

# Advanced tech drives sustainability

Innovative manufacturing, digital tools support sustainable efforts in specialties

### ↳ Sotirios Frantzas

The specialty chemicals industry plays an important role in advancing sustainability in other manufacturing sectors such as automotive and construction, and specialties producers' own sustainability efforts are supported by the development of innovative manufacturing and digital technologies from companies such as NiTech Solutions Ltd. (Edinburgh, UK) and Cyzag Ltd. (London).

NiTech is a company specialized in continuous processing, with patented reactors and crystallizers that are used to produce chemicals, pharmaceuticals, food and drink, and utilized by biotechnology companies.

NiTech's strategic focus is on helping other companies achieve their net-zero ambitions while reducing costs, and enabling them to create the flexibility needed to "right-size" their production costs effectively in response to today's changing market needs, William Davies, CEO of NiTech, told *CW*.

NiTech has commercialized one of the very few commercially validated, continuous manufacturing technologies that can operate across a range of reaction and crystallization processes, Davies said.

NiTech's Continuous Oscillatory Baffled Reactor/Crystallizer (COBR/C) technology "is patent protected, and its implementation is supported by a considerable amount of proprietary process know-how. And our core innovative, breakthrough technology has been validated with important awards for our partner Croda International PLC in Europe and in the UK," Davies said.

COBR/C recently won the Chemical Industry Association's (London) innovative technology award and the European process intensification award for technology innovation, he said.

The technology allows the continuous production of a range of products across the specialty chemical and pharma sectors, Davies said. "A combination of baffled process tubing and oscillating flow provides high

mixing intensity and will improve any process that is heat- or mass-transfer constrained," he said. "The system is fully jacketed to allow temperature control. And the high surface-area-to-volume ratio allows rapid heat input or removal, enabling high exothermic reactions to be carried out safely."

NiTech's COBR/C combines the capability for long residence times with handling of solids, and this makes it "ideal" for continuous crystallization or any process where reactions involve solids or difficult-to-mix liquids, or where reaction times are greater than a few minutes, according to Davies. Meanwhile, scale-up is straightforward, with validation achieved for industrial-scale production for volumes ranging from a few hundred to thousands of metric tons per year, he said.



DAVIES: COBR/C technology improves production efficiency.

COBR/C has "transformed" the sustainability of the Croda process by a "step-change" reduction in resources needed, Davies told *CW*. Energy use has been reduced 63% versus the batch process, with a 50% reduction in greenhouse (GHG) emissions in relation to steam usage, a 79% cut in electricity use, together with a 40% reduction in water usage per ton of product produced versus the batch process, Davies said.

Safety of the highly exothermic reaction has also been improved by reducing the material-in-play by more than 99.5% and permitting the use of in-line process analytical methods to monitor process safety continuously, he said.

Production efficiency has also been improved in a number of ways, including the lower volume of materials used for the production system, a reduction of 66% in process equipment footprint and a cut in process time from 10 hours to less than 2 minutes, Davies said.

#### Further developing COBR/C

NiTech's technology has been tested across a range of end uses in specialty chemicals, pharma and other applications, and more

than 100 compounds have been synthesized or crystallized using COBR/C across R&D, pilot and industrial scale, Davies said.

NiTech is now focused on the industrial scale-up of already proven applications for COBR/C while deepening its engagement with existing and emerging segments including in the energetics manufacturing area, he said.

"A photo-COBR has also been developed and patented, and we are looking to expand activity in the rapidly developing bio and photo-chemical sectors. NiTech technology has the potential of broad adoption across a range of sectors and especially where reduced costs and improved sustainability, including energy and emission reductions, are required," Davies said.

NiTech's photo-COBR system will allow the benefits from optimized heat and mass transfer to be combined with high efficiency and controlled and uniform light to allow photo-catalysis and photo-aided reactions, he said.

The system also enables process innovations such as continuous sequential or parallel processes to be readily executed. "This technology development has been carried out to support new synthesis routes, often bio-based, to be developed by chemists and engineers in the knowledge that efficient and scalable continuous process solutions are available," Davies said.

#### People are central to Cyzag's platform

Cyzag aims to facilitate the transition of chemical companies toward sustainable manufacturing practices, according to Cyzag's founder and CEO John Papastylianou. "By harnessing the power of digitalization, we empower manufacturers to adopt more eco-friendly and efficient solutions, significantly reducing their environmental impact," Papastylianou told *CW*.

Cyzag's platform is a "no-code cloud application" tailored specifically to address the unique needs of chemical companies with a strong emphasis on user experience, Papastylianou said. Cyzag has collaborated with several chemical companies, including Perstorp AB (Malmö, Sweden), Nouryon BV (Amsterdam) and Nobian Industrial Chemicals BV (Amersfoort, Netherlands).

The platform “tackles” the challenge of shop floor activities burdened with conflicting work processes and multiple manual tools. Cyzag’s core strategy centers on embedding operational excellence routines and workflows within live process analytics, Papastylianou said.

