

diagram

#186 / June 2023

the Bühler magazine

DRIVING

CHANGE



**THE COLOSSUS OF
THE CAR INDUSTRY**

**MEGACASTING PUSHES THE
BOUNDARIES OF IMAGINATION**

**SUPERCHARGING
BATTERY PRODUCTION**

**RAMPING UP CAPACITY FOR
A GREENER FUTURE**

**WHEN THE CAR
TAKES THE WHEEL**

**ON THE ROAD TO AUTONOMY
WITH SMART SENSORS**

BÜHLER'S ADVANCED MATERIALS BUSINESSES IN YOUR CAR

GRINDING & DISPERSING develops high-end wet grinding, dispersing, and mixing technology solutions to produce printing inks, paints and coatings, digital inks, chemicals and cosmetics, metal pastes for solar modules, and anode- and cathode-slurries for lithium-ion batteries.

LEYBOLD OPTICS specializes in the development and manufacturing of vacuum coating systems, ranging from architectural and automotive glass, precision optics, ophthalmic lenses, and optical filters, to industrial coatings for headlamps and sensors for the automotive sector.

DIE CASTING provides a comprehensive range of customized solutions for all high-pressure die-casting needs – from 3,400 kN up to 92,000 kN locking force – combining state-of-the-art technology with automation solutions specifically developed for the die-casting process.

HATCHBACK DOOR

A hatchback door produced in aluminum die casting saves up to 40% of weight in this component, thereby reducing fuel or energy consumption during the lifecycle of the car.

REAR UNDERBODY

By applying the megacasting process to a rear underbody, around 100 parts originally individually produced in steel stamping can be cast in one shot to simplify production and save costs.

AUTOMOTIVE COATINGS

Coatings are used for decoration, higher surface hardness, protection from UV radiation and corrosion, and to improve performance. Bead mill solutions are used to produce paints and coatings.

BATTERY SOLUTIONS

Two steps in lithium-ion battery cell production provided by Bühler are wet grinding of active materials and precursors, and continuous mixing of electrode slurries for large-scale electrode production.

CHROME INTERIOR

Styling is a key requirement for automobile interiors. Bühler's Chrome-Line enables chrome coating without electroplating, making it a more environmentally friendly alternative.

AUTOMOTIVE GLAZING

Functional coatings for automotive glazing consist of multiple thin film layers. Bühler sputtering solutions apply thin films with specific properties to improve visibility, durability, energy efficiency, and UV protection.

HEAD-UP DISPLAY

Head-up displays project information into the driver's line of vision, allowing them to maintain their head position. To project it clearly, enhanced and cold-light mirrors made with sputtering systems are used.

SHOCK TOWER

Aluminum shock towers are a standard structural die-cast component and are in use across a wide variety of car types and brands in order to reduce the weight of the car.

ELECTRIC MOTOR

Electric motors for battery electric vehicles consist of multiple die-cast parts. Bühler die-casting solutions are used to produce these parts to high quality standards and the tightest tolerances.

OPTICAL SENSORS AND CAMERAS

Optical sensors and cameras keep a constant eye on the car's surroundings by using thin film optical filters – applied by sputtering systems – to extract specific wavelengths out of the surroundings.

RADOME

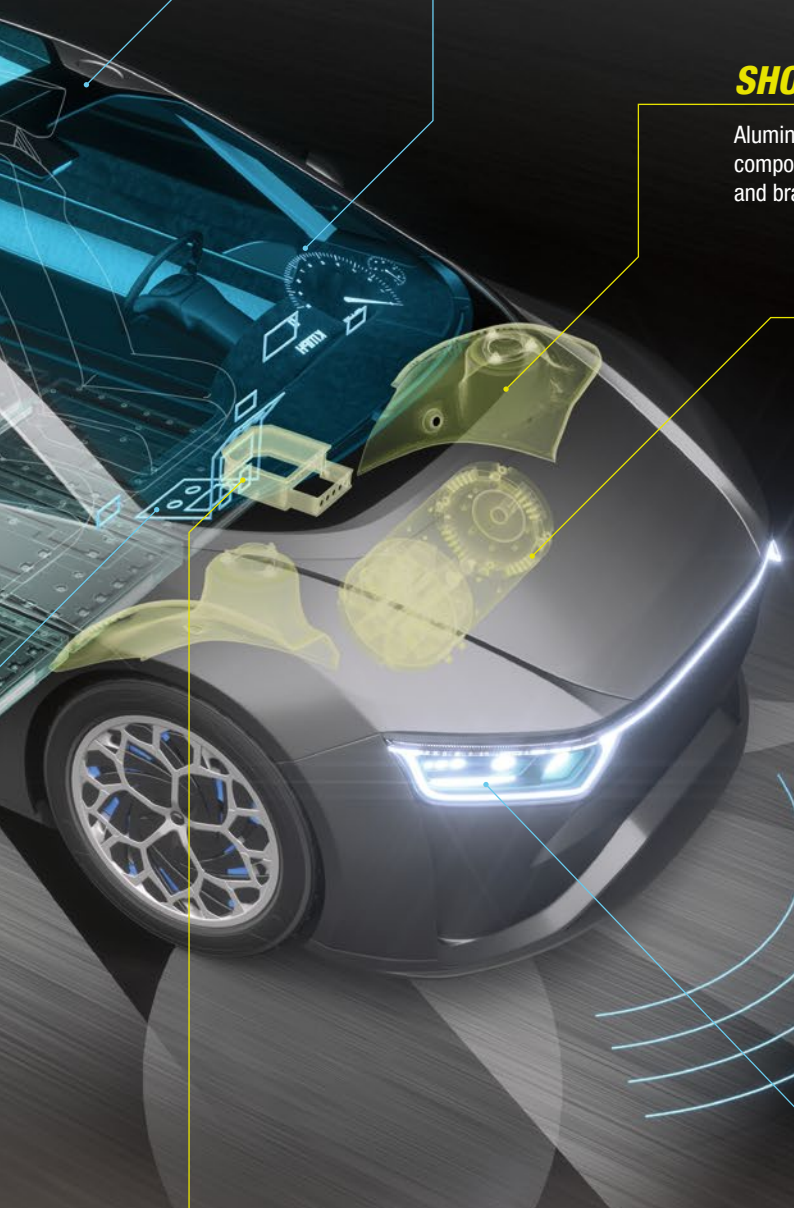
Antennas that measure or transmit data are covered by Radomes with thin-film, deposited coatings to enhance their electromagnetic transparency and protect against wind and rain.

LIGHTING AND PROJECTION

From helping the driver to see the road ahead to communicating with the environment, the role of automotive lighting is evolving. Bühler's sputtering and evaporation solutions enable this development by using thin layers of aluminum.

ONBOARD CHARGER

Housings for onboard chargers are cast to comply with the highest standards in terms of pressure tightness, cleanliness, and dimensional accuracy, while also being lightweight.





**Casting a world
of opportunities.**
Join our webinar
about megacasting.

Megacasting solutions are revolutionizing the industry. Bühler's Carat portfolio, with locking forces up to 92,000 kN, is leading the trend.

Join our webinar to learn more:

- Listen to high level presentations by renowned speakers in the industry.
- Find out more about sustainable body-in-white production with megacasting.
- Ask your questions about Bühler's die-casting solutions.

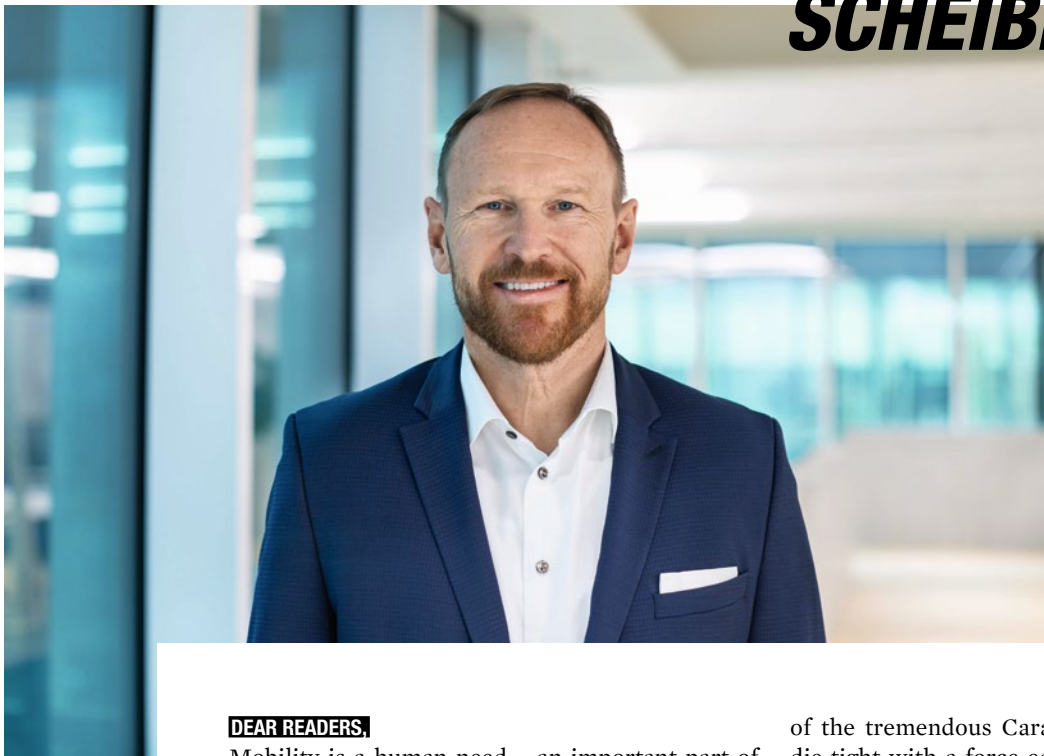
Scan the QR code and register today!

**If you have any questions,
contact us at:
die-casting@buhlergroup.com**



EDITORIAL

STEFAN SCHEIBER



DEAR READERS,

Mobility is a human need – an important part of the daily lives of billions of people the world over. Whether going to the shops, taking children to school, getting to work, visiting friends and relatives, transporting goods, or simply traveling for the sheer joy of discovering new places, we are often on the move. Mobility isn't just a nice-to-have, it's essential.

We are increasingly aware of the cost that mobility creates for the environment. According to the Intergovernmental Panel on Climate Change, the transport sector contributes up to 15 percent of global greenhouse gas emissions, of which over half is produced by road-based passenger transport. As the global population grows and incomes rise in developing and emerging economies, this is increasing. We need to shift gear to ensure that our everyday activities can be carried out with a lower impact on the environment.

This realization is driving a seismic shift in the automotive industry and this issue of Diagram is dedicated to that topic. From the new trend in megacasting, to battery development for electric vehicles, sensors and projectors that enable more autonomous driving, and coatings that improve the overall efficiency of the vehicle, together with you, our customers, we are working to find new ways to solve these challenges. Sometimes the advances are huge – who can fail to be impressed by the sight

of the tremendous Carat 920 at work, locking a die tight with a force equivalent to the weight of the Eiffel Tower? Megacasting is creating a revolution in automobile production, reducing production costs and product weight, and – crucially – improving sustainability.

This is just one example of how our Advanced Materials businesses are supporting you to drive change. As our new CEO of Advanced Materials, Marcel Natterer, says, the industry is changing fast, with many exciting opportunities and challenges. We support our customers as they navigate through this terrain.

In this issue we also look at developments in other businesses. Take a look at how we are supporting Camel Flour Mills, which has become the largest privately-owned miller in Egypt thanks to investment in the latest technologies from Bühler. In Spain we are supporting Golden Pet Food to produce quality pet food more efficiently and sustainably. And in Switzerland, we helped our customer Pronatec AG, a leader in fair-trade and sustainably manufactured products, to build one of the country's most modern cocoa processing plants.

Looking at the road we're on, it is clear that we are making a real difference. Together we will build a more sustainable future.

Sincerely yours,
Stefan

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ON TO NEW HORIZONS

The car has revolutionized the way we travel and live, and it's hard to imagine life without it. But along with the many benefits it brings us, there are also massive challenges. Harmful emissions pollute the air, and accidents claim around 1.3 million lives worldwide every year. In many major cities, the mass of vehicles means that driving speeds are barely more than walking pace. And the mass is still increasing. With around 1.4 billion vehicles on the roads worldwide today, this number is expected to increase to 1.8 billion vehicles by 2035.

These are huge challenges, but not insurmountable ones, and they are being worked on at full speed. Electric vehicles (EVs) are on the rise. In China, 6.8 million EVs were sold in 2022, and Europe will no longer allow new cars that run on gasoline or diesel from 2035. Accordingly, many new electric models are being planned by car manufacturers.

Autonomous driving has the potential to make traffic smoother and safer. In 2022, Shenzhen became the first city in China to allow robotaxis on its roads, joining other cities like San Francisco, US, where the technology has been tested for several years. However, there is a long way to go before the trend picks up speed worldwide.

The solutions are available, but now the necessary framework conditions must be created to implement them.



THE EVOLUTION



The automotive sector is currently undergoing the deepest transition since the invention of the internal combustion engine. New forms of competition, new consumer expectations, and the urgent need to mitigate climate change are forcing a rethink of every aspect of the car.



OF AUTO- MOBILITY

TEXT: STUART SPEAR

THE ELECTRIC VEHICLE (EV) is changing the way cars are designed and manufactured as well as what they are designed to do. It's also changing who makes cars. Car manufacturers used to be able to rely on the high level of capital expenditure needed to set up a car plant as a moat to market entry. This is no longer the case. EVs are simpler to make, so it is easier for newcomers operating within sophisticated supply chains to enter the market with new ideas about how things could be done more efficiently.

As governments find ways to meet their global climate change targets and cities introduce more stringent regulations to improve air quality, the demand for EVs is on the rise. Recent research by Goldman Sachs shows that EV adoption is expected to double to 16 percent by 2025, reach 33 percent by 2030, and cross the 50 percent threshold soon after 2035. This rate of adoption is key to helping combat climate change. According to the Intergovernmental Panel on Climate Change, we have the potential to cut carbon emissions from the road transport sector by up to 70 percent by 2050 the closer we get to mass conversion to EVs powered by renewables on the world's roads. With transport contributing up to 15 percent of global greenhouse gas emissions, of which over half is produced by road-based passenger transport, EVs can play a significant role in the fight against climate change, bringing fundamental change to industry and wider society.

***"IT'S A VERY DYNAMIC INDUSTRY,
AND THE SPEED WITH WHICH
ELECTRIC MOBILITY IS GAINING
MOMENTUM DRIVES INNOVATION
AT AN UNPRECEDENTED LEVEL."***

CORSIN BATTAGLIA

Head of Laboratory Materials for Energy Conversion at the
Swiss Federal Laboratories for Materials Science and Technology (Empa)

"The automotive industry supply chain is changing due to a paradigm shift in the technology and global challenges we face," explains Remo Schwerzmann, Head of Grinding & Dispersing at Bühler. "This offers new opportunities as electric powered cars need smart solutions to increase the range of the car and improve reliability, safety, and comfort through sustainable energy solutions."

One person at the center of all this change is Corsin Battaglia, Head of Laboratory Materials for Energy Conversion at the Swiss Federal Laboratories for Materials Science and Technology (Empa), where he and his team develop new materials and processes for next-generation batteries, in collaboration with industry. He is very aware of how fast things are changing and what this means for industry players. "It's a very dynamic industry, and the speed with which electric mobility is gaining momentum drives innovation at an unprecedented level," he explains.

Die-casting shifts the scale

It is not just how automobiles are powered that matters to the climate; it is also how they are made. Manufacturers are therefore also focusing on cutting production emissions by moving away from steel and shifting to making cars out of aluminum on ever-larger die-casting solutions.

Aluminum has several significant environmental advantages. It has the potential to be net zero if it is produced using renewable energy sources such as solar or hydroelectricity. It is also a highly recyclable material, meaning that the larger the aluminum parts used in the car, the greater the potential for recycling once the vehicle is scrapped. As component parts have become larger there are also environmental savings when it comes to car assembly. Larger parts mean fewer robots needed to bolt components together, so factories can be smaller, less energy is used in the manufacturing process, and fewer components need to be transported to the assembly plant. Aluminum is not just more efficient in sourcing and production, it is also lighter, which has an environmental advantage when it comes to battery range.

To produce the larger and more complex car components that are increasingly being demanded by the market requires increasing the size and locking force of die-cast machines. Bühler is working with its die-casting customers to meet this challenge. Over the past four years, Bühler has developed its Carat die-casting solutions to include the 560 and 610, and the more recent 840 and 920. Each iteration of the Carat range has meant customers being able to produce ever larger and more complex structural parts for their vehicles in one shot.

"The idea is to build the complete car out of three parts – a front underbody, a middle casting for the battery case, and then a rear underbody. We are replacing all the individual parts that must be glued or welded together with one single casting," says Cornel Mender, Managing Director Die Casting at Bühler. "There are many advantages. It makes recycling easier, it requires fewer robots, and it means the footprint of the assembly line can be reduced."

Norway is playing a pioneering role in electromobility. Four out of five newly registered cars in the country are electric today, and the target is 100 percent by 2025.

The mass conversion to electric cars powered by renewables has the potential to reduce CO₂ emissions from road traffic by 70 percent by 2050.



At the heart of every EV lies the electric battery. Making up around a third of the price of the overall vehicle, the race to drive down the cost and improve battery performance is key to the evolution of the EV market. And as the demand grows for batteries that are smaller, weigh less, produce more power, charge faster, and last longer, the production specifications of each battery manufacturer need to be more stringent. Each battery component must be of the highest quality and consistency.

Battery performance relies on the quality of the battery slurry or electrode slurry that will ultimately coat the anode and cathode that generate the electric current. Made up of nano- and micro-scale particles of lithium metal oxides, graphite, silicon, conductive additives, and polymer binders, the battery performance depends on the proper grinding and dispersal of these constituents according to the strict manufacturing parameters set by each individual battery manufacturer.

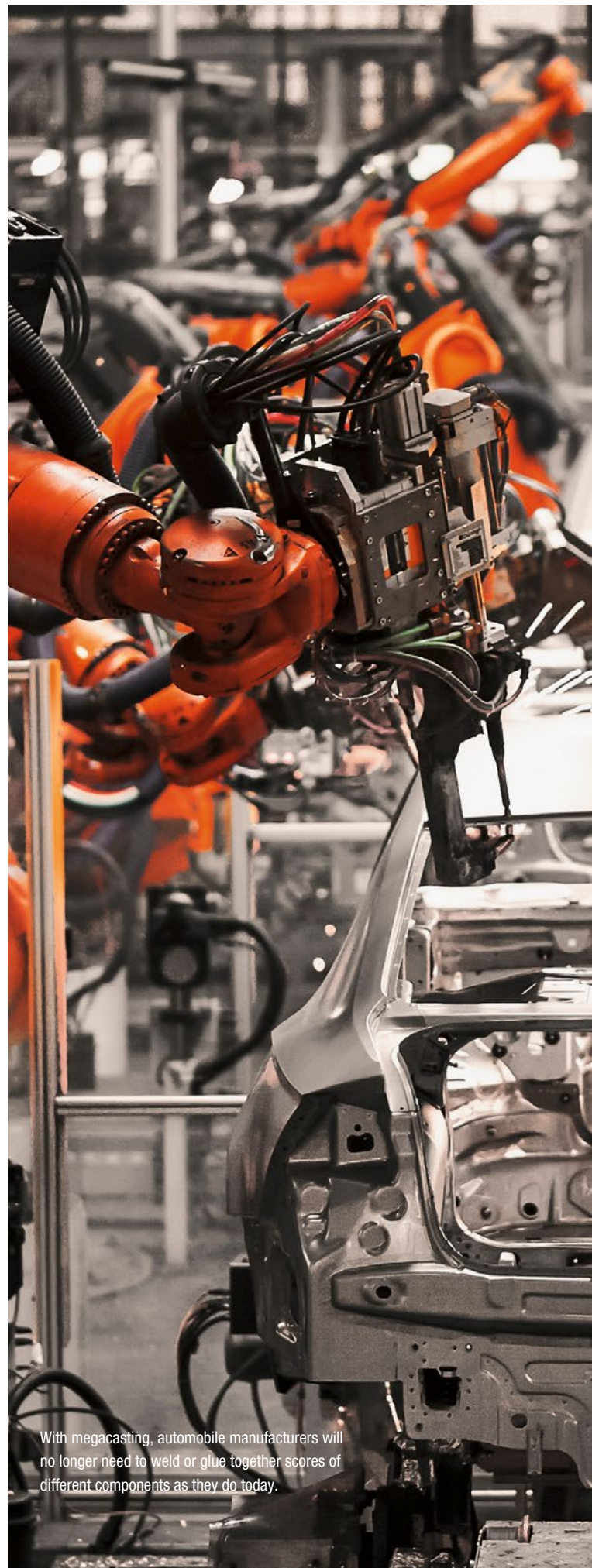
Bühler specializes in two key stages in this process: the wet grinding of the raw materials for the anode and cathode active materials, and the mixing of the electrode slurry. “While we only supply a small part of the entire value chain, we are actually deep in the industry because it is only when the slurry is mixed to the strictest parameters that high battery performance can be achieved,” explains Schwerzmann.

Transforming the mixing process

Historically, battery production has been based in Asia, where battery slurry was mixed in large vats involving the labor-intensive cleaning of each vat after each production cycle. Using vats also runs the risk of batch wastage if a testing sample fails laboratory quality controls.

