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DEAR READERS,

Our topic, “The Next Big Thing”, is something that fascinates me. There is often the assumption that the next big thing happens overnight. More often, it comes about thanks to the long-term efforts of teams of people with the mindset of developing a solution that will benefit industries and society. Getting to the next big thing takes resilience and the willingness to invest passion, time, and resources.

One thing is certain: You won’t find the next big thing if you aren’t looking. At Bühler we are scanning the horizon, sifting through information on emerging trends, tracking indicators, and just having an ear to the ground across our industries to know what our customers – and their customers – want. We also draw on the expertise and experience of our partners, customers, academia, and start-ups.

By investing nearly 5 percent of turnover every year in research and development, we keep our innovation engine humming, and that strategy has not changed during this pandemic. It’s our intention at Bühler to develop technologies that will reduce water, waste, and energy consumption in our customers’ value chains by 50 percent. We do this not just with a single solution, but across our customers’ installed asset base, with new technologies as well as with digital applications. It is with this approach that we work to live up to our vision of “innovations for a better world”.

We are now in the midst of two rapidly growing mega trends: plant-based alternatives and electromobility. Bühler is a leading technology provider in both fields, but our ability to respond to the growing demand in these markets isn’t something that happened overnight. We began developing solutions for textured proteins in the 1980s and now we’re drawing on this vast experience to provide customers with the best processing technologies for plant-based alternatives on the market. We also achieved a breakthrough in our insect technologies segment after a decade-long journey of exploration. The same is true for our battery slurry production solutions.

We’ve covered many examples of our quest to uncover and develop the next big thing in this issue of Diagram. I invite you to dive in and enjoy the following pages. Let me also take this opportunity to thank you for bringing your ideas to us, for testing our innovations, and for encouraging us to always search for the next big thing.

Yours sincerely,
Stefan
The next big thing. What is it and can you search for it? When will the next mega trend arise? We analyze, research, and develop continuously at Bühler so that we, and our customers are ready when the next big thing hits.

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Ian, why does Bühler invest 4 to 5 percent of its turnover into innovation every year?

IAN ROBERTS: Throughout our 161-year history, new technologies, new markets, and new business opportunities have driven our growth. Innovation is embedded in our DNA. The Bühler family holds us to two rules. The first is we must be the innovation leaders in our sector and may not reduce research and development (R&D) spend, even in times of crisis. The second is that we run the company as you would a family, which means thinking of the next generation. This takes resilience, staying power, and consistent long-term investment.

Innovation for us is focused on reducing energy, water, and waste in our customers’ value chains by 50 percent. Whether that is through new technologies or our new digital services, our aim is to drive efficiency and increase yields while cutting unplanned downtimes and minimizing waste. Innovation fuels the value we can bring to our customers, and we must invest in R&D to keep looking for the next big thing.

Is keeping pace in such fast-changing markets a challenge?

Markets certainly can move very fast, which means recognizing trends and being ready for them when they happen. A good example is plant-based alternatives to meat. This has gone from a vegetarian and vegan niche in terms of market size to becoming rapidly mainstream to the point where awareness around sustainability is driving a fundamental shift in people’s diets and in value chains.

We began developing dry textured protein technology in the 1980s (see pages 18-23). But it was not until 2010 that we began building our scientific understanding of high moisture extrusion by establishing a partnership platform for plant-based meat alternatives with ETH Zurich, where master’s and PhD students worked on new plant-based meat analogues. We sponsor research, develop new technologies and products, and apply our expertise to scale up to production level. As consumer demand grew, we had the industrial infrastructure and technology needed to underpin our customers’ business growth.
When you established the ETH Zurich platform, how did you recognize that plant-based meat would become such a trend?

We looked at pressures on the food system and at scientific trends. Setting up the World Food System Center at ETH Zurich to explore global food challenges gave us early insight into the pressures that the agricultural system would be under. It became clear that if the global population grew to 10 billion, we would need to deliver protein more efficiently. Of course, plant-based meat is only one of those solutions, but it became clear to us that with our capabilities and technologies we had the potential to become a key player in that space.

How do you manage such long timescales when it comes to changing markets?

Food is a conservative industry, based on traditions and great taste, and with a large installed asset base. This means that change can take some time. Recently, we have seen an explosion of the food and agriculture start-up space. Start-ups move at a pace that outstrips the market and can disrupt the traditional industry, but they frequently lack access to the necessary infrastructure. As such, we have formed partnerships in Singapore, Germany, China, Switzerland, and the US, providing access to technologies, process experts, and ingredient and flavor partners to support plant-based meat start-ups. These facilities are not exclusively for start-ups; many of our more established customers take advantage of them. To take a trend from the research stage to being able to underpin a global shift in dietary behavior, as in the case of plant-based meats, you need to partner with existing and new companies and ensure they have the facilities to create, test, and scale production.

How do you keep track of scientific breakthroughs that could influence the market?

There are many ways. We look at patents, scientific publications, we work with leading institutes around the world, and we sponsor PhD and Master projects. Sometimes we work in consortium groups in precompetitive spaces to sow the seeds of future activities. We also get a good feel for new technologies and new trends by working closely with start-ups through start-up ecosystems.

A very important source for us is being close to our customers who study trends in great depth. We build partnerships with our customers to jointly understand trends and then help them to take advantage of these trends. At our Networking Days, we engage in discussions with customers and experts to gain greater clarity on future requirements. These avenues give us a broad perspective, as identifying a new trend or business opportunity involves piecing information together from multiple sources.
How do you bring all that information together?
Once we identify an opportunity, we start basic research by combining the knowledge of colleagues and external experts to see if this is a business opportunity. The board of our Urs Bühler Innovation Fund plays a key role in bringing views together from different industries and technology spaces. We also explore how we can contribute to addressing the global challenges – for example, what is the role consistency of lithium-ion battery production through a continuous electrode slurry process. Another example is working with companies to put additional protein such as pulses into the pasta experience to get more nutrition onto the table for kids. We are taking an existing technology and adding another dimension to a staple food by changing the ingredients, while maintaining the performance of the product in its preparation.

How do you decide to allocate your R&D budget?
There needs to be close alignment with the business leaders and our strategy. Then we look at the resources and investment needed to make this a success relative to the opportunity it provides. We decide what we will do, then we assess how we can leverage our ecosystem of partners to do this faster and with a higher chance of success.

We have talked about it taking a decade or more before a process is ready for the market. How do you know when to keep investing in a plan, and when to bin it?
We are curious technologists and innovators by nature, so without constraints we will try to do everything because it fascinates us. We have a strong alignment with the business and our strategy to guide where we play and where we do not. It is a hard thing to “kill” a project because we are passionate about our work and become extremely invested in our projects and our project teams. In any project, we learn continuously and sometimes that learning is that it will simply not work, will not work at a viable cost, or the market is too immature. This is not a failure, but an important lesson that enables us to redeploy valuable resources to projects that may succeed.

R&D requires agility, but also resilience and staying power. In food, tradition and local preference means we cannot change things overnight. Even in the faster moving automotive sector, change is inhibited by the rate of transformation of the manufacturing asset base. The market for electromobility has now opened up, but this has taken decades.

When you look for the next big thing, how far ahead do you look?
We should know what we want to achieve during the next 5 years. There will be some changes, and some opportunities will arise faster than expected and some more slowly. It is also important to prepare for what we will need to master so that we can be ready for 2030 and beyond.
Are you ever surprised by trends? Do you have a good example?
I have been disappointed and surprised. I am usually overly optimistic about how fast things will pick up, so the time taken can sometimes be disappointing. Then things such as the uptake of sustainable proteins market surprise me, that after years of waiting, the adoption rate is so high.

We know it is being driven by major investments and a huge awareness around climate change and sustainability, but it has already created a permanent structural change in the food market. The opportunity here is huge, and we want to lead this change and the market.

What role do our application centers play?
The extensive network of application centers we have around the world is there to benefit our customers, be it for testing new technologies, developing new products, or training their employees. It is not just the technology or processes, but crucially, it is the knowledge that comes with the people who run them and now with well-established digital technologies it is the capability to tap into global knowledge input at all locations.

Built on generations of institutional knowledge, our technologists and experts can significantly accelerate the development process of companies, be they start-ups or established multinationals. A global network enables us to understand local context, market trends, consumer preferences, taste, retail environments, sales structures, raw materials, and regulatory environments. In this way it is not only more convenient for our customers, but also locally relevant.

A topical example of this is the global network of extrusion labs that we have built over the last 5 years, with new sites in Singapore, Germany, China, and the US opened over the last 18 months.

What excites you most about research and development?
Think about the opportunity we have at Bühler. We work with companies that provide the food for a high portion of the world. We have a key role to play in sustainable mobility. We can and do contribute to the sustainable transformation of the food, feed, agriculture, and mobility industries.

We have spoken for many years about how we can prepare for 10 billion people and achieve a good quality of life on planet Earth in 2050, and do this in such a manner that respects the balance of our planet, with climate change and biodiversity at the forefront. I am convinced that Bühler can contribute strongly to achieving this goal. Not alone, but by learning to partner well within our ecosystems, be they academics, start-ups, NGOs, multinational companies, or governments, to combine our know-how and capabilities to deliver on our targets of delivering a 50 percent reduction in energy, waste, and water consumption in our customers’ value chains. However, the scale of our impact relies upon providing solutions to our customers that not only support their business success, but also accompany them on their net zero journeys. How could this not be exciting?

**“THE SCALE OF OUR IMPACT RELIES ON PROVIDING SOLUTIONS TO OUR CUSTOMERS THAT NOT ONLY SUPPORT THEIR BUSINESS SUCCESS, BUT ALSO ACCOMPANY THEM ON THEIR NET ZERO JOURNEYS.”**

IAN ROBERTS
CTO at Bühler

Why is it important that Bühler focus its innovation on sustainability?
We sit at the center of the value chain. We provide the capability for companies to feed around 2 billion people a day and move 1 billion people through our Food and Advanced Materials businesses. Across the board our customers are looking at their role and the impact that future regulations will have on their business practices.

Like Bühler, many have declared net zero targets and are seeking good partners to contribute to achieving their targets. It is our responsibility to make sure that we support them on that journey while simultaneously helping them cut their operating costs. For many companies without the R&D resources of large multinationals, we also provide the opportunity to access new technologies, quantify their processing CO₂ footprint, open up new application and business opportunities, and support them in making plans to reduce their CO₂ footprint.
Bühler’s Application & Training Centers are unique in many respects. They are spread all over the world to respond to local tastes and market needs. Customers benefit from technologists and experts who accompany them in developing and testing new recipes and products from the idea to the trial runs.

**OUR NETWORK** of Application & Training Centers (ATCs) continues to grow. This year alone, Bühler and its partners opened two centers for alternative proteins: the Protein Innovation Centre in Singapore and the Technology Center Proteins of the Future in Germany (see pages 58–63). As a result, the network now comprises application centers in 24 locations around the globe.

“We can offer our customers trial runs, joint product development, and training close to them. If not in the same country, then in the same region or time zone,” says Sandra Lutz. As the Global Director of Bühler’s Technology & Product Development Process & Facilities, she is also responsible for the strategic orientation of the ATCs worldwide.

Having a local foothold enables customers to discuss local market trends and test their ideas with Bühler’s experts and validate and improve processes with their own raw materials and recipes. “Our technologists and experts are among the best in their field when it comes to processing local raw materials,” she explains.

