fischer & Porter's chemical industry spokesperson, Stan Whitman, points out. "On the first and second level of control, there's very distinct differences between the batch and continuous applications. Batch applications require a lot more open-close or on-off type contact signals than a continuous operation. There's a lot of scheduling requirements because the processing equipment is multifunctional. As a result, the recipes that are required to produce each of these different products are different, and in order to reduce the amount of time to set up the equipment and the program, in order to process the materials properly to make a profit-quality product, there's a lot of emphasis on automating these recipe setups. So most of the suppliers to the industry are pushing automated recipe and batch-scheduling procedures," he explains.

What the outlook for the chemical industry boils down to appears pretty clear. "I think it's a fair statement to say that process-control technology—both hardware and software—and the way in which it's implemented will make or break the processing industries in the United States," says Whitman. "More international competition is becoming sophisticated to the point that unless U.S. companies begin implementing these things here in the States, more and more of the manufacturing that we've been doing here is going to end up transferring overseas. Or, something new is foreign companies building facilities here in the States or buying up facilities here and automating them using these techniques. So more and more of the businesses will end up being operated by companies from outside the United States, rather than from within."

Lots of challenges—and opportunities—lie ahead for U.S. manufacturers. Even for manufacturers whose operations are relatively simple (such as glass tempering), "you're going to see a higher degree of measuring devices, controls, and data-keeping requirements," according to Doug Roberts, vice president of operations for Gemtron Corp., a major glass-tempering company in Sweetwater, Tenn. "Record keeping definitely will have to be much greater. Equipment obviously has got to be better to do the things they're talking about. So you'll see more capital spending to get equipment to keep the processes in control," he asserts. ○