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Folio Editorial Excellence Award Winner

Easier Disclosures to NGOs Near

Groups aim to better align climate-related reporting sought from firms

A crucial disconnect pinpoints three necessary steps.

WASTED EFFORT — that's the kind way to characterize the frustration felt in filling out a variety of disparate forms all requesting basically the same information. Most of us have run into situations where slightly different requirements or definitions caused added work that easily could have been avoided if only the groups requesting the details had used a common basis.

Our personal hassles pale against the problem faced by chemical makers and others involved in detailed reporting.

On one front, climate-related disclosures, industry can expect some relief, at least from some non-governmental organizations (NGOs). The importance of providing such information to these groups continues to grow as more investors and financial institutions as well as society as a whole demand details.

Last November, the Corporate Reporting Dialogue (CRD) launched the Better Alignment Project. This two-year initiative brings together key NGOs compiling such information — CDP, Climate Disclosure Standards Board, Global Reporting Initiative, International Integrated Reporting Council, and Sustainability Accounting Standards Board — with the goal of improving "the coherence, consistency and comparability of the Participants' frameworks and standards."

Efforts in the first year focused on climate-change reporting and involved mapping the alignment between each organization's requirements and the recommended disclosures and illustrative example metrics of the Task Force on Climate-related Financial Disclosures (TCFD), a group founded by Michael Bloomberg that includes both industrial and financial firms.

In late September, CRD released a report (http://bit.ly/32997mW) on the project's progress at the World Economic Forum's Sustainable Development Impact Summit.

The report notes that the mapping showed strong alignment between each group's frameworks and standards and those of the TCFD as well as between each other. It adds that 80% of the TCFD's 50 metrics are "fully or reasonably covered" by the groups' indicators.

However, the report also reveals that online surveys and roundtables conducted as part of the project clearly indicated that stakeholders struggle to understand how the various frameworks and standards fit together to support efficient and effective disclosures. To help address this, the report includes a section on frequently asked questions for using the frameworks and standards.

The report mentions that this disconnect between the mapping and stakeholders' perceptions has pinpointed three areas the project should address during its second year:

- Developing a taxonomy to guide users on the meaning of different terminologies and methods employed and their commonalities and interrelationships;
- Building an online, interactive tool that enables users to understand how to effectively utilize the various frameworks and standards individually or together for different reporting purposes; and
- Holding a forum to foster further exchange of developments, ideas and plans between and across technical teams to promote greater long-term alignment.

We all should applaud this effort. It promises to ease the burden of preparing effective and consistent disclosures and, thus, hopefully will spur even more chemical makers to release such important information. ●

MARK ROSENZWEIG, Editor in Chief
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Fend Off Fine Particle Frustrations

Several options can minimize issues about fines in products

The major culprit for fines is particle/particle impact.

IT'S HARD to make a particulate solid without getting some undesirable components. Unlike liquids and gases, solids can vary in size and suffer from contamination, discoloration and other variations in physical properties. The major offenders usually are fine particles. Think about it: Don't your customers complain mostly about fines in the product? These particles also can pose a safety problem as well as a nuisance or housekeeping issue.

Before looking at the methods to minimize fines, let's consider the many ways you produce these troublesome particles:

Particle formation. The problem can start in the particle formation step (crystallization, reaction or extraction). Excess supersaturation or the lack of nucleation control can allow fine particles to persist through the process. I've mentioned this issue in previous columns — "Conquer Crystallization Challenges," http://bit.ly/2mkSbu1, and "Don't Let Phase Changes Faze You," http://bit.ly/2lB1zt0.

Upstream processing. Attrition can occur in solid/liquid separation, drying, conveying and storage. I've even seen attrition in liquid/liquid separation processes where crystals have formed due to the immiscibility of the chemical in a solvent. Centrifuges are a common source of attrition due to their discharge mechanism. Filters aren't necessarily the solution for the separation, though. While they may seem a gentler option, filters can cause attrition from solids hitting the cloth or solid surface due to a poorly designed inlet.

Drying is a common source of attrition. Mechanical drying devices toss the particles around, allowing them to hit each other. Surprisingly, little attrition stems from sliding of the solids; most arises by particle/particle impact. Some particles have internal solvent left over from upstream processing. The heat applied during drying may cause particles to explode, especially if the rate of heating is excessive. You can fix this by changing the crystallization process as well as cutting the heating rate.

Conveying and storage seem to run together as a source of attrition. Again, the major culprit is particle/particle impact. In some cyclone and elbow research, we presumed that the particles mainly broke up along the walls of the cyclone or pipe. However, we discovered that particles landing on each other was a worse source of attrition. Make sure you control the discharge height when handling a friable material.

To solve the upstream processing issues, you must put on your detective hat because there are many sources of fines in your product. After you've pinpointed the source of your fine particles, you'll need to decide if it's more economical to solve that problem or resort to end-of-pipeline treatment. Many good choices exist for eliminating fines. However, some of these can require an expensive installation and reduce your productivity. So, let's look first at two common and relatively low-cost options.

Screening is an obvious choice but can make the problem worse. If you already have a screen, check the grounding or look at adding an air ionizer to remove the charge that fine particles often carry. Overloading of a screen can cause more particle/particle impact and create fines.

Fluidization is a common way to elutriate fines from the larger particles and can be built into the drying process. However, it has limited value where a sharp separation is desired. When the fines content is high, particles bunch together and then settle at a faster velocity. Also, the mass of solids removed can reduce productivity unless you can agglomerate the fines and return them to your production process, which adds another piece of equipment.

Many other elutriation devices can remove fine particles but they tend to be more expensive. Some people have tried cyclones as a poor-man's particle separator but cyclones don't provide a sharp cut in particle size. The elutriator uses a narrow flow channel and gas flowing against the particles to give a relatively sharp cut in size. Air ionization can help in rare cases.

You also can consider some specialized ways to remove fines such as washing with a solvent or flowing the bulk solids over a sticky surface. For the most part, I prefer elutriation because of its long track record in solving the excess fines problem. It retains customers. ●

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Don't Kowtow to a Contractor

Learn how to deal with difficult constructors and vendors

THE CONSTRUCTION manager thought he was in control, although he only was a contractor. Unfortunately, I was stuck with him. I asked him to install the pump first so we'd have an anchor point. He said that's not the way they do things. I told him that's how I wanted it done. So, he complained to my boss. This is the kind of response you get when a constructor is too ingrained.

The last straw was when replacement of a 1-in. nozzle on a pressure vessel that should run $4,000 wound up costing about $14,000. I reviewed the estimate, which I had insisted upon after the first few shenanigans. The detailed breakdowns indicated the job should take a maximum of 20 hours of welder time, perhaps 4 hours of quality-control inspection time and 4 hours of oversight. Instead, we were billed for 70 hours of welder time, more than 20 hours of supervision and 20 hours of warehouse time. My boss marveled at the charges. The construction manager obviously was punishing me for giving him trouble. We decided to seek a replacement contractor.

CHECK OUT PAST FIELD NOTES

More than a decade's worth of real-world tips are available online at www.ChemicalProcessing.com/field-notes/

For additional practical pointers, check out the online roster of Plant InSites columns at www.ChemicalProcessing.com/plant-insites/

The construction manager thought he could make me look bad and I'd be in trouble. What he didn't know — but should have — is that you don't mess with crusty, old curmudgeons like me. We have a bag of dirty tricks of our own.

Before we get into how to neuter a difficult construction manager, let's consider how a good one would act. That person would strive to help me to achieve my goals instead of telling me no. That's basic salesmanship: never say no to the customer. The person certainly should cite safety, ease of construction or any other issues that might weigh against what I want but shouldn't just say no. We're all salespeople. We all have customers.

Here, the construction manager assumed he was irreplaceable and had the power. You can't let that mindset persist. As I've said before ("Learn Office Politics," http://bit.ly/2mHezxw), if you can't ameliorate a bad situation — and being owned by contractor or vendor is just that — you should leave. Being the last rat off a sinking ship isn't loyalty, it's stupidity.

Fortunately, my boss was amenable to a meeting. I sat down with the construction manager. We reviewed the new ground rules: My firm, not the contractor, would buy all the valves and special equipment; a bill of lading would designate who provides what. My company would review the spool designs, before and after, they're built. The construction manager was agreeable to the first point but fought me on the second. I insisted that I must go over the construction with the builders myself, laying out the physical equipment in their shop, before a stitch of rod was added. I also ruled out switching the crew during the outage; I would require the same welders who built the pipe spools to install them. The contractor raised the expected argument that such steps would increase costs. However, I countered that most of this falls under normal quality control.

Making such rules isn't enough, though. You must get a signed statement from the contractor agreeing to them.

Now, let's return to neutering. Suppose you can't fire the company. You certainly can audit its work, though. Take apart invoices. If the firm resists releasing hours or breaking down costs, that's another point against it; document this reluctance in a memo for the file. Ask for the resumés of personnel assigned to your projects; check those people's safety records, not only at your facility but at others. Hire a third party to review the company's construction or engineering. Write detailed scopes of work and hold the firm to them. Perform spot inspections during construction — are the right people assigned and doing their work, and are they following proper quality-control procedures. Log when deliveries are late, unauthorized overtime occurs, and deadlines are missed. Remember, you're not doing this to be mean. You have the best interests of your company at heart. The fact that you're hassling a troublesome contractor is a fringe benefit.

Most companies rise to the challenge. You can develop a sound working relationship with them — but only if they're on your team and working with you and not against you. If not, you undoubtedly can find other firms eager for the job.

Most companies rise to the challenge.

DIRK WILLARD, Contributing Editor
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REAL-WORLD ACADEMICS

Editor's Note: This letter is in response to Editor-in-Chief Mark Rosenzweig's editorial, "Academics Avert "L-pocalypse," http://bit.ly/2oAh7i4.

I wholeheartedly agree with you about engineers getting real world experience prior to pursuing careers in academics. My best professors in college had real world experiences across different disciplines in different industries prior to them taking positions in academia. In my opinion, these experiences made them better professors as they could pull from these experiences and relate them to the material that we were studying. We were able to solve "real" problems that existed out in industry and not just problems from a book.

I see young engineers now coming out of college and they don't know what a rotary valve or centrifugal pump looks like. For this reason and many others, your idea toward real-world application is, in my opinion, a great idea, and I wish more people thought as you do in regards to this subject. Just wanted to give you some positive feedback.

Kenny McMillon, B.Ch.E, PMP
Process Technology & Engineering Americas

MISGUIDED APPRENTICESHIP

I am a registered chemical engineer in the State of Texas. In my opinion, the idea of a ChE apprenticeship is a very misguided idea (see, "Apprenticeship For ChE Degree Debuts," http://bit.ly/2n00iwv).

First, if a student's year from the beginning of September until the end of May, with two weeks for Christmas and spring break vacation is approximately (if my addition is correct) 830 days over a period of five years and his/her class attendance is 200 days, the student spends only approximately 24% of his or her time in the classroom. Considering the academic demands (calculus, advanced calculus, chemistry, physical chemistry, transport phenomena and other engineering courses, laboratories, electrical and mechanical courses, to mention just a few) 24% of his/her time seems inadequate.

Second, having worked in both chemical plants and engineering design offices, the idea that a company, under pressure to complete projects, is going to take time out to have their senior engineers train apprentices is in my opinion wishful thinking. The senior engineers will not have the time or the inclination to sacrifice time on a project to educate an apprentice. Even if they were able and willing to train apprentices, assigning calculations and other engineering tasks to an apprentice is dangerous at best. Consider the fact that even cub graduate chemical engineers require the time and guidance of experienced engineers. In addition, consider that much of the senior engineers education may be stale and require refreshing (more time spent off the project).

Third, [the initial company in the IChemE program] expects technicians to help train these apprentices... In my experience, technicians resent engineers and I doubt they will go out of their way to train apprentices. Even if they do, many times their experience leaves them [with] peculiar engineering ideas. This is not to say that I have not gotten a good deal of help from techs, but I would still be reluctant to trusting them with engineering tasks.

Finally, it seems to me that what this misguided proposal will result with is poorly educated engineers who are more technician than engineer. Consider the fact that when working outside of the United States, American engineers often are the most highly regarded engineers in the world.

Please don't denigrate American engineers, especially chemical engineers, to the level of technicians.