Bühler shares its process knowledge with customers and contributes to idea generation, for example through demonstrations and networking or co-creation events. Our experts advise on new product ideas, co-develop new product lines, and support customers in enhancing the performance of existing lines. Customers then test their potential recipe modifications on our pilot lines. “We want our customers to know they can turn to us with any issues or ideas, and we will develop solutions together,” Lutz says. The application centers feature the latest generation of Bühler technologies and are connected to our digital services. This aids internal research and development to further improve solutions while they are in operation. Both customers and Bühler’s own service engineers are trained at the application centers, learning how to optimally set up their process solutions, maintain them, and apply the technologies in the best possible way. This training can also take place at a customer’s plant.

A high point for Bühler’s application network was the HACCP (Hazard Analysis and Critical Control Point) certification of the moulding application center in Reichshof, Germany, in 2021. The certification allows joint developments of new, delicious product innovations and the production of samples for market tests. Bühler also has food-grade application centers in Singapore and Minneapolis.

**Further competence centers to follow** Bühler will continue to invest in its application landscape in 2022. Following the announcement of another major project to build an industrial insect processing plant for animal feed for a customer in France, Bühler will also expand its application capacities in the field of insect processing at the beginning of 2022 (see pages 30–35).

The opening of the Insect Technology Center in Uzwil complements the other application centers in Switzerland, where Bühler is already developing new feed solutions together with customers. And Bühler will enter a new field next year with two partners to accelerate the development and market penetration of cellular agriculture products such as cultured meat.
For Bühler, innovation and longevity are synonymous. Since its origin in 1860, the world has undergone serial technological and market transformations. With its strong research and development mindset, Bühler has considered how new scientific advances could provide potential benefits to customers at each evolutionary moment.
Developing the “Next Big Thing”

Bühler has been continuously launching new solutions for 161 years. The recipe for its success at research and development involves managing a complex interplay of customer expectations, academic research, technological advances, commercial acumen, and the ability to handle the unexpected. But in the end, it’s the market that will dictate the pace of change.

Every successful multinational has a process for carrying out research and development (R&D). The idea comes first, then the creative thinking to apply it to a specific market, followed by thorough questioning to test its commercial viability and make sure it fits into a wider corporate strategy. The research is the first two stages of this process, while the development is the final aspect.

To change a market involves the all-important initial idea, which can come from many different sources. Talking to customers is critical, so too is watching competitors and monitoring scientific developments, listening to and collaborating with academia and start-ups, expanding ideas from other markets, and even colleagues having eureka moments — and often it’s a combination of all of these. Which approach is taken often depends on the market. Once a new idea is given the green light, a project manager is appointed, experts are consulted, customers are brought on board, simulations are run, and prototypes are built.

As the project is shepherded through the development process, each Bühler department contributes to multi-skilled teams tasked with deciding a project’s fitness for market. From the start, the project needs to comply with wider corporate goals. For example, any current research and development idea has to show it can contribute to achieving the Bühler sustainability targets of 50 percent less waste, water, and energy in customer value chains by 2025. If an idea fails to deliver on these targets, it won’t make it further.

Embracing disruption

Sometimes, something unexpected happens overnight that radically changes a market. Other times, a solution takes much longer to be accepted or a solution designed for one application can unexpectedly resolve a completely different problem. Or sometimes, you find a dream customer with innovation in their soul and suddenly you have the potential to radically change a whole industry.

According to Daniel Bieli, Head of Research and Development Die Casting at Bühler, to innovate you must be able to deal with the unexpected and have the ability to be flexible and quickly adapt. “We are living in an increasingly changing world, which means you can’t fall into the trap of doing things the way you did them yesterday. It means everyone from management down has to be agile and have the flexibility to suddenly shift what they are working on and adapt their targets,” he explains.
Daniel Bieli should know, because his market was turned completely upside down two years ago by one of the world’s most famous disruptors. At the heart of the Bühler Advanced Materials business lies Die Casting and at the heart of die casting lies the automobile industry with Bühler’s Carat range of machines producing the aluminum parts from which many vehicles are made.

Car manufacturing requires high levels of capital investment, which can act as a drag on change as it can be too costly for manufacturers to suddenly shift production methods. When disruptors enter the market looking for the potential to redesign production methods from scratch, it can create a seismic change. This trend began taking shape in 2019, as many electric car manufacturers started looking toward the possibility of producing larger die-cast machines capable of casting single parts, which had previously required multiple castings and assembly.

Bühler responded quickly. “We went to management and told them there was something big going on in the market,” Bieli explains. “This simply was not in our plan at all, so we had to shift resources, build up a brand new project team, hire external designers to produce thousands of drawings and run simulations each day, which meant it was an incredible achievement to be able to deliver a whole new scale of machines so quickly.”

Within 18 months, Bühler had expanded its traditional 400 series Carat die-casting machines to include the Carat 560, the Carat 610, and the recently released Carat 840 and 920, capable of exerting pressure in excess of 9,000 tons when locking the two halves of the die cast together. These are massive machines (more on pages 44-47). The smallest of the new range, the Carat 560, is the same weight as a Boeing 747–400. It made designing them even

“We work with customers and start-ups who are interested in exploring new paths to increase their market share. Both benefit from that push to be prepared for the next big thing.”

MANUEL HÖHENER
Head of Research and Development Chocolate and Coffee at Bühler
more of a challenge, as every part of the production process had to be simulated: Their size meant it was just not possible to build and test prototypes.

Adapting to the market
The type of market that you are in has a big influence on how you approach research and development. While the Advanced Materials business is being driven by a revolution in electromobility, the Consumer Foods business operates in much more traditional sectors such as coffee and chocolate manufacturing. Dominated by a handful of long-established and well-recognized businesses, it has in the past required Bühler to drive innovation.

Yet Manuel Höhener, Head of Research and Development Chocolate and Coffee at Bühler, is noticing a change. “For quite a long time, we have been working within the boundaries of so-called traditional markets, with well-established products and iconic brands. Our customers have relied on our technological competencies and innovations to find answers to basic and key challenges such as capacity increase, process robustness, flexible process solutions, and more. In the past couple of years, the landscape has rapidly changed,” explains Höhener. “Mega trends such as healthy and ethical living, premium products, shopping reinvention, connectivity, and shifting market frontiers have generated new challenges, which require new developments and even radical innovation. Currently, the future is being shaped from both sides; by our customers and by us.”

It is an encouraging shift, Höhener points out. The better we understand the root causes of any given challenge, the better the outcome of our innovative solutions. The closer the cooperation and the greater the dialogue with customers, the more potential there is to achieve successful innovation.

“We can be much more creative by allowing interdisciplinary teams to take inspiration from different approaches and so open up their horizons.”

Torsten Nitsche
Head of Research and Development Milling Solutions at Bühler
Höhener cites the introduction of digital solutions, such as autonomous machines and process lines, or data-driven decisions into the Consumer Foods market as an example of the need for close cooperation. “We introduced the early stages of digitalization at the Interpack 2017 trade fair and customers were completely blown away because they had not been expecting it. In fact, as an idea it was hard to be absorbed because it was so radical at the time. It is important to work through the process with customers, be there to answer questions, and allow the time that the market requires to embrace the benefits of it. It goes far deeper. We’re talking about major consumer mindset changes.”

Managing the speed of change is a delicate process in the more conservative food sector, especially when it has an impact on texture and flavor. This, in part, is because we as consumers are slow in changing our eating habits, with it often taking a generation for real change to come about. This creates tension when it comes to research and development. While there is no shortage of innovation spurred on by academic research and through start-ups generating radical change, adoption can be a much slower process. Reconciling these two worlds takes time.

“We work with customers and start-ups who are interested in exploring new paths to increase their market share and are very interested in trying out new things. Both benefit from that push to be prepared for the next big thing,” explains Höhener.

Science drives change
Bühler not only works on R&D topics with customers and suppliers, but also with universities and start-ups to stay abreast of the latest developments, predict potential trends and, finally, identify how a bench approach could be realized at industrial scale. Two of the push factors driving innovation in the consumer food market are public health and sustainability. “Research includes ideas for usage of low-carb raw materials like chocolate with less sucrose or even without sucrose, chocolate without cocoa, vegan milk chocolate, upcycling byproducts from other processes and many more,” explains Höhener.

Another potential area of investigation includes the development of solutions to optimize or even partly replace the traditional processing of coffee or cocoa beans to cut costs and CO₂ emissions. As an outcome of such initiatives, Bühler has built the first 85 percent CO₂-neutral coffee factory together with leading coffee processor Joh. Johansson in Norway, clearly setting a new standard.

“You can’t fall into the trap of doing things the way you did them yesterday. It means everyone from management down has to be agile and flexible.”

Head of Research and Development Die Casting at Bühler

“At the moment we are working on new heating systems using hydrogen or other kinds of heating systems instead of fossil fuels as a vision for CO₂-neutral roasters,” Höhener explains.

The research and development Bühler is doing in the milling sector is also set to transform the industry. It is an example of how technological advances coming at the right time along with a market appetite to embrace change and close customer cooperation can generate radical change. While digitalization is set to transform each of Bühler’s three businesses, it is the milling industry that is currently at the forefront of change. So, what was it that pushed this also traditionally conservative industry over the technological Rubicon?

According to Torsten Nitsche, Head of Research and Development Milling Solutions at Bühler, it has been a combination of push factors around sustainability, regulation, and the risk of variable grain prices. “Customers are realizing that government obligations on them to address sustainability will only be increasing and so they are looking to us to guide them through the digitalization process, as this is an area where we are at the forefront of research and development,” says Nitsche. Millers also know they will be on the front line as food resources become stretched by global population growth and climate change. The industry understands that the route forward is increasing production efficiency.

With the market ready to change and the technology in place, Bühler needed that all-important client partnership to help drive a digital revolution. It was then that Whitworth Bros., one of the UK’s biggest milling firms with a long-standing commitment
to technological development, stepped forward to become a test bed for many of Bühler’s R&D ideas. The result was the opening of the world’s most advanced mill earlier this year. This smart mill is fitted with 15,000 data points, generating information every few seconds on all aspects of the milling process. “When you see the data coming in it is like being in the Matrix and the challenge for us is narrowing down what we do with it next,” Nitsche says.

Markets dictate the pace
Once again, the market dictates the pace of change. Except this time the change is happening so fast that all the rule books about conducting research and development are having to be thrown out the window. “Traditionally we would do basic research and then produce a strict project process, but this is a completely different way of working where we can be much more creative by allowing interdisciplinary teams to take inspiration from different approaches and so open up their horizons,” says Nitsche.

Digitalization has opened the flood gates as ideas around automation, quality control, blockchain, predictive maintenance, and production transparency are allowed to bounce off each other in a crucible of R&D that is driving the industry forward. But it is not just digitalization that is reforming the milling industry. The Whitworth mill (see pages 36-43) was built using new modular design techniques with the purpose of making the mill more efficient and sustainable. Named the Mill E3, it is an example of how it is possible to borrow ideas from other industries and cross-fertilize them with your own market.

“The trigger for the Mill E3 came around 10 years ago when we started looking at how the building sector was using prefabrication and other industries were applying modularization. We saw these as clear trends and realized that it could be a real driver for us when it came to designing the hardware needed to develop the digital mill,” says Nitsche.

The challenge with R&D is that the process is never complete. Innovation is an ongoing process at Bühler, however. So what’s the next big thing? The past shows us that in the world of research and development you can never be absolutely sure. One thing is certain though, you are never going to be able to absolutely control what is about to happen next in your market. But you stay at the top of your game by continuously investing in research and development, following the trends, and collaborating with customers and partners.
PLANT-BASED
IS GROWING

The demand for plant-based meat alternatives is growing unabated and more and more investors are turning to sustainable food, which is further boosting growth. Bühler has been active in the market since the 1980s and its solutions are in great demand thanks to its many years of technological expertise.
“I was intrigued from the start by the good nutritional values and cooking properties of the textured proteins. It’s incredible what you can do with them.”