Leveraging its knowledge around the continuous production of high-tech, non-food products, 10 years ago Bühler produced a continuous battery slurry mixing solution using twin-screw mixers. One of the main benefits of continuous mixing is the ability to automate the process and have it running 24 hours a day with no need to interrupt production to clean equipment. Continuous mixing also eliminates the risk of batch wastage. Bühler launched QuaLiB which provides a real time data flow of production parameters. This data can then be continuously monitored and tightly controlled to improve process safety, product quality, and overall yield.

“When it comes to the mixing of the slurry, we have years of in-house knowledge about how to fine-tune the required properties and how to execute a production plant,” explains Schwerzmann. In a market where each increase in battery performance means a competitive edge, the ability to fine-tune production parameters in this way is key.



With megacasting, automobile manufacturers will no longer need to weld or glue together scores of different components as they do today.



“THE IDEA IS TO BUILD THE COMPLETE CAR OUT OF THREE PARTS – A FRONT UNDERBODY, A MIDDLE CASTING FOR THE BATTERY CASE, AND A REAR UNDERBODY.”

CORNEL MENDLER

Managing Director Die Casting at Bühler

Scaling up battery production on an industrial scale is crucial to achieve climate targets. A daunting challenge especially in Europe, where research institutes, car manufacturers, and governments are trying to make up for lost ground and build a self-sufficient battery industry from scratch. Bühler's continuous mixing technology enables researchers to accurately calculate the parameters for industrial battery manufacturing by running trials on a smaller and far less expensive scale.

From automation to autonomy

How they are made, how they are powered; the automotive industry is working at full speed to find ways to meet our mobility needs more sustainably. The next revolution will be in how they are driven. Here the focus is on connectivity and automation.

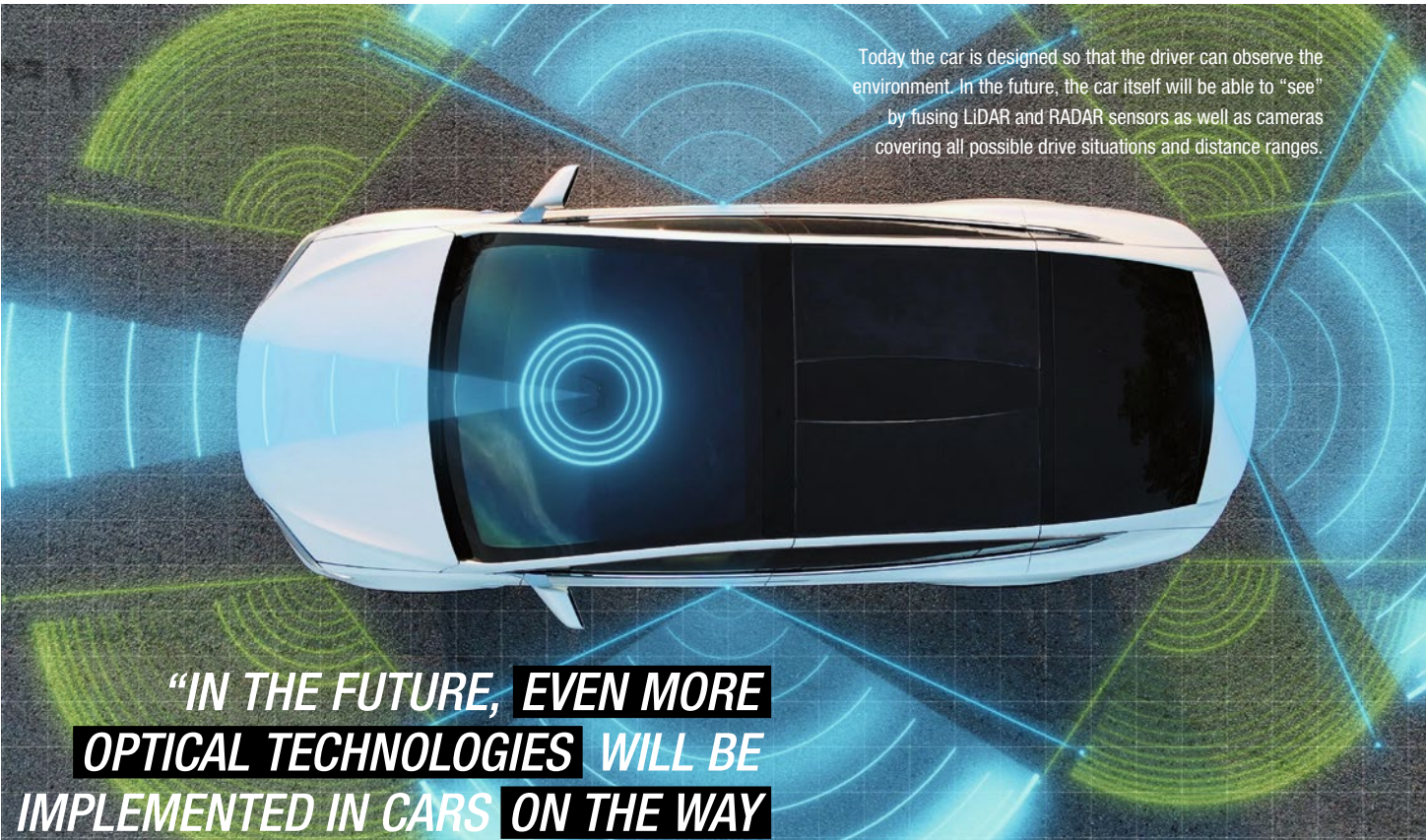
From driver assistance features like adaptive cruise control to conditional automation, where the vehicle analyzes and interprets complex traffic scenarios and makes appropriate decisions, to full automation, where the vehicle makes real-time decisions in any driving condition or environment – the journey to toward autonomous driving is already well underway.

At the core of these changes are the sophisticated optical sensors needed to make this technology work. An optical sensor is the “eye” of the car. A prominent example is LiDAR (light detection and ranging) sensor technology, which is at the forefront of this transition with its ability to send out a laser beam that can scan its whole environment and, in doing so, calculate safe distances.

Microchips are the other key technology that will increasingly play a role. As we move toward autonomous driving, they must be powerful enough to process and analyze vast quantities of data from multiple sources and make complex real-time decisions in a wide range of scenarios.

These systems can only work effectively if they can filter out irrelevant information and focus on what matters, just like a human driver. To do this requires coating the sensor, or, in more advanced systems, coating the microchip itself with filters. Bühler Leybold Optics specializes in the manufacture of thin film vacuum coating equipment and also the corresponding coating processes that can meet these stringent requirements.

“In the future even more optical technologies will be implemented in cars on the way to fully autonomous driving,” explains Dr. Steffen Runkel, Head of Optics at Bühler Leybold Optics. “Today, the car is designed so



Today the car is designed so that the driver can observe the environment. In the future, the car itself will be able to “see” by fusing LiDAR and RADAR sensors as well as cameras covering all possible drive situations and distance ranges.

**“IN THE FUTURE, EVEN MORE
OPTICAL TECHNOLOGIES WILL BE
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TO FULLY AUTONOMOUS DRIVING
AND ALTERNATIVE POWERTRAINS.”**

DR. STEFFEN RUNKEL

Head of Optics at Bühler Leybold Optics

that the driver can observe the environment well, in the future the car itself will be able to ‘see’. This will be done by fusing LiDAR and RADAR sensors as well as cameras covering all possible drive situations and distance ranges.”

Improving sustainability all around the car

With every aspect of the car in transition, new technologies and new materials are coming into play. For example, reducing the weight of the vehicle means not just shifting from steel to aluminum, but also using thinner glass substrates for automotive glazing. And with the shift to EVs, the focus is on using energy as efficiently as possible to maximize battery performance. This means not just moving to lighter-weight vehicles, but also finding better ways to control cabin temperature, for example through solar-controlled and low-emission glass and using electrochromic coatings to shade interior spaces for both comfort and privacy.

Last but not least comes the look of the car. Chrome plays a significant role in the aesthetics, but the process of applying it has many drawbacks. Vacuum coating technologies provide a clean and sustainable alternative for metalizing 3D plastic components and trim parts. In comparison to classical electroplating, vacuum coating processes drastically reduce water and energy consumption and fully eliminate harmful chemicals. As for the coatings on the exterior, by producing these on highly efficient bead mills ensures minimal energy is required for maximum effect.

As the car industry transitions from the internal combustion engine to the EV, and as old conventions are questioned and new approaches developed, Bühler’s aim is to support customers with solutions that enable them to drive forward change and to play their part in providing sustainable mobility to people the world over.



Simplify your sustainability journey. Quantify your environmental footprint.

As a technology provider for the food, feed, and mobility industries, Bühler offers a unique combination of process knowledge and quantification to build tailored sustainability solutions.

Bühler's Environmental Impact Services enable companies to:

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- certify and report key sustainability metrics;
- build a plan to reduce their footprint.



To find out more about the service scan the QR code.

Or contact us at:
jay.onien@buhlergroup.com

Let us support you on your sustainability journey!

From left to right: Burkhard Bönzel, Head of Corporate Communications, Marcel Natterer, CEO Advanced Materials, and Cornel Mandler, Managing Director Die Casting.



TRANSFORMATION

ON EVERY LEVEL

TEXT: BURKHARD BÖNDEL
PHOTOS: JEKATERINA GLUZMAN



The transformation of one of the most important industries globally – the automotive industry – is fully underway. Marcel Natterer, CEO of the Advanced Materials business at Bühler and Cornel Mandler, Managing Director Die Casting discuss the opportunities and challenges, the speed of developments, and the solutions Bühler offers to support its customers.

Cornel, do you drive an electric car and what is your experience with it?

CORNEL: Yes, I've been driving an electric car for over four years, and I would not go back. You have to think ahead about charging your car and the distance you're driving. But when we are on vacation with the family, we more frequently stop for a break for us than to recharge the battery.

Marcel, you have been in charge of Bühler's Advanced Materials business since March 1 this year. How is it going?

MARCEL: I am very excited, and also very grateful. I am taking over this fascinating business at a moment in which the markets are in a fundamental transformation. The key words of this new era of mobility are 'connectivity', 'autonomous', 'sharing', and 'electrification'. This opens up new opportunities for all market players, including Bühler. We have put a lot of focus on strategically developing innovations in recent years and we can now offer key technologies and solutions in this area – just as these trends are developing into reality.

Which of these developments is already reality, which ones are happening faster than we thought, and which are taking a bit longer?

CORNEL: The trend towards e-mobility is happening a lot faster than we expected. A while ago, we carried out an analysis with a base, intermediate, and an optimistic scenario. The current development is moving faster than even our most optimistic scenario. The shift towards e-mobility is now visible everywhere. Look at Tesla and the many Chinese new energy vehicle companies.

However, it is also clear that we will continue to live with all kinds of drivetrains for the next few decades – full electric, hybrid, fuel cell, and combustion engines. In terms of the other trends, connectivity is developing fast so that we now see the car of the future as a computer on wheels. In terms of sharing and autonomous driving, these developments will take longer to become mainstream, but there is no doubt that they will happen too.

What does that mean for the original equipment manufacturers? What are the challenges and opportunities they face in this transition?

MARCEL: Let's start with the opportunities. We are in a phase in which mobility, with the car as a key element of this, is being newly defined. With the expertise the original equipment manufacturers (OEMs) have gained over the past 100 years, they can now develop new car concepts that enable new driving and safety experiences using new manufacturing methods and utilizing new or different supply chains. They can also develop solutions that are far



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MARCEL NATTERER

CEO Advanced Materials at Bühler

more environmentally friendly and more comfortable. They can offer services to their customers. They can also produce more efficiently. And they can promote their offerings through different selling approaches, such as online, which improve the customer experience.

This suggests there are also challenges, right?

MARCEL: Absolutely. A key challenge is the speed of change. Can you change fast enough to keep pace with this new world, not only with new products and manufacturing technologies but, even more importantly, with your image? A large network of dealers, for instance – which has been a key element in promoting cars in the market to date – is no longer enough to reach the right target group.

New entrants are thinking differently and moving fast in this area. This is also true when we look at new car concepts. Software and connectivity are key, so more resources, knowledge, and competence are needed in this field. And there are other challenges that concern the whole industry. Legislation and government regulation have a major influence on the planning and development of mobility. This varies from country to country and region to region. Take, for example, the assumption or requirement that electric cars must make a major contribution to the transition towards sustainable mobility. This will require even more capability to develop CO₂-neutral cars and solutions.

What effect will this have on the competition among carmakers?

CORNEL: The cards will be completely reshuffled. That is the reason why we see so many new companies and brands, especially in China and the US. We are in a start-up phase. This situation offers most opportunities for Chinese manufactures because

they operate in the largest market, with a digital-savvy population, and they have full government support and no heritage. US carmakers have the best access to software, which gives them some advantages. The European car industry, specifically the German OEMs and their key suppliers, are in a more challenging position.

We have talked about opportunities arising from new production methods. What about die casting? What role does it play in this industrial metamorphosis?

CORNEL: Cars are mainly made from steel, plastic, or aluminum. All raw materials have their own specific profile, with pros and cons. However, only aluminum offers the possibility to produce large parts in one shot with such a level of functional integration and stiffness for the car body. This is the reason why we have seen a general trend over recent decades towards structural aluminum parts such as shock towers and longitudinal members. Now, with the change to electric drive trains, carmakers need to rethink the car body anyway and have the option of massively simplifying the way it is made.

In what way?

CORNEL: The idea is to produce the whole car structure basically with three parts: two for the front and rear, and one middle part to hold the battery, all made of very large aluminum parts that are produced in one shot. The parts each weigh easily more than 100 kilograms.

How does this work?

CORNEL: This requires a new die-casting solution, which we call megacasting. Essentially, we have developed a new class of machines – the Carat 610, 840, and 920. The last of these has a locking force

of up to 92,000 kilonewtons, a power strong enough to lift the Eiffel Tower. But megacasting only works if you rethink the flow of a cell. To give you an example: the amount of aluminum required is so high that each cell needs the capacity of a current melting furnace. In addition, the part handling equipment and the presses need to be designed to carry and process such heavy parts.

What are the benefits for OEMs?

CORNEL: One megacasted aluminum part can replace up to 100 smaller steel parts. Imagine what that means in terms of footprint and assembly in the factory. A rough estimate is that this saves around 30 percent of space and several hundred robots. Also consider the engineering efforts that can be minimized. It's hard to put all this into specific numbers, but it is obvious that it goes into the millions.

Which of the OEMs has already jumped on the bandwagon?

CORNEL: Around 10 OEMs so far have decided to include megacasting in at least one future platform. These include Tesla, which started several years ago, new Chinese car manufacturers like NIO, Human Horizon, and X-Peng, as well as Volvo and various others.

What are the challenges of megacasting?

CORNEL: The main challenges, among others, are the new dimension of the parts and integration of the casting into the car assembly line. Manufacturers want to ensure that they have 100 percent quality parts and no rejections. The requirements for full transparency and control of the process are higher than ever today.

Are these challenges specific to this industry?

MARCEL: On the contrary. This is true for many industries and solutions. The key to overcoming these challenges is to have the data and digital connections and applications – meaning sensors, data points, cloud platforms, analytics, and monitoring – in place that allow for full process control and traceability. Bühler has made huge investments in this area over recent years and can now offer a broad range of services. We have developed our own industry platform called Bühler Insights.

What does that offer customers?

MARCEL: This enables us to offer innovative services, such as MyBühler, which includes many features such as e-services, e-maintenance, and e-training, real-time remote guidance and support, web-based automation interfaces, dashboards with downtime analysis, and an online spare parts catalogue with all the related commercial functions included – and

“THE TREND TOWARDS E-MOBILITY IS HAPPENING A LOT FASTER THAN WE EXPECTED. IT IS ALSO CLEAR THAT WE WILL CONTINUE TO LIVE WITH ALL KINDS OF DRIVETRAINS FOR THE NEXT FEW DECADES.”

CORNEL MENDLER

Managing Director Die Casting at Bühler

much more for a comprehensive customer experience. Today, all Bühler solutions are connected to Bühler Insights. The key solution for die casting in this field is our integrated Digital Cell, with the SmartCMS (Smart Cell Management System). It helps our customers to achieve their efficiency and sustainability targets.

How exactly does that work?

CORNEL: The Digital Cell brings all of the individual die-casting components together under one smart digital brain called SmartCMS. With the capability to collect and manage information from all integrated peripherals, SmartCMS will drive a step change in the process. The Digital Cell aims to deliver zero percent scrap, 40 percent less cycle time, and 24/7 uptime. Megacasting makes this concept even more relevant.

How far has Bühler Die Casting come in realizing this concept?

CORNEL: Currently, we have two fully integrated cells in operation – one in our test facility and, for almost a year now, one cell at a customer for commercial production.

We are entering a phase where many visions for mobility and the car industry are becoming reality. Die casting aside, what other solutions can Bühler bring to the table?

MARCEL: Mobility and automotive are key markets for the whole of Bühler's Advanced Materials business. Leybold Optics, which is specialized in high precision coatings, has solutions to produce all the sensors and lenses needed for autonomous, safe, and comfortable driving. The information that these sensors gather is also crucial for connected mobility



systems. Another application of this core competence is the coating of car glass to improve the climate within the car. Coated car glass can help to significantly reduce the consumption of energy needed for heating and cooling – and for electric cars, for instance, that means achieving longer distances on one charge.

Last but not least, our Grinding & Dispersing business has developed a continuous process to produce electrode battery slurry – a key component for batteries – at higher quality, with lower energy consumption, and with a smaller footprint.

This is a fundamental transition. What other opportunities does it offer?

MARCEL: New services will be developed for every area of the transformation, especially around digital – for instance, in-line and instant quality control. New materials will also create new markets. Today at Bühler, we are already offering grinding and dispersing solutions that enhance the portfolio of our customers who require precursors and active materials for batteries by providing higher performance and longer lifespan.

Advanced infotainment systems, safety, and autonomous driving features, such as LiDAR, will continue to drive the demand for improved sensors

and higher precision optics. And besides the transformation of mobility, changes in the way we consume raw materials, including re-use, recycling, and processing of secondary materials, are increasingly interesting for us and will create future opportunities in our Advanced Materials business, and for our customers.

In times of disruptive change there is often an element of hype. So, how sustainable are these trends really?

CORNEL: The new factories currently under construction will produce the first vehicles in about three to five years. During that time, we see growing demand for new parts and perhaps also new platforms.

What is the biggest risk?

MARCEL: In my judgement, the trends we have just discussed are irreversible. So, I think the biggest risk for everybody involved, be it OEM, supplier, or solution provider, is to just wait and see.

And Marcel, are you considering changing to an electric car?

MARCEL: I am actually checking that out at the moment. Most likely it will be a phased approach and I will start with a hybrid.





THE LIGHT TOUCH

Most of the cars in the world today are made primarily of steel. It is strong, relatively inexpensive, and easy to form. But it has one drawback – it is also heavy. And the heavier a vehicle is, the more energy it uses.

It is estimated that every extra 50 kilograms of weight reduces fuel efficiency by 1 percent. This impacts not only the driver's wallet but also the environment as it reduces a vehicle's range.

All this is driving the search for lighter alternatives. One material at the forefront is aluminum. Lightweight, strong, and sustainable, it is proving very attractive. In Europe, the amount of aluminum in all cars increased from 174 kilograms (kg) in 2019 to 205 kg in 2022; in electric vehicles it stands at 283 kg. The trend is predicted to continue, because aluminum is not only lighter, very recyclable, but also nearly net zero when produced with renewable energy sources.

Bühler – at the forefront of aluminum die-casting solutions – is supporting the automotive industry's efforts to make cars as light as possible, helping pave the way to more sustainable mobility.

The design of the Carat 920 positively impacts the quality of complex, thin-walled parts which require an extremely powerful and accurate injection unit and a homogenous locking force application.



THE

COLOSSUS

OF DIE CASTING

TEXT: GERRIT WIESMANN



A revolution is underway in the automotive industry. Instead of assembling a slew of separate stamped steel parts, vehicle manufacturers are die casting a few single aluminum modules to constitute a big portion of the body-in-white. Buhler's colossal megacasting platforms, Carat 840 and Carat 920, help cut production costs and product weight, as well as improving the sustainability of automobile production.

BUHLER'S LARGEST DIE-CASTING PLATFORMS each weigh upwards of 600 tons and occupy the space of a generous single-family house. And while the Carat 840 and Carat 920 are about as immobile as a house, in fact they provide a crucial contribution to modern mobility, as they enable auto manufacturers, especially those making battery-electric vehicles, to die cast ever larger parts in one piece.

A single aluminum megacasting replaces dozens of parts, potentially cutting production time and investment costs, while reducing the vehicle's weight and improving its driving range.

"We are seeing a huge increase in the demand for ever larger solutions," explains Michael Cinelli, Product Manager Die Casting at Buhler. "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." Megacasting pioneers are now looking to make the rear underbody of what is also called the body-in-white in one piece of aluminum. This will save them welding or gluing together 70 to 100 components – almost all of which have to be manufactured separately.

Larger castings improve efficiency

By enabling automotive manufacturers to revolutionize how cars are made, Buhler is helping them to attain new levels of efficiency. Where they currently need an assembly line of about 300 robots to put together a rear underbody, automobile makers can switch to using a Carat 920 to produce it in one piece. As even Buhler's largest machine only requires around 800 square meters of floor space, manufacturers could save around 30 percent of expensive production space.

Buhler's largest die-casting platforms are truly shifting vehicle production into new territory. Manufacturers now have the ability to megacast structural parts as large as 1.8 meters by 1.8 meters. "We're talking about the rear and front underbody," explains Martin Lagler, Director of Global Product Management and Marketing for Die Casting at Buhler. "With our solutions, die casting these large parts is now part of the manufacturing process for automobiles."

Buhler has made this significant step by working with customers. "It is a close collaboration. And the journey is just beginning," says Lagler. Forming large amounts of aluminum in milliseconds is an extremely complex process. Manufacturers can today process twice as much aluminum in one die as they could only a few years ago.