Stephen Curyk, PE
Lago Vista, Texas

FILTER AID AWARENES

Congratulations on the article, "Make the Most of Filter Aids" (http://bit.ly/2nI1jK4), that appears in the May 2019 issue. Filtration and filtration related materials often are overlooked in the process industry.

Overlooking proper filtration procedures may be the cause of production problems and it's important to make everyone aware that proper attention must be given to filtration to avoid such problems. Thanks for such a well written article.

Jose M. Sentmanat
Liquid Filtration Specialist, LLC

ERRATUM

In our January 2019 issue, a response we received and published in the Process Puzzler column from GC Shaw, senior HSE adviser, Wood, Houston, was mistakenly attributed to Girish Malhotra. The correct attribution appears in the online version (http://bit.ly/2nFNpbj). We regret the error.

The editors of
Chemical Processing *magazine*

Is Your Site Ready for Renewables?

Several factors impact industrial use of renewable energy sources

Integrating large-scale wind or solar power production directly into existing chemicals sites is problematic.

RENEWABLE ENERGY is a growing component of the global energy mix, especially for electric power production. According to the International Energy Agency, nearly 10% of the world's total primary energy supply in 2016 came from biofuels and wastes, and a quarter of the electricity generated was from renewable sources.

Local factors strongly influence the development of renewable energy sources. For example, over 95% of domestic electricity generation in Norway is hydroelectric. This is due largely to the geography and geology of the region. On the other hand, government subsidies and tax incentives, especially in Europe, significantly spurred the growth of wind and solar photovoltaic (PV) power in that region. Access to natural resources, infrastructure, public policy, and commercial pricing of energy streams also play a major part in how different technologies are implemented, and at which locations.

Similar local and regional factors also affect the demand side. Within the chemical industry, companies are taking advantage of the growth of renewables in different ways around the globe. Intense debate also is raging on how renewable energy will affect our industry in the future. The types of changes under consideration fall into two main categories: configuration of energy distribution systems, and impact on process technologies.

Most large chemical plants and oil refineries today are integrated with some form of fossil-fuel-fired cogeneration facility that provides much of the steam and power sites require. Integrating large-scale wind or solar power production directly into existing chemicals sites in a similar way has been widely discussed, but is problematic. These renewable energy sources have a much lower energy density than fossil fuels, and renewable power plants need an order of magnitude more land; there isn't enough space for them within the battery limits of most existing chemicals sites. Moreover, because of the variability of wind and solar energy, the average power output is much less than the rated output of the power generating equipment, which has to be significantly oversized. This further increases both costs and land requirements. In addition, a site wanting to run purely on solar or wind power requires energy storage systems to smooth the variations in output. This greatly increases both the cost and complexity of large-scale renewable energy plants.

A more-cost-effective option is to build a large, stand-alone wind or solar power plant, interconnected with an electric grid system, to serve the power requirements of nearby chemical plants. For example, in The Netherlands, a green energy purchasing consortium, which includes Nouryon and Royal DSM, take electricity directly from two Dutch wind farms (see, "Chemical Makers Turn to Renewable Energy," http://bit.ly/2lyAJSB). Another example comes from Saudi Arabia where, in May 2019, SABIC, Marafiq, and the Royal Commission for Jubail and Yanbu signed a memorandum of understanding to scope a solar PV plant to provide all the electricity required during the day for SABIC's chemical sites in Yanbu.

The rise of renewables also likely will shift the industry towards more electrical technologies within the core of its processes. The most obvious example is electrolysis. Electrolysis is best known in large-scale chloralkali production. Other, smaller-scale applications exist, but its industrial use could grow considerably. For example, several European companies have announced plans to produce electrolytic "green hydrogen" (See, "Parties Unite to Develop Green Hydrogen Cluster in Amsterdam," http://bit.ly/2nqfnYu). Electrolytic paths to other industrial products could follow, see, e.g., "Carbon Utilization Gets a Boost," http://bit.ly/2nFdiIh.

Indeed, a variety of other electrical and electromagnetic technologies could get a boost from the renewable electrification trend. For example, microwave-enhanced chemistry, where microwave heating is used in reaction systems, has been known since the 1950s. Its benefits include increased rate and yield, and improved selectivity, in some small-scale applications. However, it has not been widely adopted at industrial scale.

New research is focusing on other forms of electrical and electromagnetic technologies to intensify process heating, improve product properties, and even eliminate thermal demands entirely in some cases. Possible applications include, but are not limited to, curing of composites and carbon-fiber-reinforced plastics, accelerating polymerization processes, and drying heat-sensitive materials such as textiles and plastics. ●

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SEC Proposes Changes to Reporting Rules

Efforts aim to modernize current disclosure regulations

Proposal doesn't explicitly address climate risk reporting.

PUBLICLY TRADED companies must disclose certain legal proceedings and risk factors in registration statements and in annual and quarterly reports. These disclosures significantly help investors in assessing the financial integrity of a publicly traded company; formulating a disclosure precisely is critical to compliance, while at the same time accurately capturing the nature and extent of the potential risks. This article summarizes this Securities and Exchange Commission (SEC) proposed rule, which is intended to modernize the Regulation S-K obligations, particularly as they relate to environmental disclosures, and discusses the unique challenges these reporting obligations impose on the chemical industry.

For many years, the SEC required companies to make certain disclosures in the form of reporting obligations intended to enable investors to make informed judgments about the financial integrity of a company. Unsurprisingly, the disclosure requirements relate to a variety of topics, including the materiality of certain claims in pending legal proceedings, the general development of the business, and the disclosure of certain risk factors. Over the years, the standards of materiality have changed, as well as the SEC's views about how best to define the scope of information that would enable investors to assess the companies they choose to support. The proposal reflects, in part, the SEC's commitment to update the rules to keep current with contemporary disclosure requirements and to modernize the disclosure requirements to reflect current materiality standards.

A key element of the proposal is SEC's adherence to a non-prescriptive, and what SEC describes as a "principles-based" approach to disclosure and its commitment to ensure flexibility in adapting to fast-changing circumstances and a reporting environment that has altered radically from when the rules were first adopted more than 30 years ago. Item 103 generally applies to "legal proceedings" and compels disclosure of litigation deemed "material," which generally is anything other than ordinary. Instruction 5 to the item defines an environmental penalty of $100,000 or more as not being ordinary. The proposal would change this materiality standard to $300,000. The SEC requested comment on whether it should adopt a higher threshold or adopt an inflation adjustment factor (as many government penalty assessment programs include) to account for increases occasioned by the passage of time.

Item 101 addresses description of business matters. Under current regulations, companies must disclose estimated capital expenditures for the current and succeeding fiscal years (and beyond if the registrant deems material) for environmental control facilities if they are material. In keeping with the SEC's principles-based approach, the proposed rule would eliminate the need to disclose the succeeding fiscal year and leave to the discretion of the registrant whether expenditures during that time frame are material.

Also, in keeping with a principles-based approach, the SEC's proposal doesn't explicitly address climate risk reporting. Instead, the registrant is to use its judgment as to whether climate information is material. (An initiative may ease climate change reporting to non-governmental organizations (NGOs), see "Easier Disclosures to NGOs Near," p. 7, http://bit.ly/2OX7V24.)

These days, SEC filings are routinely scrutinized by a broad range of stakeholders — shareholders, investors, competitors, NGOs, the federal government, states, facility neighbors, labor unions, area residents and more. As noted above, crafting the precise language of disclosures deemed to be material as they relate to environmental matters is exceedingly important. Similarly, the decision-making process used to identify the scope of disclosures subject to reporting under the SEC S-K rules is also critically important and must be aligned with the SEC rules and internally consistent with other internal corporate standards for defining materiality.

The proposal's principles-based approach is good news and likely will provide much needed flexibility to registrants in discharging their reporting obligations. That said, such an approach imposes a higher standard on registrants to ensure their reporting obligations are internally aligned and principle-based, meaning the disclosures should be rooted in a core set of principles that apply across the board. In other words, a registrant should carefully consider what is deemed material for SEC purposes and align that materiality standard with disclosure requirements that apply under other authorities, especially in the environmental area. Federal reporting obligations that come to mind include Toxic Substances Control Act Section 8(e) and Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) Section 6(a)(2), which require disclosure of adverse effects.

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Green Route to Nylon Precursor Beckons

Electrochemical method to make adiponitrile promises environmental advantages

USING ARTIFICIAL intelligence (AI), researchers have found a way to improve the efficiency of organic electrosynthesis. This could lead to a more innovative, environmentally friendly process to make adiponitrile (ADN), the main precursor to nylon 6, 6, say the team at the NYU Tandon School of Engineering, Brooklyn.

Traditional ADN production involves toxic, energy-intensive thermal hydrocyanation of butadiene. By contrast, electrosynthesis of ADN uses water-based electrolytes and renewable electricity sources.

The standard electrosynthetic process for ADN employs an "always on" direct current delivered to the electrocatalytic site. It also generates unwanted byproduct, propionitrile (PN). The researchers analyzed via AI 16 different experimental cases of pulse times to engineer a system delivering an intermittent current to constantly replenish reagent concentration at the electrocatalytic site.

"By analyzing electrochemical pulse techniques with AI, we were able to visualize ADN conversion efficiency across a range of pulse times without having to do more than a few physical experiments," explains Miguel Modestino, a professor of chemical and biomolecular engineering at NYU. "This innovative, integrated approach led to an unprecedented 30% improvement in ADN production and a 325% increase in the ratio of ADN to PN, mostly due a large decrease in production of the latter," he adds.

An article in the *Proceedings of the National Academy of Sciences* details the researchers' findings.

Modestino's partner on the project, doctoral student Daniela Blanco, and a former student in Modestino's laboratory founded a green-chemistry startup company, Sunthetics, to commercialize a sustainable nylon production process based on their research.

Sunthetics is talking with companies throughout the nylon manufacturing supply chain. "We have received mostly interest from nylon manufacturers assessing the possibility to back-integrate with technologies on the production of nylon intermediates. Several chemical companies also are interested in seeing where the scale up of the technology takes us and if we can implement the concept to other chemical processes," reveal the researchers.

Scaling-up the technology for a pilot demonstration will begin soon. "We envision using the core of this technology to develop more efficient and electricity-driven chemical reactors which can be implemented on new plants or to demonstrate the advances in pre-existing ones," adds Modestino.

On an industrial scale, pulsed electrosynthesis would require additional investment in power electronics to control the amplitude and frequency of potential pulses; however, the researchers anticipate the reactor infrastructure wouldn't need significant modification.

"There are many possibilities for further implementation of machine-learning optimization of electrochemical processes," Modestino adds. "A natural next step is to continue on the production of nylon intermediates by developing an electrochemical hydrogenation process for ADN to produce hexamethylene diamine. We are also starting to look into the application of similar principles to control the reduction or oxidation of selective functional groups in complex molecules. This could have large implication in pharmaceutical manufacturing, where selectivity is a key driver in the selection of synthesis paths, and our electrosynthesis approach could lead to highly selective scalable processes."

Figure 1. Miguel Modestino and Daniela Blanco pose with electrosynthesis device of their own design. The pair developed a green electrosynthetic route to adiponitrile and used artificial intelligence to improve upon it. *Source: NYU Tandon School of Engineering.*

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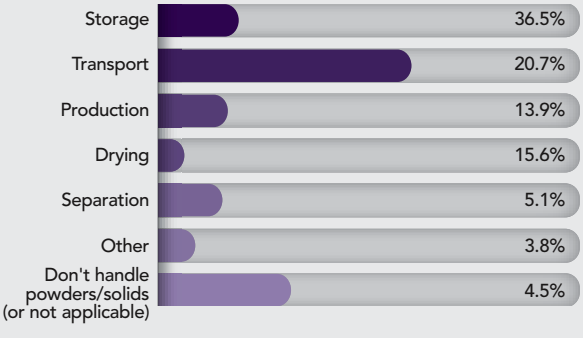
Which operation poses the most issues in your handling of powders and other solids?



By far the most respondents cited storage as their leading cause of issues.

Pollutant Shows Potential as Feedstock

NITROUS OXIDE often is called laughing gas but dealing with the compound is no laughing matter. The U.S. Environmental Protection Agency cautions that nitrous oxide has an atmospheric lifetime of 110 years and that one ton is equivalent to 298 tons of carbon dioxide. Nitrous oxide also is an ozone depleter.

