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INDUSTRY NEWS

O-I is committed to increasing recycled content to 50% on average by 2030.

LARGE BOTTLER COLLABORATES WITH O-I ON RECYCLING

Coca-Cola Bottling Co. United is partnering with O-I Glass to capture more recycled glass to manufacture into new bottles. Coca-Cola United expects to recycle more than 700,000 out-of-date and damaged bottles annually. The Birmingham, Ala.-based bottling company previously sent its glass bottles to a local recycler that used the material in fiberglass. Now, the center's recycled glass will be taken to O-I's plant in Danville, Va., and remade into new glass bottles.

HYPERCAR WILL USE XJET 3D PRINTING TECHNOLOGY

Spyros Panopoulos Automotive (SPA) is using XJet's ceramic 3D printing technology to produce an engine piston for its Chaos Ultracar. About 78% of the body of the Ultracar is set to be 3D printed, while elements such as the engine block, camshaft, and intake valves will also involve additive manufacturing. The Greece-based company is pursuing speeds of over 500 kph and acceleration from 0 to 100 kph in 1.55 seconds with the vehicle, which is currently under development. SPA says it requires parts that are strong and temperature-resistant, yet lightweight, to deal with such demands.

The additively manufactured piston. *Credit: XJet/SPA*

Borosil Renewables produces low-iron-textured solar glass for photovoltaic panels, flat-plate collectors, and greenhouses.

BOROSIL EXPANDS WITH ACQUISITION IN EUROPE

Borosil Renewables Ltd., a solar glass manufacturer based in Mumbai, India, acquired Interfloat Group, one of the largest solar glass manufacturers in Europe. The Group consists of GMB Glasmanufaktur Brandenburg GmbH, located in Tschernitz, Germany, and Interfloat Corp., based in Ruggell, Liechtenstein. With the acquisition, BRL says its solar glass output will grow to 750 tons per day, an increase of 66%. Borosil says expansions underway in India, as well those planned in Europe, will grow its solar glass output to 2,100 tons per day by the end of 2024–25.

SAINT-GOBAIN ACQUIRES REFRACTORIES MAKER

Saint-Gobain acquired Falconer, N.Y.-based Monofrax LLC from Callista Private Equity GmbH. Monofrax manufactures a range of fused cast refractories. Munich-based Callista acquired the company in June 2016 from RHI AG, and says it shifted the company from a commodity provider to a specialty niche manufacturer. Paris-based Saint-Gobain manufactures fused and sintered refractories for the glass industry and for other markets such as steel, copper, and aluminum.

Monofrax supplies its products to the glass industry worldwide.


The investment in the three-digit million euro range includes an R&D center as well as a logistics and an integrated administrative area. *Credit: IE Group*

SCHOTT INVESTS IN READY-TO-USE DRUG CONTAINERS

SCHOTT plans to significantly expand its production capacity of ready-to-use cartridges. The drug containment and delivery solution is used to store and administer drugs with the help of pen injectors or wearable devices. The company, based in Mainz, Germany, says it would increase the production capacity of ready-to-use cartridges at its facility in St. Gallen, Switzerland, and would build a production facility in Hungary for prefillable glass syringes. The company also says it invested "three-digit million euro" in a new plant in Müllheim, Germany, providing more than 100 jobs.

ARDAGH ACQUISITION OPENS MARKETS IN AFRICA

Ardagh Group completed the acquisition of Consol Holdings Proprietary Ltd., a producer of glass packaging based in Johannesburg, South Africa. Consol operates four glass production facilities in South Africa, and smaller production facilities in Kenya, Nigeria, and Ethiopia. The acquisition was $1 billion, including net debt assumed in Consol. Ardagh says it will also invest $200 million in two new furnaces. With the acquisition, Ardagh operates 65 production facilities in 16 countries, on four continents, and has annual sales approaching $10 billion.


Ardagh employs about 20,000 people worldwide.

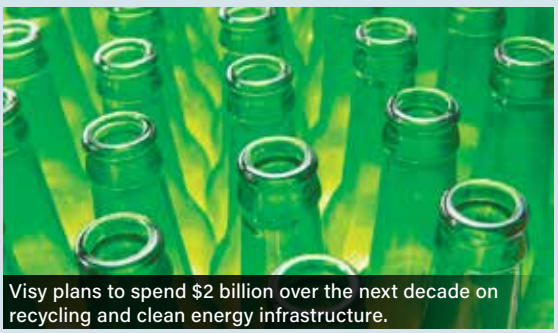

GE says the investment will enable it to make wind turbine towers more efficient and sustainable.