"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 kilonewtons to it," explains Cinelli. "That's

9,000 tons – the same weight as the Eiffel Tower. Imagine locking the die with the weight of that Parisian monument ensuring the excellence of every single shot.”

To cast ever larger and more complex parts, die-casting machines must be powerful and precise. Die casting aluminum structural components for vehicles took off a little over 15 years ago, and Bühler has been involved from the beginning. Vehicle makers were able to produce more and more models using aluminum in the body-in-whites, including structural components such as shock towers, longitudinal members, tailgates, and battery housings for electric vehicles. Large, yet lightweight, die-cast aluminum parts were a focus of industry innovation.

Bühler’s Carat series of machines has been a major driver in the segment for more than a decade. With its unique shot control and a casting process that protects the die, a Carat machine can help to increase overall productivity by up to 30 percent. Its two-platen closing unit ensures more stable production than less sturdy toggle systems, while better locking force distribution and reduced flash mean better repeatability and higher uptime. By automating it with Bühler’s SmartCMS system, all peripheral devices are fully integrated, thereby increasing the performance of the entire casting cell.


More than 800 Carat machines are in use today, making half of all structural parts manufactured worldwide. As they helped die casting to become

standard in vehicle manufacturing, the trend towards megacasting gained more and more traction. “Automotive manufacturers are currently rethinking production in many ways,” says Lagler. “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.”

Reimagining die casting

Megacasting ever larger vehicle body parts is pushing the boundaries of die casting, and of every crucial complementary discipline – component design, alloy selection, melting, dosing, tempering, spraying, casting, extraction, cooling, deburring, marking, and final handling. In addition to supplying the right die-casting machines, Bühler also helps customers conceive the die-casting cell, from the melting furnace through the process chain to the finished part and its integration into existing manufacturing sites.

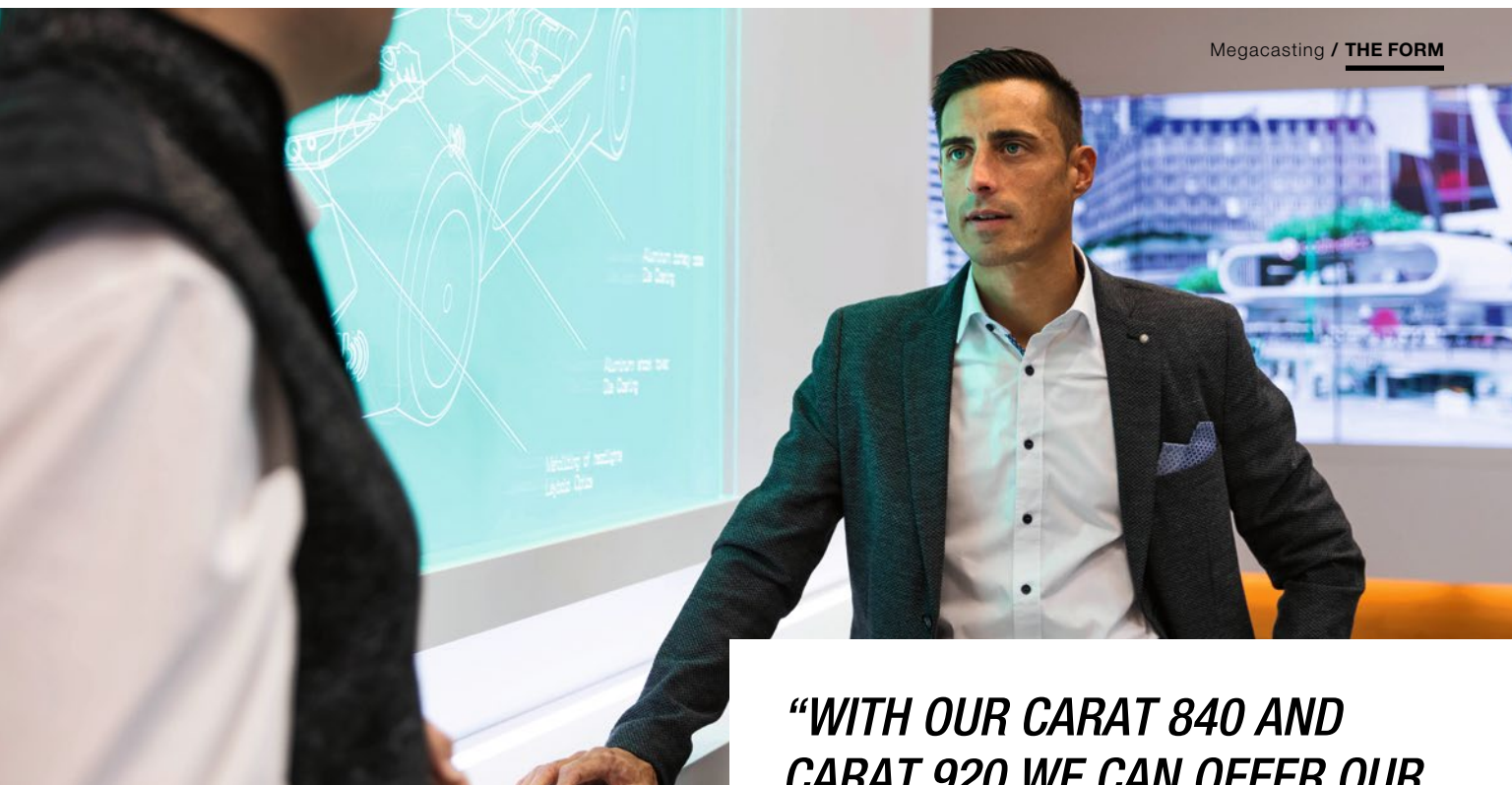
As aluminum die castings grow, all production steps must be reconceived to cope with the size and weight of the new megacastings – the fact that they can no longer be carried by humans is just one of the many challenges. That’s why Bühler works with its customers to conceive and commission entire process solutions from ingot to the body shop. Robots and transport racks, for example, are vital parts of an integrated transportation system that takes over the handling of megacastings from the



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MARTIN LAGLER

Director of Global Product Management and Marketing Die Casting at Bühler



“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

jaws of the Carat machine 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 Lagler.

Bühler helps manufacturers design and build complete custom solutions, with professional project management to deliver on time and on budget. Aside from planning and commissioning, Bühler also offers training, maintenance, servicing, and support once the megacasting cell is running.

A future of zero scrap

Another upside of such solutions is the improvements in sustainability that they bring. Aluminum die castings can be almost CO₂ neutral if low-CO₂ aluminum alloys are used for production and green electricity to power induction melting furnaces. Cells are also constructed to catch aluminum overflow and re-use it directly, avoiding transport emissions and recycling costs. “Aluminum die casting can be close to CO₂ neutral if foundries use recycled secondary aluminum and run their production on green electricity,” Cinelli says.

Bühler’s vision for the future of the die-casting industry is zero percent scrap, 40 percent less time to make a casting, and 24/7 production. “Advancing 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,” says Lagler. The aim is to make every shot perfect and to produce parts that are ready to install every time.

BENEFITS

- + Megacasting reduces product weight and production time by replacing dozens of parts that have to be put together individually.
- + A stand-alone megacasting cell cuts investment needs and production area by replacing robots and other devices.
- + Making a megacast can be close to CO₂ neutral if low-CO₂ aluminum and green electricity are used.

Find out more about Bühler’s megacasting solutions.





Magna UK chose the Carat 220 and Carat 440 for its needs. Carat is a two-platen die-casting solution with locking force ranging from 3,400 kN to 92,000 kN.



FORGING

Magna

NEW GROUND

TEXT: STUART SPEAR

The car industry is changing and Magna, one of the world's largest car part manufacturers, has, with the help of Bühler, turned concept into reality with the opening of a state-of-the-art die-casting facility in the UK.

OUR CENTURY-OLD RELATIONSHIP with cars is changing. Not only is the internal combustion engine being replaced by electric motors, but we are on the cusp of ever-increasing vehicle automation and connectivity while some of us living in urban settings are replacing car ownership with the concept of car sharing. It's not just our relationship with cars that is in flux, it's also the way they are being made.

Car architecture is evolving. Global demand for electric vehicles reached 10.7 million in 2022, representing one out of seven cars sold last year – compared to one out of 70 cars sold in 2017.

As demand for electric and hybrid powertrains rises, aluminum die casting is gaining increasing importance. Traditionally, car parts were made from steel stampings that were then bolted together by robots on a production line. Structural components produced in aluminum die casting have the benefit of integrating various parts traditionally

produced in steel stamping, enabling a functional integration in one shot. Besides this, aluminum die cast components can increase the stiffness of the car body structure. They are lighter and thereby reduce vehicle weight, which finally also increases the reach of electric cars.

A partnership is formed

Magna, one of the world's largest suppliers of car components, is at the forefront of producing structural car parts. Around 10 years ago, the company decided to build and design a new 225,000 square foot aluminum casting facility outside Telford, in the West Midlands of England, capable of housing some of the largest die-casting cells in Europe, and situated for ease of supply of vehicle parts to its UK clients and built on a greenfield site. Magna chose Bühler as the supplier of one Carat 220 and seven Carat 440 compact die-casting cells.



***“WE NEEDED SOMEONE TO
SUPPORT US WHILE WE IMPE-
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AND TRAINING.”***

DARREN HEIGHT

General Manager, Magna UK



The compact design of the Carat 440 die-casting cell at Magna UK enables stable production processes.

With the intuitive DataView control system, the operators can make real-time adjustments to the die-casting process in the entire cell – including peripheral devices – directly on the touchscreen.

“We did look at several suppliers as within Magna we do use other companies as well. With Bühler we recognized they are renowned for their quality and also that the local support within the UK was very good,” says Darren Height, General Manager of Magna UK. “We needed a close partner because there are not enough engineers in the world in the die-casting area and so we needed someone to support us while we implemented the machines as well as offering ongoing support and training.”

With 168,000 employees across 343 manufacturing operations in 29 different countries, Magna plants manufacture practically everything that goes

into a car apart from the tires and windows. The Telford plant, run by Cosma, a division of Magna, specializes in making body structures from light-weight aluminum castings.

The decision to work with Bühler was the start of a close working relationship resulting in a long-term collaboration. Seen as one of the most advanced die-casting operations in the world, colleagues from both companies have over recent years been learning from each other as they forge new ground in the field of die cast engineering.

On a challenging scale

Building from scratch in Europe on a greenfield site is a relatively rare event in die casting. “This really does not happen very often,” explains Jeremy Mitchell, Head of Die Casting Northern Europe at Bühler. “I have been working for Bühler for over 30 years and this is only the second greenfield site that I’ve been personally involved in where we start with a muddy field and end up with the production hall that we have today.”

A greenfield site comes with many challenges. “It all starts with the design of the building itself to make the best use of the available space. In this project phase we supported Magna to fit the machines in the building,” Mitchell says. “This is not as easy as it might sound – we are talking about die-casting cells standing on over 100 square meters of floor-space and each of these needs a special foundation able to carry close to 300 tons of weight.”

And, of course, a die-casting facility is not only about the die-casting equipment, it is also necessary from the beginning to plan for the flow path of the production itself. Starting from the aluminum ingot being delivered to the final product going out of the door after pre-assembly.

Each production process within the cell is inter-related, requiring Bühler to have oversight of each process. The furnace used to melt the aluminum needed to be at the right level for the larger machine, while Magna required a unique laser etch that needed to be incorporated into the cell. Such a high level of interconnectivity meant close collaboration. Bühler worked with Magna at every step of the way. Each cell involved a unique approach to both incorporate Magna’s existing production processes as well as adapting to handle much larger component sizes with all of the modifications designed to improve quality and improve efficiency. Originally planned for eight die-casting machines, the entire team showed a lot of flexibility by incorporating a ninth into the plans.

The building of the facility then involved some unique challenges, again including the sheer scale of the machines being installed. “We only had one door through which to get the large parts of the

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MAKE IT BECOME A REALITY.”***

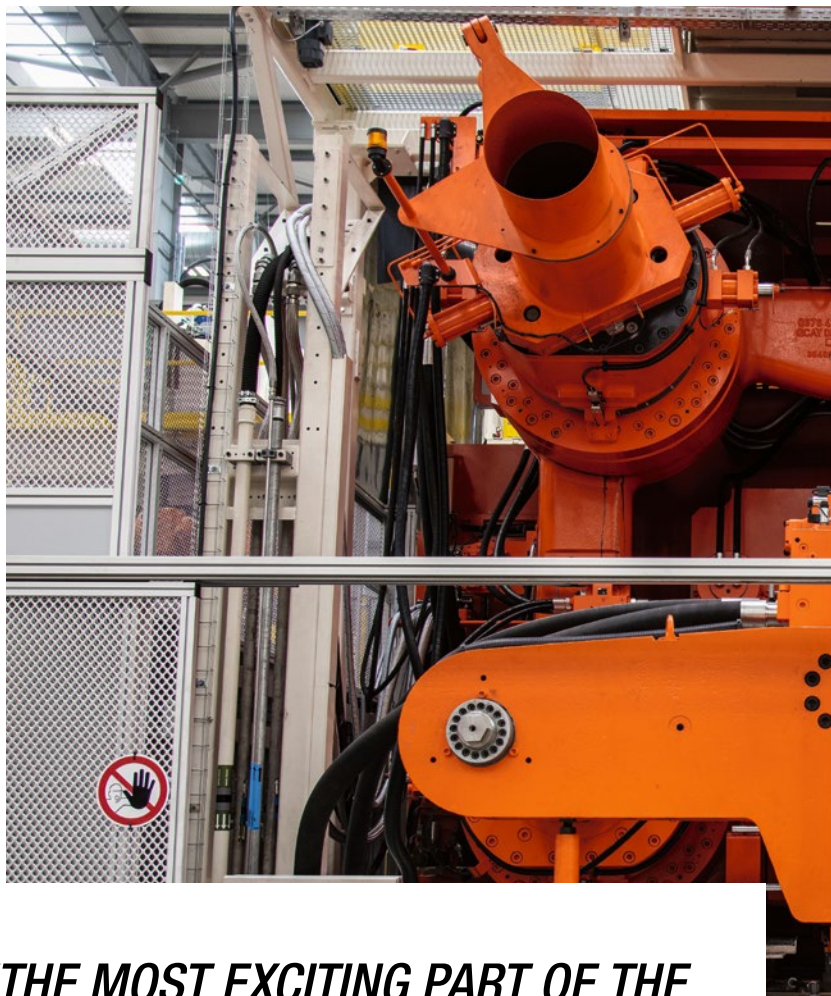
IAN ASTERLEY

Technical Manager, Magna UK



die-casting machine, which weighs 87 tons. With only centimeters to spare on either side of the lorries when they were trying to reverse, each move had to be plotted and planned to know exactly where the lorries needed to be to install the lifting equipment to lift such heavy weights,” says Mitchell. “The most exciting part of the project was when the first shot of the first die-casting cell was successful, after working towards this for almost two years.” The first part Magna needed from the die-casting cells was a two-cavity shock tower for Jaguar Land Rover. “That night, the entire team went out for a joint dinner to celebrate the successful first shot.”

Making the project work out so successfully was only possible with the great collaboration between the two companies and especially between the 20 people involved as a core team from the beginning. “Considering the immense size and complexity of the project, everything went smoothly,” Mitchell explains. “A project like this only comes along once or twice in your professional career. I am still at the Magna site regularly and every time I walk through the halls, I am proud to have been part of this amazing project and team.”



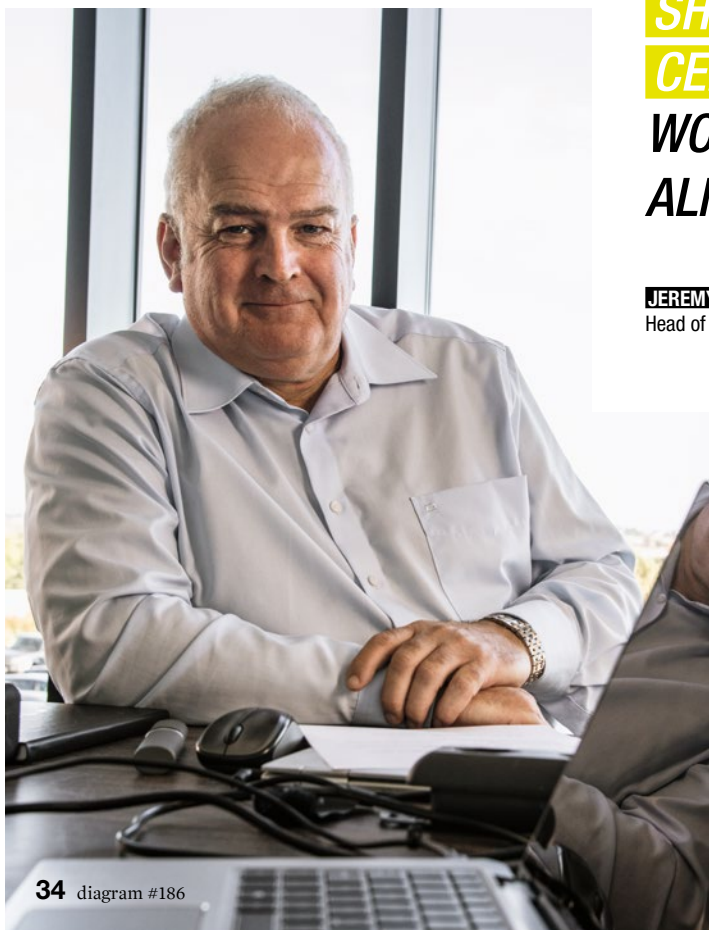
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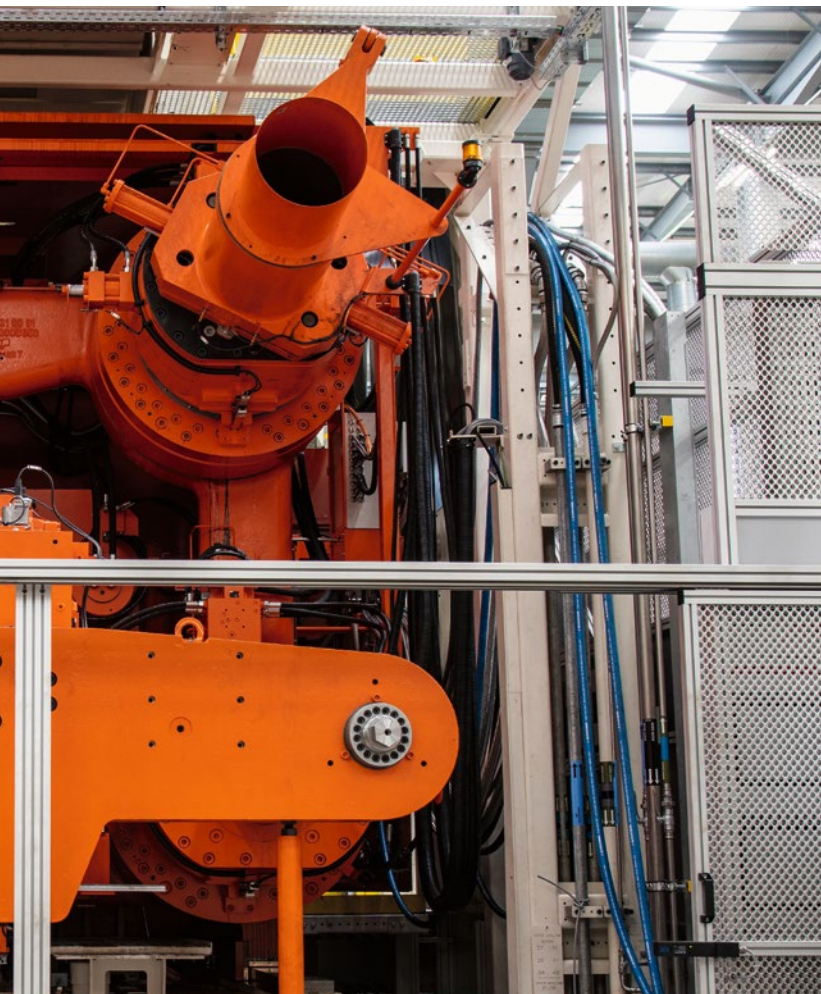
JEREMY MITCHELL

Head of Die Casting Northern Europe at Bühler

Having provided support with the plant design and production cells, Bühler’s relationship with Magna entered a new phase with the opening of the plant in 2018. Training and technical support now moved center stage as Bühler provided comprehensive on-site training for Magna operators and is continuing to support with fast service operations.

Magna is involved in some of the most complicated thin-walled structural casting in the industry, requiring highly-skilled operators. Magna has plans to address the current shortfall in die-casting engineers through a combination of recruitment and upskilling existing staff. “We recognize that there is





The Carat's unique shot control and casting process protects the die, increasing overall productivity by up to 30 percent.

a generational gap when it comes to die cast engineering and we want to give back to the industry and start the next generation of engineers coming through," explains Height. "There is the formal side of training which is sending people to classrooms, but a big part of it is on-the-job training, which is why we required resident engineers from Bühler working closely with us on that side of things."

Close collaboration

Providing training for die-casting professionals to make the best use of the equipment is also a core competence Bühler is cultivating. Bühler offers training at its Application & Training Centers in China, the US, and Switzerland, and its team of highly trained die-casting professionals also offer training at customer sites on their own installed equipment – as in the case of Magna. Bühler has also learned a lot from the relationship.

Ian Asterley, Technical Manager at the Magna plant, has experience working in other die-casting operations. In addition to the advanced technology and high level of process control, a major advance

in the Magna plant is the amount of real-time data available to process technicians and engineers, allowing more informed and accurate decisions during the production cycle.