KONRAD MUNZ
Senior Process Engineer at Bühler

LEONARDO DICAPRIO Bill Gates, Katy Perry, big meat producers such as JBS, BRF, and Tyson or investors like Blue Horizon and Big Idea Ventures are all backing plant-based meat alternatives. The consulting firm Roland Berger predicts a compound annual growth rate of 12 percent from 2019 to 2025 globally for plant-based meat alternatives. According to a study carried out by the management consultancy firm Kearney, the share of plant-based alternatives will comprise 10 percent of the total meat market by 2025, and as high as 25 percent by 2040.

“We are no longer talking about a mere trend – it’s more like a revolution in the meat market,” says Christoph Näf, Head of Business Unit Human Nutrition at Bühler. “Bühler has been active in this field for a very long time before the market experienced such a boom, and now the market is benefiting from our advanced knowledge.”

One person who has a very clear recollection of the early days when there was very little demand for alternative meat substitutes is Konrad Munz, Senior Process Engineer at Bühler. From the late 1980s onwards, he conducted initial trials for prospective customers in the Nutrition Application Center in
Uzwil, Switzerland. At that time, these trials were exclusively for dry textured proteins. The business was not yet profitable and regularly had to justify its existence. In the 1990s, Bühler supported Universidad Adventista in Argentina and a customer in Malaysia in the development of textured proteins on site. In doing so, it acquired a lot more experience in this field.

“It was fascinating to be part of this development process right from the start and I believed in the products. The machines from the Universidad Adventista and the customer in Malaysia previously processed cereals, so we had to find a way to significantly increase the process temperature with new screw elements, which in turn required different cooling dies in order to achieve a stable process,” says Munz. “The development at the beginning was on a case-by-case basis. With every customer, we moved further with the development, and were astonished that it has taken years to see more products in the stores. They were really niche products back then.”

Exploring the potential
From 1998 onwards, the Bühler team received more and more requests to carry out trials in the laboratory, and they managed to sell first machines to Cuba and China. This was followed approximately every two years by further lines to China, Russia, Argentina, and Serbia. Munz explains that while opportunities came in slowly at the start, he enjoyed being able to work with customers to refine the processes and test and further improve recipes.

“I was intrigued from the start by the good nutritional values and cooking properties of the textured proteins,” explains Munz. “Initially, my colleagues showed little interest in the products we had developed in the application center. It simply wasn’t the right time. However, I was always interested, and took the test products home and cooked with them. It’s incredible what you can do with them.”

Although wet textured proteins are now booming, Munz is also still convinced of the value of dry textured proteins. “They are able to absorb a large amount of liquid, which also makes it easy to have an effect on the aroma.” Munz believes dry textured proteins are suitable for those who want to reduce meat consumption because in addition to all their nutritional attributes, they are also cost-effective.

Christoph Näf also highlights the potential of dry textured proteins: “Dry textured proteins have a very good shelf life and are easy to store and transport.” Spaghetti Bolognese sauces and, in some instances, burger patties are made by some food producers today using dry textured proteins.

Starting in 1999, Bühler conducted its first trials with wet textured proteins for customers. However, there was little interest at the time since it required a specialized cooling die and only allowed for low throughputs. “Inquiries have been rising over the last 5 to 6 years. It’s an older technology with advancements that boost efficiency and create dramatically larger production,” Näf explains. For Bühler, the transfer of knowledge from the technologists who have worked on the technology since the start to younger team members is therefore also of great importance.

“BÜHLER HAS BEEN ACTIVE IN THIS FIELD FOR A VERY LONG TIME BEFORE THE MARKET EXPERIENCED SUCH A BOOM, AND NOW THE MARKET IS BENEFITING FROM OUR ADVANCED KNOWLEDGE.”

CHRISTOPH NÄF
Head of Business Unit
Human Nutrition at Bühler
Conversely, they contribute the latest findings from their scientific training. Bühler has expanded its extrusion team in recent years in response to growing demand. Gloria Gantner is one of the process engineers at Bühler. In addition to her training as a food engineer at ETH Zurich and her experience in meat and fish processing, she draws on Konrad (Koni) Munz’s experience. “Koni has a great deal of experience, he has done trials even with the most exotic raw materials, and that’s why he knows how to solve almost every problem,” says Gantner. “The breadth of the field, the many opportunities available to experiment, as well as working in a booming area where there are still many unanswered questions allows me to contribute and help to further shape developments.”

Although Munz has already reached retirement age, he continues to assist Bühler in an advisory capacity, passing on his knowledge to the next generation at Bühler and customers while still carrying out trials himself. He is currently breathing new life into an old laboratory extruder. This machine was installed over 30 years ago when he started working at the Nutrition Application Center and has been shipped back to Switzerland after a long time abroad. At the Locher brewery in Appenzell, it will now serve to develop sustainable plant-based products. “I’m continually intrigued by the durability and quality of our extruders as well as the variety of applications,” says Munz.

In order to advance the technology as quickly as possible, Bühler is collaborating with several partners. One of them is the DIL (see pages 58-63). The DIL and Bühler constructed a new test platform on which wet textured proteins can be produced from low throughputs up to a throughput level of 1,000 kilograms per hour. “The PolyCool 1000 has the highest output available on the market at present. Accordingly, demand is high,” says Näf. “It is thanks to the good cooperation with the DIL that we’ve been able to achieve such an increase in output.”

Givaudan is another key partner. “Givaudan is a taste expert, while Bühler is a texture expert. Together we are the ideal team to create healthy and tasty products,” Näf explains. Bühler also collaborates with universities to work on innovations, for example with ETH Zurich. Bühler established a platform with the ETH Zurich in 2010 for developing plant-based meat alternatives, where it sponsors projects for product and process development. Another breakthrough was recently achieved in this partnership with the use of a new aeration technol-
ogy that makes plant-based products resemble the texture of meat even more closely. This protein aeration technology can be fitted to any existing Bühler extruder. A patent application for this new technology has been filed and the solution has been on the market since 2021.

More innovations thanks to partnerships

The fact that Bühler is so knowledgeable in processing most plant-based proteins in addition to extrusion technology is an advantage. “From soy, oilseeds, and pulses to byproduct upcycling and novel ingredients such as microalgae and insects, we are leading the way in developing sustainable alternatives,” says Näf. “We have the complete solution for the protein value chain from bean to burger.” The next boom is on the way.

While plant-based meat alternatives have already made their market entry and new offers are being added on a daily basis, another trend is already evident in the financial markets, with investments into cultured meat rising. According to Kearney, lab-grown meat will account for 40 percent of the total meat market already by 2040, overtaking not just textured proteins, but traditional meat as well.

Of course, Bühler is already working on this together with partners to be ready with the best solutions when this next big thing breaks through.
The Bühler spin-off Circular Food Solutions AG (CFS) uses brewers’ spent grain to make bread, biscuits, and chocolate spreads healthier. The start-up has now succeeded in producing meat substitutes that are tasty, sustainable, and a great alternative to plant-based protein isolates.
AT ITS FINEST

TEXT: BIANCA RICHLE, PHOTOS: THOMAS EUGSTER
The important thing in the upcycling of brewers' spent grain is to preserve valuable ingredients while ensuring food safety and accomplish this in an efficient and environmentally friendly way. “Thanks to the latest technology from Bühler, we have been able to produce Legria powder for use as an ingredient; this means producing a substance as well as manufacturing a wide variety of food products with Legria that meet all the important requirements. We are especially proud that we are now also in a position to produce plant-based meat substitutes,” says Petry.

The crux of the matter is the relatively complex steps required to process brewers' spent grain. “It is only thanks to Bühler’s efficient technology that it is now possible to use brewers’ spent grain profitably,” says Petry. Plant proteins will play a crucial role when it comes to feeding the increasing population in the future. Due to the high demand, there are already supply problems, for example with pulses. Legria can help reduce the reliance on pulses for

BREWERS’ SPENT GRAIN is a real powerhouse. It’s rich in fiber, trace elements, and protein, and it could play an important role in the food industry. However, the majority of the estimated 30 to 40 million tons of brewers' spent grain produced annually as a by-product in beer production worldwide has thus far only been used as animal feed or it ends up as waste. “The reason brewers’ spent grain has not been put to better use until now – even though people have been brewing beer for 3,000 years – is because it is a challenge to efficiently achieve a safe and consistently high-quality product for industrial processing,” explains Carsten Petry, CEO at CFS, which produces Legria, an ingredient made with spent grain.
meat substitutes. “With Legria, we can add value to a by-product while helping to close the protein gap by using plant proteins,” says Friedrich Witschi, Business & Application Development Officer at CFS. “Legria is an excellent example of upcycling by-products to create more value. As such, it reflects our focus on creating value from every kilo of material that leaves the field. We cannot afford to utilize valuable agricultural land to generate waste. With the current transition to more sustainable protein sources it provides a more sustainable option for product formulation,” says Ian Roberts, CTO at Bühler and Chairman of CFS.

Most meat substitutes available today are based on soy. “Legria powder is an interesting alternative to soy,” Witschi explains. It contains approximately 22 percent protein and is used in combination with other protein sources, such as peas or wheat gluten. “Thanks to the fibers in Legria, we achieve a texture that is very similar to that of meat.”

Tasty and healthy
But what exactly is Legria? To brew beer, barley is germinated briefly and then dried again, which is how malt is produced. It contains the enzymes that are important for the brewing process and to convert the malt starch into sugar during the mashing process in the brewhouse. After the mashing process and saccharification, the solid components are separated. Brewers’ spent grain remains as a by-product of this process.

“What's special is that it’s a natural, unprocessed raw substance that is available in large quantities and can be turned into a tasty ingredient or even an end product through technology,” says Witschi. Legria powder is low in sugar and contains high levels of B vitamins, calcium, and micronutrients such as iron, magnesium, and zinc. It has been demonstrated that the high fiber content of over 55 percent supports intestinal health.

Various studies prove the positive effect of dietary fiber on the gut and the health of the entire organism. Since the modern Western diet is very low in fiber, Legria-enriched products can help increase fiber content in a simple way.

The World Health Organization (WHO) recommends 30 grams of fiber a day. By eating a Legria burger patty weighing 125 grams, one can obtain 10 percent of the recommended daily requirement. By adding a slice of Legria bread, another 10 percent are added. “The great thing about Legria is that we can provide a full-flavor experience and a health benefit at the same time,” Witschi explains. Legria can also improve the nutritional value of products significantly. “We have customers who have managed to increase the nutrition score of their product by an entire level with Legria.”
Various trials are currently underway with potential customers. One company that has already successfully tested the Legria products is the SV Group, a leading restaurant and hotel management group based in Zurich. Restaurant manager Franco Trivelli frequently uses Legria products for his dishes in the SV Restaurant Viva in Uzwil, Switzerland: “Sustainable and healthy meals are our priority. Legria meat substitutes achieve both. It’s very versatile and easy to use, from lasagna to samosas.”

The CFS team has carried out tests on an industrial scale already. Petry and Witschi are so confident in their product that they have already produced 100 tons of Legria powder that can be used to make meat substitutes or bread. “This stock means we can supply customers quickly and easily,” explains Witschi. Legria powder can be purchased directly. “We also provide support if someone wants to use our formula for textured products or develop their own products that are not yet available on the market.”