GE ACQUIRES STAKE IN 3D CONSTRUCTION PRINTING FIRM

GE Renewable Energy announced a minority investment in COBOD International, a Denmark-based company that manufactures 3D printers for the construction industry. COBOD is experiencing double-digit growth and is a market leader in 3D construction printing, with more than 50 sold worldwide. Financial details were not disclosed. The companies opened a research and development facility in Bergen, N.Y., that will study how to 3D print the concrete base of towers used in wind turbines.

VISY PLANS INVESTMENTS IN AUSTRALIA

Visy says it will invest $500 million to build a new glass container manufacturing facility in Yatala, Australia, as part of executive chairman Anthony Pratt's pledge to invest $2 billion in the country over the next decade. The facility will produce about one billion glass containers annually for clients in the beverage industry. Visy became a dominant player in the beer bottle manufacturing industry in Australia after a $1 billion deal to acquire the local glass bottle manufacturing business of O-I Glass in 2020. Pratt owns Visy with sisters Heloise Pratt and Fiona Geminder, and has sole ownership of Pratt Industries in the U.S.


Visy plans to spend $2 billion over the next decade on recycling and clean energy infrastructure.

GLOBALIZATION: STAYING AGILE IN THE FACE OF WORLDWIDE MANUFACTURING CHALLENGES

By David Holthaus

Many companies have been challenged to find skilled, specialized employees in their industries. *Credit: Schott*

Whether expanding into new, growing markets or sourcing raw materials from faraway countries, businesses are increasingly operating in a global environment that can be rewarding but at the same time risky. Nimble businesses that are prepared to adapt to the challenges of doing business in an unpredictable world can succeed, say several we spoke to.

Despite supply chain challenges, cultural barriers, and a worldwide pandemic now in its third year, Lithoz GmbH, the Vienna, Austria-based maker of ceramic 3D printers, announced in April an installation at a technical university in South Africa. The company, only 11 years old, now does business on every continent except Antarctica, says CEO Johannes Homa.

"We were born a global company," he says. "From the very first day, we were looking into the world."

That's an essential vision in the interconnected economy of the 21st century, but the hurdles to achieving it can be high.

PRESSURES ON GLOBAL MANUFACTURING

The most recent Global Manufacturing Purchasing Managers Index from J.P. Morgan cites the pressures affecting production and trade around the world. The Index is an overview of the manufacturing sector based on monthly surveys of more than 10,000 purchasing executives from 32 of the world's leading economies, including the U.S., Japan, Germany, France, and China.

Its May report highlighted what might be called the trifecta of global manufacturing pressures: COVID-19, supply chain problems, and inflation. "COVID restrictions in major cities in China hit production amid global supply chain constraints and high prices," it says.

The three stressors are interrelated, creating a global perfect storm. Average purchase prices for materials and supplies rose to one of the highest levels of the past 11 years, the May report says. "Stretched global supply chains contributed to the price inflationary pressure, with vendor lead times again lengthening to a near-record degree," it adds.


Carol Jackson

In its global outlook for manufacturing in 2022, consulting firm Deloitte found solid reasons for optimism: Industrial production and capacity utilization surpassed pre-pandemic levels in midyear 2021. The year ended with strong increases in new orders for all major manufacturing sectors, it adds, signaling continued growth in 2022.

But these positive economic indicators come with what the firm says are "historic labor and supply chain challenges." The most pressing among these are workforce shortages and supply chain instability, both of which can reduce operating efficiency and profits. This turbulent marketplace will demand "business agility" to succeed, Deloitte says.

AGILITY BRINGS STABILITY AND OPPORTUNITY

Pittsburgh-based HarbisonWalker International is the largest producer of refractory materials and services in North America. Although it is primarily based on this continent, is has longstanding operations in Europe and Asia, and the company traces its founding to the United Kingdom in the early 20th century. For HWI, agility means both stability and opportunity.

"We tend to go where our customers need us," says Carol Jackson, HWI's president, CEO, and chairwoman. "Sales opportunities are global."

The company also sources raw materials for its products from China, South America, and other parts of the world.

Elected CEO in 2017, Jackson has a long career working internationally in the chemicals, glass, ceramic materials, and specialty steel industries, having been director of global raw materials purchasing at PPG Industries, as well as other roles. She is also the immediate past president of the World Refractories Association.

She emphasized HWI's agility, even in the current environment. "We have the ability to be that first and only call for our customers," she says. "We're there at a moment's notice."

The company serves industrial customers in the steel, glass, petrochemical, energy, cement, and many other sectors, where quality, consistency, and reliability are demanded. Although the global supply chain is stressed, HWI's longstanding relationships with its suppliers helps.

"We have a very stable supply chain that we've worked long and hard to develop," she says. "We're a good customer to our supply base. As a result, we tend to get earned, preferential treatment."

Supply chain instability was one of the five global manufacturing trends to watch this year, according to the Deloitte experts. "There's no mistaking that manufacturers face near-continuous disruptions globally," the report says.