The data is also providing important feedback for Bühler. "Getting the feedback off the machines is giving us a real opportunity to learn," Asterley explains. "I think one of the great success stories is that it allows further collaboration with Bühler to improve the machines. We have added close to 10 extra modifications to the software. If we see an opportunity, we can spawn an idea and then work with Bühler to make it become a reality by producing a rollout plan."

INFO



Magna International

Aurora, Ontario, Canada



Founded in 1957.



Magna designs, engineers, and manufactures nearly every aspect of a vehicle. Its global network comprises 168,000 employees, 343 manufacturing operations, and 88 product development, engineering, and sales centers in 29 countries.



Magna supplies 58 OEMs (original equipment manufacturers) around the world.



Magna UK uses Bühler's Carat 220 and 440 die-casting technology to make high-quality car parts.

VIDEO



Watch the video about Magna UK to learn more about the development of their greenfield project.



Alumobility

***ALUMINUM* — THE LIGHTWEIGHT CONTENDER**

TEXT: BIANCA RICHLE

Aluminum has been used in sports cars for decades. Now the material is literally making light work of mid-range cars too, and electric cars are virtually unthinkable without aluminum. In addition to its low weight, the 100 percent recyclable metal also scores points for increased range, CO₂ savings, and safety aspects.

FROM ZERO TO ONE HUNDRED IN FOUR SECONDS. Fast acceleration like this is only possible if a sports car is lightweight. Consequently, high-performance vehicle manufacturers have been using aluminum for decades. Luxury car manufacturers have embraced the use of aluminum since the 1990s to increase efficiency and performance. They make the axle area, auxiliary parts, and structural components out of aluminum to reduce weight. The engine and transmission housing is cast from aluminum in the majority of cars today – for both internal combustion engine and electric drive systems. In principle, it's possible to build the entire vehicle, including the structure and body panels, from aluminum. Some electric vehicle (EV) manufacturers are already doing this. In the future, the trend toward aluminum will continue to grow, primarily due to increasing electrification. "An aluminum chassis is especially suited to EVs. Thanks to its lower weight, you can reduce the battery size and achieve the same level of performance," says Dr. Thomas Rudlaff, Managing Director of Alumobility.

Alumobility is a global initiative of leading aluminum and downstream technology partners, providing technical studies and thought leadership. Alumobility aims to help deliver on the promise of lighter, more efficient, and more sustainable mobility. "The whole issue of efficiency is bringing aluminum more and more into the forefront," Dr. Rudlaff

explains. It's also why Tesla, as well as all the newcomers to the EV market, are now using aluminum almost exclusively. For established carmakers, the change is a bit more difficult, as it requires them to convert part of their production process.

Good energy absorption increases safety

Efficiency is not the only reason in favor of lightweight construction with aluminum. "Lightweight cars handle better, which is especially evident when cornering," Dr. Rudlaff says. "And secondary objects such as tires or brakes can also be built lighter since they don't have to support as much weight."

A lightweight car saves about 100 kilograms of weight compared to a conventional car. Energy absorption is also important. "Aluminum absorbs more energy than steel when it folds. That's why many crash management systems are already made of aluminum," says Dr. Rudlaff. This is decisive for electric cars, as the battery must remain protected at all costs in the event of a collision. The properties of aluminum are highly favorable for vehicle construction and are often underestimated. "People think aluminum is soft, but in hailstorms, for example, aluminum performs better than steel."

**"THE WHOLE ISSUE OF
EFFICIENCY IS BRINGING
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INTO THE FOREFRONT."**

DR. THOMAS RUDLAFF
Managing Director of Alumobility

Aluminum has two characteristics in common with all other metals: first, it is 100 percent recyclable and second, it can be remelted any number of times. About 75 percent of the aluminum ever produced is still in circulation. "Aluminum has the advantage of having a lower melting point than steel," Dr. Rudlaff says. This pays off during recycling. When aluminum is recycled, it requires only 5 percent of the energy used in primary production, so the use of secondary aluminum is very worthwhile. Low CO₂ values of up to 0.5 kilograms of CO₂ per kilogram of aluminum can be achieved.

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The use of primary aluminum also makes a lot of sense if sustainably produced aluminum is used for this purpose. Aluminum produced with renewable energy achieves a footprint of 4 kilograms of CO₂ per kilogram of aluminum. If the CO₂ quantification is below 8 kilograms per kilogram of aluminum, production is more sustainable than steel.

“Aluminum makes the vehicle lighter. For internal combustion engines this means that the efficiency of the energy balance is better, which means lower fuel consumption,” Dr. Rudlaff says.

For electric vehicles, energy consumption also decreases sharply when vehicles are lighter. For example, for a vehicle with an unladen weight of 1,600 kilograms compared to a vehicle with an unladen weight of 1,500 kilograms, the lighter vehicle saves approximately 1 kilowatt hour per 100 kilometers. This means that the battery could be 6 percent smaller to generate the same range.

Making the battery smaller is worthwhile financially, as its raw materials and production are very cost-intensive, and it also has a positive impact on the carbon footprint because the smaller battery is much less resource intensive. “The beauty is that you get the same acceleration performance with a smaller battery,” says Dr. Rudlaff.

Fewer components

The aluminum body can either be manufactured using sheet metal construction or die cast. “The advantage of die casting is that many functions can be combined into one component. This allows me to reduce the components, which is promising for production,” says Dr. Rudlaff. “In addition, I can plan my parts according to weight distribution. This is more difficult and costly with sheet metal construction. Die casting can be customized precisely according to calculations, which is appealing in terms of construction. You can calculate where to put loads, use a die-cast part, and if I already have one, how I integrate other components.”

It remains exciting to see how the industry will continue to develop. But for Dr. Rudlaff, one thing is clear: “The future is electric, and the future is aluminum.”

DR. THOMAS RUDLAFF
Managing Director of Alumobility

INFO



Alumobility

Global, founded in Zurich, Switzerland



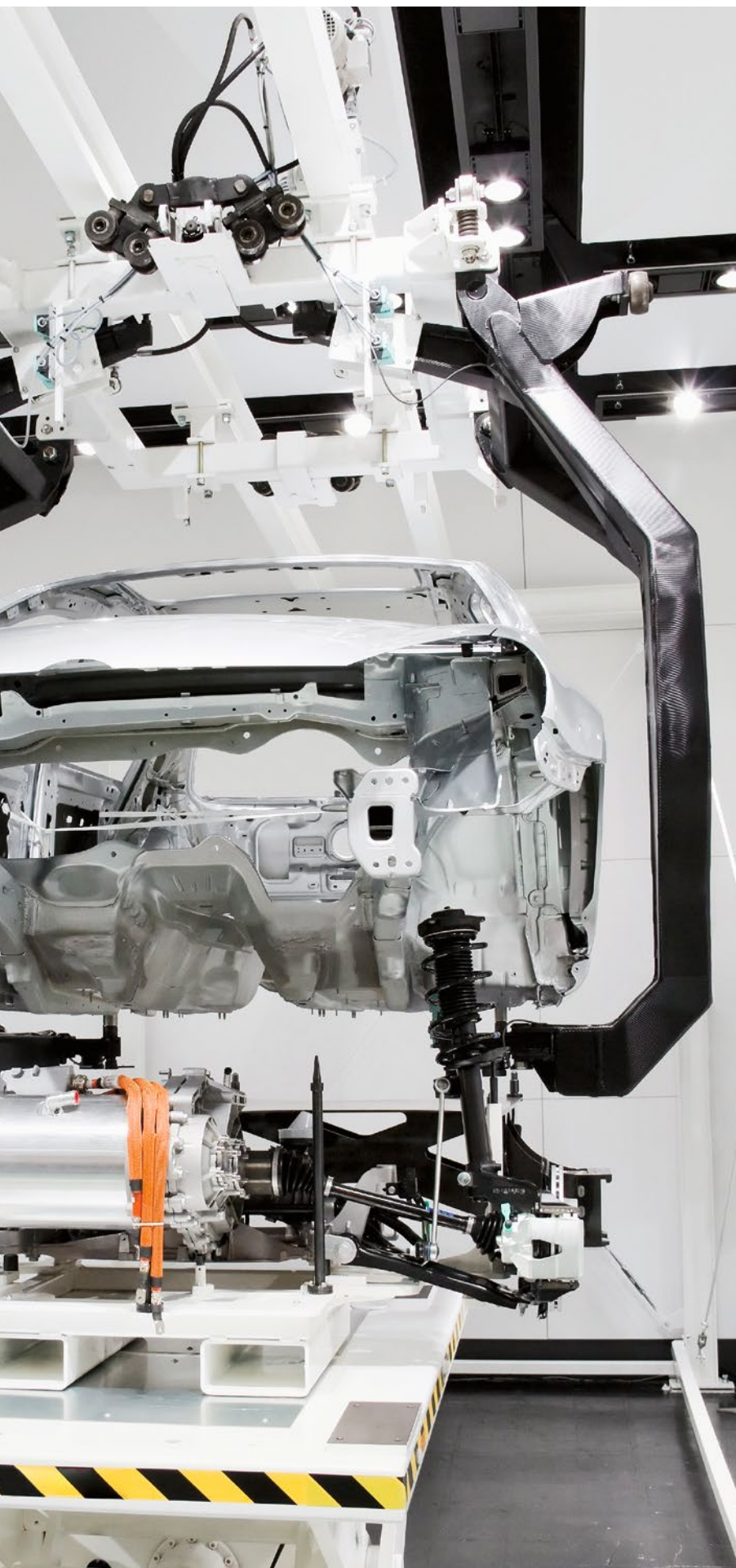
Founded in 2021.



Alumobility is a global ecosystem of leading aluminum and enabling downstream technology partners. Through technical studies and its thought leadership, Alumobility aims to help fulfill the promise of lighter, more efficient, and more sustainable mobility.



Alumobility's members include the aluminum producers: Constellium, Novelis, Speira, Magna, ARO, Atlas Copco, fischer group, and Sika.



DR. THOMAS RUDLAFF



As Managing Director, Dr. Thomas Rudlaff is responsible for Alumobility's strategy and governance, including promoting the organization's mission and expansion of the ecosystem through new members and partners.

A former engineering executive with Mercedes-Benz and Audi, Dr. Rudlaff brings more than 30 years of experience designing and developing lightweight vehicle structures to Alumobility. He has led multiple projects to launch fully aluminum vehicles, including the first aluminum-intensive vehicle at Mercedes-Benz. In addition to making vehicles safe and reliable, he is passionate about creating cars that are fun to drive, yet more sustainable for the environment. Earlier in his career, Dr. Rudlaff led an association dedicated to manufacturing technology. He has also been a regular contributor to industry organizations, including Automotive Circle.

Dr. Rudlaff holds a degree in physics from the University of Kaiserslautern, Germany, and a PhD in laser technology from the University of Stuttgart, Germany.

Aluminum is lightweight, flexible, and malleable, allowing for more innovative design opportunities. While its strength and durability profile are similar to steel, it folds more predictably in a collision, allowing for better crash absorption.

EVERY *Trace Die Cast* SHOT **COUNTS**

TEXT: LUKAS HOFSTETTER
PHOTOS: MICHAEL TEDESCO



Trace Die Cast have read the signs of the time well to become a key supplier of die-casting parts for the booming electric vehicle market. What started out in the late 1980s as a prime example of entrepreneurship and drive to innovate is now a thriving company with a strong sense of purpose that is facilitating fundamental change in American mobility. With Bühler's Carat die-casting technology, Trace has backed the right horse and is leading the race in times of great disruption and new opportunities.



WHETHER IT'S THE FAMOUS Kentucky Derby horse races, a sip of sweet Bourbon, or the iconic Chevrolet Corvette – Kentucky is known for its deeply-rooted traditions. Driving through the Bluegrass State just south of America's Rust Belt, an area that stretches through the Midwest and Northeastern States, visitors are also reminded of the vital role industry plays as the backbone of the American economy. At the same time, as a major force of innovation, the law of markets guides it to constantly evolve to remain competitive. In Bowling Green, Trace Die Cast perfectly embodies this role.



No room for error: Kent Guthrie and his team ensure that every single part leaving the factory is of the highest quality.



Trace Die Cast uses recycled aluminum for the parts it manufactures. Aluminum is an infinitely recyclable material.



Trace Die Cast operate a total of 41 die-casting cells around the clock in three shifts.



The family-owned, mid-sized American manufacturing company with a workforce of around 400 is a major driver behind the accelerating transition towards green mobility in the US. With an ever-increasing demand for high-end parts needed for electric vehicles (EVs), Trace Die Cast is ready to scale up production and build on their early mover advantage.

A once-in-a-lifetime opportunity

“A couple of years ago, we sat down with our engineers to discuss the business opportunities that our expertise in precision aluminum casting offers. We realized that the shift from the internal combustion engine to battery-powered cars is going to be an era-defining megatrend,” says Chris Guthrie, President and CEO of Trace Die Cast. “We noticed an increasing demand for much more difficult parts with lighter weight and thinner walls. Our engineers were adamant that with the modern die-casting machines and the great people at our company, we have an edge over our competitors. That’s

Chris Guthrie (right), President and CEO of Trace Die Cast, and Steve Jacobson, President and CEO of BühlerPrince, discuss the challenges of producing parts from scratch.



“OUR ENGINEERS WERE ADAMANT THAT WITH THE MODERN DIE-CASTING MACHINES AND THE GREAT PEOPLE AT OUR COMPANY, WE HAVE AN EDGE OVER OUR COMPETITORS.”

CHRIS GUTHRIE

President and CEO of Trace Die Cast

when we knew we needed to move aggressively into the EV market and seize the opportunity to become a key player in the mobility of the future.”

Chris Guthrie and his brother Kent Guthrie, Vice President of Facilities, lead Trace Die Cast in the second generation. Their father, Lowell Guthrie, founded the company with two partners in 1988 and started with two die-casting machines. Their growth path in the last 25 years is closely linked to Bühler. In 1999, Trace Die Cast bought the first die-casting cell from Bühler, and in 2012 bought their first Carat two-platen die-casting machines. Thus far, they have installed 41 Bühler machines.

Five hundred miles from Bowling Green, Bühler’s Steve Jacobson and his team anticipated the call from the Guthrie brothers in 2015 to move forward on their ambitions.

“When Trace Die Cast approached us to start producing parts for electric vehicles, we had some exciting discussions. Breaking into this new market required new technology and skills for Trace Die Cast. It also presented the unique chance to enter this endeavor together, to develop new applications, and overcome challenging situations to grow into those opportunities,” explains Jacobson, President and CEO of BühlerPrince in Michigan.



In its quality control center, Trace Die Cast uses state-of-the-art technology to ensure every part is flawless.

This customer proximity paired with Bühler Switzerland's expertise in die casting perfectly positioned Jacobson's team to support Trace Die Cast on their mission to take a leading role in supplying parts for EVs. "The biggest challenge was to find ways to produce parts for EVs that have never been designed like this before," he says.

Lightweight and powerful

One of the key parts that Trace Die Cast manufactures around the clock are battery trays. Located at the bottom of electric cars, they need to be sturdy to protect battery packs and support the weight of a battery unit that ranges between 40 and 50 pounds (20 to 25 kilograms).

Since the weight of an EV determines its range – one of the key selling points in a highly competitive market – every gram counts. Plenty of food for thought for the engineering teams.

"We needed to develop a process solution that delivers on all those new requirements. These parts incorporate many features which may exist in different powertrain parts in traditional vehicles – we needed to incorporate them into one part," explains Jacobson. The parts needed to be dimensionally correct due to the rectangle shape so they can be mounted side by side in series.

"Another challenge was ensuring the parts were properly sealed for difficult weather conditions as they are mounted underneath the vehicle and subject to rain, snow, mud, and winter road treatments," Jacobson explains.

Aluminum die casting was the perfect choice to guarantee Trace Die Cast can meet the strictest quality requirements. For Kent Guthrie, the trial phase to develop these parts was as stressful as it was exciting. "Manufacturing these parts required all of us to rethink the way we produce. We put our heads together and ran countless trials to develop production standards that can satisfy the highest demands with every shot," he explains. The Bühler team counted on Kent Guthrie's decades of experience for valuable input to establish the most reliable processes possible.

There literally is no room for error when it comes to parts for electric vehicles. "The tolerances are extremely tight since there is no engine noise to cover some of the driveline noises that happen in a traditional car," says Guthrie.

In a silent EV – another key selling point of battery powered cars – even almost unnoticeable sounds greatly affect the driving experience. "Our job is the constant search for perfection in every shot, just like an elite tennis player. The margin of



Trace Die Cast's experts visit the Die Casting Application Center in Uzwil regularly for training to ensure they get the most out of their technology.

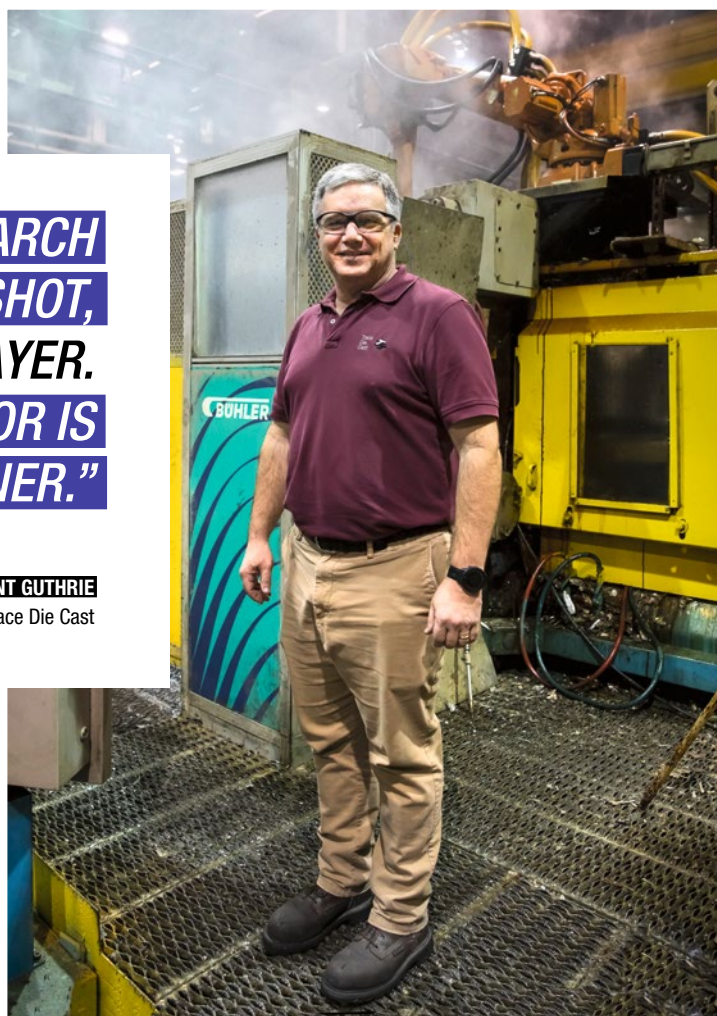
***"OUR JOB IS THE CONSTANT SEARCH
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THE MARGIN OF ERROR IS
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KENT GUTHRIE

Vice President of Facilities, Trace Die Cast

error is getting thinner and thinner. We need to deliver day in, day out. That's why we travel regularly to Bühler's Die Casting Application Center in Uzwil, Switzerland to learn about the latest technology and to train our operators in handling the machines," explains Kent Guthrie. He and two of his colleagues spent a few days in January 2023 in Uzwil, Switzerland to learn about Bühler's ServoDrive solution.

"The biggest costs in any foundry are your material costs and your energy costs. We're investing in our new machines to have the ServoDrive pump groups so we can save up to 45 percent on energy consumption," says Kent Guthrie. This represents a



Where the magic happens: the green mobility transformation starts in the foundry of Trace Die Cast in Bowling Green, Kentucky.



massive reduction in times of rising energy costs that continue to drive inflation rates up across the globe. Training together is a two-way street. “It’s a huge advantage for us to learn about challenges that we don’t necessarily know about yet in terms of the complexity or the difficulty of these parts no one has ever made before. Feedback from customers like Trace Die Cast, who run our equipment 24/7, is essential. That’s the perfect way for us to get reliable data and inputs from live operations under the toughest conditions,” explains Jacobson.

Performance under toughest conditions

Setting foot in Trace Die Cast’s production plant in Bowling Green, it’s evident what Jacobson means. Industrial furnaces melt recycled aluminum blocks at 3,000 degrees Fahrenheit. Workers feed it into 41 die-casting machines with locking forces from 10,400 to 22,000 kilonewtons. Steam clouds from the spray cooling rise to the ceiling, dimming the lights for brief moments and creating an almost surreal atmosphere. The workflows are perfectly in tune, running all day in three shifts like an orchestra led by an invisible conductor. “Make or break” perfectly sums up the pressure the parts – and Trace Die Cast – are under.

Trace Die Cast’s bold strategy has paid off. The Guthrie brothers walk through the manufacturing facility and check a freshly cast part for their customer Rivian, based in Normal, Illinois. It’s one of the fastest-growing car companies, specializing in electric SUVs (sports utility vehicles) and electric pick-up trucks. The world’s largest retailer, Amazon, already counts on over 1,000 Rivian delivery vans and plans to have 100,000 vehicles on the road by 2030 to meet its climate targets.



Trace Die Cast produces multiple engine components for the automotive industry.

Trace Die Cast’s long-standing customer, Ford, which makes up around 70 percent of their output, recently announced their target of producing 600,000 electric vehicles in 2023. Ford’s goal is clear: to overtake Tesla and become the number one seller of EVs in the US. This includes their flagship F-150 Lightning pick-up truck, an icon in America’s second-largest US-based carmaker’s portfolio. According to Business Insider magazine, Ford aims to build 150,000 F-150 Lightnings a year

VIDEO

Watch the video to learn how Trace Die Cast successfully entered the fast-moving electric vehicle market.