**A wide range of applications**

Legria powder can be used in a great variety of ways. In baked goods, cookies, chocolate spreads, and breakfast cereal. Legria makes it possible to reduce sugar content by up to 50 percent. “All without compromising on texture or taste,” says Petry. When it comes to bread, consumers benefit from the high fiber and protein content of Legria. The Niffeler bakery in Henau near Uzwil has developed a bread with the Legria team. “The big challenge was to specify the right quantity of Legria,” explains Sämi Niffeler, a master baker and confectioner.

In the first step, he succeeded in producing bread with 5 percent Legria. In the meantime, the master baker has further refined the recipe, and the bread now contains 10 percent Legria. “The bread is grainier and perhaps a bit nutty, but it doesn’t stand out in terms of taste from a conventional wholegrain bread,” says Niffeler. The Legria bread is popular with his customers.

“Now it’s just a question of getting Legria known and gaining a foothold in the market,” adds Witschi. The team also has a long-term goal of creating a large industrial plant for Legria. Legria has already overcome some important hurdles, but it still has a long way to go: “Working on innovations takes a lot of patience and perseverance, and you must be able to keep going. It helps to have a partner like Bühler by your side,” says CEO Petry.
Friedrich Witschi joined Legria in 2021 as Business & Application Development Officer at CFS.

THE STORY BEHIND LEGRIA

When colleagues Carsten Petry and Mary Olwal attended the internal “Master of Bühler Management” (MBM) training course in 2015 and developed a business idea, they identified the Legria concept as an opportunity to use and upgrade existing resources in a sustainable way and turn them into healthy food. The Urs Bühler Innovation Fund (UBIF) immediately recognized the potential of the business idea: “With the upcycling of brewers’ spent grain, we have the opportunity to create healthy and sustainable products that provide added value for brewers and consumers,” says Peter Stähli, CEO at the Swiss Entrepreneurs Foundation, member of the UBIF Advisory Board and Member of the Board of Directors at CFS.

UBIF supported the start-up founded by Petry and Olwal from the initial idea through acceleration to the financing of the market launch. “Legria is an example of how we support intrapreneurs systematically at Bühler,” says Johannes Wick, CEO of Business Grains & Food at Bühler and Member of the Board of Directors at CFS. With this support from Bühler and other partner companies, the young entrepreneurs have developed an innovative processing and application solution that transforms brewers’ spent grain into an ingredient that contains 54 percent fiber and 20 percent protein. The upgrading of the brewers’ spent grain is just the first step.

The long-term goal is to profitably add value to a wide variety of by-products in the food industry. Friedrich Witschi joined Legria in 2021 as a Business & Application Development Officer to contribute his many years of experience in this area. The team founded Circular Food Solutions AG (CFS) in 2021 to prepare for market launch and allow prospective investors to invest in this forward-looking company.

Would you like to learn more?
Visit the Legria website: legria.ch

INFO

Thanks to the fibers in the Legria powder, a texture very close to that of meat is achieved.

VIDE0

Watch the video about the creation of Bühler bread with Legria at the Niffeler Bakery.
Building a new business in a developing market takes time and a fair amount of resilience. The journey can be bumpy and comes with a learning curve. But with resilience and good management, results will follow. Nearly nine years since the formation of Bühler’s Insect Technology initiative, the business is now celebrating two major milestones: a new contract to realize its second industrial scale insect plant and the opening of the Insect Technology Center in Uzwil, Switzerland, planned for February 2022. In this interview, Andreas Baumann, Head of Market Segment Insect Technology at Bühler, shares the challenges and victories of this journey.
Andreas, your team has just signed a new contract with the company Agronutris to build an insect plant in France. Can you give us some insights on that new project?

**Andreas Baumann:** The new project with Agronutris, a French biotechnology company that specializes in rearing and transforming insects into proteins, is a big milestone for us. It confirms our goal of establishing ourselves as a key solution provider for the insect industry and increasing the inclusion of insect proteins in animal feed, thereby contributing to more sustainable feed supply chains.

We are honored to work with Agronutris’ team and bring together all our skills, expertise, and technology to drive their success. We will deliver a full-scope system to Agronutris. This includes feedstock preparation to provide safe, palatable, and nourishing feed to the larvae in a timely manner, a fully-automated larvae growth system with sophisticated climate control, the processing line to efficiently transform the grown larvae into protein meal and lipids with consistent quality, as well as the frass (excrement) handling system for a secure off-take of the rearing residues. In addition, we will be responsible for the entire automation and the timely project execution. The latter includes engineering, procurement, manufacturing, supply, installation, and commissioning.

The 16,000 square meter insect plant in Rethel, France, will be ready to operate in 2023. When operating at full capacity, the facility will process up to 70,000 tons of organic residues and produce high-quality protein for the aquaculture and pet food markets.
Agronutris is a start-up, right? Over the last few years, dozens of start-ups have come on the scene. How have you been addressing the needs of this specific group?

After their fundraising and the team expansion, I would consider Agronutris a scale-up, which is the next phase of a start-up. But when Bühler started working with them, they were indeed a start-up. Normally, if you are a start-up and want to work towards the execution of an insect plant project, there are many aspects to be covered. You need to build the organization, work on the business case, and secure financing for the project.

This is the business development part. Then you have the operational aspects. You need to find the correct feedstock to rear the larvae. You will need to make sure you have good genetic material to start with. You will need to work with the insects to build the whole operational know-how. We at Bühler, with our expertise and technology, can help these organizations to go through this process smoothly.

This sounds as if there are many aspects to be covered. How can Bühler support them?

We have been working with a wide variety of customers, who have different expectations. Over the last years, we have developed a customer journey with a customized approach. This means that before we propose anything, we listen to the needs of each
client and be flexible. We must consider their specific pain points, experience in this sector, the phase in which they are regarding business development, and growth plans. In some cases, there is the need to prepare a feasibility or an engineering study. In other cases, clients approach us with proper tender documents, based on which we make our offer.

Throughout the years we have identified key success criteria for such an endeavor. With that in mind, we can, for example, help customers to select the optimal feed mix recipes based on local availabilities and prices or connect our clients to potential breed suppliers. We can also give input on the facility construction and support in the permitting process.

Furthermore, we have specific services to support customers in marketing their products. We also discovered that the Bühler brand helps to give our clients credibility to their potential investors. For us, the main goal is to propose a solution that will work and be profitable for them.

What about the feed industry? How can your team help the already established feed industry to advance towards the insect market?

Insects provide good opportunities as a natural and sustainable ingredient of animal feed. Besides the pure nutritional composition, insect-based ingredients have functional benefits. In recent times, many pet food products containing insects have been launched, highlighting their hypoallergenic and/or anti-inflammatory functionalities. In aqua feed applications, the inclusion of insect-based protein meal resulted in healthier animals, which triggered a better feed conversion rate.

Moreover, the application of insect lipids in piglet diets leads to better weight gain, which helps to optimize growing time. This shows that there are already some very promising applications. But I am convinced there is more to come.

Can feed producers become insect farmers?

Of course. Many feed producers have the challenge that considerable amounts of their protein sources need to be imported. Insects can be grown everywhere on locally available organic residues. This means that a feed producer can become more independent regarding the availability of global protein sources. In addition, investment in an insect plant will drive more innovation and sustainability into the organization.

There is more big news: the opening of the Insect Technology Center in Uzwil.

Yes! The Insect Technology Center will be officially inaugurated in February 2022. At this facility, we have the right infrastructure and expertise in one location to extend our services. In this center, we will conduct larvae growth trials with various feed-
stock, develop product samples to support the sales activities of our customers, evaluate breed solutions, and run customer training. Another benefit is that our rearing units that perform growth trials are mobile, which enables us to send them to other locations, making them available to our customers worldwide. At the Center, we will also continue running our own tests, thereby constantly improving our technology and services for the insect market.

If we look back, it has been a long journey since the inception of the Insect Technology business at Bühler. Could you give us an overview of this journey?
The insect technology history at Bühler is composed of three main acts. The first act was the internal work to establish an entity that can approach potential clients. This act started in 2013 when our leadership in Uzwil initiated a program in Corporate Technology about alternative proteins, and insects were part of that. By then, we had begun to develop the first studies to evaluate insects as an alternative source of protein and the potential role of Bühler in the insect sector.

In 2014, China also started to express high interest in the entire insect market. Together – in an intensive exchange – we developed the insect opportunity further. A while later, we created an internal start-up to approach the market.

Act two took place from 2017 to 2020, when Bühler supported Protix through a joint venture to build its 14,000 square meter insect protein facility. In 2017, we embarked on a deep research program with ETH Zurich to establish rearing and processing technologies that are in line with animal welfare standards. The opening of the world’s first fully automated industrial black soldier fly plant in Bergen Op Zoom in the Netherlands in 2019 was a key milestone for the entire insect industry. The Protix facility has reached its full processing capacity in 2020, which marked the successful completion of the joint venture between Bühler and Protix. Thereafter the two companies continue their own growth journeys.

And in 2021 you entered a new phase – act three of this story.
Yes. It is a new phase. Over the last years we have learned a lot, gained maturity, and filed nine patents to protect our solutions. With these proven technologies in the portfolio, the next natural step was to leverage our core competencies, which in our case is to serve the different customers in this industry with the most effective and reliable solutions. The new plant for Agronutris is already an important project in this phase.

Just how do insects contribute to a more sustainable future and to Bühler’s sustainability strategy?
To feed the 10 billion people who are expected to live on our planet by 2050 about 250 million metric tons of additional protein will be necessary annually. This represents an increase of 50 percent compared to today. This challenge must be addressed with more sustainable production of existing sources of protein as well as alternative sources for direct human and animal consumption. Edible insects can play a key role: They are an important source of protein while being environmentally friendly.

Bühler is committed to ambitious targets that will help mitigate climate change and build a more sustainable food system. Therefore, insects offer a unique opportunity. They are a source of protein for food and feed, and are fed on waste, helping to address the huge problem of food waste. Their frass can be used as a fertilizer. That is why insect proteins are an important pillar in the Bühler strategy to become the leader in sustainable proteins.

What is the “next big thing” that’s in store for the insect business?
Today we are only at the beginning of this inspiring endeavor. There are so many more opportunities out there where we can show our skills and help the industry to further develop. There are also other insect species, such as mealworms for human consumption. We have great technology for that as well. Then there are increasing requests for building larger insect facilities.

Meanwhile, there is still a lot of room for optimization. We at Bühler keep working tirelessly on that. We want to make it better and more sustainable. We have been putting a lot of effort into tracking the
data, maximizing output, reducing costs, and minimizing greenhouse gas emissions. And we are devoted to supporting the industry to really reach its full potential.

**What are your plans for 2022?**
We aim to deliver Agronutris’ new plant in the most efficient way, keeping the time schedule, and ensuring the project runs smoothly and safely. We also want to bring our new Insect Technology Center up to full speed. In addition, there is a lot to be done with other requests and new contracts. I believe it will be a busy year as this industry sector gains speed. And we are energized to go through that journey together with our customers.

**Without people there is no business. How has this adventure been for the Insect Technology team that have driven this project?**
We are a team of 14 experts who have been working for some years as a more independent start-up within Bühler. As of 2021, we have integrated ourselves into the larger operation under Bühler’s Value Nutrition business area. With this move, we retain the flexibility and customized approach needed for this dynamic industry but have the great support of the rest of the organization, most importantly with colleagues from other engineering departments.

We are happy that we are now part of the Bühler Group and can leverage that entire know-how and experience in favor of our customers.

Jessica Wild checks the larval weight gain and the structure and temperature of the feed.
Years in the planning, the first Mill E3 is now a reality, providing vast quantities of digital data on the milling process that is set to transform milling practices globally. Learn more about how Whitworth Bros. Ltd. in the UK is expanding opportunities within milling with Mill E3.
15,000 data points monitor every aspect of the production, from raw material delivery to the sealing of flour-laden trucks ready for delivery to clients.