High demand, rising costs of materials, and now, with a war in Europe contributing to a rapid rise in fuel costs, "The entire supply chain for every commodity from beginning to end is stressed," Jackson says. "That means inflation."

MAKING DECISIONS DESPITE UNCERTAINTY

Rising costs are just one of the challenges Schott AG is encountering as it expands globally. Mainz, Germany-based Schott, a multinational company specializing in manufacturing glass and glass-ceramics, has long had a global footprint. It is currently represented in 34 countries, with around 17,300 employees working at 56 locations around the world.

"We are constantly monitoring markets, and we invest in areas where we see potential for sustainable growth," says Schott spokesperson Neda Jaafari.

The main challenge to its global expansion is the nature of the VUCA world, Jaafari says. VUCA is shorthand for managing in a business world that has become Volatile, Uncertain, Complex, and Ambiguous.

In South Africa, Lithoz installed what it says is the first 3D printer on the African continent. *Credit: Lithoz*

"We have to face new challenges such as geopolitical developments, which means that we have to make decisions despite a degree of uncertainty," Jaafari says.

In this VUCA environment, Schott is moving forward with its expansion plans.

In March, the company announced an investment of 76 million euro at its production site in Lukácsháza, Hungary. The company is planning to build new production capacity for its prefillable glass syringes. Typically, new drugs enter the market in vials, and single-use syringes are used to extract and administer them. But looking ahead, these drugs may be stored in syringes that are prefilled with the medication, simplifying the injection process for health care workers and increasing the dosing accuracy for patients, Schott says.

The expansion in Hungary "will greatly benefit the global market and strengthen supply security for major pharmaceutical companies and contract manufacturing organizations," says Andreas Reisse, executive vice president of Schott's pharmaceutical business unit.

In May, the company announced a similar "double-digit euro" expansion at its plant in St. Gallen, Switzerland, to increase the production of its ready-to-use glass cartridges to administer pharmaceuticals.

In fiscal 2021, Schott invested 350 million euro in expansions. This year, it says it's planning an investment of 450 million euro, which would be a new high mark for the company. "We are laying the foundation for further profitable growth in the coming years," Jaafari says.

Schott is also moving ahead with strategic mergers and acquisitions. In September 2021, it announced the acquisition of Arizona-based diagnostics company AMI, building its expertise in the booming diagnostics market and strengthening its presence in one of its chief growth markets, the U.S.

Schott says it developed a growth culture internally, as its management has defined principles to succeed in the VUCA world. By applying them, "we were able to create a very resilient organization to overcome these challenges," Jaafari says.

Along with geopolitical risks, the VUCA world is filled with currency exchange rate fluctuations, rising energy, raw material, logistics costs, strained supply chains, and chip shortages. In just one example of the world's unpredictability, China experienced power shortages and resorted to rolling blackouts in 2021, further slowing an already disrupted supply chain.

HarbisonWalker International sources raw materials from around the world. *Credit: HWI*

Schott is planning to invest 450 million euro in global expansions in 2022. *Credit: Schott*

To try minimizing these challenges, Schott management created risk-mitigation plans that are in place. They also continually conduct market analyses and seek customer commitments before investing, Jaafari says.

HWI was also able to operate successfully in the volatile global environment by working to ensure its stability, Jackson says.

"We approach everything from a risk-mitigation standpoint," she says. "We attempt to identify the areas of volatility, and we have contingency plans, or risk-mitigation plans, in place to address those things. You can only control the things that are in your control."

Johannes Homa

NAVIGATING THE WORLDWIDE PANDEMIC

A global pandemic that continues to disrupt business around the world was not something most companies would have anticipated before 2020. Now, its impact needs to be included in any business plan.

The pandemic made travel impossible or inadvisable for months. For Lithoz that meant being nimble enough to find ways to install new 3D printer systems in other countries through remote means.

"We had a very good partnerships and well-trained people so we could overcome this," CEO Homa says.

In August 2021, with COVID-19 travel restrictions in place, Lithoz remotely installed a 3D printer at the University of Wollongong in Australia.

Working with the university and Australian 3D printing provider Objective 3D, the remote installation of the high-resolution ceramic printer was successful. It will be used by the Australian National Fabrication Facility Materials Node, which is based at the university, in a range of applications in the development of bioprinting hardware.

"It has become clear to us just how critical flexibility in the manufacturing world is," Homa says.

One of the main challenges of doing business in other countries, according to Homa, is understanding different cultures, and different ways of doing business. To do that, "We get local people in local places," Homa says.