Kent (left) and Chris (right) Guthrie greet each other after a test drive of a Ford F-150 Lightning and a Rivian R1S electric SUV.

at the factory in Dearborn, Michigan. With such staggering numbers, both Ford and Rivian count on Trace Die Cast to continue delivering their high-end parts around the clock.

A promising future

Chris and Kent Guthrie are ready for the challenge. “In 2018, our capacities were focused 100 percent on internal combustion engine vehicle parts. Today, 60 percent of our output is parts for traditional cars, and 40 percent is for electric cars. We expect that ratio to be 50/50 by 2024,” says Chris Guthrie. With the green transition gaining more traction by the day on America’s roads, the question is how Trace Die Cast will keep up with the ever-increasing demand?

“We just ordered six new Carat die-casting cells from Bühler. I believe that we’re very well prepared to continue growing together with this megatrend while still being able to serve all our customers during this time of transition. It’s just exciting to be part of this major shift in the car industry and help drive change from Kentucky into the world,” says Kent Guthrie as the brothers head out for a test drive of a Ford F-150 Lightning and a Rivian R1S electric SUV. Made with key parts from Trace Die Cast in Bowling Green, of course.

INFO

**Trace
Die
Cast**



Trace Die Cast, Inc.

**Bowling Green, Kentucky,
United States**



Founded in 1988.



Trace Die Cast is a Tier One and Tier Two supplier of high-quality aluminum die castings for the automotive industry.



Trace Die Cast counts General Motors, Ford, and Rivian among its customers.



Trace Die Cast relies on a total of 41 of Bühler’s Evolution and Carat die-casting machines to produce parts for cars with internal combustion engines as well as electric cars.





ELECTRIFICATION

Electric vehicles (EVs) are taking over our streets at mind-blowing speed. The International Energy Agency (IEA) expects that EV sales will increase by 35 percent year on year to 14 million cars in 2023. This creates an unprecedented demand for efficient and reliable batteries, which forces the European Union as a key player to ramp up its industrial battery production.

Storage capacity for renewable energy will further drive demand for state-of-the-art battery technology. The IEA expects the global renewable power capacity from wind and solar to grow by 2,400 gigawatts from 2022 to 2027. To capture the excess energy and provide it to consumers when required, the world needs powerful stationary storage facilities. The ability to produce batteries on an industrial scale will be key to achieving the ambitious sustainability goals.

From research institutes to car manufacturers to new players on the market – the race to increase know-how and establish vast production capacities is on. The prize for the frontrunners is awe-inspiring; a share of the global lithium-ion battery market that is expected to reach USD 215.9 billion by 2027 according to Business Wire. Ready, set, go!



TEXT: LUKAS HOFSTETTER

TAKE UP *THE CHARGE*

KEEPING TRACK OF THE INCREDIBLE PACE of the green transition is a tough task. In February 2023, the European Parliament voted to approve a new law banning the sale of petrol and diesel cars from 2035 to accelerate the transition to electric vehicles. Meanwhile, the global renewable power capacity generated from wind and solar is expected to grow by 2,400 gigawatts from 2022 to 2027, according to the International Energy Agency (IEA). This amount is equal to the entire installed power capacity of China today.

In the United States, the Inflation Reduction Act (IRA) provides tax credits worth hundreds of billions of dollars for renewables until 2032 to move away from gas, coal, and oil as the country's primary sources of energy. What connects these ambitious targets? Batteries, either in the form of power supply for electric vehicles, or as storage

capacity for renewable energy sources. The required quantities are staggering, and the race to secure battery capacity is on, not least driven by geopolitical interests. The European Union (EU) acknowledged the widening technology and capacity gap between Europe and Asia – in particular China, Japan, and South Korea – and formed the European Battery Alliance (EBA) in 2018.

By the end of 2021, 111 industrial battery projects were being developed across EU Member States, with more than 10 gigafactories for the production of battery cells. According to the EBA, the EU is set to meet 69 percent and 89 percent of its increasing demand for batteries by 2025 and 2030 respectively and should be capable of producing batteries for up to 11 million cars per year. It is expected to invest EUR 382 billion to create a self-sufficient battery industry by 2030.



Batteries are ubiquitous. From smartphones to electric vehicles to entire large-scale storage facilities for renewable energy, life without rechargeable batteries is unimaginable. With governments, companies, and consumers accelerating the green transition to avoid the worst impacts of the climate crisis, multiplying production and increasing the efficiency of batteries will tip the scale in our favor.

making up lost ground on the Asian competition. Hänsel knows that his team is in a unique position thanks to the far-sighted research and development strategy at Grinding & Dispersing.

“In our Battery Application Center in Uzwil, we run concept trials together with customers on our lab-sized, twin-screw extruder with a 20-millimeter screw diameter, which allows for a capacity of 20 liters per hour. Our continuous mixing technology to produce battery slurry combines the basic operations of continuous raw material dosing, pre-mixing, kneading, fine-dispersing, and degassing in a single device. After the trials, we’re able to determine exactly the parameters needed for production on an industrial scale for our customers.”

In addition to the application center in Uzwil, Bühler’s Grinding & Dispersing business runs a pilot-scale extruder with a 30-millimeter screw diameter and a capacity of 100 liters per hour in Wuxi in China.

Powerful impact

The savings potential increases dramatically when scaling effects unfold their magic. “Around 70 percent of battery costs are attributed to raw materials. The production costs in gigafactories make up 20 to 25 percent, while around 5 percent are other costs. That’s why we see the biggest lever to bring down costs and accelerate the green transition in the industrial production space,” says Hänsel.

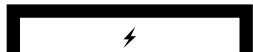
According to his team’s research, the specific energy consumption to produce 1 ton of battery slurry using batch mixing technology is 224 kilowatt hours per ton (kWh/t). Bühler’s continuous mixing technology consumes four times less energy; a mere 56 kWh/t, and a staggering savings potential amid rising energy costs. Combined with a high

Far away from the political commotion, Christian Hänsel puts on his lab clothes and safety equipment and heads to the Battery Application Center in Uzwil, Switzerland. He’s a Process Engineer in Bühler’s Grinding & Dispersing business and conducts trials to increase efficiency and sustainability in battery production.

Hänsel and his team are at the very heart of this megatrend – their research, trials, and the battery factories they equip for customers might well decide how fast society can move away from fossil fuels.

“Our customers find themselves in a challenging situation. Demand is ever increasing, and with this comes a myriad of questions. The most urgent one is to find ways to establish battery production at industrial scale,” he says. That’s especially the case in Europe, where many players have been a little late to the party and are now faced with the task of





BENEFITS

- + The continuous mixing technology consumes four times less energy than batch mixing for 1 ton of battery slurry – a mere 56 kWh/t.
- + The energy efficiency of the continuous mixing technology combined with the high degree of automation and improved yield reduces the total cost of ownership.
- + Production makes up 20% to 25% of production costs of batteries – a huge lever for producers to bring down costs through innovative production technologies.

Find out more about
Bühler's innovative solutions
for the efficient production of
electrode active materials and
electrode slurries.



***“DEMAND IS INCREASING, AND
WITH THIS COMES A MYRIAD OF
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CHRISTIAN HÄNSEL

Process Engineer Grinding & Dispersing at Bühler



degree of automation and improved yield, the total cost of ownership is further reduced, which lowers the entry barrier for new players on the market.

Never standing still

Resting on their laurels, however, is not in the DNA of Grinding & Dispersing. At the end of March 2023, the team hosted 50 guests from 27 companies and 13 countries to introduce and discuss a more sustainable means of battery production: dry battery electrode (DBE) technology. Currently, the components are mixed into a liquid paste that is put on a foil and dried – a process that is time- and energy-consuming, but also requires toxic solvents which cost money and impact the recycling of batteries.

The DBE technology, on the other hand, is based on the ability of polytetrafluoroethylene (PTFE) to fibrillate under shear. A polymer fiber network is built up in which the electrode components are immobilized. A soft composite structure is discharged from the extruder and the flaky product can be pressed into an electrode layer and subsequently laminated to the current collector foil, yielding the final electrode structure.

This promising technology resonated well with the guests from academia, research institutions, and industries such as car manufacturers looking to

ramp up their own battery production. “We had fantastic keynotes and discussions on DBE. This encourages us to continue our research in this technology and develop a path towards industrial production with our partners,” explains Hänsel as he heads back to the Battery Application Center to prepare the next trial. Given the pace in the race for independence and supremacy in battery production, it seems almost certain that he’ll be spending most of his time doing what he enjoys most: experimenting, collaborating, and discovering new ways to supercharge the green energy transition.



**Simplify electrode
slurry production.**
Save costs and
improve quality.

Bühler provides reliable, scalable, and industry-proven solutions for wet grinding of active materials and precursors, as well as continuous mixing of electrode slurries for lab, pilot, and large-scale production.

Our solutions offer:

- shorter mixing times and consistent product quality;
- high productivity up to 2,500 l/h per line and scalable processes;
- significantly less waste and higher energy efficiency;
- 60% lower operation costs thanks to high level of automation.



Scan the QR-Code to find out more about our solutions.

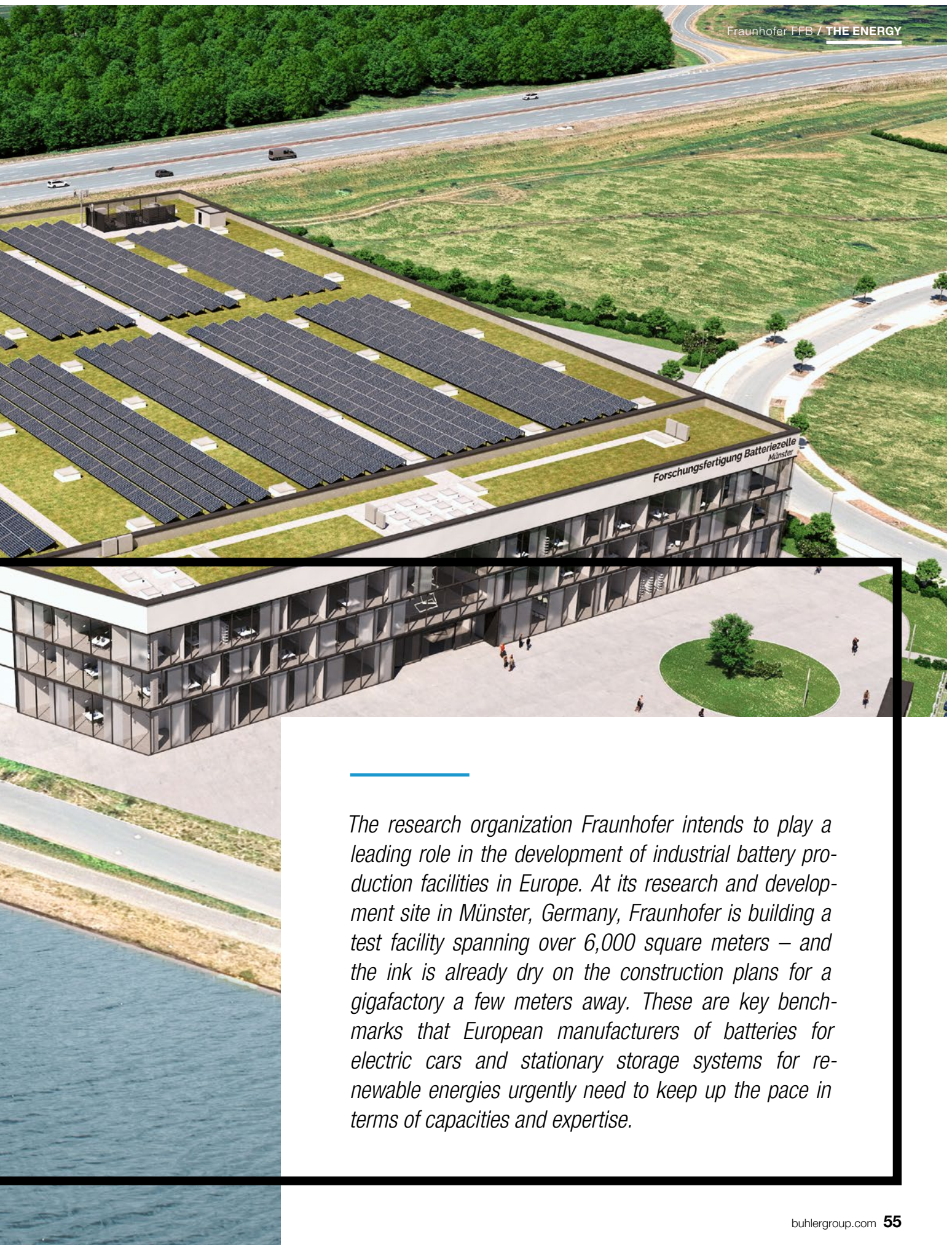
Contact us at:
grinding.dispersing@buhlergroup.com

When completed, the FFB Fab building will house a versatile manufacturing line that will enable industrial companies along the entire value chain of battery cell production to test all or selected process steps and optimize them for their purposes.

Fraunhofer FFB

RAMPING UP **ENERGY TRANSFORMATION**

TEXT: LUKAS HOFSTETTER



The research organization Fraunhofer intends to play a leading role in the development of industrial battery production facilities in Europe. At its research and development site in Münster, Germany, Fraunhofer is building a test facility spanning over 6,000 square meters – and the ink is already dry on the construction plans for a gigafactory a few meters away. These are key benchmarks that European manufacturers of batteries for electric cars and stationary storage systems for renewable energies urgently need to keep up the pace in terms of capacities and expertise.

THESE ARE IMPRESSIVE FIGURES that underline the global thirst for battery capacity. According to the World Economic Forum (WEF), 10.6 million electric cars were sold in 2022. This represents 60 percent year-on-year growth and an overall market share of around 14 percent.

According to the Inside EV platform, brand leader Tesla leads the field with 1,313,851 vehicles delivered (an increase of 40 percent compared to 2021).

Behind it, the Chinese rising star BYD (Build Your Dreams) is catching up with 911,141 vehicles (an increase of 184 percent). Volkswagen (excluding MAN, Scania, and Navistar for comparison purposes) – the world's largest automaker by sales – is behind the two leaders with 570,737 all-electric cars sold in 2022 (an increase of 26 percent).

Appearances do not deceive, and established car manufacturers are finding the switch to electric car production more difficult than specialists like Tesla and BYD. The Achilles' heel here is the production of batteries – the heart, the selling point in terms of range, and the main prize of electric cars.

Markus Eckstein knows this all too well. While he enjoys biking to work at the Fraunhofer Research Institution for Battery Cell Production (FFB) in Münster, his fascination is with electromobility. "The Fraunhofer FFB has a clear goal. We research and develop solutions for scaling production technology for lithium-ion batteries. Our customers are German automakers who want to get into battery production to make themselves less dependent on international suppliers and plant manufacturers in the battery industry," explains the FFB Research Associate.

Volkswagen, for example, says it will produce only electric cars for the European market from 2033. "The next 10 years will bring almost unimaginable changes. That makes it all the more exciting for us, as a research and development facility, to make our contribution so that we can switch to electromobility as quickly, as efficiently, and as sustainably as possible," says Eckstein.

According to a study by the consulting firm McKinsey, by 2030 global demand for lithium-ion batteries will be around 4,700 gigawatt hours (GWh). In 2023, it is expected to be around 713 GWh.

A quantum leap

The Fraunhofer FFB campus is a proof of the dynamic way in which the topic of industrial battery production is moving politics, research, and industry. The pilot plant is located in the FFB's Workspace, where the Fraunhofer FFB carries out

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ALMOST UNIMAGINABLE CHANGES.
THAT MAKES IT ALL THE MORE
EXCITING FOR US, AS A RESEARCH
AND DEVELOPMENT FACILITY."***

MARKUS ECKSTEIN

Research Associate at the Fraunhofer Research Institution for Battery Cell Production (FFB)





Continuous mixing is tested in the FFB Workspace. The materials for coating the cathode and anode are mixed in a continuous process and applied via the coating system.

Throughputs of around 100 liters of electrode slurry per hour are possible with the 30-millimeter extruder.



research using the continuous mixing technology provided by Bühler's Grinding & Dispersing business. "The Fraunhofer FFB has been taking its first steps since June 2021 on this line, gaining experience in continuous mixing together with OEMs (original equipment manufacturers) and other partners. Throughputs of around 100 liters of electrode slurry per hour are possible with the 30-millimeter extruder, including the corresponding peripherals. This plant is the ideal basis for pilot trials, as it combines an industry-relevant production capacity with simple operation. Thanks to its modular design, a very large number of process parameters can be run down within a very short time and thus the mixing process can be efficiently optimized," explains Philipp Stössel, Team Manager Process Technology Grinding & Dispersing at Bühler.

Ten kilometers further south, in the Hansa Business Park Münster, the complete outer shell of the FFB PreFab, the next milestone of the Fraunhofer FFB, is already in place. Eckstein can hardly wait to move in with his team and integrate the equipment from the Workspace into the PreFab. "When the interior construction is completed in 2024, we will

conduct experimental research here with customers and universities on 6,000 square meters. In our innovation modules, we can take advantage of the shorter changeover and cleaning times. This allows us to improve existing processes, apply new technologies, and extrapolate the knowledge gained to industrial applications," he says.

The game-changing move

One interesting new technology is dry battery electrode (DBE) technology. Currently, components are mixed into a liquid slurry that is applied to a film and dried – a process that is not only time- and energy-consuming, but also requires toxic solvents that cost money and interfere with battery recycling.

"Dry blending eliminates the solvents, providing sustainability and cost-saving benefits. There is even the possibility of increasing key properties such as the energy density of a battery cell, as thicker electrode layers can be processed. The DBE process route also opens doors in the solid-state battery field. We are actively researching DBE technology, but scientific collaboration with institutions such as the Fraunhofer FFB is fundamental to build up new

knowledge within a useful period of time and to enable the leap to industry,” explains Stössel. For the time being, however, classic wet blending will continue to be the standard. “If we want to achieve an energy transition – be it with the switch to electric cars, or the storage capacities needed for solar and wind energy – industrial battery production is the game-changing move,” explains Stössel. To test this on a one-to-one basis, nothing less than a gigafactory is needed. And this is precisely what will be built in the coming years a stone’s throw away from the PreFab – logically dubbed the FFB Fab.

Eckstein is pleased that this public tender was also awarded to Bühler. “Thanks to Bühler’s continuous mixing technology, we can determine accurate parameters for scaling and transfer them to the gigafactory scale. Bühler’s battery experts keep challenging us to look at things in a new way, and we are in active exchange when it comes to new technologies and best practices. For example, we are fascinated by QuaLiB, an in-house development at Bühler, which allows the quality of the electrode slurry to be analyzed in real time and ensures traceability of the process,” explains Eckstein.

The industrial plant that has been commissioned is based on a 93-millimeter extruder as well as sophisticated systems for handling, storing, and metering the raw materials, and for slurry storage. The mixing plant will be able to process up to approximately 1,200 liters of electrode slurry per hour.

Skilled workers in focus

The facility is also designed to eliminate hurdles – hurdles that, today, stand in the way of many potential entrants into the battery business; hurdles that are stalling Germany’s and Europe’s great race to catch up. “If a medium-sized company wants to get into cell production, they lack the equipment to produce pilot series. We need to remove this obstacle quickly to put Germany on the map as a location for battery production,” says Eckstein.

“A lot of research is already happening, especially by the OEMs, but it’s often carried out within their own four walls. The knowledge of how to build and operate such factories is something we have to generate together. We need to share it so that Europe is able to make good battery cells to meet its sustainability and climate goals independently,” he adds.

In addition to generating and sharing knowledge, building a skilled workforce is fundamental. According to the National Platform Future of Mobil-



**“IF WE WANT TO ACHIEVE AN
ENERGY TRANSITION, INDUSTRIAL
BATTERY PRODUCTION
IS THE GAME-CHANGING MOVE.”**

PHILIPP STÖSSEL

Team Manager Process Technology Grinding & Dispersing at Bühler

ity (NPM), up to 65,000 skilled workers, many of them highly specialized, will be needed every year in Europe by 2030.

“In our ELLB, European Learning Lab for Battery Cells, we are creating training opportunities in subjects related to batteries themselves, but also in how to operate these highly complex systems. We want to share the know-how we have developed in order to build up more and more skilled personnel who can get the most out of the plants in these factories,” says Eckstein.

The political goals and guardrails are clearly set. The societal consensus to move away from fossil fuels and toward sustainable forms of mobility and energy has accelerated with the Russian war against Ukraine and the accompanying energy supply crisis. What remains is to look ahead at the further devel-



The FFB PreFab facility will feature a pilot line for small-scale battery cell production and have machine capacity of about 200 megawatt hours per year for electrode production.



opment of battery cell manufacturing in Europe. “The goal in Europe has to be, first of all, for all OEMs and battery cell manufacturers to build up as much mass as possible. Once we have a decent number of gigawatt hours installed, we have to think about how to get more quality into the cells. Issues such as rejects or recyclability of materials will become even more important in about 5 years, when a basic capacity for battery cell production is available,” Eckstein explains.

How quickly and how efficiently Europe can catch up will also depend on the work of the Fraunhofer FFB. It could well be that industrial battery production will be established in its neighborhood in Münster in the near future – there is certainly no shortage of expertise and bright minds with vision.


INFO


Fraunhofer FFB

Fraunhofer Research Institution for Battery Cell Production (FFB) in Münster, North Rhine-Westphalia, Germany



Founded in 2018.