Every five seconds sensors feed data to Mercury MES to facilitate control of every aspect of the mill’s internal workings and to Bühler Insights, where algorithms compare past and present production parameters to ensure the mill is always operating at optimal efficiency.

“This is an incredibly exciting project for us. We launched it at our Networking Days @IpackIma in Milan in 2018 and now, here at Whitworth, it is a reality,” says Roman Sonderegger, Head of Wheat & Rye at Bühler. “This mill allows us to gather and analyze amounts of data that we have never had the opportunity to collect before. It means we will be finding out things about the milling process that we have never even thought of, enabling us to come up with ideas and new services that we can turn into a reality for all our customers.”

Whitworth Bros. Ltd. is a traditional family company that has put technological innovation at the heart of its business model. It is a philosophy that has transformed the company through a process of organic growth and acquisition into the UK’s largest miller. The Whitworths Holdings Limited Milling
Group has 17 flour mills across 10 sites. Central to the development of Mill E3 has been the good relationship forged over 20 years between the people working at Bühler and Whitworth Bros. It has engendered a trust that has enabled both companies to first collaborate on the building of this innovative mill and now to work together to develop the sort of digital innovations that will revolutionize milling practices.

“Bühler is excellent at building flour mills and we are pretty good at running them,” explains Peters, who has nearly 40 years of experience in the milling industry. “We can feed back observations of real-time conditions in which we are dealing with client expectations and production pressures. Running and maintaining a mill is quite different from building one.”

For Peters, one of the most powerful aspects of Mill E3 is the volume and speed of the data flow. “What is most exciting about the technology is that it provides the operator with data in real time which enables the miller to take key and well-informed decisions about the plant,” he explains. “We feel at Whitworth that we are pioneering. What we need to understand through the 15,000 data points is the optimum machine parameters needed to make very consistent end products. Once that is defined accurately, you can then be more exacting in the way you set up your mill process and further push your process capabilities.”

A revolutionary design
But it is not just the way Mill E3 operates that is radical; it is also revolutionary in its design. On each level, groves of pneumatic stainless-steel tubing run from ceiling to floor with intermittent glimpses of the transformation from wheat to flour...
that is taking place. The layout means every process is easily observed with simple access to all the modules for maintenance and to check for seamless process flows. The Whitley Bridge plant requires just one operator for the whole mill.

“Bühler has come up with so many solutions over the years, and now what we have done together in this one setting has given us the most advanced mill in the world,” says Andrew Thomson, Technical Miller at Whitworth Bros.

Mill E3 gained its name due to its three areas of efficiency around space, time of installation, and energy savings. All three were developed with cost saving and sustainability in mind. To be able to reduce the footprint and volume of a mill means fewer building materials, less building time and less land usage. Both the equipment in the mill and the mill itself have been designed to maximize energy savings, while the time it takes to install the mill has been cut significantly using modular plug-and-play milling solutions such as the Bühler Blower Module and the Bühler Airlock Module, the Vitaris combicleaner cleaning system, and the Arrius fully integrated grinding system.

“This is also a very significant moment in working towards our corporate target of cutting energy, water, and waste by 50 percent in our customer value chains by 2025,” Sonderegger explains. Some of the digital services used in Mill E3 include the Temperature and Vibration Management Service (TVM), Yield Management System (YMS), Error and Downtime Analysis (EDA), Overall Equipment Effectiveness (OEE) and Replay. Together these provide continual data feeds on machine performance, potential maintenance issues, trends in machine performance and how they relate to quality and efficiency. But at the core of any milling process lie the rollers that do the actual grinding.

The mill in Whitley Bridge is the first time that Bühler has installed the latest Arrius fully integrated grinding system in a completely new plant and at scale. It is here that energy conservation is being best achieved. This is due to sensors monitoring variables in temperature and vibration along with the consistency of the wheat to better control the distribution of the feed and allow the rollers to adapt to the wheat’s characteristics and the targeted finished product quality.

“The wheat coming into the mill is first checked by online sensors to establish its key parameters,” explains Thomson. “Then the sensors in the Arrius recheck and control the distribution of the feed, which allows the grinding system to adapt again to the changing characteristics of the wheat at the point of milling. It is this unique usage of sensor technology that ensures optimal grinding parameters are achieved at all times.”

Andrew Thomson has been at Whitworth Bros. for 17 years and has been fully involved with the new mill at Whitley Bridge. He probably has the greatest insight into the daily operation of Mill E3, and for him the key benefit is transparency.

“We can see at all times the quality of flour we are making and if there is any fluctuation in quality, we can immediately isolate the flour by changing silos rather than waiting for a laboratory test, as well as being able to automate the quality control process,” says Thomson. “The dashboard is also fantastic because the moment you open your control system you can see immediately what the mill is yielding and trace that back to see how it has performed through the night, I can see the trends whereas traditionally I would rely on a manual calculation.

Towards the SmartMill

For Thomson, the real thrill of Mill E3 lies in its future potential, and he believes the ability to analyze, monitor, and control machine performance will yield some of the greatest future benefits.

“We are at the very early stages of using this information and are putting together teams in collaboration with Bühler to see how we can best use all the data,” Thomson says. “The way I see it, we will be able to predict machine maintenance and perfor-
The Arrius fully integrated grinding system is a central component of Mill E3.

“BÜHLER HAS COME UP WITH SO MANY SOLUTIONS OVER THE YEARS, AND NOW WHAT WE HAVE DONE TOGETHER IN THIS ONE SETTING HAS GIVEN US THE MOST ADVANCED MILL IN THE WORLD.”

ANDREW THOMSON
Technical Miller at Whitworth Bros. Ltd.
mance from noise and vibration sensors giving us direct data flows and trends, rather than relying on an operator walking past a machine and realizing that there might be a problem. I like that we get all of the data points collected for us and that we see all those points on the Mercury MES. We can use that data to help us target a more streamlined approach to continue increasing profitability and efficiency in the mill.”

It is this new insight into machine performance that will provide the next step in the evolution of milling towards the ultimate goal of the fully automated SmartMill. Milling is on a journey and over recent years milling technology has been developing from machine automation to the data-assisted mill provided by services such as Bühler Insights. “The SmartMill services are like having a lot of Lego bricks available and the miller can pick whatever pieces are needed to deliver on those needs and targets,” Sonderegger explains. “What is most exciting about this journey is that we are only at the beginning and all the data we are gathering will allow us to develop new ideas and new services to help our customers around the world.”

The volume of data being generated at Whitley Bridge will now enable the next evolutionary stage in the form of the self-adjusting mill, capable of using the plant's own production parameters in a closed loop to optimize production. Key to this will be a granular understanding of the mechanics of milling so that in the new iteration of the mill, processing can be automatically adjusted rather than requiring the intervention of the plant operator.

Just the beginning
“The journey is the SmartMill, and we are on the way to the fully automated mill. We still need the miller, who is the expert who will set up the autopilot according to the mill’s specific needs,” says Sonderegger. “To reach that stage we need short innovation cycles rather than trying to develop everything to perfection in one go, and it is our relationship with Whitworth that allows us to have a hypothesis and then try to adapt rather than build the perfect world at once.”

Another key feature of Mill E3 that is still in its infancy is blockchain. It is a groundbreaking technology that is generating a lot of interest among...
Whitworth’s major customers. Blockchain has the potential to provide the secure transfer of data to customers, thus increasing transparency around the exact production parameters being used to mill their product.

“Eventually you won’t have to continually sample for additional laboratory testing, SmartMill will be able to include certain parameters in the blockchain as part of the delivery notice to the client,” says Peters. “It means having a quality record for that bulk consignment that could form part of a blockchain trail that goes from that customer down the value chain, ensuring complete integrity.”

The key advantage of blockchain is secure data collection and storage, allowing for highest data security and transparency. It will enable a consistent, retraceable, and food-safe product. Future applications of blockchain technology could include using sensors in vehicles both delivering wheat for processing and flour to clients, to monitor time taken, ambient temperature, and other safety processes. It could be used to monitor machine performance as a form of smart insurance or to improve traceability. The vision is that blockchain will reduce the need for frequent sampling and laboratory testing as the miller will have real-time access to production parameters as part of the product certification process.

One of the most exciting aspects for everyone working on Mill E3 is the level of creativity it allows when coming up with new ideas. Peters cites weather forecasting as an example of one of the ways he sees the SmartMill potentially developing. Weather conditions change the condition of the grain being milled. In hot weather, for example, it is necessary to add additional water to the grain to bring it up to optimum milling condition.

Peters envisages being able to feed local weather conditions into the mill’s process control to create real-time automation of wheat conditioning targets. “We feel at Whitworth Bros. that we are on a voyage of discovery that will open up endless opportunities. Thanks to our open and close relationship with Bühler we have the opportunity to play a significant role in shaping the future of milling.”

“WE ARE ONLY AT THE BEGINNING AND ALL THE DATA WE ARE GATHERING WILL ALLOW US TO DEVELOP NEW IDEAS AND NEW SERVICES TO HELP OUR CUSTOMERS AROUND THE WORLD.”

ROMAN SONDEREGGER
Head of Wheat & Rye at Bühler

Watch this video to see Mill E3 in action at Whitworth Bros. Ltd.
ONE UNDERBODY IN ONE SHOT

TEXT: MARKUS REBER
PHOTOS: JEKATERINA GLUZMAN
It is becoming a reality; the possibility of producing entire front or rear underbodies on die-casting machines is within reach. For automotive production, this will be the next big thing. A rear underbody made from a single die simplifies production dramatically – 70 parts become one. Assembly lines with 300 robots are eliminated, saving production space. And Bühler, thanks to its experience with large structural components, will play a driving role here.

**“THE CARAT 920 IS ABLE TO INJECT OVER 200 KILOGRAMS OF LIQUID ALUMINUM INTO A DIE WITHIN MILLI-SECONDS, HOLDING THE DIE TIGHT BY APPLYING A FORCE OF 92,000 KN TO IT. THAT’S 9,000 TONS – THE SAME WEIGHT AS THE EIFFEL TOWER.”**

MICHAEL CINELLI
Product Manager Die Casting at Bühler

**THE TREND** toward larger body in white parts in die-casting continues. About 15 years ago, a trend in die-casting took off on a massive scale. Automotive manufacturers began to produce aluminum structural components such as shock towers on die-casting machines. This becoming standard was possible thanks to pioneering work by Bühler. The process has proven its worth. The trend toward even larger structural parts continues to this day, with no end in sight. “Automotive manufacturers are currently rethinking production in many ways. At Bühler we not only have the machines for them to put their future visions of even larger parts into reality, but we also support our customers in developing all the processes to do so,” says Nico Jordi, Product Manager Peripherals Die Casting at Bühler.

Lightweight yet large, the demand for body parts is the driving force of innovation for automotive manufacturers. The large machines in the Carat series have dominated this segment for more than a decade. More than 700 of them are in production worldwide every day, making up 50 percent of all structural parts manufactured worldwide. For years the Carat has been producing entire chassis sub-units, for example shock towers, longitudinal members, tailgates, or battery housings for electric vehicles. To cast such complex parts at all, die-casting machines must be powerful and precise.
Launched in October 2021, the Carat 840 and Carat 920, with incredible locking forces of up to 92,000 kilonewtons (kN) currently round off the upper end of Bühler's die-casting platforms. “We are seeing a huge increase in the demand for ever-larger machines. With our Carat 840 and Carat 920 we can offer our customers solutions for large structural parts with complex geometries and new body in white parts,” explains Michael Cinelli, Product Manager Die Casting at Bühler.