POTENTIAL RAW MATERIAL

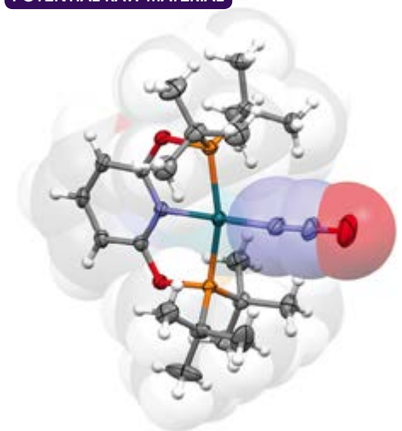


Figure 2. Well-defined transition metal complexes of nitrous oxide (color overlays) may foster its use in chemical reactions. *Source: University of Warwick.*

Work by researchers at the University of Warwick, Coventry, U.K., in isolating novel compounds of nitrous oxide points to a possible future strategy for dealing with nitrous oxide emissions by using the gas in value-added chemical processes.

"As a chemical reagent its potential has yet to be fully harnessed and to do so in a sustainable manner is a formidable challenge for the scientific community," explains project leader Adrian Chaplin.

This challenge largely revolves around the robust triatomic structure of nitrous oxide that typically requires energy-intensive forcing conditions to enable reactions. Efforts to develop mild and selective alternatives have borne little fruit.

The Warwick team first looked at the application of homogenous transition-metal complexes to the gas. However, members of the team write in a recent article in *Angewandte Chemie* that while such a strategy is attractive, the inorganic chemistry underpinning such interactions is "conspicuously under-developed." The researchers only identified four such discrete transition-metal complexes of nitrous oxide in the literature — all of which were poorly characterized largely because of the gas's poor ligand properties.

So, instead, the team built upon earlier work at Indiana University, Bloomington, Ind., and the University of North Carolina, Chapel Hill, N.C., — and its own in-house studies — which used cationic phosphine-based pincer complexes of rhodium as a platform for studying the coordination chemistry of nitrous oxide (Figure 2).

Rhodium is a widely employed transition metals in organic synthesis; advanced analysis techniques enabled the team to identify and characterize its coordination with nitrous oxide in two separate pincer complexes.

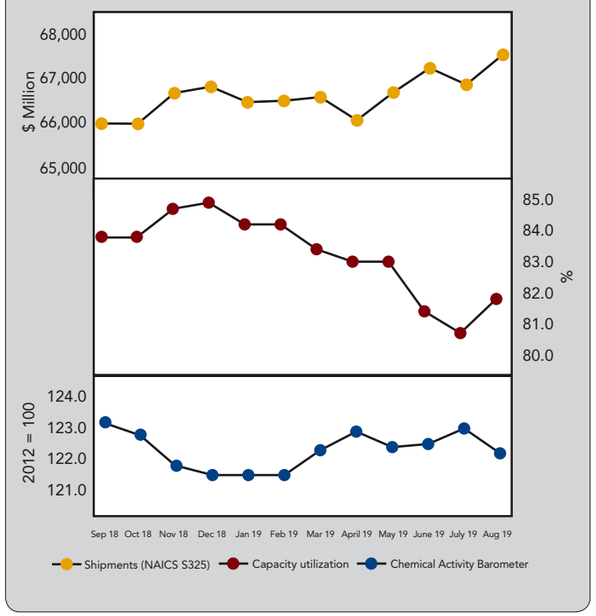
"The compounds that we have prepared represent the starting point of our journey, but the associated experimental data seems to be guiding us in the right direction and we are looking forward to where it takes us," notes Chaplin.

The next step is to explore the onward reactivity of such adducts in the context of catalytic applications.

The potential industrial application of the work will hinge on the chemical robustness of the catalyst. "In our case, we have used chelating pincer ligands, which are noted for conferring such stability, so that is promising," says Chaplin.

Eventually, he believes, the work could generate new routes to fine chemical synthesis, along with bespoke oxidation reactions. ●

ECONOMIC SNAPSHOT



Shipments and capacity utilization rose but the CAB slipped. *Source: American Chemistry Council.*

Two Products Win Vaaler Awards

A tablet for field instruments and a gasket receive recognition

By Mark Rosenzweig, Editor in Chief

SINCE 1964, *Chemical Processing* biennially has bestowed Vaaler Awards on products that promise to significantly improve the operations and economics of plants. This year's awards were open to entries that were commercialized in the United States between May 2017 and June 2019.

The awards are named after John C. Vaaler (1899–1963), who was chairman of *Chemical Processing*'s Editorial Board from 1961 until his death. He became editor-in-chief of *Chemical Processing* in 1946, after 24 years in the chemical and related industries.

An impartial panel judged the entries. It consisted of the members of *Chemical Processing*'s Editorial Board — a group of technical professionals with diverse responsibilities and from a variety of industry sectors (see sidebar). The panel assessed all entries on three criteria: technical significance; novelty or uniqueness; and breadth of applicability. It wasn't obliged to give any awards — but decided to honor :

- Field Xpert SMT70 from Endress+Hauser, Greenwood, Ind.; and
- Origin RC510 Gasket from Teadit North America, Pasadena, Texas.

RUGGED TABLET EASES FIELD INSTRUMENT MANAGEMENT

Field instruments play a critical role in the safe and efficient operation of plants. Managing these instruments over their entire lifecycle and documenting work done usually consumes significant staff time. The Field Xpert SMT70 (Figure 1), a tablet personal computer from Endress+Hauser, gives today's mobile workforce a powerful and rugged tool to ease commissioning as well as ongoing maintenance of field instruments in hazardous and non-hazardous locations — saving time and cost per device while helping ensure safe and reliable production. The tablet is ready to go right out of the box and works with virtually every modern field instrument, regardless of vendor. Its simple touch-enabled device configuration software navigates a technician through commissioning, troubleshooting and configuration work.

Field Xpert SMT70 comes preinstalled with device configuration software and device libraries. The easy-to-use tool communicates with all modern field instruments that use DTM (device type manager) or EDD (electronic device description) technology. Automatic hardware detection enables fast one-click connection to devices. The tablet also can provide online software and DTM/driver updates to afford new functionality and maximum security.

TABLET FOR FIELD INSTRUMENTS

Figure 1. Rugged device connects via a single click to virtually any modern instrument and enables online updates to add functionality and maximize security.

The unit is approved for Class 1, Division 2, Groups A, B, C, D, T4 and Class 1, Zone 2, Groups IIC, T4.

Launched in the United States in January 2018, the slim 1.2-kg tablet boasts an 11.6-in. high-definition sunlight-readable display, a 2-megapixel front-facing camera, a micro-SD card slot, Windows 10 Pro, automatic saving of a HART device report in Endress+Hauser's Netilion Library, and up to 7 hours runtime. It contains an Intel i5 processor, 8-GB RAM and a 256-GB solid-state drive. Options include a 5-megapixel autofocus camera with LED flashlight, upgraded run time of up to 14 hours, and a docking station that provides 1-GB Ethernet, 4 USB ports and an HDMI connection.

Field Xpert SMT70 features touch-enabled device configuration software in 20 languages. Communication ports and supported networks include USB, Ethernet, HDMI, Wi-Fi and Bluetooth, with 4G LTE and GPS as options. The tablet also supports Endress+Hauser's Heartbeat Technology and FieldCare instrument diagnostic, verification and monitoring functions, adhering to NAMUR NE 107.

THE JUDGES

Dan Brown, capital project manager, Pfizer, Kalamazoo, Mich.
Vic Edwards, process safety consultant, Houston
Fred Gregory, process safety and risk manager, Lubrizol, Deer Park, Texas
Rachelle Howard, senior process control engineer, Vertex Pharmaceuticals, Boston
Julie O'Brien, director of sustainability, Air Products and Chemicals, Allentown, Pa.
Roy Sanders, process safety consultant, Lake Charles, La.
Ellen Turner, market development representative, Eastman Chemical, Kingsport, Tenn.
Dave Vickery, manufacturing and engineering technology fellow, Dow Chemical, Midland, Mich.

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Lubrizol

UNIQUE MANUFACTURING PROCESS PRODUCES BETTER GASKET

Effective sealing of manways and bolted joints often is essential to ensure safety and prevent product loss. For instance, petrochemicals transported via rail require tight sealing of the railcars' manway dome lids. The Origin RC510 gasket (Figure 2) offers major improvements in leak reduction and bolt-load retention over elastomeric sheet gaskets, reducing costs and material wastage as well as providing unmatched durability. The product consists of restructured hollow-glass-microsphere-filled PTFE and is manufactured by unique technology.

The gasket is easy to install and uninstall, making multiple use a possibility, and provides extended life over multiple cycles. While designed particularly for railcars, it also suits use on bolted joints with low load potential, such as in plastic piping and fiber-reinforced-plastic assemblies. However, the gasket is robust enough for standard piping applications. Three variants now are available — for railcar manway dome lids, acid piping and general services.

Leakage tests — repeated cycles subjecting gaskets to 35-psi pressure and 250-ft-lbs torque at room temperature, with each 24-hr cycle involving opening and closing a lid each hour for eight hours and then pressurizing for the next 16 hours — showed no noticeable decrease in performance for Origin RC510 after 40 cycles; competitive gaskets totally failed after only 10–30 cycles. Moreover, the wound gasket doesn't suffer from aging or weathering, and doesn't have shelf-life limitations, so it can be stored indefinitely.

Innovative "Origin" technology produces the gasket, which was introduced in the United States in June 2018. That technology yields a wound sintered PTFE gasket. It enables tailoring the gasket to specific needs. Customization, for instance, can include radial density variations, different colors to denote gasket region and properties, or even distinctive fillers along its radius.

Figure 2. Made by an innovative process, the wound PTFE gasket provides better sealing while avoiding the high scrap rates incurred when using sheet material.

The process starts with PTFE resin powder, which can be mixed with one or more fillers. It then is extruded, laminated and cut into tapes of pre-set width, which determines the gasket thickness. Next, the tape is wound to the gasket inner-diameter/outer-diameter size and sintered to produce the final product. Unlike sheet materials, whose available sizes limit gaskets to no larger than 2.0-m diameter, the Origin technology can produce gaskets in larger sizes, depending upon manufacturing capabilities. ●

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Choose the Right Heat Transfer Fluid

Consider a variety of factors to ensure effective and enduring performance

By Chris Wright, Global Heat Transfer

THE ROLE of a heat transfer fluid (HTF) is simple — to transmit heat to a process stream. However, selecting a high-temperature HTF to use in a new operation isn't a simple task for a non-specialist. Here, we'll address some of the common conundrums that every company will face and provide some practical pointers.

HTFs generally are mineral or synthetic; it's very common to compare the relative characteristics of these fluids. However, this comparison really only makes sense in two scenarios — during the design of a new facility or when planning to completely replace an aged fluid with a virgin HTF. In most cases, the key consideration is effectively maintaining an existing system to ensure the plant operates as efficiently as possible and the HTF achieves a long working life (Figure 1).

THE FIRST DECISION

When starting to design a new plant, you must decide whether to use water or steam as the heating medium or to rely instead on a mineral or synthetic HTF. Mineral and synthetic HTFs are established viable alternatives to water or steam — and the preferred choice at temperatures above 200°C (392°F).

Mineral and synthetic HTFs, relatively speaking, provide a safer operation that requires less monitoring because they operate at lower pressures than steam. For example, at a temperature of 343°C (650°F), steam has a vapor pressure that is 200 times higher than that of a synthetic HTF such as Globaltherm Syntec, which is a terphenyl-based fluid — 13,790 kPa (2,000 psi) versus ~71–86 kPa (10.3–12.5 psi), respectively.

Figure 1. Maintaining optimum performance requires effective ongoing maintenance.

Mineral and synthetic HTFs don't require pressurizing at temperatures up to 350°C (662°F). Another advantage of using a mineral or synthetic fluid, as opposed to water, is that it generally has a lower freezing point. For example, the freezing point of Globaltherm Syntec is -28°C (-18.4°F). Lastly, HTFs also tend to be less reactive and corrosive to pipes and other parts of the system than water.

There are a lot of different HTFs and many people mistakenly believe there's little difference between them. Unlike in food processing, where food-grade HTFs — highly refined mineral fluids that are colorless, nontoxic, non-irritating and non-fouling to allow for potential incidental contact with foods during manufacture — are available, no specific grades exist for chemical and pharmaceutical processes. Instead, selection involves matching a fluid, either a mineral or synthetic HTF, to the system and the process requirements.