“This integration ensures that the processes for identifying and solving problems are not only followed meticulously but are also enhanced by data-driven insights. This fosters a sustainable manufacturing culture on the shop floor, establishing a results-driven environment where strategic objectives are translated to key results and initiatives. Additionally, it supports standardization and templating of proven use cases to other plants,” according to Papastylianou.

The company’s primary purpose is to help chemical companies make manufacturing more sustainable by mobilizing their shop floor teams, he said. To achieve this, Cyzag has developed a “unique” approach to software delivery that prioritizes early engagement and collaboration with the frontline workforce, Papastylianou said.

“As we witness an ever-increasing push for net-zero emissions, we understand the critical role of engaging people and how essential is the partnership between people and digitalization in driving the industry’s journey towards sustainability,” Papastylianou added.

People play a significant role in generating value in the specialty chemicals industry, and digitalization is the key to engaging the frontline workforce and maximizing their potential in achieving sustainability targets, he said. The human factor also plays a crucial role in advancing digital transformation in the chemical industry, he added.

“Having support from leadership is essential, but it is not enough on its own. Generating buy-in and ownership among employees is equally vital to create a culture of digital innovation that permeates the entire organization. Fostering a sharing and learning mindset, even in overlooked areas like the industry shop floor, is critical to achieving successful digital transformation. This requires dedicated effort and unwavering commitment from all levels of the organization,” Papastylianou said.

Digital technology’s real value lies in its ability to bring about changes in people and processes, he said. It empowers organizations to reevaluate conventional work methods and make well-informed decisions based on new

data-driven insights, he added.

“It is important to debunk the perception that technology is meant to replace people. On the contrary, a successful organization understands that technology is best utilized when it enables individuals to perform better in their daily work. It should foster a culture of continuous improvement and make employees feel valued,” Papastylianou said.

The data revolution goes beyond information collection, he said. It is more about enabling people to work smarter and make better business decisions, he added.

Achieving this goal necessitates the integration of operational efficiency into work processes and routines with real-time process analytics, and the synergy creates an outcome that is greater than the sum of its parts, he added.

“When adopting a holistic view and merging operational processes with process analytics, the gains can be substantial. At a recent implementation, there was a reduction of two hours in operational waste per shift and a surge in engagement with process analysis.

Moreover, the first project aimed at variable-cost reduction in our tool realized an equivalent savings of €100,000 per year in steam consumption within just two months,” Papastylianou added. “Embracing a digital transformation mindset with people at its core is essential for driving successful and impactful changes in the chemical industry. Ultimately, people are pivotal to achieving sustainable manufacturing. Therefore, digitalization is the tool that enables us to tap into their collective experience and knowledge, thereby greatly increasing our chances of success.”

#### Digitalization for sustainability

Digitalization is of “immense” importance to the chemical industry as a sector that is responsible for 7% of global energy-related CO<sub>2</sub> emissions, Papastylianou said.

The level of digitalization among chemical companies varies despite the urgency to embrace digital transformation that was boosted by the COVID-19 pandemic, he said. Many companies are still relying heavily on manual processes, with some isolated digital tools in place that typically operate independently, creating silos, Papastylianou added.

“What we rarely observe is a holistic view of digitalization on the shop floor, one that incorporates data literacy, robust work processes and a culture of sustainable continuous improvement. In addition, each plant within an organization tends to be managed differently, resulting in limited standardization of data structures for central analysis and the transfer of best practices between plants,” Papastylianou said.

A unified approach that encompasses the entire manufacturing organization of chemical companies is needed to unleash digitalization’s full potential, he said.

“By embracing a cohesive digital strategy and fostering a culture that values sustainability and continuous improvement, companies can leverage digitalization to drive operational efficiency, enhance environmental performance and successfully achieve their ambitious sustainability goals,” he said.

The relationship between digitalization and sustainability is “symbiotic” because digital technologies empower organizations to take more effective and data-driven actions toward decarbonization and sustainable practices, Papastylianou told CW.

Digitalization makes sustainability data accessible, verifiable and transparent, ensuring accountability in measuring and monitoring data and facilitating consistent commitment to sustainability actions over time, he said.

Digital technologies enable faster identification of challenges and virtual testing of solutions due to their enhanced data-processing capability, empowering chemical companies to make informed decisions and implement effective measures to reduce carbon emissions and environmental impact, Papastylianou added.

Another benefit of digitalization is its ability to provide easy access to data for optimizing efficiency, reducing energy and water use and cutting waste, he said. This accessibility extends to all levels within an organization, and it is not limited to data scientists or sustainability specialists, he added.

“By involving all stakeholders, companies can foster a culture of sustainability throughout the organization,” Papastylianou said.

Meanwhile, digitalization facilitates the monitoring of GHG sinks and other forms of green waste, he said. ■



PAPASTYLIANOU: Digital tools boost workforce.