The Eiffel Tower and the Carat
The Carat 840 and 920 are as big as a house and 8 meters high. “The Carat 920 is able to inject over 200 kilograms of liquid aluminum into a die within milliseconds, holding the die tight by applying a force of 92,000 kN to it. That’s 9,000 tons – the same weight as the Eiffel Tower. Imagine locking the die with the weight of the Parisian monument in every single shot,” explains Cinelli.

With the new solutions, customers can produce structural parts of about 1.8 meters by 1.8 meters. This brings large parts of any car within reach. “We’re talking about the rear and front underbody. This is still a glimpse into the future. But with our solutions, these large parts are coming into reach,” says Jordi. Forming that much aluminum in milliseconds is an extremely complex process. “Two years ago, our customers could only process half as much aluminum at once with our solutions. Here, together, we have made a big step, and the journey is not over yet,” he explains.

Die casting is an energy-intensive process, especially for such large parts. But aluminum is a very elegant metal in terms of sustainability, because it can be fully recycled. “Aluminum die casting can be CO₂-neutral if foundries use secondary aluminum and run their production on green electricity,” Cinelli explains. He adds that this also applies to newly produced aluminum if renewable energy is used for the entire process, including melting.

With die-casting machines, every shot should be perfect, and it should be possible to install every cast part. Therefore, Bühler’s vision for the future of the die-casting industry is zero percent scrap, 40 percent less cycle time, and 24/7 uptime. “Advancing further toward this vision is even more important: The larger the castings, the bigger the lever to minimize production costs by reducing scrap, cycle time, and increasing uptime of the die-casting system,” Jordi says.

Redesigning processes with customers
As aluminum die castings grow, all production steps must cope with their size. This poses many challenges for the foundries. For example, they can no longer be carried by humans – and that is just one of many challenges.

“THE LARGER THE CASTINGS, THE BIGGER THE LEVER TO MINIMIZE PRODUCTION COSTS BY REDUCING SCRAP, CYCLE TIME, AND INCREASING UPTIME OF THE DIE-CASTING SYSTEM.”

NICO JORDI
Product Manager Peripherals Die Casting at Bühler
That’s why Bühler is rethinking, designing, and commissioning entire solutions to offer process solutions from ingot to the body shop together with its partners. Robots and transport racks form one continuous transportation system and take over the handling from the casting to the body shop. “We at Bühler, and our partner network, can provide solutions for all these processes thanks to our wide practical knowledge in commissioning and running such large cells, collaborating with foundries and suppliers all over the world,” says Jordi.

When die-casting machines produce large body in white parts in one shot in the future, the effects will be profound. The complexity of body in white construction would drop drastically. As an example, a rear underbody would be produced in just one part, not from 70. Automotive manufacturers could massively reduce their investments.

Currently, a rear underbody is welded and glued together on the assembly line by about 300 robots. These robots would all be eliminated, which would greatly simplify the production process. A Carat 920 takes up around 100 square meters of floor space. But if it produces rear underbodies from a single die, it will save manufacturers around 30 percent production space. This level of efficiency is what Bühler is working toward.

“WITH OUR CARAT 840 AND CARAT 920 WE CAN OFFER OUR CUSTOMERS SOLUTIONS FOR LARGE STRUCTURAL PARTS WITH COMPLEX GEOMETRIES AND NEW BODY IN WHITE PARTS.”

MICHAEL CINELLI
Product Manager Die Casting at Bühler

INFO

“GETTING THE MOST FROM THE CARAT”

The Carat two-platen series comes with a stiffened platen design for homogenous clamping force application that allows minimum deflection and a high degree of dimensional accuracy of the castings. In combination with the unique Bühler real-time controlled injection unit and the DataView control system, Carat provides the highest injection dynamics and quality – shot after shot. And the cell management system SmartCMS is giving customers the possibility to view, control, and program the entire cell. With a wide range of sophisticated functionalities, they can boost the productivity of their entire system.
Merlin AI features the latest camera technology and sorting algorithms.
Head of R&D Digital Technologies David Kinsella and Product Manager Melvyn Penna reveal the behind-the-scenes discussions that led to the creation of Bühler’s latest engine for the newest versions of our color sorters – Merlin Ai. Learn how it responds to current issues such as the impacts of climate change, skilled labor shortages, and digitalization, and why it will be such an asset for food and non-food processors.

Merlin Ai is essentially an all-new machine in terms of its hardware and electronics. It features new sorting algorithms for color detection, new camera technology, defect sizing, self-learning, tracking, calibration, and defect removal. “It allows the most complex of sorting applications to be accomplished with ease, enhancing the detection of foreign material (FM) and subtle defects while increasing product yield. It was developed with the customer user experience at the forefront of the program,” explains Melvyn Penna, Product Manager at Bühler.

Merlin Ai was developed to elevate the usability and connectivity of the optical sorter using a new suite of algorithms and advanced learning techniques. This new sorting engine is the “next big thing” in optical sorting, according to Johannes Wick, CEO Grains & Food at Bühler. “Merlin Ai will enable the industry to move away from using sorters solely for quality control and will instead encourage processors to open up totally new applications for grading and qualifying raw materials in function of the composition of the material,” he explains.

The concept for Merlin Ai was sparked following market research conversations between Bühler and its customers about what they would require optical sorters to do in the future. “We spent time in the mills speaking directly to millers about their most pressing pain points. We also spoke to our in-house Application Specialists to gauge what the market as a whole was in need of and what would be feasible to develop,” says David Kinsella, Head of R&D Digital Technologies at Bühler. The resounding response from customers was that they wanted more flexibility and simpler control over complex

SIMPLY PUT, Merlin Ai is the new brain of Bühler’s Sortex optical sorting machines, now exclusively available for the wheat and rye sector. As a future development, it will be rolled out across various other food and non-food segments including pulses, coffee, seeds, peanuts, grains, rice, tree nuts, oats, and plastics. As a pioneer in optical sorting, Bühler has built on decades of experience and the best of Swiss and British engineering know-how. At the forefront of optical sorting innovation, Bühler introduced infrared sorting to machines in the 1970s and artificial intelligence to optical sorters in the 1980s with the Sortex 9000 being the first machine to have microprocessor control. In the 2000s, 24/7 remote monitoring of sorters was launched with Anyware-Pro. The new Merlin Ai sorting engine is now set to push optical sorters to the next level of usability, performance, and product traceability.
They can trust that ultimately they will not be compromising on quality as the optical sorter will clean the product to the highest standard and adhere to any requirements. This will result in greater profit margins for the customer, as they will save a considerable amount of money on the input material,” Kinsella explains.

With Merlin Ai, an engineer or skilled operator is not required for set-up or maintenance; it’s easy to set up and easy to use – no training or technical skills are needed. This attribute is even more important in the face of the current shortage of skilled workers across Europe and North America. Merlin Ai provides a layer of assurance for processors.

The simple user interface (UI) allows easy navigation and control of the machine, while default pre-set modes, and AI and machine learning capabilities enable quick set-up for new products.

“WE’VE LEARNED FROM THE DIGITAL AGE THAT PEOPLE EXPECT HIGH LEVELS OF USABILITY. MERLIN AI WILL BRING SORTING MACHINES TO THAT HIGH LEVEL. IT’S INTUITIVE.”

DAVID KINSELLA
Head of R&D Digital Technologies at Bühler

defects. Additionally, they desired an easy, user-centric design and the implementation of artificial intelligence (AI) concepts. “With the development of Merlin Ai, we also wanted to be sure that we were responding to our customers’ most urgent needs in the face of Covid-19, the heightening effects of climate change, and shortages of skilled workers across the globe, and so on,” explains Penna.

From a performance point of view, while the Sortex A had already set the bar in the world of optical sorters, Bühler’s R&D team was still not satisfied. With the Merlin Ai sorting engine, they have managed to achieve an additional 50 percent reduction in yield losses. “This means less food waste and a minimized footprint for processors, which is much better for the planet,” Kinsella says.

Removing complex defects with ease
As time goes by, the effects of climate change are becoming more and more apparent. There is growing uncertainty over harvest quality and availability in addition to the emergence of different types of contaminants and diseases resulting from changing weather conditions.

“Fortunately, with Merlin Ai we can ensure superior reduction of insect damage, sunn pests, mycotoxins, deoxynivalenol (don), Fusarium (filamentous fungi) and other complex defects which are the same size and/or weight as the wheat kernels,” Penna says. “This is thanks to new LEDs with triple the amount of light, new full-color cameras combined with our new color detection and defect size processing algorithms to enhance defect detection.”

Merlin Ai effectively prevents the need for millers to downgrade or reduce the quality of their material, which would lower their profits. It also ensures adherence to food safety regulations which consumers are becoming increasingly aware of in the face of heightened health consciousness around the globe.

“Merlin Ai enables small millers to purchase cheaper wheat that contains higher levels of input contamination. They can trust that ultimately they will not be compromising on quality as the optical sorter will clean the product to the highest standard and adhere to any requirements. This will result in greater pro-fit margins for the customer, as they will save a considerable amount of money on the input material,” Kinsella explains.

With Merlin Ai, an engineer or skilled operator is not required for set-up or maintenance; it’s easy to set up and easy to use – no training or technical skills are needed. This attribute is even more important in the face of the current shortage of skilled workers across Europe and North America. Merlin Ai provides a layer of assurance for processors.

The simple user interface (UI) allows easy navigation and control of the machine, while default pre-set modes, and AI and machine learning capabilities enable quick set-up for new products.

“We’ve learned from the digital age that people expect high levels of usability. Merlin Ai will bring sorting machines to that high level. It’s intuitive. Anyone can use the machine with confidence and achieve the results they need for that day. Similar to how we unbox a new laptop or phone and begin to intuitively navigate our way through the set-up without needing the manual, Merlin Ai has been developed to ensure the highest ease of use,” says Kinsella.

Enabling Industry 4.0 readiness, Merlin Ai’s connectivity to Bühler Insights delivers conversion of raw data from Sortex machines into KPIs and metrics on a single Bühler Insights dashboard. It is
suitable for anyone in the factory to use and gain insights from the sorter. Instead of simply providing metrics such as ejector defect rates, Bühler can provide information that has real meaning such as input contamination, yield, total reject mass, uptime hours per day, yield per mode/recipe, and total accept mass. It enables downtime analysis, quality monitoring, and plant comparison.

“Invaluable data on defect removal and machine wear status is easily accessible for multiple stakeholders anytime. A user log featuring time-stamped mode/control changes is also available, as well as an alarm configuration for high ejection rate due to high input contamination or changes to incoming contamination of a particular defect type,” Penna says. “This will enable processors to quickly make decisions and take action and thereby save money by either reducing waste or increasing productivity.”

Patterns and trends from historical data generated from Bühler Insights will also help millers around the world to maximize their uptime and future-proof their operations.

“Our Research & Development department is always looking to innovate, build on, and enhance existing technologies so we can be confident that we are responding to the most current issues in the industry,” Kinsella explains. “As such, our work is never done because we’re constantly being inspired and challenged by the world around us. Innovation is at the heart of Bühler and the development of Merlin Ai is proof of that.”

Would you like more information?

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Vyncke combines inventiveness and craftsmanship for sustainable energy production from biomass.
For more than 100 years, the Belgian technology supplier Vyncke has been building its expertise on energy production from a wide range of biomass by-products, including industrial and municipal waste. This year, Vyncke entered a strategic partnership with Bühler to scale up the impact of Vyncke’s solutions in the food and feed industry – playing a major part in creating more sustainable value chains and the business success of our customers.
prices, Vyncke entered the biomass market with their technology to burn flax straw waste in boilers to generate affordable energy. “Our founders saw a great opportunity to support a growing local industry and do good at the same time. We have been driven by that very principle ever since, long before terms like global warming and Kyoto were added to our vocabulary,” says Peter Vyncke.