In early 2021, Lithoz set up Lithoz China in Shanghai, a key strategic market in the manufacturing world, and currently the Lithoz base in Asia. To establish a presence in China to work with its customer and distributors there, Lithoz turned to EOS China, a 3D-printing technology firm that has operated in the Chinese market since 2013. With the collaboration, Lithoz was able to leverage the operations, service resources, and experience of EOS, a provider of 3D-printing technology to manufacturers around the world.

The first international expansion of Lithoz was to the United States. In 2016, the company began looking for someone to run its business in the U.S. and found Shawn Allan in New York. Allan is now vice president of Lithoz America, which not only handles sales and service but also develops specialty applications and materials for its customers, Homa says.

Lithoz partnered with EOS to establish operations in China. *Credit: Lithoz*

WORKFORCE AND CULTURE CHALLENGES

For bigger companies, workforce challenges were an issue for some time. Those challenges can be magnified when looking to grow into other countries. The key is having a strong company culture at the home base, says HWI's Jackson.

"It's been my experience if a company is looking to build operations in other parts of the world, the most successful ones are ones that ensure they have strong and consistent work practices and processes and good governance that they can embed and transfer that knowledge into the region they are attempting to grow into," she says. "The real challenge is how to export a company culture."

Ensuring that work practices are the same all over the world is important, Jackson says. "That's one of the biggest challenges in governance and building operations overseas," she adds.

The scarcity of talent is an ongoing problem both at home and abroad, and it is not expected to improve soon, the Deloitte report says.

Record numbers of unfilled jobs are expected to continue to limit higher productivity and growth, the report continues. Deloitte estimated a shortfall of 2.1 million skilled jobs by 2030 in the U.S. alone. To attract and keep talent, it recommended that manufacturers pair strategies such as reskilling with improving their brand and working with trade groups and others to improve the perception of manufacturing employment.

"It is challenging to find qualified, skilled, technical workers for our specialized industry," says Schott's Jaafari. Her company is addressing that by focusing on building up and driving its employer branding, and by collaborating with universities and trade schools on joint programs to attract future talent.

As manufacturers continue to rebound from the shock of the pandemic's emergence in 2020, they'll continue to confront new headwinds as they look to expand globally and work with suppliers around the world. Addressing them in an agile way could build resilience for today's challenges and for whatever obstacles tomorrow may bring.

Why manufacturers are eyeing growth

The following are excerpts from Deloitte's 2022 Manufacturing Industry Outlook, which was led by Paul Wellener, vice chairman and U.S. industrial products & construction leader at Deloitte LLP. Reprinted with permission. The full report can be found at https://www2.deloitte.com/us/en/pages/energy-and-resources/articles/manufacturing-industry-outlook.html.

REMAKING SUPPLY CHAINS FOR ADVANTAGE BEYOND THE NEXT DISRUPTION

Supply chain resilience has been a thread through our recent outlooks, and the challenges are acute and still unfolding.

There is no mistaking that manufacturers face near-continuous disruptions globally that add costs and test abilities to adapt. Purchasing manager reports continue to reveal systemwide complications from high demand, rising costs of raw materials and freight, and slow deliveries in the United States. Transportation challenges are likely to continue in 2022, including driver shortages in trucking and congestion at U.S. container ports.

As demand outpaces supply, higher costs are more likely to be passed on to customers. Root causes for extended U.S. supply chain instability may include overreliance on low inventories, rationalization of suppliers, and hollowing out of domestic capability.

Supply chain strategies in 2022 are expected to be multipronged, according to our survey, including 41% of executives who report their companies will further add or diversify suppliers in existing markets.

Fifty-three percent of surveyed organizations plan to enhance data integration for supply-and-demand visibility and planning. Manufacturers are likely to continue to seek an upper hand by integrating operational data for more transparency and insight in operations. For example, centralizing a manufacturing control tower can bring together data from different facilities, production lines, and equipment and visualize dependencies on suppliers and effects on logistics.

Digital supply networks and data analytics can be powerful enablers for more flexible, multitiered responses to disruptions. The risks from not "connecting the dots" through available data can be significant: A lack of supply chain integration could stall smart factory initiatives for 3 in 5 manufacturers by 2025.

Beyond the data, reshoring of components or even final assemblies are likely to pick up steam as global sourcing and low-inventory models continue to diverge. Rising wages and transportation costs globally make nearshoring or onshoring more competitive at the same time that organizations look to avoid a repeat of 2020–21.

Twenty-four percent of manufacturing executives surveyed are considering moving operations closer to end customers in different regions in 2022. Some manufacturers already in the process of localizing supplier networks in response to tariffs may redouble efforts.

The United States–Mexico–Canada Agreement is likely to continue to drive nearshoring from China to Mexico. Along with trade, policymakers may further support domestic supply chains. The White House's 100-day supply chain review in 2021 recommended initiatives and investments to strengthen resiliency in supply chains for semiconductors, large-capacity batteries, critical minerals, and pharmaceuticals.