As a link between science, research, and industry, the Fraunhofer FFB aims to establish a research infrastructure for environmentally and commercially sustainable battery cell production.



Its customers are original equipment manufacturers, battery manufacturers, and universities.



The Fraunhofer FFB operates a pilot plant provided by Bühler for continuous mixing of battery slurry. In 2024, when the PreFab is commissioned, research will continue on a 30-millimeter extruder. In parallel, the industrial plant – called Fab – will be built with a 93-millimeter extruder and throughputs of up to about 1,200 liters of battery slurry per hour. Despite its size, the industrial plant will also be modular, allowing the processing of different cell chemistries, for example, anode and cathode formulations.



DRIVERLESS FUTURE?

In San Francisco, US, robotaxis are already a frequent sight, cruising the streets alongside regular road traffic. Robotaxis are now running day and night, but with restrictions on when they can take passengers. Meanwhile, tech hub Shenzhen, China, is allowing registered autonomous vehicles to travel on certain roads. The purpose is to test and train self-driving vehicles.

Safety is, of course, the number one priority, and there are still challenges to be overcome. Nevertheless, with every kilometer driven, the technology is improving. It is no wonder that all the major original equipment manufacturers (OEMs) are investing in the development.

The technology required to make this happen includes sophisticated onboard cameras, sensors, and head-up displays – all of which are part of Bühler's solution portfolio.

We are not there yet, but progress is constant. When it works as envisioned, it has the potential to reduce accidents. Currently around 1.3 million people die each year as a result of road traffic crashes globally. The cause of most accidents is human error.

While fully autonomous vehicles may still be many years away, increased automation is making headway. OEMs are beginning to announce vehicles with "conditional driving automation", which means that a human driver must be available to take over in some traffic circumstances. It is the next step on the road to autonomy.



A profound change is underway in how we drive. Vehicles are becoming more automated and more autonomous, not only assisting the driver but taking over key decisions. To achieve this, cars must learn not only to see, but also to communicate with their environment. Innovative optical technologies play a central role in achieving this goal.

AS ANY CITY DRIVER KNOWS, safely navigating unpredictable urban environments requires not just quick and accurate reactions but also fast thinking and good judgement. Is the motorcyclist ahead about to turn and cross your path? Has the child at the side of the road seen you? Do you have space to overtake the vehicle ahead before the road narrows? Scores of complex events unfold around the car at every moment – the person at the wheel has to be aware of everything that matters and is responsible for the decisions and actions they take.

That has been the standard since the invention of the automobile. But now the industry is moving toward a new vision as more of the tasks traditionally carried out by the human are taken over by the machine, with the goal of making traffic situations safer for all of the various participants. Adaptive cruise control slows the car down when it comes too close to the vehicle in front of it; the blind spot assistant warns of vehicles approaching from the



TEXT: JANET ANDERSON

THE CAR **AT THE WHEEL**

side; the lane assistant notifies the driver if the car unintentionally drifts to the edge of the lane. "It started with technologies that assist the driver and help them to better anticipate and overcome dangers, such as emergency braking assistance, improved rearview mirrors, and intelligent headlights," says Dr. Steffen Runkel, Head of Optics at Bühler Leybold Optics. "But increasingly, it means the car itself is making the decisions."

Sensors and sensibility

The technology that enables cars not only to sense their environment but also to take sensible decisions comes from the field of optics.

Optical sensors are at the heart of this. Sensors can scan the environment and detect the size and distance of objects. Projection modules are then needed to communicate relevant information to other road users in the vicinity – a prerequisite for autonomous driving. Both sensors and projection

modules can be integrated into various parts of vehicles. The smartest location for them, however, is most likely within advanced lighting units, as these have to be integrated into the car body in any case.

To scan and detect the environment accurately, the sensors need to be able to sort out the important information from distractions, like reflections from sunlight, for example. In other words, they need the kind of filter that the human brain applies to the information we receive from our senses.

Leybold Optics in Alzenau, Germany, specializes in this area. Over 20 years ago, its HELIOS sputter coater technology was developed and is used to manufacture exactly this type of filter. Known as a band-pass filter, it consists of a specific sequence of nanometer-thin optical layers created using the sputtering method. "A material like silicon or tantalum is used for the coating. We call this the target. It is placed as a block in the sputter cathode," explains Dr. Runkel. "With the help of an energetic plasma,

individual ions are created which bombard the target material. This ejects individual silicon or tantalum atoms out of the target material, which in turn condenses on the filter. By adding oxygen gas, these layers oxidize and become transparent. This results in several nanometer-thin layers of various materials. Depending on the composition, they filter different wavelengths and can thereby block unwanted reflections from sunlight or the distracting light from other vehicles when driving at night. The sensor detects only the light that is wanted, sent out from a laser, and reflected back by the surroundings of the car.”

The HELIOS technology has advanced so far today that the filters produced can sort out the light waves with a high level of differentiation. They work in the light spectrum from ultraviolet to infrared by applying up to 800 layers of various optical materials to a filter. Another important factor is that a HELIOS system can coat several workpieces simultaneously, thus increasing production volumes. This makes the production of filters much more cost-effective – a key driver in the growth of this market.

“Optical sensors need to be smaller, cheaper, and more easily integrated. This is what we are working on with our customers,” Dr. Runkel explains. “Sensors are built on complementary metal-oxide semiconductor (CMOS) technology. Up until recently, the filters had to be applied to glass which was then glued on the CMOS sensor. Now we are

applying the filters directly to the chip. This saves production steps and removes the need for additional glass and lamination.”

Leybold Optics has started the journey of adapting the coating technology to the requirements of the semiconductor industry using the HELIOS 800 Gen II sputter coater. It has demonstrated that it can apply complex filters directly to CMOS wafers with a coating thickness that is consistent to ± 0.5 percent and better. It can also coat up to 12 substrates in just a few hours, more accurately and significantly faster than the conventional process. “This enables our customers to produce the next generation sensors at scale,” says Dr. Runkel.

From detector to decision maker

While sensors are critical, they are not the only technology that is driving the development of autonomous vehicles. Making the right decision takes more than just detection. A self-driving vehicle must evaluate all the information generated by the sensor in real time and convert it into an appropriate action.

“IT STARTED WITH TECHNOLOGIES THAT ASSIST THE DRIVER AND HELP THEM TO BETTER ANTICIPATE AND OVERCOME DANGERS. BUT INCREASINGLY, IT MEANS THE CAR ITSELF IS MAKING THE DECISIONS.”

DR. STEFFEN RUNKEL

Head of Optics at Bühler Leybold Optics

Filters help the sensors to work better by removing distracting light. This enables the vehicle to detect what matters, even when driving conditions are not ideal.

It therefore needs intelligent software programs based on artificial intelligence that can make the correct decisions. If these vehicles are to be adopted by consumers and meet regulatory requirements, improving safety has to be the primary goal.

To ensure that this goal is achieved, vehicles must be able to identify objects accurately. “If a truck is not recognized as a truck but as a bridge, then the system is not roadworthy. If street signs can be detected by the camera system with only about 90 percent accuracy, that is not good enough. We still do not have a system that can reliably see all eventualities,” says Klaus Herbig, Head of Market Segment Precision Optics at Bühler Leybold Optics.

However, many of the core technologies are becoming more widespread. For example, LiDAR (short for light detection and ranging) is a method related to radar that works with light rays instead of radio waves. Acting as the car’s “eyes”, it scans the environment and can identify and therefore recognize potential dangers. Today it helps the driver react faster, keep a safe distance from the vehicle in front, or trigger emergency braking in critical situations. In future it will enable cars to drive themselves autonomously, communicating with their environment and other road users via projectors integrated into the headlights. “Today these scanners are used in premium cars. In future, they are likely to become standard,” says Herbig.

Currently LiDAR systems are installed on the car’s roof, arranged at various angles so that they can capture all of the surroundings. However, such systems will only reach market maturity when the components are smaller and can be integrated into existing car components, such as headlights.

“The entire industry is working in top gear on this, both established companies and start-ups. There are dozens of start-ups around the world that have their own ideas of how LiDAR technology could work in cars in the future,” says Dr. Runkel. “There is a lot of testing and development going on. The system must be 100 percent reliable; 95 percent is not enough. It also needs to be more affordable. As the system is more widely applied in the automotive industry, the costs will come down.”

The Leybold Optics team works closely with customers and partners to keep track of the technology that is being used. “We are in regular contact with research institutions in Germany, France, and Belgium, and with automotive manufacturers and their suppliers,” says Herbig. “We offer them the opportunity to test their creative ideas and developments in our Application & Training Center in Alzenau.”

The Application & Training Center includes a 1,200-square-meter test area, a high-tech lab, and a highly modern research and development area with two HELIOS systems. There is also a DLC (diamond-like carbon) machine, which is used for manufacturing items such as cameras for night vision. The forward-facing cameras need to withstand enormous loads, like stormy weather and use in heavy traffic. The DLC can coat the outer camera window to make them very resilient.

BENEFITS

- + The HELIOS sputter coater provides high productivity with atomic-scale precision thanks to plasma-assisted reactive magnetron-sputtering (PARMS) process technology.
- + HELIOS’ on-substrate optical monitoring enables the highest reproducibility to safeguard production.
- + The HELIOS achieves maximum laser damage threshold values, low scattering, and high reflectivity, setting new benchmarks for optical filters.

Find out more about Bühler
Leybold Optics’ HELIOS series:



The road to autonomy

According to a report published by the consulting firm McKinsey in January 2023, even if the road to autonomous driving is proving longer than the first visionaries expected, there is a consensus gathering around its potential to transform transportation and society as a whole. Today, most cars include basic advanced driver-assistance systems.

By 2030, the consultants forecast that the value of the hardware market to support autonomous driving, including domain control units, cameras, sensors, LiDAR, and radar, could be between USD 55 billion and USD 80 billion. The combination of all three of these technologies is seen as the way forward because each of these sensors works at a different distance.

“Many of these ideas are still in development,” says Dr. Runkel. “It is already clear that the car of the future will learn to see through a variety of smart sensors based on optical and radar technologies. Our solutions can support the industry in driving toward this goal and making mobility safer for everyone.”



GO WITH THE FLOW

TEXT: JONATHAN WARD

Capacitors were the original electrical energy storage devices. They are now among the world's most widely used electronic components, with a vital role in the drive systems of today's electric and hybrid vehicles. As capacitor technology continues to evolve, it could play an even bigger part in the mobility solutions of tomorrow.

THE FIRST ELECTRIC BATTERY wasn't a battery at all. In the mid-18th century, scientists and inventors around the world were fascinated by the mysterious phenomenon of electricity. The first practical way to store electrical energy was known as the Leyden jar, named after the hometown of Dutch scientist Pieter van Musschenbroek, one of several pioneers to independently create the device.

The ideas that led to the Leyden jar were wrong: its inventors thought that electricity could be stored in liquid form, dissolved in water or alcohol. The jars were designed to facilitate that process, using a glass container with a conductive metal rod inserted through its lid.

It was Benjamin Franklin, scientist and one of the Founding Fathers of the United States, who later discovered that Leyden jars worked just as well with

nothing in them. He used empty jars wrapped and lined with metal foil, eventually replacing the jars with flat glass plates. In a letter of 1749, Franklin described an arrangement of multiple plates as "... what we call'd an Electrical Battery."

Not a battery but a capacitor

We now know that the Leyden jar and its descendants were not batteries but rather early examples of the capacitor, a device that has become ubiquitous in modern electrical and electronic systems. Batteries store and release charge through chemical reactions. Capacitors work by catching and releasing electrons. They consist of two conductive plates, held close together but separated by a barrier of insulating material. When a positive charge is applied to one of the plates, it attracts electrons to the



other. Unable to cross the barrier, those electrons simply hang around until conditions change and they are free to flow back into the circuit.

A modern battery can store many times more energy than a capacitor of equivalent size and weight, but capacitors have other properties that batteries can't match. Batteries work best when they work slowly. Their chemical reactions take time, and charging or discharging a battery too quickly can damage or destroy it. A capacitor, by contrast, can cope with extremely rapid charge and discharge cycles with no ill-effects.

Giving a useful boost to e-vehicles

That ability to absorb and release energy quickly is what makes capacitors so useful in power electronics applications, including the drive systems of electric vehicles. Large capacitors perform multiple functions in modern electric vehicles. They smooth the flow of energy through the circuits that convert direct current from the battery to alternating current at the motor, for example.

And they can act as a buffer at times of high demand, absorbing excess energy during regenerative braking or discharging to boost acceleration. Making capacitors that perform well in electric mobility applications is tricky. The storage capacity

of a device is closely related to the area of its conductive plates, but engineers need compact, robust components they can easily integrate into their designs. One way to do that is to make the plates and insulating layer from thin, flexible materials that can be rolled up into a small package.

Today's component makers are taking that approach to extremes. Ultra-thin film capacitors, which are common in automotive applications, use oriented polypropylene (OPP) or polyester (PET) films as their insulators. "In automotive applications, we see film thicknesses down to 1.2 micrometers," says Michael Mücke, Head of R&D and Product Management for Bühler Leybold Optics' Flexible segment, the part of the business that makes the machines that apply coatings of conductive material onto the insulator material.

Precision coating provides the key

Manufacturing a thin film capacitor involves multiple process steps. Films receive a thin aluminum coating to form the plates, with thicker layers added in select areas to create connection points. Prior to coating, a printing system masks parts of the film with a layer of oil, so the conductive coatings only go where the component design requires them.

Precision vacuum coating using physical vapor deposition, including thermal evaporation, is a core Bühler expertise. However, applying coatings that are 50 times thinner than a human hair to thin polymeric films creates its own special challenges. "You need to ensure that you don't damage the film during handling," says Mücke. "Even allowing it to wrinkle would negatively impact the coating process."

The Leybold Optics CAP vacuum coating systems incorporate multiple innovations to achieve the best possible quality and process reliability. They include sophisticated control systems that precisely manage the tension and position of the film as it travels through the coating chamber. "We develop our own software for the control system," says Mücke. "We want to continually adapt the speed of the coating and winding systems to achieve a consistent result, while minimizing oscillations that could disturb the film."

Temperature management is critical, too. Within the coating chamber, supporting process drums are cooled to between -15°C and -20°C to ensure the hot aluminum does not melt the film. An optical verification system inspects the entire coated surface as it leaves the chamber, backed up by cameras that take high resolution images of select areas.

The rolls of film can be as long as 60 kilometers, yet resource efficiency and quality criteria have to be maintained throughout the process. "Our aim is to minimize scrap and achieve 100 percent quality over a full roll of film," says Mücke.

BENEFITS

- + The Leybold Optics CAP series vacuum coater offers superior thermal management of the thinnest, most sensitive polymer substrates, increasing productivity thanks to efficient substrate cooling.
- + It meets all coating needs, from standard to high-end applications, thick to the thinnest films, plain to segmented designs, pure layers or layer stacks.
- + Bühler's DISS technology monitors and controls layer profiles and the width of free margins in real time, reducing scrap and offering a consistently high product quality.

Find out more about Bühler Leybold Optics' vacuum coater for flexible roll-to-roll coatings.





AMAZING GLAZING

TEXT: JONATHAN WARD

Bigger and brighter. Advances in automotive glazing are improving the comfort, safety, and efficiency of modern vehicles. Now, new layers of invisible technology are creating windows that can adapt their appearance and behavior, offering privacy, information, and even entertainment as required.

A MODERN VEHICLE contains around 5 square meters of glass, that's almost twice as much glazing as 30 years ago. The reasons are clear: in addition to their greater size, today's cars are more likely to use large, steeply raked windshields and glass sunroof designs. Big windows are popular with designers and customers alike, but they create engineering challenges. And the industry's rapid transition to electric power makes those challenges more acute.

"With an electric vehicle, efficiency is all-important," says Dr. Marcus Frank, Head of Application and R&D Glass at Bühler Leybold Optics. "You want to use every watt-hour in the battery for extra range, not spend it on auxiliary functions." The most energy-intensive auxiliary function in a passenger car is the equipment needed to keep the passengers at a comfortable temperature.

Large expanses of glass make cabin temperature control tricky. In cold weather, glass windows and roof panels conduct and radiate heat from the interior of the vehicle. Heating comes for free in an internal combustion car, thanks to large quantities of waste heat generated by the engine. With a highly efficient electric motor, cabin heating must draw precious extra power from the battery. At low temperatures, when battery performance is already impaired, heating loads can cut the range of an electric vehicle by 30 percent.

In hot climates, the situation is no better. Solar energy passing through the windows can quickly heat the cabin to uncomfortable or even dangerous temperatures. Modern vehicles deal with that heat by using air conditioning systems that distribute pre-cooled air into the cabin. That's another energy-intensive job: When it is working hard, a 3-kilowatt air conditioning unit can reduce the fuel efficiency of a conventional vehicle by 20 percent.

One way to reduce the energy required for cabin heating and cooling is to make smarter glass. Coatings and films with carefully engineered optical characteristics allow the creation of glazing that filters incoming and outgoing radiation at specific frequencies. The filters can perform different functions: reflecting heat radiated by occupants back into the vehicle, for example, or minimizing the solar energy entering the cabin by blocking the transmission of light at visible and non-visible wavelengths.

Infrared reflective coatings involve ingenious nano-scale engineering. They are usually made as a stack of alternating layers including silver and metal oxides. "The individual layers in these coating systems have thicknesses in a range between 2 nanometers (nm) up to 70 nm; the thickness of the silver layers is around 15 nm," says Dr. Frank. "But a full stack might include up to 20 individual layers."

The stacking doesn't stop there. To improve its strength and preserve the delicate solar control coatings, advanced automotive glazing uses laminated construction, with two or more layers of glass sandwiched together with robust plastic interlayers. Putting the coated side of the glass inside the sandwich protects it from impacts, abrasion, and corrosion. Laminated glass and solar control coatings are widely used in architectural glazing to make buildings more comfortable and energy efficient. Vehicle glazing uses the same basic technologies, but automotive applications involve some extra challenges, says Dr. Frank. "The automotive industry has strict standards relating to the optical properties of glass, especially in windshields and front windows. They are there to ensure the driver always has a clear view of the environment around them."

And then there's weight. Extra mass requires extra energy to move it, and that is a particular problem for electric vehicles. To compensate for heavy batteries, carmakers are looking for ways to reduce weight elsewhere in the vehicle. One way to do that is with thinner glass. "Architectural glazing might use 4 millimeters (mm) to 6 mm glass sheets," says Dr. Frank. "In automotive applications we see sheets as thin as 1 mm."

Applying precise, complex coating stacks to large pieces of thin, flexible glass requires sophisticated manufacturing technology. That's an area where Bühler has developed considerable expertise. Its specialist vacuum coating machines used in the automotive sector include numerous features designed for safe handling and effective quality control. They include closely spaced rollers to support the glass as it travels through the machine, and advanced process control. "After every stage in the process, we use in-line spectrometers to check the optical properties of the glass," explains Dr. Frank. "Our machines use that data to continually adjust their

operating parameters. If you ensure every layer in the stack is within specification, you know that the finished glass will perform as expected."

A window on the future

In the most advanced vehicles, glazing is evolving even further. Automotive suppliers are now incorporating active materials into their multi-layer glass sandwiches, creating products that can alter their appearance and behavior on demand. Polymer dispersed liquid crystal (PDLC) films, for example, allow the tint of a window or roof panel to change under electronic control. That allows occupants to dim their windows for privacy or comfort reasons. Applied selectively, the technology could replace the ubiquitous sun visor with panels that adapt instantly and automatically to shield the driver's eyes from low sunlight.

Incorporating organic light-emitting diode display technologies into windshields will enable a new generation of head-up displays that allow drivers to see useful information without taking their eyes off the road. Looking even further ahead, autonomous vehicles could create bold new opportunities for advanced automotive glazing. The windshield of the future might transform into a widescreen monitor, allowing car occupants to work, watch videos, or play games on the move.

BENEFITS

Leybold Optics GLC H series glass vacuum coater:

- + With a modular design and easy reconfiguration, it can apply low emissivity, solar control, anti-reflection, mirror, and other functional coatings.
- + Unique gap management technology allows just 30 mm between substrates, saving coating material and improving productivity by up to 25 %.
- + High-quality, energy-efficient components and optimized process compartment design enables fast deposition with reduced power consumption.

Find out more about
Bühler Leybold Optics' glass
vacuum coaters.





optiX fab

PICO- METER

PRECISION

TEXT: JANET ANDERSON
PHOTOS: JUDITH AFFOLTER

The journey toward autonomous vehicles requires the development of powerful and efficient microchips that can process vast quantities of surrounding data in fractions of a second. This is only possible thanks to EUV lithography, an optical technology that uses extreme ultraviolet light to create highly advanced microchips. optiX fab in Jena, Germany plays a crucial role in this process, working with a high level of precision at an unimaginably tiny scale.



"WE WORK TO SINGLE-DIGIT PICOMETER coating thickness accuracy," says Dr. Torsten Feigl, CEO of optiX fab. "Imagine a millimeter divided into a thousand, that is a micrometer. Now divide a micrometer again by a thousand, that is a nanometer. Then if you divide a nanometer by a thousand, you get a picometer. In other words, it is equal to one trillionth of a meter. The human brain cannot imagine this world. It is as difficult as imagining light years."

optiX fab is one of the few companies in optics that work at such a tiny scale. It does so in order to coat the most precise mirrors in the world, needed in the manufacture of advanced microchips. The automobile industry is one sector in which these play a crucial role.