Today, his company enables its customers to reduce their CO₂ emissions by 3 million tons annually with their solutions for food and agriculture, wood, and recovered fuels. The partnership with Bühler will primarily focus on food and feed customers.

“Whether it’s grain, rice, corn, or cocoa, our solutions turn food and feed manufacturers’ biomass by-products into a climate-neutral form of energy,” Vyncke says. “The use of biomass energy helps to control greenhouse gas emissions as the only fraction released is what the plants absorb from the atmosphere during their growth. This creates a neutral CO₂ cycle and enables customers to save energy costs – a great example of how smart engineering drives sustainability while creating economic value.”

Vyncke’s food and agriculture business focuses on converting organic by-products into reliable and stable process energy. That’s where the partnership with Bühler comes into play.

A natural evolution

“Since we moved into the food and feed industry, we’ve done some fantastic projects together with Bühler and achieved significant impacts on CO₂ reduction and cost savings for our customers. The real strength of our strategic partnership with Bühler is that it has in essence been a bottom-up project,” Vyncke explains. “Our teams were collaborating for years before we decided to officially join forces. They already think, plan, and execute as one cohesive unit with the customer’s benefits in mind, and the official partnership is just the natural next step rather than a ‘forced’ decision.”

What’s the foundation of this fruitful partnership? Peter Vyncke believes there is a clear recipe for success: “Have no secrets and be the first one to give. What it translates down to is that we always shoot straight, call things as they are, and avoid losing precious time by beating around the bush. The second mantra we all adhere to is to offer something first, especially when a project is under threat of getting stuck. I learned this a long time ago from a partner in India, and this attitude of being the first one to give only brings benefits. If a negotiation or an installation gets a little bumpy, reaching out rather than persisting on your opinion opens up new possibilities you haven’t even thought of.”

Megawatt thermal (MWth) for hot water, steam, thermal oil, or gas, and one to twenty Megawatt electric (MWe) for power generation.”

Vyncke employs 370 like-minded change makers in nine locations. “Today we engineer, install, and start up around 40 energy plants per year all over the world. There’s nothing quite like the feeling of what we call ‘the first fire’ and we celebrate it every time with our customers to share our joy and passion for fire,” explains Vincent Weyne, Sales Director at Vyncke. “Each solution is tailor-made to a plant’s needs, and the fire burns up to 1,000 degrees Celsius to generate between one and one hundred

“OUR FOUNDERS SAW A GREAT OPPORTUNITY TO SUPPORT A GROWING LOCAL INDUSTRY AND DO GOOD AT THE SAME TIME. WE HAVE BEEN DRIVEN BY THAT VERY PRINCIPLE EVER SINCE.”

Peter Vyncke
Owner of Vyncke Clean Energy Technology
WE SHARE THE SAME COMPANY CULTURE: WE’RE BOTH FAMILY-OWNED, DOWN TO EARTH, WITH AN UNDETERRED FOCUS ON DELIVERING THE BEST QUALITY TO OUR CUSTOMERS.”

JOHANNES WICK
CEO Grains & Food at Bühler
Johannes Wick looks forward to leveraging the enormous potential this new partnership offers to all parties involved. “We share the same company culture as Vyncke: We’re both family-owned, down to earth, with an undeterred focus on delivering the best quality solutions for our customers. We can now expand our service portfolio along the food and feed value chains and create meaningful impact to deliver on our targets of reducing energy, waste, and water usage in our customers’ value chains by 50 percent by 2025,” he explains.

Part of the solution
Now that Vyncke and Bühler offer the energy part of a food or feed plant as one unit, their competitiveness has sharply increased – to the benefit of their customers. “Our customers now get a fully integrated solution from two experts in their fields acting as one partner. This will enable us to improve efficiency, transparency, and speed of installation,” Wick says. In times of rising energy prices, demands of increasing profitability, and societal and political calls to reduce emissions, there’s pressure on industry to deliver meaningful results quickly.

Peter Vyncke is excited about the prospect of scaling up Vyncke’s impact and drastically reducing CO₂. “When Bühler’s CEO Stefan Scheiber said during the Bühler Networking Days 2019 that industry must become part of the solution instead of being part of the problem, hundreds of leaders carried that call to action back to their companies,” Vyncke explains. “So did we, and by teaming up with Bühler, we set ourselves the target of equipping 20 percent of their customers’ installed base and 80 percent of new plants that Bühler builds with our solutions. We’re just scratching the surface so far and we’re ready to provide an economic and ecologic energy boost for an industry that literally feeds the world.”
Vyncke’s focus is on designing and building custom high-tech solutions that light the fire in customers’ eyes.
Over three decades, the DIL Deutsches Institut für Lebensmitteltechnik (German Institute of Food Technologies) has established itself as an important element of the international food industry. From research on cutting-edge topics such as future proteins to the development and production of proprietary process solutions, the DIL unites academia and industry in the common pursuit of more efficient and sustainable value chains. In early 2021, it formed a strategic partnership with Bühler. Our customers benefit from this close collaboration.
THE DIL IS EMBEDDED in the rural and idyllic western region around the town of Quakenbrück in the German state of Lower Saxony. As tranquil and slow-paced this town may seem at first glance, it is also home to the DIL’s state-of-the-art Food Science & Technology Campus stretching across an expanse of 9,000 square meters. Over 200 employees work at its research and production facilities, built to the highest standards. “The DIL has grown rapidly in recent years. We are very proud of our role at the intersection between research and industrial production in the food industry, and we are also highly aware of our responsibility. Especially at the current time, when the agricultural industry and downstream food processing are playing a central role in the important sustainability and climate debate,” says Dr. Volker Heinz, Director of the DIL.

Its name may sound very official, but the DIL is actually 100 percent independent and keeps pace with private sectors. “We operate in four business areas: product innovation, process technology, food safety, and the Center of Food Physics. Our research areas are divided into bioeconomy, structure and functionality, protein technology, robotics, and process analytics,” Heinz explains. This unique composition enables the institute to generate new knowledge in food production and processing and channel the acquired knowledge into industrial processes. “We are integrated into around 50 research partnerships at national and international level. With over 190 partners in the industrial sector, we are constantly exchanging new findings and receiving important impetus from industry that we, in turn, incorporate into our research. This exciting dynamic is what really fascinates me about working at the DIL, because it creates a continuous regenerative cycle of innovation.”

Christoph Vogel can only confirm this. As Head of the Proteins & Ingredients Market Segment at Bühler, he works in close contact with the institute. “The DIL has been an excellent platform for the food industry to develop future-oriented solutions. The modern laboratories combined with profound knowledge also help our customers to overcome the challenges of modern food production,” he says. “The DIL in Lower Saxony is at the center of the meat industry, which now has a wonderful opportunity to set itself apart. At the DIL, our customers can develop their innovative products with the latest Bühler technology and produce trial batches under food grade conditions. If the product is successful, the customer doesn’t have any scale-up risk and we can build and commission the entire plant together.”

Unique in Europe
Dr. Volker Lammers, Head of Process Engineering at the DIL, is in his element in the laboratories. With his colleague Dr. Marie-Christin Baune, Food Process Engineer Scientific Associate at the DIL, they analyze the structure of a pea-based extruded meat substitute. “Alternative and more sustainable protein sources are certainly the hottest topic at present. In our heterogeneous team of engineers, scientists, technicians, and extrusion specialists,
we cover the entire spectrum of process engineering – from basic research to the process of transferring it into solutions with industrial applications,” he says. “We continue where traditional research at universities stops. From start-ups to medium-sized businesses and international heavyweights, we help players to optimize processes, improve products, and develop new food products.”

The DIL’s Center for Proteins of the Future, which opened in August 2021 in collaboration with Bühler, plays a central role in this. Ultimately, it’s the applicability of an innovation that determines its success or failure. “With the new extrusion facility, we have a unique set-up in Europe that allows us to test industrial processes,” says Lammers. Thanks to the new PolyCool 1000 cooling die, Lammers’ team is able to process up to 1,000 kilograms of textured proteins per hour. Such capacities, coupled with expertise at the institute, are in demand beyond the country’s borders, especially in the booming meat substitutes business.

“The DIL has been researching process technology for plant-based proteins for over 10 years. We see two essential prerequisites for their lasting success. First, we need to use technology to make good products that consumers like and value. We have made a great deal of progress in this area in recent years. Second, price is a decisive factor when it comes to product selection. Thanks to the steady increase in efficiency, the sector is rapidly catching up with traditional meat processing,” says Lammers, before heading to a meeting with a local sausage producer who wants to expand his range with plant-based alternatives together with the DIL.

The hunt for new protein sources
For Marie-Christin Baune, the balance between research and application is the spice of life: “I’m involved mainly in research projects on alternative proteins. One exciting project is RaPEQ (rapeseed as a native source of high-quality protein for human consumption). Once the oil has been pressed, the press cake is produced, which is currently used only as animal feed. It contains canola protein, which has an excellent amino acid profile and would be beneficial to humans. Since rapeseed has a somewhat bittersweet aftertaste, solutions are being sought

“WITH THE NEW EXTRUSION FACILITY, WE HAVE A UNIQUE SET-UP IN EUROPE THAT ALLOWS US TO TEST INDUSTRIAL PROCESSES.”

DR. VOLKER LAMMERS
Head of Process Engineering at the DIL
in the breeding sector. At the same time we are researching the process of combining rapeseed protein with other protein sources to determine the mixing ratio that allows the rapeseed taste to become prominent again,” says Baune.

The DIL is pursuing a different approach to research in cooperation with an aroma producer. Here, research is underway to find masking agents that can trump the bitter taste.

A classic cross-disciplinary project is ‘ProFuture’ involving 40 partners within the EU’s Horizon 2020 funding program. Baune and her team are conducting an important study on microalgae as a protein source: “On the one hand, we are aiming for more sustainable algae cultivation through more efficient process solutions, for example, by feeding CO₂ by-products into the photobioreactor. In the classical photosynthesis process, the algae are embedded in a tube system and grow due to sunlight and carbon dioxide. On the other hand, we are carrying out research at the DIL together with our partners on protein isolation from algae as well as general use of algae as nutrition,” explains Baune. The advantages are obvious. The land requirement is minimal compared to the agricultural setting, and certain types of algae can grow in processed wastewater or seawater and therefore do not require fresh water. “In terms of photosynthetic yield, and accordingly with regards to biomass yield, algae grow much quicker than normal plants. Under good climatic conditions, such as those found in the project in Portugal, algae can be cultivated and harvested in reactors throughout the year,” Baune explains.

Thanks to a protein content of over 40 percent, polyunsaturated fatty acids and the formation of vitamin B12, which is not found in plant-based foods and is otherwise only available to vegans in supplements, algae have the potential to make a significant contribution to sustainable nutrition for up to 10 billion people in 2050. “We are currently about halfway through the four-year funding program. As a sponsor, the EU would like to see a fast transfer of research to the market,” says Baune. Together with partners in the food industry, the DIL is now developing products like vegan sausage, soup, pasta, vegetable creams, sports nutrition, and baked goods.
“The DIL is involved from research to market, including upscaling, the logistics chain, and life cycle assessment. This versatility and immersion of ideas, some of which are quite uncommon, together with start-ups is what excites me so much in my work,” Baune explains.

Sustaining momentum
Since the interdependent generation and transfer of knowledge are deeply anchored in the institute’s DNA, it is no wonder that the next milestone is already established. At its newly established Food Science and Technology Campus Artland, students from around the world will be starting their master’s degree in Food Process and Product Engineering in the winter semester 2022/23.