ACCELERATION IN DIGITAL TECHNOLOGY ADOPTION COULD BRING OPERATIONAL EFFICIENCIES TO SCALE

Manufacturers looking to capture growth and protect long-term profitability should embrace digital capabilities from corporate functions to the factory floor.

Smart factories, including greenfield and brownfield investments for many manufacturers, are viewed as one of the keys to driving competitiveness. More organizations are making progress and seeing results from more connected, reliable, efficient, and predictive processes at the plant. In 2022, 45% of manufacturing executives surveyed expect further increases in operational efficiency from investments in industrial Internet of Things (IIoT) that connect machines and automate processes.

Emerging and evolving use cases can continue to scale up from isolated in-house technology projects to full production lines or factories, given the right mix of vision and execution. For example, one heavy equipment manufacturer has been accelerating convergence of "man, machine, and method" by optimizing performance using sensors to track assets and connecting its machinery to the cloud to enable real-time insights on maintenance. Others have been transforming brownfield facilities with IIoT, robotics, automation platforms, and AI-enabled tools to support production.

U.S. manufacturers have room to run with advanced manufacturing compared to many competitors globally. The number of industrial robots as a share of manufacturing workers in the United States is below countries like Korea, Singapore, and Germany.

Half of executives we surveyed expect to increase operational efficiency in 2022 through their investments in robots and cobots [collaborative robots]. Investment in artificial intelligence technologies is also expected to see a compound annual growth rate (CAGR) above 20% through 2025.

Discrete manufacturing is among the top-three industries expected to invest most heavily in AI, primarily in quality management and automated preventive maintenance use cases. Advanced global "lighthouse" factories showcase the art of the possible in bringing smart manufacturing to scale. Foundational technologies such as cloud computing enable computational power, visibility, scale, and speed.

Industrial 5G deployment may also expand in 2022 with advances in technology and use cases. One global equipment manufacturer invested in multiple private 5G networks to enable automation and intelligence on factory floors as well as to support connected products. Use cases for mobility, such as communication with automated guided vehicles and mobile robots, are likely to complement other edge-computing applications, such as quality monitoring, to increase factory efficiency.

AODD PUMPS FOR IMPROVED CERAMICS PRODUCTION

In a critical worldwide market that is central to the manufacture of many everyday products, AODD pumps offer efficiency, reliability, and versatility that can result in optimized operations.

By Agostinho Rosa Neto

As we approach the bicentennial of the ceramics industry—large-scale ceramics production originated in Europe around 1830—many countries beyond the industry's traditional base in Europe and the United States are now involved with the manufacturing of these materials. Emerging markets in BRIC countries (Brazil, India, and China) came to lead the advancement of tile manufacturing in the past few decades, while Mexico and Turkey are setting the pace, along with China, in the production of sanitaryware.

The basic definition of ceramics—articles made from clay hardened by heat—no longer adequately expresses the slew of advances in ceramic manufacturing technology that helped transform the industry. Giant silos and ovens, printers that can emboss any type of image on a tile, and robots for the automated enameling of sanitaryware are some examples of this great transformation.

To store all these technologies, huge ceramics plants of more than 100,000 m^2 are required. Regardless of location or product produced, the ceramic manufacturing process relies on pumps to transfer very abrasive materials, solid-laden slurries, and corrosives. Finding a way to identify best efficiencies for the process—the highest flow rate with volumetric consistency and with the lowest air consumption, with a greater mean time between failure (MTBF)—is often the greatest challenge for ceramic plant operators.

In tile production, the engobe and glaze application process is key, where a pump's ability to provide the greatest MTBF makes the difference. In sanitaryware production, the molds must be filled as quickly and smoothly as possible, without the generation of air bubbles that can create craters in the pieces. In both cases, most of the pumps that are used have 2-inch and 3-inch (51-mm and 76-mm) inlets and outlets because they must deliver high flow rates with low air consumption.

Traditionally, manufacturers used two pump technologies in ceramic production. The first is the progressive cavity pump, which has several operational shortcomings in these applications, including an inability to consistently handle liquids with high levels of abrasives, which leads to increased maintenance cost; wear on expensive stators, rotors, and mechanical seals, which will eventually need to be replaced; and overall higher purchase, operating, and repair/replacement costs.

The second common pumping technology used is the peristaltic (hose) pump, which can deliver liquids with a high amount of abrasive particles. To do that, however, it may be necessary to oversize the pump because it needs run at low speed. There is also the issue of hoses wearing out rather quickly and needing replacement, meaning higher costs for maintenance and repair/replacement. Plus, there is the ever-present chance that a hose will burst during a production run. To safeguard against this event, the hose is outfitted with an alarm to warn of leakage, after which the pump will need to be shut down immediately or a catastrophic failure may result.