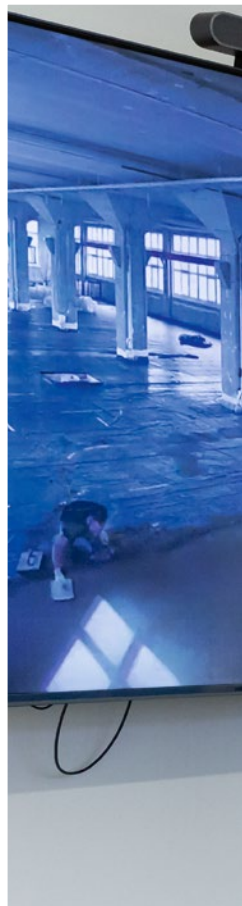
Moving from driver assistance to partial automation and finally full automation requires microchips with ever higher processing capabilities. In order for the chips to meet these requirements, the writing on them must be carried out at the smallest resolution. The only way to do this is with EUV lithography, which uses extremely short-wave ultraviolet light to burn circuits on the chip. To focus the light beam, super-polished mirrors are used that have been coated with a highly reflective EUV layer system

made of over 100 layers each only nanometers thick. This is where optiX fab's expertise lies – working with atom-level precision.

Working under perfect conditions

Based in Jena, the historic capital of the optics industry in Germany, optiX fab carries out its extraordinary work in an ordinary-looking old factory building. But looks can be deceptive. Thanks to the building's history, it is the perfect place for Dr. Feigl and his team to work. Built in 1934 by Zeiss, the German manufacturer of optical systems and optoelectronics, it is one of the most stable industrial buildings in Germany. Each square meter can bear a load of 3.5 tons with no vibrations – nothing moves.

These are exactly the conditions optiX fab needs to house and operate its four NESSY coating machines, provided by Bühler. The NESSY is a magnetron sputtering system which optiX fab uses to coat the mirrors for EUV lithography. Each of the 12-ton machines fits neatly into the spaces between the pillars of the old building and can operate faultlessly for hours on end. "It is almost as if Zeiss knew back then what we would need to carry out EUV lithography today," says Dr. Feigl.





optiX fab is a spin off from the Fraunhofer Institute for Applied Optics and Precision Engineering (IOF). Dr. Feigl had been at the head of a working group at IOF that made EUV coatings for the semiconductor industry and had already worked with NESSY, the first of which was delivered to IOF by Leybold Optics in 2003.

The machine was developed by the two teams working together to meet the high requirements of the rapidly changing technology and market. As demand grew for chips that were faster, with more memory and more power at the same size, the industry began using light at shorter wavelengths to print smaller structures on the chips, shifting from 248 nanometers (nm) to 193 nm. "By the mid-1990s, it was not clear what technology the next generation of chip would require," says Dr. Feigl. "That was when the industry decided to explore EUV – extreme ultraviolet." There were several challenges with using this new wavelength. It meant a major shift in the hardware required – and NESSY was the result. In 2013, Dr. Feigl commercialized the technology.

EUV rays lie between X-rays and UV rays. In this part of the spectrum, it is not possible to use lenses to focus the light to write on a chip. The reason is that at 13.5 nm the rays are absorbed by the materials around them. Instead of lenses, precisely shaped mirrors are therefore used to focus the light. And since even air absorbs the rays at this wavelength, the chips must be printed in a vacuum. Finally, at this wavelength the construction of the mirror requires great expertise to achieve sufficient reflectance. At a wavelength of 13.5 nm, each layer of coating on the mirror is only a fraction of a percent reflective. To make the mirror sufficiently reflective requires a complex multilayer coating.

"This is what we do at optiX fab," Dr. Feigl explains. "We take a highly polished substrate and build up layers of coatings." The layers are built up of alternating materials, such as molybdenum and silicon. The alternating layers could be, for example, 2.7 nm and 4.2 nm thick respectively, built up in pairs to around 100 layers. As the light passes through each layer, due to absorption it is reflected



"IN THE 1990s IT WAS NOT CLEAR IF EUV TECHNOLOGY WOULD MAKE IT TO PRODUCTION. NOW WE HAVE PRODUCTS MADE WITH THIS TECHNOLOGY THAT ARE USED BY PEOPLE AROUND THE WORLD EVERY DAY."

DR. TORSTEN FEIGL
CEO of optiX fab

Dr. Feigl shows how the old building in Jena was converted into a high tech fabrication plant.

less and less the lower the layer – as little as 0.1 percent. The expertise is in building up the layers in such a way that together they create sufficient reflectance. The key to this is using the right materials, at the right thickness, in the right places – and this is where single-digit picometer accuracy is required. “We have to develop a coating recipe for each mirror. That’s a process that can take anything up to 2 years. When we get it right, we are able to achieve over 70 percent reflectance,” says Dr. Feigl.

Working with an engineering masterpiece

The largest mirror that optiX fab has coated to date is a 662-millimeter diameter collector. Weighing 40 kilograms, it took a year to develop the coating recipe. There were 300 layers on the substrate. The angle of incidence varied from 6 degrees at the center to 36.5 degrees at the edge, requiring a variation in thickness of the layers from 6.883 nm to 8.459 nm – all at an accuracy of less than 10 picometers.

Today they achieve 1, 2, or 3 picometers accuracy. Recently for a customer from Ireland, the team worked with wavelengths of 2.745 nm. This meant building up 2,000 layers that were between 0.1 nm and 0.6 nm thick each. One of the key parameters was to ensure that the first layer in the multilayer stack has exactly the same thickness as the last one. “The machine needs to be stable over 12 hours to achieve this. With NESSY, Bühler made that happen. It is an engineering masterpiece,” says Dr. Feigl.

For Klaus Herbig, Head of Market Segment Precision Optics at Bühler Leybold Optics, it is still astonishing what the optiX fab team achieves – even though he has worked with them since the beginning. “Their technology input is at the physical edge,” he says. “We know how to build the machine that does the coating with unmatched levels of layer precision. They know how to combine the different materials and to keep them stable over time. They have to understand the process well to do it properly. The success relies on their skill.”

From clean room to the machine room

In the old Zeiss building, optiX fab has installed the four NESSYs in a row in the machine room. A load lock separates the machine room from the clean room. The process starts in the clean room, where the substrate to be coated is put in a “flow box”.

In the clean room, there is next to no dust or vibration. In the flow box, the air is even cleaner than in the rest of the clean room. The substrate is installed in the coating holder, then transferred to the load lock using “touchless tools”. In the load lock, the air pressure is pumped down and the substrate is then transferred to the coating chamber of NESSY, which operates under ultra-high vacuum conditions.

The coating then runs automatically. The substrate spins below the target in a planetary movement. All the movements, speeds, and distances are programmed and controlled on the instrument panel, including the level of vacuum. Twelve engineers and physicists are on hand to look after the four NESSYs. The different coating materials are stored in the machine room, too. Some of these are supplied by Bühler.

As the substrates and coating materials can be very expensive, tests are carried out beforehand using the real substrate. The substrate shape is cop-



Tina Seifert, EUV coating specialist at optiX fab, transfers the substrate from the clean room through the load lock to the coating chamber of NESSY in the machine room.



optiX fab coats the most precise mirrors in the world used in EUV lithography.

“WITH E-MOBILITY AND AUTONOMOUS VEHICLES, THE REQUIREMENT FOR ADVANCED CHIPS WILL SKYROCKET. AND WITH THE GROWTH OF ARTIFICIAL INTELLIGENCE, THE MARKET IS FAR FROM SATURATED.”

DR. TORSTEN FEIGL
CEO of optiX fab

ied in aluminum silicon samples placed within it at specific coordinates, it is then coated, and measurements are taken to check that the target values have been achieved. The test runs are carried out over and over again. It might take anything from 10 to 100 attempts to be sure before using the real substrate.

Once NESSY has done its job and the coating is completed, the mirrors are transferred back through the load lock to the clean room. Next, they are packed, sealed, and sent to the National Metrology Institute of Germany in Berlin, which measures the EUV reflectance. With this, optiX fab can prove that it is delivering exactly what its customers require.

The mirrors are then returned to Jena and shipped to customers around the world – to the Netherlands, United States, Japan, and Korea, but also increasingly to customers within Germany. Since its foundation, optiX fab has created more than 21,000 EUV and soft X-ray mirrors using this process – an average of almost 10 a day. Today this technology is an established part of the industry, but it was a big step to take at the beginning. “When I placed my first order for a NESSY from Bühler, we had no long-term contracts. Now we have four NESSYs and demand is growing so much we will soon need another,” explains Dr. Feigl.

As optiX fab celebrates its tenth anniversary, the need for connectivity between people and things continues to grow – not least between increasingly autonomous vehicles and their environment. Furthermore, to many people’s surprise, Moore’s law shows no signs of stopping – the number of transistors per chip continues to grow, and the race goes on to produce the smallest and most efficient microchips in the world.

Reaching the stars

Exciting new applications of optiX fab’s technology are emerging. One example is in space. Two years ago, optiX fab supplied a coated mirror for the European Space Agency’s Solar Orbiter, and they are now in discussions with NASA about the next solar mission.



Dr. Torsten Feigl, CEO at optiX fab, and Klaus Herbig, Head of Market Segment Precision Optics at Bühler Leybold Optics, discuss the purchase of more NESSYS.

“OPTIX FAB’S TECHNOLOGY INPUT IS AT THE PHYSICAL EDGE. THEY KNOW HOW TO COMBINE THE DIFFERENT MATERIALS AND TO KEEP THEM STABLE OVER TIME. THE SUCCESS RELIES ON THEIR SKILL.”

KLAUS HERBIG

Head of Market Segment Precision Optics at Bühler Leybold Optics

INFO

optiX fab.

optiX fab GmbH

Jena, Germany

- 🕒
 Founded in 2013.
- ⚙️
 optiX fab designs, develops, and fabricates extreme ultraviolet (EUV) imaging, illumination, and collector optics.
- 🤝
 optiX fab supplies EUV equipment manufacturers worldwide.
- 🏠
 optiX fab uses Bühler’s magnetron sputtering system, NESSY, to coat the mirrors used in EUV lithography.

With 12 employees, expanding to 15 this year, optiX fab is ready to meet the challenges. “When I started in the 1990s it was not clear if EUV technology would ever make it to production. Now we have products made with this technology that are used by people around the world every day. For example, since the iPhone 12, Apple has used chips created with EUV lithography. We delivered the hardware that made that possible,” says Dr. Feigl. “It is still a growing market. With e-mobility and autonomous vehicles, the requirement for advanced chips will skyrocket. And with the growth of artificial intelligence, the market is far from saturated.”

Working like Michelin star chefs

“To exploit many of these opportunities, we need computer chips with ever greater capacity. The need for EUV lithography is set to grow, and Bühler and optiX fab are driving in the same direction,” explains Herbig. The optiX fab team has the expertise and the experience to achieve this, but Dr. Feigl says they could not do it without NESSY. “Our brain power and NESSY together create the outcome. We are like Michelin star chefs working with top-notch kitchen equipment – that is what NESSY is for us.”

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HELIOS series. Go beyond the limits.

Meet the most exacting demands for your thin-film coating needs with the HELIOS series of sputter coaters.

Our HELIOS portfolio for high precision mass manufacturing offers:

- high productivity with atomic-scale precision thanks to plasma-assisted reactive magnetron-sputtering (PARMS) process technology;
- on-substrate optical monitoring to achieve the highest reproducibility;
- maximum laser damage threshold values, low scattering, and high reflectivity, setting new benchmarks for optical filters.



Scan the QR code to find out more about the HELIOS series.
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Innovations for a better world.

BÜHLER



LET IT SHINE!



TEXT: JONATHAN WARD

Chrome plated elements make vehicles look and feel fantastic, but the process used to produce them can create health, safety, and environmental risks. Now eco-friendly chrome coating systems are helping to make this area of automotive manufacturing more sustainable, while giving car designers new creative opportunities.

CARS AND CHROME have a long association. As vehicle ownership surged in 1950s America, manufacturers competed for consumer attention with designs that took their inspiration from the space race. Popular models of the day sported fins, elaborate lights shaped like rocket exhausts, and meters of gleaming chrome trim.

Car design has moved on since then, but chrome retains its place in the language of automotive styling. Modern vehicles use bright chrome finishes on brand insignia, model names, and a wide variety of interior and exterior components. Those parts are now more likely to be molded plastic than pressed steel, but the purpose of the chrome remains the same, providing visual highlights and a luxurious finish that owners enjoy. Modern automotive chrome also shares some less appealing characteris-

tics with its 20th-century antecedents. Most decorative chrome is applied by electroplating, which produces clean, durable parts, but requires dangerous raw materials.

The hexavalent chromium compounds used in the process are toxic and carcinogenic, and companies that operate electroplating equipment must comply with strict regulations, and implement measures to protect workers from fumes, and the responsible disposal of waste materials.

More haste, less waste

An alternative way to create a bright chrome surface on plastic parts is via sputtering a physical vapor deposition (PVD). In this process, parts are placed in a vacuum chamber alongside a “target” made of pure chromium. The high vacuum minimizes contaminants that cause discoloration or adhesion problems. An inert sputter gas, usually argon, is injected into the evacuated chamber and an electric field is applied that leads to an ionization of the gas molecules, creating a plasma.

The positive sputter gas ions are accelerated by the electric field towards the target. The ions hit the chrome atoms of the target with high energy leading to an ejection of chrome atoms. Those atoms stick to whatever they hit next, building up a thin chromium layer on the surface of the part. By adding magnets to the process, the plasma is densified, which speeds up the sputtering process. This PVD variant is called magnetron sputtering.

PVD is fast, reliable, and makes efficient use of energy and materials. In industrial applications, it can be run as a batch process, or integrated into a

continuous production line. Crucially, since PVD uses pure chromium and inert argon, there are no toxic materials involved and very little waste. In recent years, PVD has become the preferred way to produce chrome finishes in a wide range of applications, from packaging to the side-view mirrors used in cars. Until recently, however, carmakers had stuck with electroplating for most decorative applications.

“Electroplating produces a layer of chromium around 10 micrometers thick,” explains Christian Hoyer, Sales Manager for Bühler Leybold Optics. “PVD deposits around 100 nanometers of material. It’s two orders of magnitude thinner, an incredibly efficient use of material.”

The challenge is that automotive interior trim components are expected to maintain their appearance through many years of hard use. They resist being knocked, scratched, and scraped by vehicle occupants and their possessions. “The automotive industry has extremely demanding tests for the durability of interior finishes. The electroplated chrome, which is 100 times thicker, has proven its durability in the past,” says Hoyer.

As automotive companies look for ways to make their processes cleaner and more sustainable, however, the search for alternatives to chrome plating has intensified. “PVD chrome on plastic interior trim parts may not offer sufficient durability by itself,” explains Hoyer, “But it can work well as part of a system.”

Such systems have been under development by automotive suppliers for several years. They involve a carefully engineered “layer stack” of different materials. “A durable system starts with a good foundation,” explains Hoyer. “That means choosing a suitable plastic for the part itself and adding a strong base coating to further improve the stability and resistivity of the surface.” The PVD layer is applied onto that base, then typically protected by a topcoat of transparent lacquer to further increase durability and to apply aesthetic effects.

Giving designers new options

PVD chrome coatings can also be made to perform in ways that electroplating cannot emulate. Precise control of the extremely thin chrome layer allows the creation of surfaces that work like a two-way mirror. By adding such translucent metal coatings on to transparent plastic components, and placing LED lights under them, carmakers can create features that look like chrome during the day, then become part of the vehicle’s ambient interior lighting at night. The ability to precisely control the reflection and transmission of light and other electromagnetic waves using PVD chrome coatings is giving designers new options for vehicle exteriors.

Translucent chrome coatings allow the installation of daytime running lights that are completely hidden inside other styling features until they are switched on. And coatings that are transparent to radio waves mean carmakers can conceal radar systems, used in adaptive cruise control and emergency braking, behind a vehicle’s insignia.

The advantage is clear

As carmakers tackle the transition to electric drive-trains, new applications for PVD chrome coatings are emerging. “The radiator grille has always been an important part of a vehicle’s brand identity,” says Hoyer. “Electric cars don’t need a radiator anymore and therefore no grille, so designers are given a variety of choices for what to do with that space.”

Some of today’s electric vehicle designs use a blank plate in place of the traditional grille, but PVD coatings create opportunities for much more creative options, he says. Recent concept designs have included digital display panels at the front of the vehicle that can show different patterns at will.

Engineers are experimenting with similar systems to aid communication between future autonomous vehicles and drivers, cyclists, and pedestrians. Options under investigation include displays that show text or emojis to other road users, and even “googly eyes” that look in the direction the vehicle intends to go.

BENEFITS

- + DynaJet SP sputter metalizer combines high throughput and low production costs while maintaining the flexibility and compactness of a batch coater.
- + The ChromeLine is the preferred choice if you want to lift productivity to the next level with an inline sputtering system.
- + The ChromeLine minimizes CO₂ impact by using extremely energy efficient turbomolecular pumps that use much less energy and cooling water than conventional oil diffusion pumps.

Find out more about
Bühler Leybold Optics’
metalizing solutions.



CREATING

Camel Flour Mills

A LEGACY

INTERVIEW: LUKAS HOFSTETTER



Mohamad Moatabar (right) and Stefan Scheiber are convinced that the two companies will continue writing their success story together.

Camel Flour Mills is on a mission to ensure that dozens of millions of consumers have access to safe, affordable, and nutritious staple food. The recent takeover of Five Star Flour Mills makes them the largest privately-owned flour producer in Egypt and a major player in the entire Middle East and Africa region. Mohamad Moatabar, Owner and Chairman of Camel Flour Mills, discusses challenges, opportunities, and the legacy he wants to leave for future generations.

Mr. Moatabar, what are the biggest challenges Egypt is facing in terms of food security?

Water scarcity, land degradation, food price volatility, food waste, climate change, and population growth are some of the main issues that come to mind. It all comes down to the need to produce more food with fewer resources and prepare our food system for even more volatility going forward.

What are the solutions?

On a higher level, we need to take concerted action to improve our water management, invest in sustainable agriculture, promote food waste reduction, and develop policies to address the impacts of climate change.

How does Camel Flour Mills tackle these problems?

After acquiring Five Star Flour Mills, we are the largest privately-owned milling group in Egypt,

with a processing capacity of 3,200 metric tons per day. This enables us to benefit from increased economies of scale, grow our revenue synergies through a diversified and well-planned portfolio, and streamline our distribution network. All this helps us to get the most out of every grain we process and deliver it as flour across Egypt and the Middle East and Africa.

What role does Bühler play in helping you to achieve your ambitious targets?

Bühler is the global technology leader for the food industry. We know that we can count on Bühler's state-of-the-art equipment, on its highly experienced team of millers and engineers, and on its technical support and training, which is crucial in getting the most out of our plants. And then there's Bühler's drive for innovation and continuous improvement of their technologies to meet evolving needs and challenges – that's an area where we really benefit from our trusted partnership.

Can you reveal the secret of your success?

Ever since I started my first trading company in Iraq as a young man and later acquired my first flour milling business in the early 2000s, I focused on a long-term strategy with two key objectives: differentiation through quality and economic advantage through scale. Everything I do is based on three key pillars: technology, people, and research and development.

What are your dreams and goals for Camel Flour Mills?

First, I want to put our Group and Egypt as a country on the global map through continuous scaling, upgrading, and improving of our infrastructure.

Second, I want to continue our journey to become a company that is synonymous with ethical business practices, sustainability, diversity and inclusion, and corporate social responsibility. Third – and most importantly – I aspire to leave a positive legacy by contributing to the ongoing development of our industry and society through education, training, social impact projects, youth mentoring, and of course by providing safe, affordable, and nutritious staple food for millions of Egyptians and beyond.

Camel Flour Mills became Egypt's biggest privately-owned flour producer after taking over Five Star Flour Mills.

INFO



Camel Flour Mills

Cairo, Egypt



Founded in 2005.



Camel Flour Mills is the largest privately-owned flour producer in Egypt and a major player in the Middle East and Africa.



Camel Flour Mills delivers flour to food producers, bakeries, and supermarkets in Egypt and the Middle East and Africa.



Camel Flour Mills relies on Bühler's milling technology from grain intake to cleaning, milling, and packaging, as well as grain silos and ship unloaders.