Restrictions imposed in the particular sector or by company policy may affect HTF appropriateness. For instance, at a company that places high importance on its environmental credentials, suitability may require striking a balance between a fluid's functional properties and the ability to handle it. Here, assessments might cover factors such as a fluid's relative risk when handled and ease of disposal as well as the biological, chemical, physical and allergenic hazards it presents. As a general rule, mineral HTFs are less restrictive in their handling requirements and less hazardous to humans and the environment than more highly refined chemicals used in synthetic fluids.

In addition, your insurance company may influence what's an appropriate HTF choice. Some insurers have been known to define a list of acceptable HTFs, as opposed to recommending a single HTF. The terms of many policies allow auditing to ensure use of an appropriate HTF.

Equipment manufacturers also may recommend particular fluids. This can lead to a lot of confusion. For example, when planning annual new

fluid refills, a manager responsible for the system may restrict the choice to one of the named HTFs, even though other brands may have the same chemistry and composition and offer a more-cost-effective option.

KEY CONSIDERATIONS

The operating temperature of a HTF depends on its base chemistry and purity (Figure 2). As a rule, mineral HTFs have a lower maximum operating temperature than their synthetic equivalents. You must match the fluid to the upper operating temperature. It is one of the crucial factors that will influence the aging of the fluid; the HTF will degrade faster if the upper operating temperature is breached for

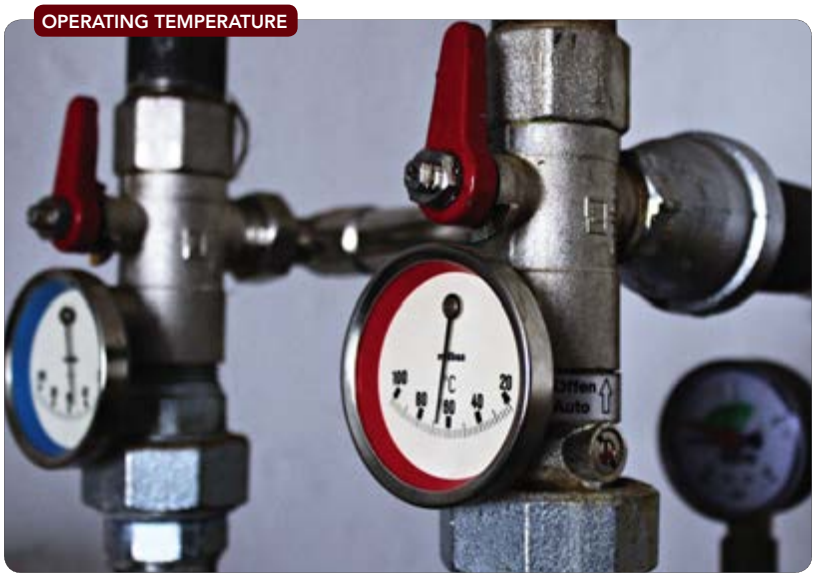

Figure 2. A heat transfer fluid's base chemistry and purity determine its upper temperature limit.

prolonged periods. The net effect is a reduced fluid lifespan.

Synthetic fluids better resist thermal degradation at higher temperatures and, therefore, are preferred at those higher temperatures (which could be up to 400°C (752°F) in the case of Globaltherm Omnitech). This helps safeguard against thermal degradation if the upper operating temperature is exceeded.

However, mineral fluids perfectly suit operations where the upper operating temperature isn't exceeded or if the temperature is >20°C below the fluid's upper operating temperature.

HTFs must meet a number of key criteria depending on the specifics of the application. These include high-temperature thermal stability, product purity and heat transfer efficiency. The thermal stabilities and properties of mineral and synthetic HTFs differ. For instance, lower-quality mineral HTFs, such as group one base oils, tend to be less thermally stable, which creates a higher risk of fouling. They also have a lower maximum operating temperature (260°C, 500°F) than group three base oils (~316°C, ~ 606°F); for more details, see my 2016 article "What to consider when making the buying decision about a heat transfer fluid for your system," *J. of Applied Mech. Eng.*, http://bit.ly/2LT0yqB.

So, like any decision, the choice of HTF is a tradeoff, in this case between cost, high thermal stability and performance. Mineral HTFs often provide an attractive option for services that don't exceed their maximum operating temperature ranges; they generally are cheaper than synthetic HTFs.

Fluid purity can have an impact, as Lang and Lee reported in "Heat transfer fluid life time analysis of biphenyl-diphenyl oxide (BDO) grades for concentrated power plants," http://bit.ly/35g4n0M. (Examples of HTFs containing BDO include Dowtherm A, Therminol VP-1, Globaltherm Omnitech and Diphyl.)

The authors compared the thermal degradation of Dowtherm A and a non-branded HTF (lower purity due to higher chlorine content) and quantified the impact of impurity in terms

of the cost of new fluid refills over the lifetime of the BDO HTF. They concluded that the non-branded BDO HTF was 1.7–2.4 times more likely to degrade than the lower-impurity branded BDO HTF over the course of a 25-yr life span. This increases the cost of annual new fluid refills over this time frame.

As this research highlights, you should consider the importance of a fluid's impurity (which its maker should specify upon request) when selecting a fluid. Given the relatively low cost of mineral fluids, the annual new fluid refill cost/kg/yr represents a good way to measure and manage overall costs.

By the way, you may achieve cost savings for such refills by including them in a fluid maintenance program in which an external company manages the fluid and maintains it on a day-to-day basis to sustain a healthy operation and HTF.

In addition, the heat transmission characteristics of the HTF are an important consideration because heat transfer efficiency indicates how well a fluid will transfer heat from the fluid film lining the pipe wall to the body of fluid flowing through the pipe itself.

ANCILLARY FEATURES

You also may need to consider a number of other properties such as viscosity, expansion rate, flash and fire points, and resistance to oxidation.

Viscosity. The objective is to get a fluid that has a low viscosity at low temperature because this affects the lowest startup temperature for the system. This is particularly important if the HTF system is housed outdoors or has no backup heating system.

A general rule of thumb is to avoid fluids with a kinematic viscosity >60 cSt at 40°C. Mineral and synthetic fluids, such as Globaltherm M and Globaltherm Syntec, have viscosities <60 cSt at 40°C. While the synthetic fluid has better thermal stability up to 345°C, both have similar viscosities at 40°C and 100°C. Furthermore, the mineral-based HTF can operate down to a lower temperature than the synthetic HTF.

Expansion rate. You must consider the thermal expansion coefficient

when assessing if a particular fluid is appropriate for the size of the expansion tank in the HTF system. Consult the fluid manufacturer for the given rates of a fluid's expansion.

Flash and fire points. You should perform routine sampling and analysis to quantify the extent of a fluid's thermal degradation and its closed flash point temperature. A decline in closed flash point temperature indicates a rise in the formation of short-chain hydrocarbons ("light-ends") from thermal degradation of the fluid. Their presence in the fluid signals that a system isn't venting effectively and volatile components are accumulating.

You must remove these byproducts because they can negatively influence pump efficiency and represent an increased safety risk to the overall HTF system.

Every fluid, mineral or synthetic, will degrade when operating at sustained high temperature for prolonged periods. This degradation rate is faster in mineral HTFs. However, with close monitoring (for the formation of short- and long-chain hydrocarbons) and use of predictive measures to project its future health, a mineral fluid is a feasible option for processing operations.

Resistance to oxidation. Oxidation commonly is associated with mineral HTFs; polymerization products, such as sludge, form when saturated hydrocarbons react with oxygen. Contaminants such as water accelerate this process. However, using a nitrogen blanket to limit contact with air and a fine filter sieve to remove carbon and contaminants from the circulating HTF can slow the process.

While the chemistry of a mineral fluid means it's more reactive to oxygen, you can take effective measures to prevent or intervene should you detect polymerization byproducts.

OPT FOR THE BEST VALUE

You should select an HTF based on value, which ultimately is a tradeoff between fluid cost and performance. If you need a high-temperature HTF, ensure the prospective fluid can perform adequately for prolonged periods at the necessary temperature. That requires diligently verifying and comparing heat transfer rates, fouling potential and thermal stability before purchase. You can do this by familiarizing yourself with the fluid manufacturer's product data sheets.

The key features of well-designed mineral or synthetic HTFs are thermal stability when operating at high temperatures for prolonged periods, good thermal transfer efficiency and high purity.

Once your selected HTF is in use, it's important to regularly monitor its condition so you can predict and prevent thermal degradation over time. Synthetic fluids require just as close monitoring as their mineral counterparts because all fluids will thermally degrade when operating at high temperatures for prolonged periods. Adequate monitoring will ensure your HTF operates to its maximal potential and lasts as long as possible. ●

CHRIS WRIGHT is a research scientist for Global Heat Transfer Ltd. Stone, U.K. Email him at chrisw@globalgroup.org.

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MODELING EASES DEBOTTLENECKING

Process simulation is playing a crucial and expanding role

By Seán Ottewell, Editor at Large

THE QUEST to squeeze more capacity from existing assets undoubtedly is as old as the chemical industry itself — and efforts certainly aren't flagging. Indeed, debottlenecking projects are proliferating around the world.

For example, the raft of 2019 project announcements includes the debottlenecking by Solvay, Brussels, Belgium, of its hydrogen peroxide plant in Jemeppe-sur-Sambre, Belgium, with similar projects to follow at its sites in Bernburg, Germany, and Voikkaa, Finland; efforts by Oxea, Monheim am Rhein, Germany, to continue improving and debottlenecking manufacturing processes at its five existing carboxylic acid production units in 2020 in preparation for the goal of bringing a sixth world-scale production plant on stream in 2021; and a project by BP's joint venture Lotte BP Chemical Company, Ulsan, South Korea, to add 100,000 metric tons (m.t.)/yr via debottlenecking, bringing acetic acid capacity there to 650,000 m.t./yr. In addition, Eastman Chemical, Kingsport, Tenn., has completed debottlenecking of its diethylhydroxylamine unit in St. Gabriel, La., that increased capacity by 15–20%, with other similar projects in planning stages.

In North America alone, efficiency drives by the chemical processing and oil and gas industries have prompted $1.3 billion in debottlenecking projects, according to research by Industrial Info Resources, Sugar Land, Texas.

THE POWER OF SIMULATION

"Debottlenecking and retrofitting in general are ideal situations in which to use process simulation. They are definitely strong leads for our software," says Stéphane Déchelotte, CEO of ProSim, Toulouse, France.

This is especially true, he adds, when a customer already has a plant that is up and running and so can use its own data to validate the simulation of its process. "From there you can fully validate the simulation as a test case on a digital twin and identify exactly where and how the debottlenecking needs to take place."

Two recent projects cited by Déchelotte used the firm's ProSimPlus Energy software package to debottleneck and improve plant energy consumption.

One involves French agro-industrial group Avril, Paris, which heavily focuses on renewable chemistry and biofuels. The company's Diester biodiesel brand, developed over the last 20 years, is produced mainly from rapeseed oil and is incorporated in a proportion of 8% in diesel fuel distributed from French service stations.

"We worked with Avril to reduce bottlenecks in a biofuel plant. The outcome was a dramatic reduction of more than 40% in energy consumption with an ROI [return on investment] of less than a year. This project involved modifying the distillation column and associated heat exchangers," Déchelotte explains.

The second was for Air Liquide, Paris, on a steam methane reforming plant. The focus here was on the reformer and heat exchangers. The simulation project identified ways to reduce energy consumption by 10–20%, depending upon plant operations.

"You never know at the start of a simulation project what you are going to find, but usually the final savings are substantial," he adds. "Both projects were performed within six months and the cost of each was under US $50,000. So we're not talking about a huge investment. The cost of a study is very small relative to the possible savings."

A simulation study usually uncovers a whole range of potential improvements but a company may not choose to do all of them, especially ones that require a plant shutdown, Déchelotte notes. After a company decides which changes it wants to make, ProSim carries out another simulation using just those parameters.

One niche business that is very important to ProSim is debottlenecking of nitric acid manufacturing plants, especially in North America. Its ProSimPlus HNO_3 software package, honed for 30 years, is aimed at the traditional dual-pressure and mono-pressure nitric acid manufacturing processes, together with the nitrous vapor absorption units used in fertilizer, explosives and adipic acid manufacture (Figure 1).

"Usually we are working with quite old plants where there isn't a lot of money to invest. So the companies are constantly carrying out retrofitting and debottlenecking projects," Déchelotte explains.