Nowadays, air-operated double-diaphragm (AODD) pumps are often used instead of these traditional pump technologies to transfer barbotine, the base material in tile and sanitaryware manufacturing. In general, it is the design and method of operation of AODD pumps that enable them to reliably outperform their progressive cavity and/or peristaltic (hose) pump cousins in ceramics production.

AODD DESIGN

The simple design of AODD pumps features few moving parts, which simplifies maintenance, while the seal-less construction results in fewer leaks, a critical consideration when handling very abrasive and solid-laden liquids that are prevalent in the manufacture of ceramics. AODD pumps are available in a choice of metal and plastic housing constructions, while a wide array of elastomers can be used in the diaphragms, some of which eliminate abrasion concerns. AODD pumps also possess the capability to move liquids with low air pressure. These features make for a powerful combination that offers many benefits to ceramics manufacturers.

Below are some examples of the operational capabilities of common sizes of AODD pumps and how they can be used in two key stages of the ceramic production process, which can require pumping pressures of up to 125 psi (8.6 bar).

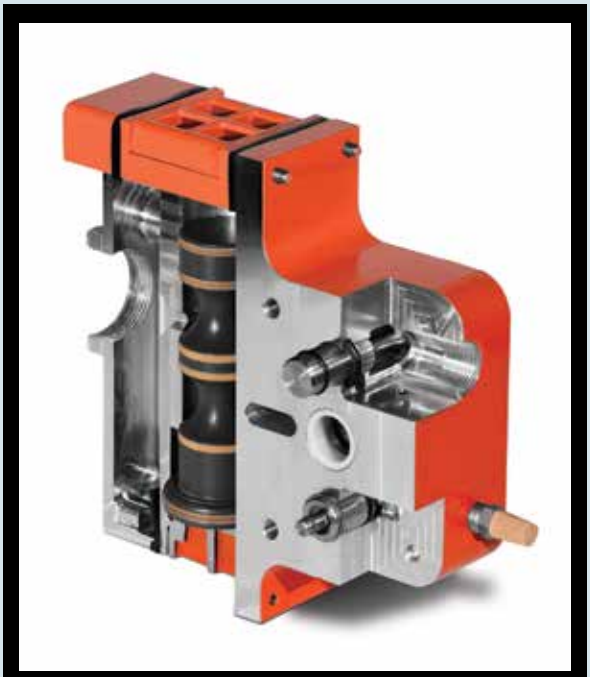
Painting and enameling booth

- 1 inch (26 mm): A bolted metal configuration allows this pump to achieve flow rates up to 56 gpm (212 L/min), depending on the diaphragm type, with the ability to handle solids as large as ¼ inch (6.4 mm)
- 1½ inch (38 mm): This larger bolted metal AODD pump can reach flow rates up to 135 gpm (510 L/min), again depending on the diaphragm type, with the ability to handle solids as large as ¼ inch (6.4 mm). An advanced liquid-chamber design allows the creation of these higher flow rates.

Barbotine transfer

- 2 inch (51 mm): This bolted metal configuration enables the pump to achieve flow rates up to 181 gpm (685 L/min), depending on the diaphragm type, with the ability to handle solids as large as ¼ inch (6.4 mm)
- 3 inch (76 mm): The larger inlet/outlet size of this bolted metal pump can achieve flow rates up to 271 gpm (1,026 L/min), depending on the diaphragm type, with the ability to handle solids as large as ½ inch (12.7 mm)

The versatility of these AODD pumps also means they can be used in many other applications within a ceramic plant, such as to wash/clean sanitaryware molds with corrosive chemicals, water treatment, and filter press.



The Wilden Pro-Flo SHIFT Air Distribution System revolutionizes AODD pump operation through a design that reduces air consumption by up to 60% when compared to competitive models. *Credit: Wilden*

The latest additions to Wilden's family of diaphragm models are the Chem-Fuse Integral Piston Diaphragm and EZ-Install Diaphragm, both of which deliver improved performance through higher levels of reliability, service life, and efficiency. *Credit: Wilden*

AODD OPERATIONAL CAPABILITIES

A closer look at the built-in operational capabilities of AODD pumps indicates three main advantages for use in ceramic applications.

Optimized internal flow paths. An AODD pump with an optimized internal flow path will minimize the change of direction of the liquid that is being transferred, which reduces its velocity and the abrasive effect of any suspended solid. This optimization also helps the flow stay laminar, which keeps solids in the current line, reducing the abrasive effect. This new design allows the flow rate to be increased while still running the pump at lower strokes per minute, which allows a smooth, laminar flow that reduces the abrasive effect even more. The liquid path is also designed for longer diaphragm life, minimizing the contact between the diaphragm and the liquid chamber. These pumps are also easier to maintain through the elimination of unnecessary fasteners that can be hard to reach. The manifolds are also interchangeable, allowing modifications to be made quickly and easily.