For Clemens Hollah, Head of the Director’s Office at the DIL, this step is a matter of course: “Our food system is undergoing an incredibly dynamic process of transformation. To surmount the global challenges together, we need to drive innovation and train and develop skilled workers. With this degree program, we are promoting our region as a hub for food innovation and expanding our network.”

So, where will the journey take the institute next? “When I started here in 2016, we had approximately 60 employees with around 10 research projects. We now have more than 200 employees, and about 50 projects are running in parallel in the scientific sphere. In addition, there is contract research, such as the projects we carry out with Bühler,” says Heinz. “This growth is due to the fact that we are always working at the interface between research and industrial production. We don’t have to look at the food system in terms of partitioned segments. We can relate to it as a whole system that requires continuous innovation. I can’t imagine a more exciting job. After all, the increasing push from society and business for greater food sector innovation will definitely sustain this momentum.”
THE SECRET FOR PERFECT COLORS

TEXT: BIANCA RICHLE
PHOTOS: THOMAS EUGSTER
Rotoflex AG is an important partner of Bühler when it comes to developing new products for grinding and dispersing ink colors. For over 10 years, the Swiss-based company has thoroughly vetted our new technologies, actively contributing to ensuring that MacroMedia, MicroMedia+ and Invicta are fit for the market. Rotoflex is now testing prospective service offers for Bühler. Both sides benefit from the partnership.
CHEMICAL CONTAINERS as far as the eye can see and an intense paint smell in the air. Three chemists mix various ingredients in the open and spacious laboratory as they create ideal ink color mixtures for printing new chocolate packaging and labels for beverage bottles and even banknotes.

The company, Rotoflex AG, based in Grenchen in the Swiss Canton of Solothurn, specializes in dispersing – mixing – ink colors for food packaging and security printing. Its clients are primarily print shops. The company’s production halls accommodate seven high-energy agitator bead mills. These seemingly inconspicuous bead mills are responsible for almost the entire magic of the production process. Due to consistent grinding and dispersion at micro-scale, the agitator bead mills produce the proper ink color intensity and ensure the consistent quality of the finished product. “Working with Bühler machines opens the door for us to new customers,” says CEO Pascal Diemand. “Technicians will often ask us: ‘So, what kind of bead mills do you use?’ The Bühler brand is like a reference – and we benefit from it.”

Bühler, in turn, benefits from the flexibility of SMEs and their willingness to advance developments. Rotoflex is one of the companies with which Bühler collaborates in the area of wet grinding to advance its respective technologies. “We have a very close partnership with Rotoflex, an innovative enterprise that is highly agile,” says Sandro Perone, Business Development Manager at Bühler. “When it comes to new developments, there are always phases where nothing goes as planned. Honest and constructive feedback from the customer and quick decision-making are crucial in moments like these to achieve a breakthrough.”

As was, for example, the case with the development of MacroMedia. In the first test runs in the lab, things looked promising. In real life production circumstances, however, reaching the desired quality was a challenge. Together with Rotoflex, Perone and his team reached a breakthrough and brought MacroMedia to market maturity. “The contribution of our customers should not be underestimated,” explains Perone. “We are very grateful that Rotoflex provides this essential service.”

Diemand sees their contribution from a different perspective: “Our employees are highly committed. It is exciting and fulfilling for them to participate in new developments.”

Efficiency is the top priority

For Rotoflex, efficiency is the top priority for all new developments. “Operating in the packaging industry means working in a fiercely competitive market with tight margins, which is why we can only be successful by ensuring maximum efficiency,” explains Diemand. Rotoflex strives to make its processes even more efficient. For example, it uses the digital customer portal myBühler to ensure quick and hassle-free ordering of spare parts. Many of Rotoflex’s machines are also connected to the Internet of Things (IoT) via Bühler Insights.
“OPERATING IN THE PACKAGING INDUSTRY MEANS WORKING IN A FIERCELY COMPETITIVE MARKET WITH TIGHT MARGINS, WHICH IS WHY WE CAN ONLY BE SUCCESSFUL BY ENSURING MAXIMUM EFFICIENCY.”

PASCAL DIEMAND
CEO Rotoflex AG

Rotoflex is constantly researching new innovations to find the ideal color mix for printing new packaging. It is moving away from the more traditional inks business to niche markets to gain a competitive edge.
Rotoflex is currently testing other possible IoT services with Bühler that could be of interest to other customers. “Our production manager can monitor the systems 24 hours a day with the help of the IoT and can track the behavior of the machines for each batch produced. Using graphs and data, we can compare and optimize operations,” explains Diemand.

The Smart Dashboard is especially useful for his employees. “Up until now, the machine operator had to remain and wait on-site for many hours during the night shift until the batch was fully processed. Employees can now simply go home during processing. If there is a problem, an alarm is triggered, and the on-call service can intervene if necessary.”

New markets as a new opportunity
“Rotoflex is an incredibly flexible and client-oriented small-scale company,” says Perone. So much so that Rotoflex even makes individual formulations for each client, according to Diemand. This is necessary, he says, because the climate in Italy, for example, is different from that in Russia, resulting in a different viscosity.

“Only by taking the individual parameters into account can you achieve perfect print quality,” explains Diemand. And yet, the last few years have not been easy for the company. After its largest customer fell away in 2017, the company was no longer profitable from one day to the next. Diemand was brought on board in 2019 with the requirement to move the company away from traditional business to more innovative niche business and to secure Switzerland as a production location in the long term. A lot of positive change has happened since then.
“By getting into security printing, we have been able to build a second foothold that is ideally suited to our strengths – very small volumes for specific applications in top quality,” explains Diemand. Rotoflex has also put out feelers into new markets such as Africa and Asia. “In this regard, we are benefiting enormously from the good network that Bühler has around the world.”

During the worst of the Covid-19 pandemic when customer visits were simply not possible, Rotoflex sought opportunities in the crisis and used the time to optimize its processes and focus even more on research and development opportunities. “We have made huge progress and are coming out of the crisis stronger than we went in,” explains Diemand. “We’ve been able to expand our European business a lot.”

Currently, like many others, the company is challenged by raw material shortages in the procurement market. “We are using our full flexibility so that our customers don’t have to feel any of this.”

The classic packaging market is a competitive market in which smaller companies are finding it increasingly difficult to keep up with the bigger players. With innovative solutions, for example packaging reduction, Rotoflex nevertheless intends to hold its own in the future. “We have a laboratory that is almost oversized for the size of our company, allowing us to push ahead with the development of sustainable solutions that are of interest to the industry,” says Diemand.

Rotoflex is working on a barrier coating that doesn’t allow liquid or oxygen in. Such barrier coatings could replace today’s triple-film laminates, which include an aluminum layer in the middle, reducing waste and enabling recycling. It is also working on an antimicrobial barrier coating designed to render viruses harmless, but the difficulty is to develop a product that can come into contact with food. Given Rotoflex’s agility and drive for innovation, it should come as no surprise if they achieve a breakthrough in this area as well.

INFO

ABOUT ROTOFLEX

Rotoflex AG is a leading provider of specialty ink colors and varnishes for the package and security printing industry. The medium-sized enterprise has been in business for over 40 years and is characterized by a high degree of flexibility and the ability to react to particular client demands.

Rotoflex has been part of the Daetwyler Group since 2017. The Daetwyler Group is a family-owned, longstanding corporation from Switzerland with 10 sites and over 500 employees worldwide. Rotoflex exports about 75 percent of its products and exclusively works with bead mills by Bühler for its core process of wet grinding.

Rotoflex AG is strongly focused on developing new solutions to stay competitive in the market.
... that we have a global community of 650 field service engineers at our locations across six continents?

... that there are two main paths of distribution? The regional service centers focus on meeting regional demands. The service hubs orchestrate global requests and bundle shipments to reduce the CO2 footprint.

... that we have more than 250 fully dedicated professionals working in the field of parts delivery management?

... that around 600 parts quotations are offered every working day, of which 30 percent are processed through myBühler?

... that the extended service hub in Uzwil that we commissioned in 2019 features a fully-automated small parts warehouse and boasts 18,000 bins and additional space for 3,500 high-rack pallets?

... that around 500 Bühler field service engineers visit customers each day?

... that we have a global network of more than 65 workshops to serve our customers in several industries such as chocolate, animal feed, brewing, and milling?

... that we have over 460 orders are dispatched to our customers every working day?

... that we have 32,000 different parts in stock in nine different locations to ensure the fastest delivery to our customers?

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Source: Bühler Group.

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ELECTROMOBILITY is happening. It is happening based on lithium-ion battery technology. And it is happening big time. Just recently, Tesla joined the illustrious club of companies that are worth more than USD 1 trillion. Rental car operator Hertz has placed an order for 100,000 Tesla cars. Ford – founder and father of the “model” terminology – has at the time of writing received 160,000 reservations for its F-150 Lightning electric pickup truck.

Rivian has not delivered cars on a commercially relevant scale yet, but it was the most successful IPO of the year, achieving a valuation in excess of USD 80 billion, topping established incumbents. Amazon has announced it will buy 100,000 delivery vehicles from Rivian. So much is happening, it’s impossible to pay justice to all the announcements.

So will there be enough battery production capacity? It is commonly expected that a 30 percent electric vehicle share will be reached by 2030. Based on an annual number of 100 million vehicles produced, that equals 30 million battery packs. If, for simplicity, we assume that all those will be battery electric vehicles with a battery pack of 100 kWh capacity, then a total annual production capacity of lithium-ion batteries of 3,000 GWh – or 3 TWh – will be required. This is the equivalent of no less than 100 gigafactories at 30 GWh, and building them will be quite an undertaking.

For quite a while now, Asia has been acknowledged as the battery epicenter of the world. The rest of the world is now waking up, too. There was the game changing announcement that Volkswagen will build 6 gigafactories of 40 GWh annual battery production capacity to reach a total of 240 GWh. Daimler has announced 200 GWh in 8 gigafactories of 25 GWh. Stellantis has announced 260 GWh, and Northvolt is at 150 GWh. Most target completion dates are set for 2030. Again, it is impossible to list everything that’s underway. The bottom line is: Yes, there will be enough batteries available. Some years back, the spread between demand and supply was a factor of six, then it was at three for some time before the Bühler Networking Days 2019, and today we seem to be fully geared towards a match.

It’s also interesting to note that battery electrochemistries that are known to be cheaper and safer than the latest technologies are en vogue again. They come at the expense of less energy density, but the market has realized that long-haul mileage may be of lesser importance in future megacities with integrated transportation networks. On the other hand, significant technological advances have been made, for instance in the field of solid state lithium-ion batteries, which enable higher electrical specifications and are cheaper to produce because the solvent drying is eliminated in the electrode coating process.

Let’s now take a step back. While this all sounds breathtaking and is indeed stunning to witness, let’s remind ourselves why we are actually driving the change: To contribute to solving global climate change and limit warming according to the targets set forth by the Paris Climate Agreement. Where is the energy that flows into the batteries coming from in the first place? How fast will we actually change the global energy system to make a significant impact, with so many countries still heavily relying on coal?

A coal-fired electromobility revolution would be defeating the purpose of contributing to limiting climate change. The overarching goal still remains to change the energy system of the world, where we simply need to stop burning fossil fuels wherever we can. Some countries are very advanced in this regard, but others struggle. Electromobility is a great solution, but if one says A – let’s go for it; clearly one cannot shy away from B – doing it with the ultimate goal in mind. We will surely address this important topic in the Bühler Networking Days 2022.