"There are typically three aims to such projects: a reduction in emissions; a reduction in energy use; and an increase in production. With some changes, typically to columns and condenser coolers, we can achieve all three of these targets. It's a very busy market, mainly in the U.S., and we have seen a huge increase in sales of the related software."

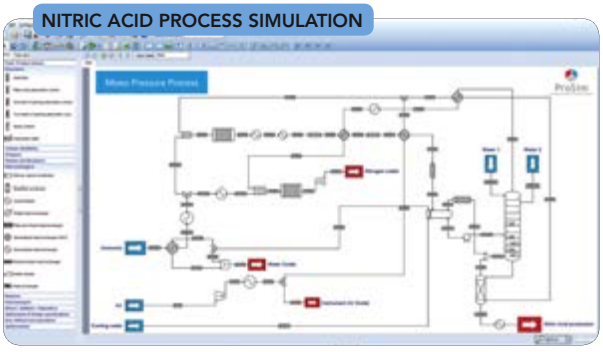

Figure 1. Modeling package handles complexities that pose challenges for general-purpose simulation software. *Source: ProSim.*

A number of factors contribute to this success, he believes. General-purpose simulation software struggles with the complexity of the physical and chemical phenomena involved in nitric acid processes — typically gas-phase chemical reactions whose thermodynamic properties aren't easy to model. The specificity of equipment used in such plants makes the processes tricky to simulate, too. Also, the software should take into account sizing parameters, for example pipe volumes and the spacing of absorption column trays, at early stages of process design because these can affect mass and energy balances if production is to be increased at a later stage. Operating companies that have developed in-house programs for the main unit operations often lack the flexibility to look at the entire production process.

The massive growth in availability of plant data spurred by growing adoption of the industrial internet of things (IIoT) promises better simulations, he adds. "Our software is used offline, but we are always interested in technology that lets us take advantage of all the data available on the plant. We can mine this and use it to validate our models. Being able to use many years' worth of detailed data to do this gives us very, very accurate simulations so the reliability of our software is improving all the time."

THE FULL LIFECYCLE

It's also enabling the emergence of unified lifecycle approaches to simulation. This involves extending one process model throughout the entire lifecycle of the plant, from concept to operations. Its aim is to do away with the problems caused by legacy architectures and operating systems as well as the need for a high level of software programming skills and to take advantage of the emergence of the IIoT and artificial intelligence.

Such next generation platforms provide a digital twin of the plant through the process lifecycle that today's tools can't.

Many current simulators typically only support a single phase of the lifecycle and often are based on thermodynamics of different simulation vendors and disparate calculation methods, according to Aveva, Cambridge, U.K. This not only leads to lack of trust in the results but also causes substantial rework in having to build a new simulation model in each new tool. As a consequence, the results of each model are hard to compare.

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Launched in March 2017, the SimCentral simulation platform is Aveva's answer to this problem.

One engineering/procurement/construction (EPC) firm that adopted the platform saw dramatic benefits with a cooling water revamp project at a North American refinery. When the refinery operator asked, "What if we completely remove this area or switch this equipment?," the EPC replied, "Give us two hours." Prior to adopting SimCentral, such an evaluation would have taken two weeks. The EPC also noted that the learning curve isn't steep, even for engineers with no prior experience of using process simulators.

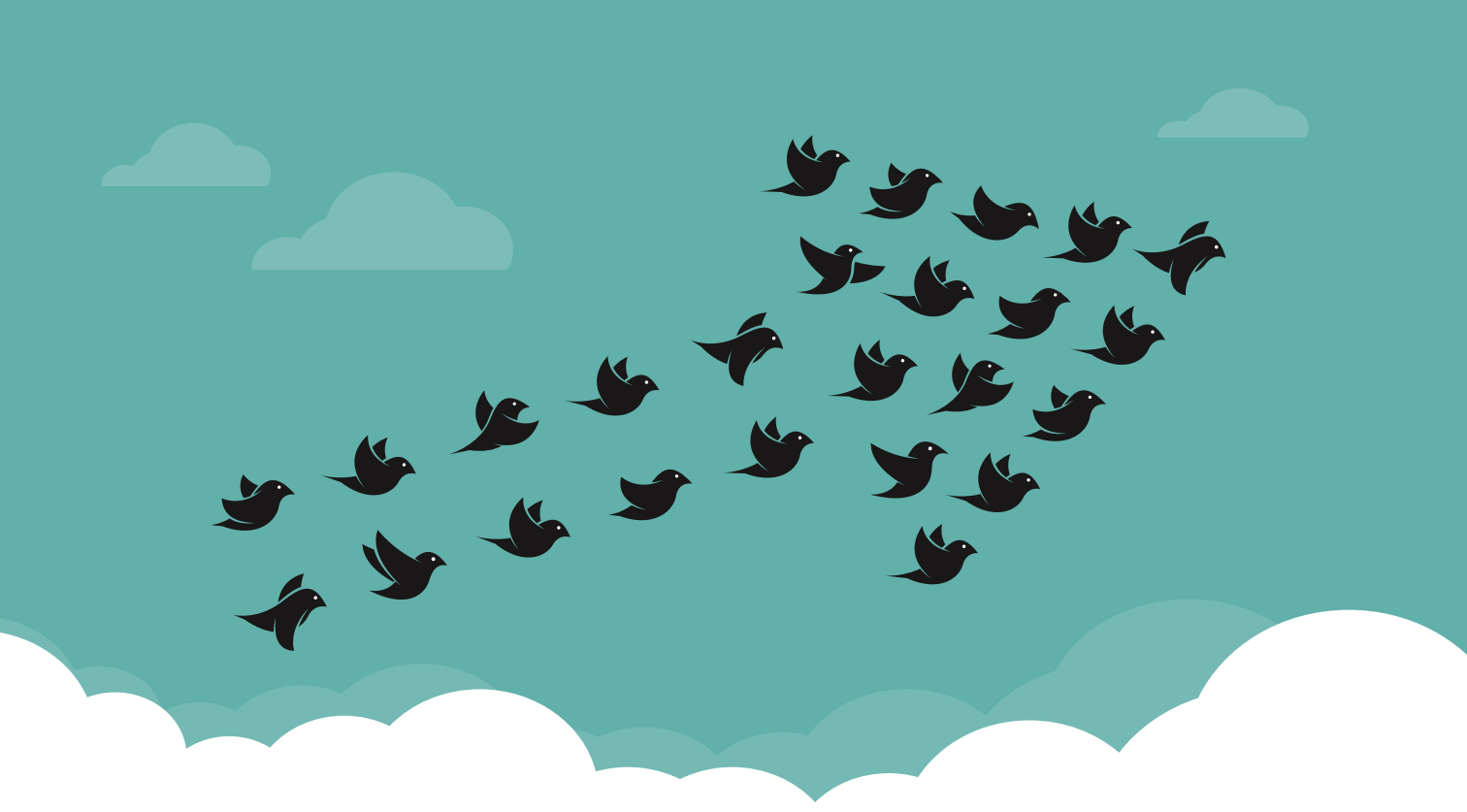
Hyundai Engineering, Seoul, Korea, chose the same technology after seeing how quickly and efficiently it could model complex processes.

The company was looking at how best to design, engineer and build vacuum transfer lines. These can be challenging given their high velocity and two-phase flow, leading to poor separation in the vacuum towers that they feed.

"We chose SimCentral simulation platform after seeing how quickly and efficiently complex processes could now be modeled," says Hyundai.

The platform's ability quickly to handle and avoid critical velocities helped process engineers find the right design faster, reducing both the time and cost of the simulation exercises, notes Aveva.

The platform also has received positive feedback in workshops with chemical companies, including for ease of debottlenecking process utility systems by fluid flow network simulation, better collaboration between modeling and control experts by early understanding of process controllability through unified dynamic simulation, and a 50% reduction in simulation effort across the entire plant lifecycle. ●



Make the Most of Migration

A methodical approach to control system modernization can optimize results

By Darryl King, JMP Solutions

YOUR GOAL: maximize the efficiency of your equipment while keeping costs under control. This sometimes translates to a modernization effort that will improve throughput by enabling decreased cycle times not feasible with current equipment.

A modernization project will help you reduce lifecycle costs. Old equipment gets more expensive to maintain over time and, if you upgrade, you'll decrease downtime by having systems that are easy to maintain and troubleshoot — ultimately improving your quality metrics and cutting scrap rates.

What you certainly don't want is being forced to launch such a project because of an emergency.

Take the case of one company that was running a legacy system that included three of the nine controller units the vendor ever manufactured. No conversion utilities existed for the units, so every change required manual re-programming. Multiple legacy platforms, uncoordinated alarms that weren't tied together, poorly maintained documentation and lack of drawings meant the company continually faced the need for extensive engineering.

Suddenly, the equipment broke down and there was going to be a high price to pay to fix it. The company had a short window to perform a shutdown to replace process instrumentation and control elements while minimizing downtime. Moreover, to enhance operator acceptance of the new system, the company wanted to maintain the look and feel of the old one.

The company worked with JMP Solutions to evaluate several platforms and automation vendors. The project scope accounted not only for meeting current demands while maintaining existing screens for operators to minimize disruption but also for future-proofing equipment to ensure the opportunity for ongoing growth.

Coming up with the most-suitable solution required:

- an understanding of the situation and development of a comprehensive plan to eliminate downtime;
- extensive experience with programmable logic controllers (PLCs), drives, human/machine interfaces (HMIs), supervisory control and data acquisition systems, motion controllers and applications that meet the needs of the business such as manufacturing execution systems;
- a proven methodology and approach that is result oriented and provides clear metrics for project completion as well as a timeline;

- change-management guidance that can assist the entire company navigating through a major hardware upgrade with minimal disruption to work processes; and
- documentation and training so everyone on the team feels comfortable with the new systems and can operate them with maximum efficiency.

MAKE A PLAN

Of course, you shouldn't wait to migrate until an emergency forces your hand. Instead, you should approach modernization in a methodical way. First, you must assess your situation.

The key to successful migration starts with conducting a roadmap assessment where you identify the outcomes you want to achieve for your businesses. Often, this involves gathering operability reports, defining future roadmap goals, performing system and plant inspections, and using other management tools to collect information not only about the equipment but how it's used.

Throughout the process, you'll learn about automation options, services and the strategies needed to develop a project that is delivered on-time, on-budget, on-scope and with minimal risk. Initial discovery discussions should point to key performance metrics, clarify next steps and the kinds of solutions to deploy to effect change.

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You should be looking for a roadmap to project success. What tools do you need to employ? What is the timeline for project implementation, including when must you plan for downtime and how can you minimize the impact on your business? In addition, the timeline should specify a target date for project completion.

The roadmap assessment also can work through potential operational issues and, in turn, prioritize your business outcomes such as how your project will impact yield improvement, energy management, efficiency tracking, compliance and supply chain coordination. Analysis and prioritization of these desired business outcomes will provide the context that will drive project scope and related equipment.

The roadmap also should contain a project plan — which might include multiple stages that correspond to an engineering specification as well as lifecycle support. This could involve greater manufacturing flexibility through scheduling of multiple products on the same process equipment and simpler regulatory compliance through elimination of a process waste stream.

Take the case of a company that was looking for an integrator to deliver a project and ongoing controls implementation support over a 21-year period, covering new unit installations and upgrades of existing systems as they complete their lifecycle. In addition, the integrator needed to provide consistent support on all levels, including project, expansion and upgrade, and extension of staff.

The plan was to evaluate the existing controls set-up in one facility with the aim of increasing product throughput and quality as well as support of a major system upgrade and conversion to some new applications and ensuring their compatibility with the controls architecture. The operating company decided to use this opportunity to expand the project scope by including a second complete process train that required ongoing system and process additions, upgrading of legacy controls, integration of system batch data with enterprise resource planning software, and support for site migration.

Here, the presence of full-time staff who understood and had specific expertise in the controls architecture of the company eased project implementation.

The results were impressive: increased throughput and yield with the addition of multiple trains and process controls that manage the product batches; greater flexibility through scheduling of multiple products on the same process equipment; simpler regulatory compliance by elimination of a waste stream; and decreased time to value and project risk due to controls being delivered on time and to specification.

A big piece of the upgrade process is to ensure that, if you're not maintaining a controls expert on staff to continually assess and work through your control system architecture lifecycle, you're training your team with best practices. This might entail arranging for some ongoing support, even on a sporadic basis, from the integrator involved in the project.