High-efficiency air distribution systems (ADSs). Next-generation ADSs optimize air usage through a breakthrough design that reduces air consumption by as much as 60% through the elimination of the wasteful loss of air to the atmosphere at the end of each pump stroke. Many ceramic plants use a huge number of 3-inch (76-mm) pumps that consume a large amount of air. Therefore, reducing air consumption by 60% is a tremendous benefit.

State-of-the-art diaphragm designs. There are also some recent advances in the materials and designs used for AODD pump diaphragms, all of which can improve performance and reliability in any severe liquid-handling application. Two of the most recent advancements in this area are

- Integral piston diaphragms (IPD): These diaphragms are designed to deliver an elevated level of performance, which makes them ideal for use in high-volume ceramics manufacturing applications. Most significantly, the IPD design eliminates potential leak points at the outer piston, along with outer-piston abrasion that can compromise diaphragm life, especially when pumping abrasive fluids. IPDs are also easier to clean than traditional diaphragm models, which makes for faster changeovers within product runs.
- Quick-install diaphragms: These diaphragm models feature a unique convolute shape that do not require inversion of the diaphragm during installation. This feature allows for quick, easy installation with minimized risk of injury, making them a convenient like-for-like replacement for traditional diaphragms with corresponding reductions in pump downtime.

CONCLUSION

To meet the diverse, demanding, and critical needs of the ceramics industry, a complete roster of AODD pump designs, many of which feature cutting-edge advanced technology, can provide improved efficiency, reliability, and safety, all of which help maximize performance in the various stages of the ceramics manufacturing process.

ABOUT THE AUTHOR

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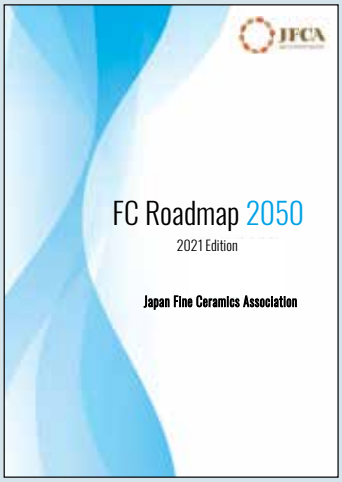
FC ROADMAP 2050



The Japan Fine Ceramics Association (JFCA), an organization comprising more than 100 corporate members with a mission to promote development of the fine (advanced) ceramics industry, recently published an English-language version of its 2021 "FC Roadmap 2050."

The first edition of this roadmap published in 2016. The purpose is to investigate advanced ceramic technologies and products that will meet increasingly diverse needs of society, market, and industry by the year 2050, and to identify technological developments needed over the coming three decades to realize these needs.

"Facing globally grand challenges, such as climate change, energy, sustainability, communications, and health care, we need new ceramic technologies to provide new solutions to them. JFCA developed this roadmap to anticipate the coming gap in advanced ceramic materials available and advanced ceramics that will be needed," says Tomosaburo Yano, executive director of JFCA.

The roadmap consists of the core report and a supplement. The core part comprises roadmaps on key technologies for advanced ceramics to reach 2050 goals, based on results of interviews with numerous researchers, engineers, technologists, industrialists, and other specialists from industry, universities, and research institutions in fields related to ceramic technologies.

Table I. Six primary and three crosscutting fields with one to five themes each. *Credit: JFCA*

Fields		Themes		
Primary Fields	Transportation	Motive Power	Power Supply & Vehicle	Aircraft, e-VTOL, Space plane
	Telecoms	Telecom Infrastructure	Communication Terminals 1	Communication Terminals 2
	Medical	Advanced Medicine	Implant	Prevention, Remote & Home Healthcare
	Energy	Clean Fuel	Solar, Thermoelectric, Energy Harvesting	Wind, Ocean, Geothermal, Hydro
		Biomass & Thermal Power	Nuclear Energy	
	Infrastructure	Electricity, Gas & Water	Information & Communication	
	Environment	CCUS & Purification	Resource Recycling (exc CCUS)	Energy Saving
		Smart Agriculture, Forestry & Fisheries		
Cross-cutting Fields	Sensor	Pressure, Acceleration, Sonic Wave	Light, Electromagnetic Wave & Magnetism	Gas, Biological Element & Electrical Potential
	Battery	Automotive	Storage Batteries	Fuel Cells
	Semiconductor	Materials & Devices		

Table II. Major innovations in advanced ceramics over the next three decades. *Credit: JFCA*

Category	Major innovations
Application	H_2 energy cycle, CO_2 separation, Water purification, Electronic, Communication, Transportation, Medical, *etc.*
New materials	Materials search via. MI/AI, Polymer-integrated ceramics, Self-crack-healed ceramics, *etc.*
Properties improvement	Multi-functionality, Harsh environment resistance, New properties of ceramic/non-ceramic composites, *etc.*
Structure control	Atomic-level control, Precise surface/interface control, Integrating dissimilar phases, Critical defect control, *etc.*
Processing	Sensor/monitor-controlled manufacturing, Zero-waste production, Recycling/reusing, MI/AI-incorporated, Advanced 3D printing, *etc.*
Analysis/ Evaluation	Advanced modeling/simulation, Better prediction via. MI/AI, Visualization/monitoring of process, *etc.*

CORE ROADMAP FEATURES

- Covers six primary fields (transportation, telecommunications, medical care and welfare, energy, infrastructure, and environment) as well as three device technologies for crosscutting fields (sensors, batteries, and semiconductive materials and devices).
- Addresses one to five relevant themes in each field, adding up to 27 themes, or roadmaps, in the nine fields, as shown Table I.
- Organized into three levels: market, product, and technology. "Market" describes overall trends, market size, technology needs, etc., in each of the primary themes over the next three decades. "Product" addresses performance, functionality, quality, etc., that the markets will demand. "Technology" discusses potential approaches to realize the products.
- Demonstrates a variety of products and technologies in which ceramics play key roles, so that readers can identify the significance of ceramics.

ROADMAP SUPPLEMENT

The supplement presents a survey of opinions of researchers and engineers from around the world concerning the future visions identified in the core roadmap. The questions asked of experts include

- Major issues that will affect society over the next three decades.
- Major application fields that will be influential to the advanced ceramics industry over the next three decades.
- Key technologies that will be necessary for development of ceramics over the next three decades.
- Major innovations in advanced ceramics over the past four decades.
- Major innovations in advanced ceramics over the next three decades (Table II).
- Driving force necessary for the future development of advanced ceramics industry, e.g., society/research system, human resource development, and research/technical issues.

The full report is 64 pages long and on sale now for $3,000. For further information or to purchase, contact Keiko Koyanagi at koyanagi@jfca-net.or.jp.

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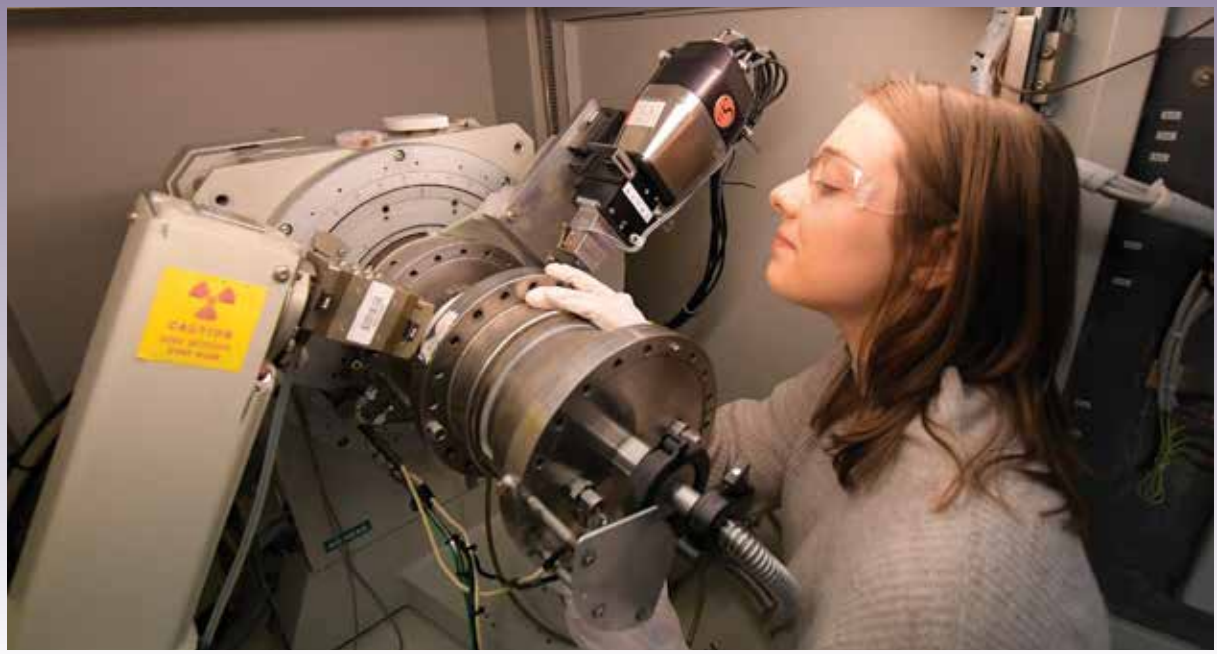

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