UPDATE DOCUMENTATION

That training must involve a documentation project. You must upgrade your documentation when you upgrade your systems. One polypropylene producer was looking to find

a partner that could provide primary distributed control system (DCS) and PLC support for one of its North American plants. This included updating and enhancing control system documentation to support maintenance and ongoing troubleshooting.

The company needed multiple PLC installations on plant auxiliary systems, replacing relay-based controls with HMI PLCs. In addition, the project had to provide support of the company's existing system that controls the polymer reactors and extruder, field audit, verification and development of 500+ loop drawings in preparation for a major PLC migration. So, a follow-up project was launched to update all plant process control and logic drawings.

The plan also involved work on migration of an aging compressor control system as part of an initiative to upgrade several legacy PLC-based auxiliary systems. The control system modernization project led to increased throughput through process debottlenecking and upgrades. Moreover, the company realized greater product yield and quality by replacing aging polymerization tracking software. In addition, more-consistent availability of process feedstocks and decreased time to value and lower project risk via efficient project management resulted in better production schedule alignment.

What's included in a documentation project might seem obvious. However, every step you take in this migration must be written down and photographed or diagramed — whatever "illustration" you think will suffice for a person or team that wasn't involved in the migration to do it again. Adding a "scribe" to the project team often is a good idea; otherwise, task someone on the team with that activity. No point is too small to document. Again, think about it as if you weren't involved in the project. Is the documentation adequate to enable you to replicate the work?

Choose a simple way of documenting — via paper or common computer spreadsheet, presentation or collaboration software — whatever your company is most familiar with from a sharing perspective. Also, store every document in an area or system accessible only to those who need it. Online retention is best, especially if a company has multiple locations.

While documentation is important, you also must factor training into your plan and your timeline. You should

train your personnel on both the equipment and process that you're automating, even if you have contracted with an integrator for support.

Often an integrator will possess specialists with expertise in your industry and experience with how automation systems perform in the process. They can add their knowledge of the equipment and play a critical role in partnering with your team, maintaining the system and making changes in it throughout the migration as well as after the project is complete.

AVOID THE POTHOLES

A number of issues might throw your project off track. Here are five key causes of failure during migrations:

1. *Lack of sufficient understanding of the migrating equipment, including sub-systems, attached equipment, communications (device and system level), and specialty hardware.* Expertise not only in the equipment you are installing but also in the equipment you are replacing is critical. How can you replace a system if you don't know what it did and how? Ensure you have the technical diagrams/documents on hand as you begin this migration and, if you don't know exactly how that system worked, find out!

2. *Flawed timeline for execution, weeks versus weekends.* Detailed planning helps determine the best path forward. Often a project lasts longer than anticipated, so be realistic or ensure your integrator is realistic about what you must do to get this project completed and how long each step will take. Stage-gate analysis is critical in any complex project; performing these analyses at crucial points along the migration timeline ensures the schedule is as realistic as possible. It also imposes a formalized risk identification and mitigation process on the project, allowing application of countermeasures at the earliest and most-cost-effective point.

3. *Inadequate maintenance and operator training to support the new system.* There's nothing worse than converting your system just to have it unsupportable with your internal resources.

4. *Absence of fallback planning.* It's critical to have a means to undo what you did should an emergency arise — so the plant can continue to operate. As previously discussed,

documentation is key. You must document every step of the migration — what you did, how you did it, when you did it, and why you did it. That way, if you have to step it back, you can do so methodically without "breaking" the process.

5. *Poor spare parts inventory.* Having essential replacements on hand is important to this process as well, especially after the migration, because the new equipment isn't necessarily stocked internally. A bill-of-materials review always should take place before milestone migration dates are set. This review will reveal which parts might fail first, so that you can cross-reference useful life expectancy with availability and lead time on a per-part basis to develop a preventative-maintenance-driven in-house spare parts strategy.

WHERE TO TURN

Any company looking to embark on an upgrade project should consult with some of the certification associations that can provide information on the backgrounds and experience of integrators you're considering. In the case of hardware upgrades, the Control System Integration Association, www.controlsys.org/, is a critical resource to help ensure you use an integrator that delivers top-notch results.

In many cases, besides offering expertise on various manufacturers' systems, an integrator can provide specific chemical industry knowhow related to processes that will help in assessing your situation. By using the firm's specialists as an extension of your staff, you can take advantage of their knowledge and insights to minimize the learning curve needed for your personnel.

Most importantly, you want to ensure you're evaluating an integrator on its ability to understand the outcomes you're trying to achieve for your business. Increasing quality, throughput and safety; decreasing cost and risk; and positively impacting time to market are just a few results that should top your lists. Some integrators offer an onsite roadmap assessment. It's a good way to get things started.

DARRYL KING is director of sales, control systems and AGVs for JMP Solutions, Cambridge, Ontario. Email him at DKing@jmpsolutions.com.

New Gasket Tackles Tough Tasks

Patterned material provides enhanced compressibility for better sealing | By Jim Drago, Garlock Sealing Technologies

GASKETS ARE ubiquitous components in a processing plant. Every flange, equipment joint and connection point will have some form of gasket to prevent fluids from compromising (i.e., leaking from) a process system. However, effective sealing can pose challenges. A new form of polytetrafluoroethylene (PTFE) gasket, Gylon Epix, already has successfully addressed a number of persistent problems at plants.

The gasket, which is available in $^{3}/_{32}$-in.-thick, 60-in. × 60-in. sheets, features a raised hexagonal pattern (Figure 1). It exhibits enhanced compressibility over both $^{1}/_{16}$-in. and $^{1}/_{8}$-in. traditional gaskets, seals easily when compressed by flanges and maintains assembled bolt torque better than comparable $^{1}/_{8}$-in. PTFE gasket materials.

SUCCESSES

Trials at three early adopters of the new material underscore its value.

Fatty acid production. A German manufacturer of oleo-based chemicals, including fatty acids, glycerin, fatty alcohols and fatty esters used in consumer and personal health products, was experiencing problems sealing a 29.3-in. (745-mm) outside-diameter spiral heat exchanger. A gasket located atop the heat exchanger was exposed to polysaturated fatty acid and coolant at a continuous temperature of 428°F (220°C) and pressure of 87 psig (6 bar). J-type clamp bolts fasten the lid to the heat exchanger. Spiral heat exchangers present challenges because the gasket must seal across the entire face of the lid, requiring a gasket that will efficiently transmit the force from the bolts across its entire surface.

The traditional PTFE sheet gasket was allowing leakage across the exchanger's spiral passes, decreasing efficiency. The gasket exhibited cuts from the spiral separation bars and required frequent changes that disrupted manufacturing and decreased plant productivity.

We installed Gylon Epix 3501-E in December 2017 and, after six months of testing, concluded it sealed well. Upon disassembly in July 2018, we found it to be in good condition, with no traces of cuts, discoloration, brittleness or sticking to the lid (Figure 2). We installed a new gasket in July 2018, which now has completed a successful one-year trial; the gasket continues to perform well.

Phosphate processing. New or refurbished equipment generally seals bolted connections well. As the equipment ages, gaskets and flange surfaces help seal gaps caused by corroded, worn, misaligned or repositioned equipment flanges. At a Mexican acid processor, Class 150, 8-in. raised-face flanges of the inlets and discharges of phosphoric and sulfuric acid transfer pumps had become worn and corroded. Temperatures were 104°F (40°C) and pressures 57 psig (4 bar). The $^{1}/_{8}$-in.-thick glass-filled PTFE gaskets didn't consistently provide a tight seal. So, the plant applied mastic filler to treat damaged flange surfaces as a stop-gap measure.

We installed Gylon Epix 3504 in December of 2017; it performed successfully without the need for flange treatments or special installation handling. Its enhanced compressibility fills the gap of imperfect flanges. It performed well until its removal in September of 2018 when the pump mechanically failed for a reason not related to the gasket. The acid processor is adding Gylon Epix to its approved materials list because it worked without the need for mastic, was flexible and easy to handle, and performed with zero leaks.

Terephthalic acid manufacturing. A southeastern U.S. producer of terphthalic acid (TPA) was experiencing leaks with traditional glass-filled PTFE sheet gaskets on a pressure vessel operating at 230°F and 60 psig that has a 60-in. × 10-in. rectangular gasket joint opening. Large rectangular joints can have uneven surfaces due to warpage of the cover. In July of 2018, Gylon Epix 3504 was installed and is still in service as of September 2019 and performing well. The company has accepted the product into its system and is re-ordering. ●

JIM DRAGO, PE, is principal applications engineer for Garlock Sealing Technologies, Palmyra, N.Y. Email him at jim.drago@garlock.com.

NEW GASKET MATERIAL

Figure 1. PTFE gasket features a raised hexagonal pattern that provides better compressibility.

SPIRAL HEAT EXCHANGER GASKET

Figure 2. Disassembly after more than six months' service revealed gasket was still in good condition.

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Mend a Mixing Mix-Up

Understanding the nuances of proper use of static mixers is crucial

THIS MONTH'S PUZZLER

As a process control consultant, I was brought in to fix a blending problem with a set of static mixers installed to replace an agitator (figure online at http://bit.ly/35JK5gs). The four static mixers are supposed to blend ingredients together before sending them to a feed tank for a packaging line. The liquid ingredients range from 0.3 cP to 250 cP; there're also some solid ingredients that make up about 1% of the final volume added. The plant hired me specifically to tune the loops for precise control.

According to the production manager and maintenance engineer, the startup with the new controls was a disaster. They were expecting tuning to solve all their problems. They are refusing to pay me.

In confidence, an operator revealed to me that the plant used to blend these ingredients in a baffled agitated tank by batch; the blended stream goes to the feed tank for packaging lines. However, when the agitator gearbox failed, the maintenance engineer reckoned he could save money by abandoning the agitator in place and replacing it with static mixers — despite the quality control manager's protests that not using the agitator would make achieving six-sigma results hard. It doesn't help that some ingredients are solids.

The materials that pass through the static mixers go to the feed tank. That small unbaffled tank has a tiny agitator (for the size of the tank); the tank oscillates like a bobble head.

Should I admit I blew it? Should I have investigated the quality control problem a little more before accepting the job? Is there anything else you can recommend to fix this problem?

TRY AN INDUCTOR

Here are my thoughts: Static mixers could be used to replace the agitators when mixing liquid ingredients. However, there was a solid ingredient in this application. The operator mentioned "the plant used to blend these ingredients in a baffled agitated tank by batch; the blended stream goes to the feed tank for packaging lines." This means the solid suspended well and did not settle in the pipeline and inside the feed tank.

In the new set-up with the static mixers I assume the liquid ingredients were being mixed by the static mixers while recirculating — then transferred to the feed tank, where the solid ingredient was added. With a tiny agitator and no baffles, the solid may not be dispersed well. This may contribute to the inconsistent product. I would recommend to use an inductor system, like the venturi principle, to add the solid ingredient while the liquid ingredients are being mixed and circulated through the static mixers.

The oscillation of the tiny agitator could come from the natural frequency/critical speed of the agitator shaft. Using a variable frequency drive to change the running speed would solve the problem.

Jian Deng, inside sales engineer
Charles Ross & Son Company,
Hauppauge, N.Y.

SEEK EXPERT HELP

Consider this: Several pieces of information are missing from the problem statement and the drawing:

1. What type of static mixer was used? Static mixer vendors offer a variety of mixer designs, each suited for a narrow range of applications such as dispersion, static mixing of high viscosity liquids, laminar mixing, turbulent mixing and others. A mixer for one application may show poor results in another application.
2. What is the length of the mixer? Based on type of liquids and flow regime (turbulent, laminar, transition), vendors recommend a certain minimum length to accomplish mixing. Shorter length will result in poor mixing.
3. What does "did not work" specifically mean? Was the static mixer plugged? How bad was the mixing? As noted above, make sure the mixer type is fit for the application and you have adequate length of mixer. Get help from the vendor.

Now, let's consider some testing the vendor might propose:

1. Running mixing tests with the help of the vendor.
2. Using an analyzer to show degree of mixing. The analyzer will keep circulating the liquid mix back to the tank if the analyzer shows poor mixing. The forward flow to the second tank (feed tank) will occur when mixing is adequate.

3. Exploring split-range control. The issue we need to address is how to measure degree of mixing with an analyzer. If viscosity of the mix is an indication of degree of mixing, we can have viscosity as the set point. You may also consider mixture density as an indicator for degree of mixing. Whatever surrogate variable you use for degree of mixing, the analyses should be quick; if the analyzer takes too long, you won't be able to use it for control. (Too long a lag time could make the control totally ineffective.) Here again, seek help from experts at a mixer vendor.

GC Shah, senior advisor
Wood Group, Houston

NOT A WISE MOVE

Agitators are expensive to maintain but are reliable — and usually unavoidable; I've seen agitators still providing reliable service 32 years after their manufacture date. Static mixers are meant for liquid/liquid blending of similar liquids.

Static mixers also can be used to help in heat transfer but are a poor choice because of the expense of pumping liquid compared to agitation. Even a small agitator can produce three times the fluid circulation of a large pump. And as the size of a pump goes up, the size of the static mixer goes up. Why not buy an agitator instead? As for heat and mass transfer of viscous liquid, a static mixer could be valuable if the flow rates are modest. If you're thinking about pumping 100 gpm of 2,000-cP liquid around, the cost is probably prohibitive but the ability of agitators and a heating or cooling coil to work effectively diminishes, making such a use of a static mixer perhaps the only way to go. In my experience in polymer mixing, I've investigated accidents where heat could not be dissipated fast enough, resulting in an explosion. Part of this problem was high solids loading of the batch but I doubt if static mixers would have been the answer to the problem.

Solid addition is always tricky, especially where small amounts of ingredients are added by hand. Six

sigma? I doubt it, especially for a batch process; at best, maybe two sigma. Mixing solids into solution is another difficult process. If the ingredients fail to blend and accumulate in the bottom of the tank, the additions must be adjusted and lot variation will make it impossible to achieve consistency. Buying pre-blended liquids means storage and other quality control problems.

Who put the idea in your client's head that the problem was a quality control one? If you did to make the sale, then, as Shakespeare wrote, you are "hoisted by your own petard." If the client thinks process control is a factor, it's wrong. Too often instrumentation and controls are thought to be the way to cure or lessen a bad design. It's better to fix the bad design than wake up to find that the additional controls provide their own brand of headaches — if they afford a solution at all.

As for the unbaffled center-mounted agitator, this is a disaster. Solid-suspension and mixing will be incomplete and the tank anchors and agitator gearbox will take a beating.

There is a minor improvement in process control that might help: go with electric actuators instead of pneumatic ones. This change will reduce sticky response by taking the actuator out of the picture.

Dirk Willard, consultant
Wooster, Ohio

JANUARY'S PUZZLER

The reboiler on our 30-year-old distillation column (Figure 1) finally has failed us; the tubes have been replaced four times. However, we would like to avoid an emergency shutdown and wait until a scheduled outage in a few months. Recently, we added a duplicate second column; we installed that column to allow boil-outs because changes in feedstock caused fouling every quarter year in the old column. Product demand has both columns running as hard as possible. Any suggestions for how we can maintain production? If need be, our other plants may be able to pick up the slack. Should we abandon the old column and rebuild it? I've also discovered a second problem: nobody can find the R-stamp report for the first three tubesheet repairs. I ran into a similar problem when I checked some other heat exchangers in these columns: we have the last R-stamp report but we're missing others. What can be done? Do we need to worry?

Send us your comments, suggestions or solutions for this question by December 13, 2019. We'll include as many of them as possible in the January 2020 issue and all on ChemicalProcessing.com. Send visuals — a sketch is fine. E-mail us at ProcessPuzzler@putman.net or mail to Process Puzzler, *Chemical Processing*, 1501 E. Woodfield Rd., Suite 400N, Schaumburg, IL 60173. Fax: (630) 467-1120. Please include your name, title, location and company affiliation in the response.

And, of course, if you have a process problem you'd like to pose to our readers, send it along and we'll be pleased to consider it for publication.

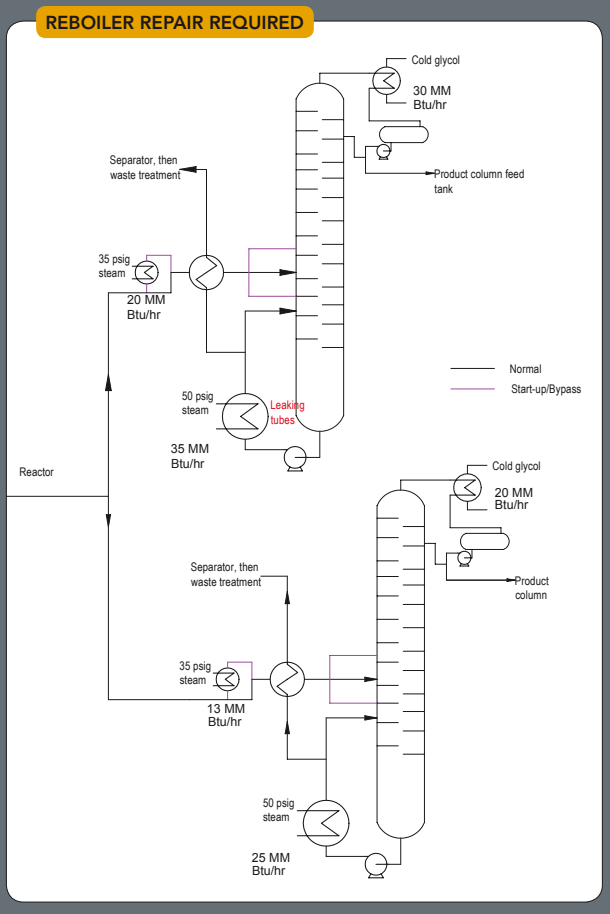

Figure 1. Strong product demand adds to pressure to avoid an emergency shutdown.

Deftly Move Liquids Out of Danger

Consider a number of factors when designing an emergency transfer system

A pump-out system usually makes most sense.

DE-INVENTORY SAFETY standby systems may sit for years before use. In fact, unless they are intended for unit shutdowns as well, the objective is never to activate them. However, when called upon, the systems should handle extreme circumstances reliably and with minimum operator intervention.

Liquid de-inventory systems fall into four categories: pressurized; displacement; gravity drain; and pump-out. In pressurized systems, a high-pressure reservoir of gas forces liquid from the system into a reservoir. In displacement systems, a liquid displaces the process flow and forces it to a destination. In gravity drain systems, liquid can empty into a reservoir at a lower elevation. In pump-out systems, a pump moves the liquid to a safe reservoir outside the unit. Pressurized and displacement systems are relatively rare. Plants commonly opt for gravity drain and pump-out systems to transfer liquid inventory.

Gravity drain systems work reliably as long as the process elevation, drain reservoir elevation and connecting piping are adequate. Often, though, e.g., when a vessel needing emptying is at or near grade, there's no reasonable way to make the elevations work.

For pump-out systems, no widely accepted design rules exist. Different philosophies and regulatory regimes can lead to disparate pump-out system choices. So, let's briefly look at some areas needing decisions.

Determining the net positive suction head available ($NPSH_A$) to use for a pump-out system requires answers to questions about three major factors:

1. Will compositions be changing dramatically from normal operation? One example would be all the liquid from the trays in a tower dropping into the tower bottoms and needing pumping out. On large towers with steep composition profiles, this can result in vaporizing mixtures in the tower boot. The head required ($NPSH_R$) to prevent vaporization in the pump suction may be less than that for the usual assumption of bubble-point liquid.
2. Will system pressure be at normal conditions? Do the pump-out contingencies include loss-of-containment? In this case, the pump must operate while the system is depressurizing. Again, the pumped liquid may contain vapor.
3. Must the pump drain the system to very low liquid levels to remove as much inventory as possible? Here, the $NPSH_A$ should reflect the low liquid level.

There are no easy solutions for pumps that will have vapor in the feed during pump-out. The best course of action is to reduce $NPSH_R$ and use a slower-speed pump. A 1,800-rpm pump can tolerate more abuse for the same conditions than a 3,600-rpm pump. Don't rule out even lower speeds. In one case, I specified 900 rpm for a pump-out system.

Pump-outs often occur when operators are fully engaged in dealing with other issues. So, a base assumption is that once the pump-out system is turned on, the operator doesn't have to think about it again.

Low $NPSH_R$ pumps often suffer problems with suction recirculation. They should have a recirculation line to alleviate this. To make the system as reliable as possible, use an orifice in the recirculation line rather than rely on an active control valve for low-flow protection. This mandates increasing the pump capacity.

The flow recirculation loop shields against suction recirculation and gives some protection against temperature rise during blocked flow.

If the downstream flow is blocked, the work going into the pump will pass into the recirculating liquid. That liquid may recirculate inside the pump or in an external loop. In either case, unless there's heat removal in the loop, the temperature of the liquid will increase. An external loop has larger inventory, so temperature will rise more slowly even without external cooling.

Unless the recirculation loop has some method of heat removal, the recirculation will slow — but not eliminate — the effect of fluid heating. If the loop includes a cooler or the recirculation goes upstream of the pump to a location where it can cool, then the recirculation loop will help lower pump heating.

Adding recirculation to the pump suction increases pump reliability. The recirculation loop helps reduce problems from suction inlet recirculation and, at a minimum, cuts the impact of fluid heating at zero net flow.

Opting for a slow-speed pump and a robust design with a recirculation loop generally offers significant advantages — including, importantly, minimizing the need for attention by operators when they might be very busy.

ANDREW SLOLEY, Contributing Editor
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AODD Pumps Help Reduce Energy Costs

Almatec C-Series air-operated double-diaphragm (AODD) plastic pumps now include C 40 (1½-in) and C 50 (2-in.) models. The pumps' design reportedly increases bolt torque to improve pump safety when compared to competitive pumps. An integrated Perswing P air-control system delivers the efficiency to optimize production rates and lower energy costs. Suction and discharge ports are available as separate housing parts with different footprints. This allows the pumps to be quickly and easily matched to existing installations. Suited for difficult pumping applications, the pumps do not have any mechanical seals, drives or rotating parts that cause wear over time, which improves reliability and extends product life.

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Enclosure Keeps High-Temperature Samples Stable

The Hot Box for outdoor process sampling applications can deliver high temperatures up to 150°C/300°F in compact footprints. The enclosures employ a combination of conduction and convection heating assisted by a novel air circulation system.

The compact boxes enable providing elevated temperature environments for sampling systems in small form factors. This simplifies installations close to the process lines being tested, thus minimizing sample lag time and substantially reducing hidden costs of analyzer installations such as heated sample lines. The units are constructed using high-performance insulation sandwiched between sheets of glass-fiber-reinforced polyester to provide a highly stable environment for maintaining elevated temperatures.

Intertec Instrumentation Inc.
832-554-1153
www.intertec.info

Ball Valve Speeds Industrial Maintenance

A three-piece ball valve for carbon and stainless steel pipe pressing systems is approved for all MegaPress applications, excluding natural gas. It's available in ½-, ¾-, 1-, 1¼-, 1½- and 2-in. sizes, and multiple materials for specific applications. The carbon steel valve includes a choice of EPDM or FKM sealing elements. The Type 304 stainless steel valve has an FKM sealing element, while the Type 316 stainless steel valve has an EPDM sealing element. The valves reportedly make industrial maintenance and installation programs faster and more efficient by minimizing downtime and keeping projects on schedule. Secure connections can be made in seven seconds or less with no adapters.

VIEGA LLC
800-976-9819
www.viega.us

Plugs Provide Heavy-Duty Sealing

HFT Pipestoppers heavy-duty steel plugs suit applications such as leak testing, pipe stopping and blocking. They can be used for low-pressure testing and plugging all pipes, pipelines and pipe work between 2 to 48 in. (50 to 1,200 mm) in diameter. They reportedly provide a strong, leak-free seal with each plug having a long life span. The plugs can be immersed in water for extended periods of time, and used at higher temperatures as well as in acidic or alkaline environments. The single and double steel plugs are available with sealing rings made from viton, silicone, neoprene, nitrile or natural rubbers for resistance to different temperatures and chemicals.

Huntingdon Fusion Techniques
800-431-1311
www.huntingdonfusion.com

System Streamlines Silo Monitoring

This wireless communication system helps reduce the cost and complexity of installing a silo inventory management program. Easily programmable, compact devices replace wires with over-the-air technology using simple point-to-point configuration. Point-to-multipoint systems are easily scaled for more-complex deployments using additional wireless units, base stations and wireless repeaters. Either setup can transmit up to a mile line-of-sight outdoors or 500 feet indoors. For easy point-to-point communication, the WR-30-TR wireless bridge uses two weather-proof units to transmit analog, Modbus or discrete data over the air. For more complex applications, a custom point-to-multipoint system can be built using two or more WR-90-TR units in conjunction with a base station.

BinMaster
800-278-4241
www.binmaster.com

Basket Strainers Handle Corrosive Media

The injection-molded natural polyvinylidene fluoride (PVDF) SB Series basket strainers line is designed for straining extreme corrosive media and high temperatures, as well as sensitive media and systems. The strainers are available with threaded or socket fusion connections in IPS or EN/DIN specifications. Flanged ends are also available for 1 in./DN25, 1½ in./DN40 and 2 in./DN50. Available with multiple basket perforations in PVDF, stainless steel or alloys, and mesh baskets in stainless steel. FPM O-ring seals are standard. Sizes range from ½ in./DN15 through 2 in./DN50. All sizes carry a pressure rating of 150psi/10 bar non-shock at 70°F/23°C. Maximum service temperature is 240°F/115°C.

Hayward Flow Control
888-429-4635
www.haywardflowcontrol.com

Pressure Transmitters Suit Hazardous Areas

The compact D22 pressure transmitter and D32 differential pressure transmitters are designed for measuring pressure, gases, vapors and liquids in a range of applications. The transmitters' output signal is adjusted through internal zero/span potentiometer, accessible on the electronic board. The transmitters have a high level of standard accuracy from 0.2%; higher accuracy is available upon request. Both products are ATEX and IECEx certified for use in hazardous areas.

Delta Mobrey USA
713-425-6352
www.delta-mobrey.com

Vibratory Feeders Handle Product Gently

K3 vibratory feeders feature a drive system combined with an advanced control package for gentler product handling, higher accuracy and quicker product changeover, says the company. The feeders reportedly achieve accuracies averaging 35% better than traditional vibratory technologies. The feeders' shock absorber design delivers continuous, even product discharge with minimal pulsations. A flexible pendulum technology provides shock absorption only parallel to the desired direction of motion, eliminating rotational movement. This ensures even material flow along the entire length of the tray. The control system and feeder electronics include internal sensors which measure acceleration, displacement, load, current and temperature at rates of up to 25,000 times/sec.

Coperion Corp.
856-256-3175
www.coperion.com

Flow Meter Fits in Confined Spaces

The smart plug-and-play Picomag electromagnetic flowmeter now measures the flow of electrically conductive fluids and the process temperature and conductivity. It enables easy commissioning with Bluetooth using the SmartBlue App and seamless integration with IO-Link technology. It can be installed into any pipe up to 2 in. in diameter, even in confined spaces. For this purpose, various process connection adapters, such as NPT-thread, R-thread, internal thread, Tri-Clamp or Victaulic, are available. The flow meter has high repeatability (±0.2%) and reliably measures values — e.g. for correctly measuring water flows or for minimizing energy costs in utility applications.

Endress+Hauser
888-363-7377
www.us.endress.com/picomag-news

Motor Starter Facilitates Emergency Shutdowns

Contactron pro, a hybrid motor starter that simplifies wiring and safety integration, has a T-bus backplane system that rapidly distributes 24-V power, bridges the e-stop enable signal, and adds auxiliary contact modules. The auxiliary contact modules allow feedback of the motor state and implementation of self-sealing motor circuits. When used with the PSR-MC38 safety relay, the motor starter can easily permit a SIL 3/PLe group of emergency shutdowns via one interface. Hybrid technology offers three-phase motor switching up to 5 hp. Compared with traditional contactors, it reduces wiring time and space by up to 75%, says the company.

Phoenix Contact
800-888-7388
www.phoenixcontact.com

Software Simplifies Modeling

MapleMBSE software enables companies to employ a model-based systems engineering (MBSE) process without requiring every project stakeholder to be an expert in complex MBSE tools. The latest release offers enhanced modeling support, easing building and investigating model structures, as well as new integration options with model management systems. The software provides a streamlined, Excel-based interface to the systems model with task-specific views for editing the model directly, thereby ensuring consistent information and knowledge sharing across the design group. The familiar interface allows subject matter experts to obtain and analyze the information they need to make decisions, and feed the results back into the model.

Maplesoft
800-267-6583
www.maplesoft.com

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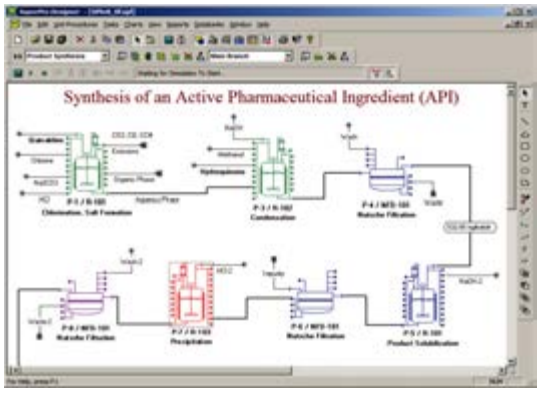

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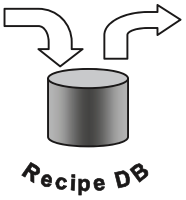

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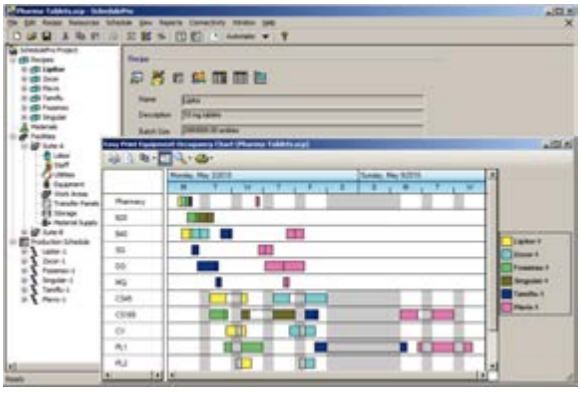
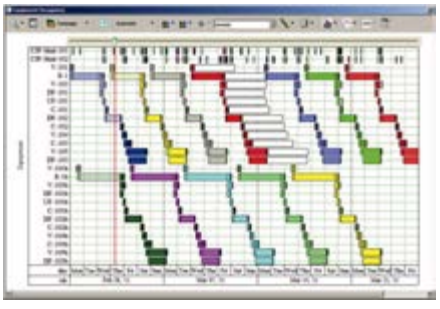
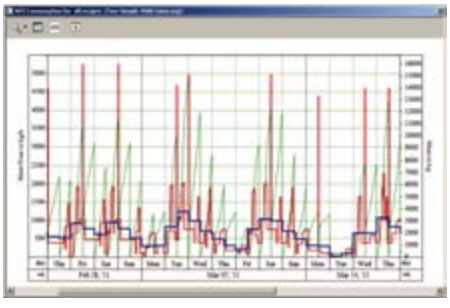


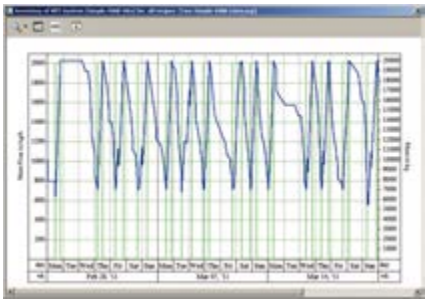
Migrate to SchedulePro to model, schedule, and debottleneck multi-product facilities



Easy production tracking, conflict resolution and rescheduling



Tracking demand for resources (e.g., labor, materials, utilities, etc.)



Managing inventories for input, intermediate, and output materials

SuperPro Designer is a comprehensive process simulator that facilitates modeling, cost analysis, debottlenecking, cycle time reduction, and environmental impact assessment of integrated biochemical, bio-fuel, fine chemical, pharmaceutical (bulk & fine), food, consumer product, mineral processing, water purification, wastewater treatment, and related processes. Its development was initiated at the Massachusetts Institute of Technology (MIT). SuperPro is already in use at more than 500 companies and 900 universities around the globe (including 18 of the top 20 pharmaceutical companies and 9 of the top 10 biopharmaceutical companies).

SchedulePro is a versatile production planning, scheduling, and resource management tool. It generates feasible production schedules for multi-product facilities that do not violate constraints related to the limited availability of equipment, labor, utilities, and inventories of materials. It can be used in conjunction with SuperPro (by importing its recipes) or independently (by creating recipes directly in SchedulePro). Any industry that manufactures multiple products by sharing production lines and resources can benefit from the use of SchedulePro. Engineering companies use it as a modeling tool to size shared utilities, determine equipment requirements, reduce cycle times, and debottleneck facilities.

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Simulation Project Targets Biopharm Process

Software aims to address process knowledge gaps and speed time to market

Software could replace costly laboratory and pilot-plant trials for scale-up.

A RESEARCHER at the Graz University of Technology (TU Graz), Styria, Austria, has won funding from the Austrian Research Promotion Agency (FFG) to commercialize his work simulating biopharmaceutical processes.

Christian Witz, researcher with the Institute of Process and Particle Engineering at TU Graz, shares the €3.4 million ($3.76 million) pot with eight other projects selected by an international jury from a field of 26 for funding from the FFG's spin-off fellowship program. This aims to develop intellectual property held in the country's universities and research institutions. The nine latest projects join 24 other spin-off fellowships that already have won funding.

In Witz's case, funding will help him set up a company to further develop and market the software he and his co-researchers created as part of the Institute's Computational BioProcess Design (ComBioPro) project.

"At the moment, the biotech industry lacks in-depth process knowledge. People know that the manufacturing process works, but they don't know the reasons why or how exactly it functions," says Witz.

One of the main challenges, he adds, is that the simulation programs currently available need substantial computing power, software expertise to manipulate, and take months to perform the necessary calculations.

However, a new in-house code developed during the project enables realistic simulations of complex industrial-scale devices used in engineering processes. Originally developed for aerated and stirred-tank reactors, it now can find, test and interconnect "highly efficient" algorithms to graphic processing units (GPUs) to simulate the physical process inside devices such as bioreactors.

Possible customized applications include the movement of the fluid flow field, bubbles, particles, droplets, species and microorganisms as well as the device geometry including stirrers, heat exchangers, porous zones and sensors. Using metabolic models enables inclusion of the biological activity of the microorganisms.

As part of the ongoing work, Witz will integrate further algorithms into the software, which will allow for even more exact and user-friendly representation of physical and biochemical processes in bioreactors.

Among other things, the aim is to partially automate the evaluation of raw simulation data, and to simulate very large air bubbles in a reactor. The simulation results will ultimately feed into decision-making processes for design and production. In turn, this would enable companies to simulate more projects in a shorter time and carry out tests showing where and how productivity losses occur in a reactor.

"My system will cut simulation times from months to a matter of hours. It can be operated by people without simulation know-how and runs on standard commercial graphic cards," notes Witz.

The new software shortens the time needed for troubleshooting and promises more detailed insights into processes. This will help to make biopharmaceutical manufacturing more efficient.

Witz identifies three main market benefits to the software: replacement of costly laboratory and pilot-plant trials for scale-up, or deviation management; acceleration of market launches of new products; and in support of regulatory approvals for state-of-the-art drugs.

Using scientific methods enables replacement of trial and error and minimizes millions in losses. Thus, he says, the company's goal is to be an important building block in the digitalization of a rather conservative industry and build on the trend towards Industry 4.0.

"Companies need to perform fewer experiments to make the step from the lab-scale to industrial-scale production. Savings in the development [of each new drug] are estimated to be between €300,000 ($331,000) and €1 million ($1.1 million)," says Witz.

Biopharmaceuticals is a huge, rapidly growing business. According to market analyst Mordor Intelligence, the global market for biopharmaceuticals in 2018 exceeded $237 billion. Moreover, this should rise to over $388 billion by 2024 — a compound annual growth rate of nearly 9%. Biopharmaceuticals already account for seven of the top-selling medications in the world.

However, they are also more expensive to make than chemical drugs such as the disease-modifying anti-rheumatic drugs. The materials needed cost more and manufacturing processes that rely on live organisms are more complex. R&D costs are higher, too.

This is illustrated by the U.S. Food and Drug Administration's approval in May of Zolgensma to treat spinal muscular atrophy — a rare disease in infants. This one-time gene therapy treatment is manufactured by Novartis and — at $2.1 million for each use — becomes the world's most expensive drug following its approval.

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