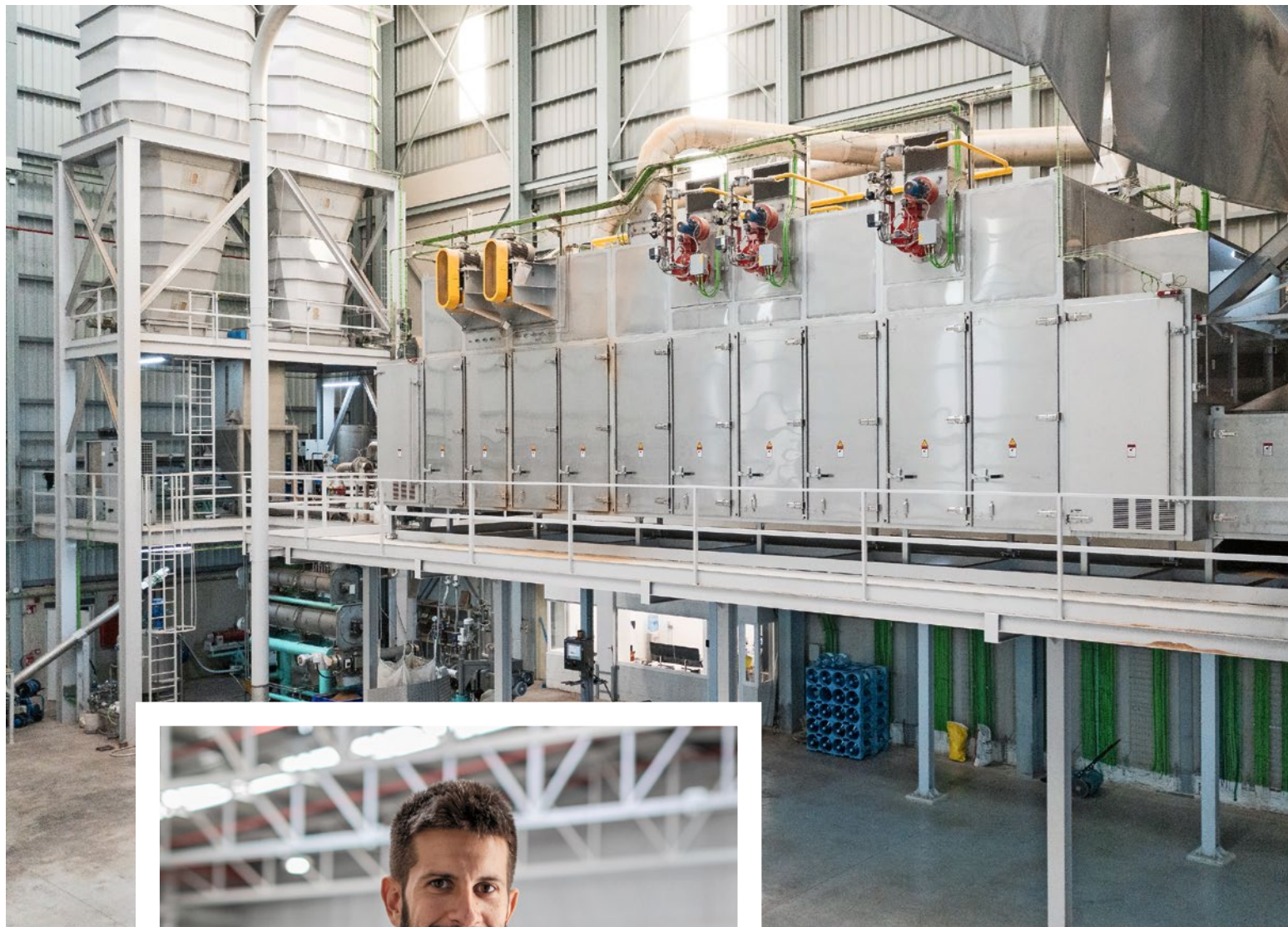
Golden Pet Food

FOOD FIT FOR YOUR FURRY FAMILY

TEXT: STUART SPEAR
PHOTOS: SAGAR SHIRISKAR



Our relationship with our pets is changing. We celebrate their birthdays, buy them gifts, and we are increasingly conscious of their diets. This, as well as the growth in pet ownership during the pandemic, has led to a boost in pet food sales and a shift in the types of foods we buy for our animals – pet food must be sustainable and healthy. Miguel Navarro and his family set up Golden Pet Food in Spain to meet the increasing demands of this market.



“THE PET FOOD SECTOR IS EXPERIENCING HIGH GROWTH AND WE BELIEVE THERE WILL BE MANY OPPORTUNITIES TO CREATE NEW PRODUCTS THAT WILL BE DRIVEN BY INNOVATION.”

MIGUEL NAVARRO

Founder and Managing Director of Golden Pet Food

At its plant near Madrid, Golden Pet Food produces food for cats, dogs, and puppies. The high-quality products are designed to meet different dietary requirements.



Golden Pet Food supplies its products to Spain, Morocco, Israel, other parts of North Africa, and the rest of Europe.

COMPANIONSHIP IS CORE to the human psyche and one of the sources of that companionship has historically been our domesticated pets. Today, however, our relationship with them is changing. The past few years has seen a growing trend in the humanization of our pets. We celebrate their birthdays, purchase fashion accessories for them, buy toys on impulse, and search the internet for pet care services. We also want them to eat the very best.

Not only is our relationship with our pets changing but so too is pet ownership. When Europeans were deprived of human companionship during the Covid-19 pandemic lockdowns of 2020 and 2021, many got pets to compensate. Figures for European pet ownership published in 2021 by the European Pet Food Industry Federation show 46 percent of Europeans or 90 million households now own a pet, up from 85 million in 2019.

These trends could not have come at a better time for Miguel Navarro, who founded and runs Golden Pet Food. In 2018, the family-owned business decided to build a new pet food plant at their headquarters, situated between Toledo and Madrid, around 40 minutes south of the Spanish capital.

The family chose Bühler to install the two key processes in their dry pet food plant – the single-screw extruder and the Aeroglide dryer. Both solutions were installed into the new plant in 2020. “The most important thing for us is the issue of quality,” explains Navarro. “We try to reflect quality in our processes, in our professional staff, with everything focused on the product, making sure it is of the highest possible standard. There is a lot of competition in this market so if you want to differentiate yourself you must always strive for the highest quality.”

The relationship with Bühler goes back to the beginning. “Golden Pet Food approached us about five years ago to discuss their plans to expand and build a new factory,” explains Michael Davis, Area Sales Manager at Bühler. “They knew us and our reputation, and we convinced them that if they took our extruder and dryer, they would achieve a higher long-run performance and efficiency.”

Forty years ago, Navarro’s father launched Gracesa, an animal feed company that supplied pet food producers. In 2016 Navarro saw an opportunity to buy the pet food company Golden Pet Food with plans to offer the highest quality product possible as a perfect synergy with his father’s business.

Demand was already growing when the pandemic hit and changed many people’s lifestyles. “There was a huge jump in the number of pets per capita during the pandemic because people did not leave their houses. The pet food sector is currently experiencing double-digit growth,” explains Navarro. “This is true especially in Spain, which is one of the countries in the eurozone with the lowest number of pets per capita, so in recent years we have been seeing a considerable increase.”

Today, Golden Pet Food supplies Spain, Israel, Morocco, other parts of North Africa, and the rest of Europe. They produce a variety of food for cats, dogs, and puppies, with their range meeting different dietary needs.

Fit for a member of the family

Golden Pet Food products use the finest raw materials in order to meet the increasing demand for quality and variety in the market – demand that is driven by the trend toward humanizing pets.

“We don’t think of ourselves as pet owners but more as pet parents, which means we want the very best for our cat and dog children,” explains Marcel Ramseyer, Head of Market Segment Pet Food at Bühler. “Humanization means that trends in human food consumption are being replicated in the pet food sector. Greater fresh meat inclusion is a big thing, while we are also seeing a rise in alternative plant-based protein solutions as well as vegan dog food.”

Navarro believes the secret to differentiating his company's product in a highly competitive market is the quality of the extruder he uses. It is in the extrusion process that the cooking takes place following the processing of the raw materials by blending, mixing, and grinding. It is here that the modification of the starch and denaturation of proteins happens, along with the shaping, expansion, and texturing of the end product. This process also dictates the quality and taste of the product.

"In the end it is the extruder that is the heart of the production process, so that is where you have to put more focus because it is where you can provide more value to your product," explains Navarro. "The Bühler extruder offers us a very homogeneous product that is highly digestible. It has also allowed us to launch different types of products that need high starch digestibility, which we were not able to reach with our previous machines."

Navarro also appreciates other benefits that the extruder offers, including the fact that it is very intuitive to operate. This means that staff can be trained quickly to use it and it is very easy to maintain and clean – all factors that are important in meeting the highest food safety standards.

The Bühler single-screw extruder provides a pre-conditioner set aside from the main shaft. It also provides access to under the machine as well as a large access door to the pre-conditioner to enable fast, effective cleaning. "The pre-conditioner is designed to have an independent mixing chamber on the top separated from the retention chamber, so your product is prepared the best way for the following extrusion step," explains Ramseyer.

Another key production process provided by Bühler for Golden Pet Food is the dryer. According to Navarro the critical characteristics he needs in his pet food dryer are the ability to produce a

"DIGITALIZATION IS A VERY IMPORTANT PART OF OUR PROCESS. IT REMOVES HUMAN FAILURES THAT MAY BE IN THE PROCESS AND DELIVERS INFORMATION THAT SUPPORTS DECISION TAKING."

MIGUEL NAVARRO

Founder and Managing Director of Golden Pet Food

homogeneously dried product, a clean design, easy maintenance, and energy efficiency. He estimates that by having a 10-ton-an-hour throughput the Aeroglides has shaved around 40 percent off his energy costs compared to his old dryer, which was capable of only 6 tons an hour.

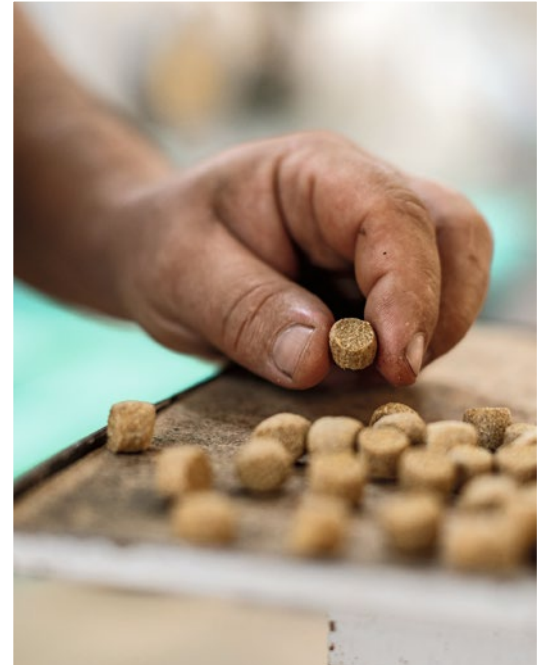
"Among all the different dryers we looked at, the Bühler dryer best fulfills our need for efficiency, cleanliness, and product homogeneity," explains Navarro. "By installing the Bühler dryer, we have saved money and a lot of time compared to our old dryers by cutting down on weekly maintenance as it is much cleaner to operate. We have also found, over time, that we are saving easily close to 50 percent of the time we use to spend maintaining the old dryer and it is around 15 to 20 percent more efficient."

Golden Pet Food now offers a wide range of products. For dogs alone the company has 50 different recipe formulations requiring the high-speed changeover of production lines to ensure minimum downtime. Digitalization is one of the best ways

When Miguel Navarro decided to build a new factory, he approached Bühler. Area Sales Manager Michael Davies was at his side to discuss the core technology needs.



The Bühler single-screw extruder is the secret to differentiating Golden Pet Food's products in a highly competitive market.



Golden Pet Food has 50 different recipe formulations for dog food alone. Digitalization enables high-speed changeover of production lines.

of achieving this, along with a range of other efficiency savings. This is another reason why Navarro has again turned to Bühler. His plan is to install a mirror production line which will include a digitalization package using Bühler Insights, Bühler's platform technology for optimizing plant efficiency, and MoisturePro, a cloud-based digital service to optimize drying performance, enabling better production, faster recipe formulation and even greater cost savings. "Like any other company today, digitalization is a very important part of our process in terms of expenditure of time and personnel. It removes human failures that may be in the process and delivers information that supports decision taking," explains Navarro. "It's difficult to be competitive today without digitalization."

The Bühler Insights platform acts as a gateway to harness the benefits of digitalization and provides transparency into process and machine data so actions can be taken to increase performance and optimize processes. The MoisturePro digital

solution uses moisture sensors to analyze the final product with data instantly relayed to the dryer control software, where algorithms continuously adjust production parameters so that the optimum moisture content is achieved and maintained throughout the production process.

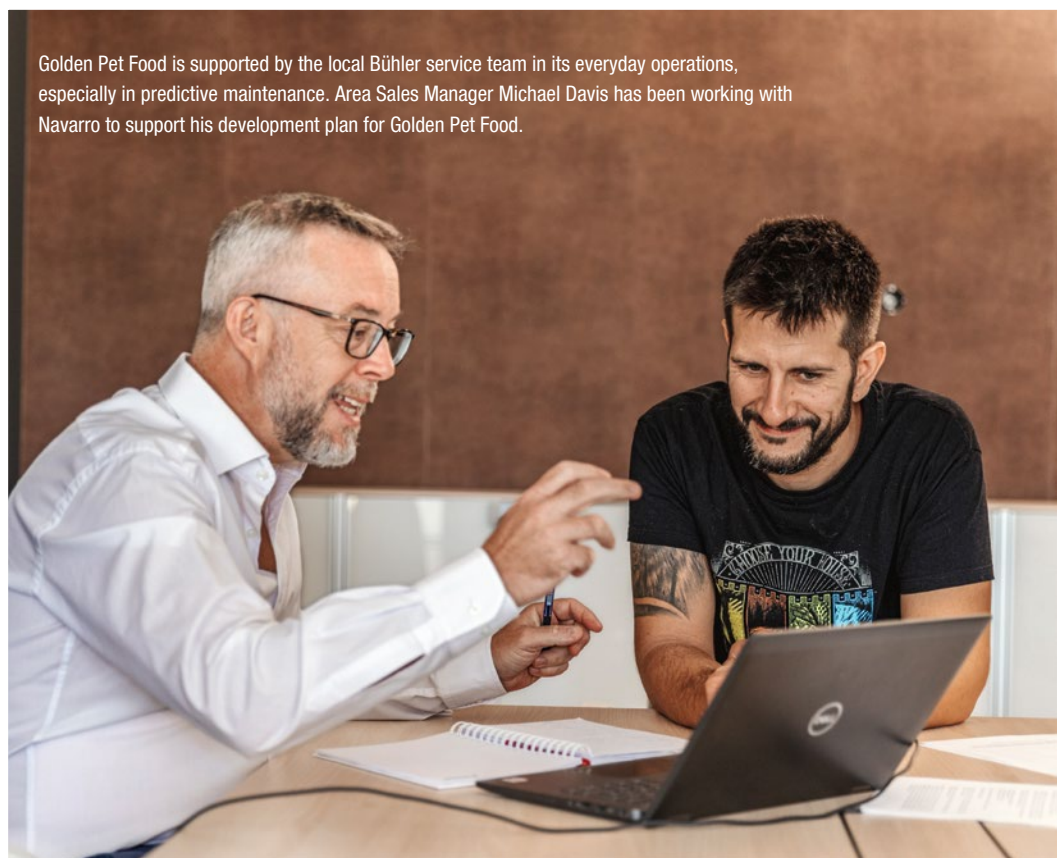
The right moisture and consistency

One of the challenges for pet food manufacturers is getting the right moisture level in the product. Typically, the industry has a target level of 28 percent moisture. Over drying the product uses excess energy and increases costs unnecessarily; if it is too moist there is a risk of recalls from potential mold.

"The industry typically over dries to avoid recalls, but by using MoisturePro they are able to reduce their standard deviation from the 28 percent target by 1 percent, which means by year end they have saved significantly on energy costs. This is a big plus in the current climate with energy costs going through the roof," says Davis.



One of the most important characteristics of a dryer is energy efficiency. Aeroglide has reduced Golden Pet Food's energy costs by around 40 percent compared to its old dryer.



Golden Pet Food is supported by the local Bühler service team in its everyday operations, especially in predictive maintenance. Area Sales Manager Michael Davis has been working with Navarro to support his development plan for Golden Pet Food.

VIDEO

Watch the video about Golden Pet Food to learn more about the production of high-quality pet food.





“WE DON’T THINK OF OURSELVES AS PET OWNERS BUT MORE AS PET PARENTS, WHICH MEANS WE WANT THE VERY BEST FOR OUR CAT AND DOG CHILDREN.”

MARCEL RAMSEYER

Head of Market Segment Pet Food at Bühler

Bühler is also set to supply Golden Pet Food with its Granulex® 5 series hammer mill. It grinds the raw materials used in the pet food to provide the correct consistency for the extruder.

Brand new and just off the production line, this is the first time the Granulex® 5 is being installed in a pet food plant. On top of increasing throughput capacity and grinding to more stringent parameters the new technology is significantly more energy efficient.

Service close at hand

A large Bühler team based in Madrid supports Golden Pet Food in its everyday operations, especially in predictive maintenance, which ensures machine spare parts are available ahead of demand. “Having a service center so close to our facilities saves us a lot of time in supplies, in machine maintenance, and in problems that may occur in the prod-

INFO



Golden Pet Food

Toledo, Spain



Founded in 2016.



Golden Pet Food produces a range of healthy pet food for dogs and cats of different ages and dietary needs. The recipes are formulated by veterinary experts with a focus on palatability and digestibility.



Golden Pet Food supplies retailers in Europe, North Africa, and Israel.



Golden Pet Food uses Bühler’s single screw extruder and Aeroglide dryer to make high-quality pet food.

uction plant. The closer and more personal the contact with your partner the easier things are,” explains Navarro.

Always alert to the next big trend in his market, Navarro believes that demand for ever-more sustainable pet foods is set to grow. Bühler is ready to support Golden Pet Food on this journey by continuing to supply innovation that focuses on production efficiency, helps reduce waste, and is increasingly energy efficient.

“Sustainability is one of the great focal points in society today. You have to look at your processes to make them as sustainable as possible because your customers require you to comply with sustainability standards. If you can’t meet them, you just can’t be competitive,” says Navarro. “The pet food sector is experiencing high growth and we believe there will be many opportunities to create new products that will be driven by innovation.”

A photograph of a large industrial facility, likely a paper mill, featuring multiple levels of machinery, walkways, and large cylindrical tanks. The scene is brightly lit with overhead industrial lights.

PRONATEC AG

PIONEERS

WITH A PURPOSE

PRONATEC AG has been distributing fair-trade and sustainably manufactured products for the global food and cosmetics industry and the grocery trade for over 45 years. It has been a pioneer in this field, launching the world's first organic and fair-trade certified chocolate in 1996. Twenty-five years later, the next logical, yet courageous step followed. It constructed one of the world's most modern cocoa processing plants, gaining independence from external contractors to reach pole position for organic cocoa production.



From left: Yannick Rihs, David Yersin, and Simon Yersin from PRONATEC AG check the quality of the cocoa beans.

IT WAS 1996 when David Yersin, the CEO and owner of PRONATEC AG, decided to tackle the challenge of producing organic fair-trade chocolate, and managed to produce the first chocolate to receive an organic and fair-trade label. “At the time, there were few suppliers of organic cocoa,” says David Yersin. “That’s why we had decided to source cocoa ourselves in the Dominican Republic.” PRONATEC established a local company for this purpose.

More than 45 years ago, the Swiss company started trading fair-trade sugar, vanilla, and a variety of spices. PRONATEC sought direct contact with the farmers to achieve this. “It was important to us from the beginning to pay fair prices,” Yersin says. “We do not buy our organic certified fair-trade raw materials through middlemen. We prefer to source directly from small farmers and cooperatives whenever possible.”

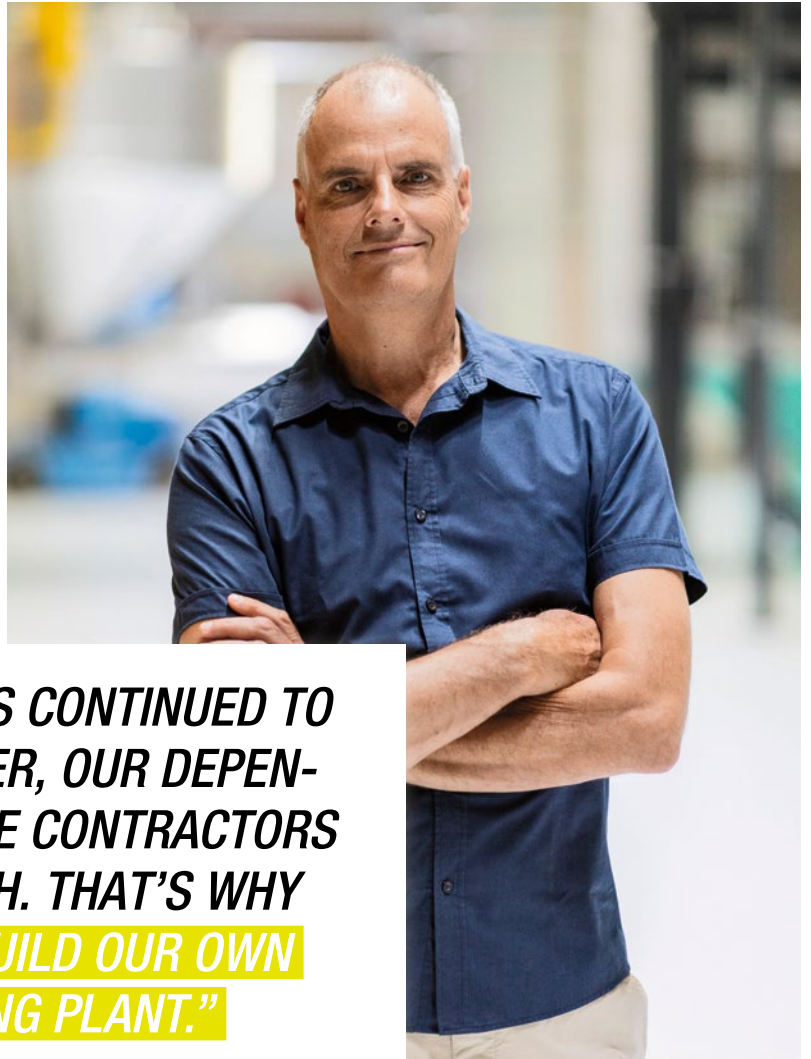
Thanks to the close collaboration with its partners in the countries of origin and a direct supply chain that is entirely controlled by PRONATEC, the company can guarantee the traceability of its products at all times. PRONATEC has recently started working with an app-based traceability tool for this purpose, in which all parties involved record the path of the beans from the country of origin to the cocoa processing plant using a barcode via smartphone. “This traceability from farmer to factory is unprecedented,” Yersin says.



The Tornado roasting system is the heart of the PRONATEC AG plant.

Until the point that PRONATEC decided to build its own cocoa plant, it relied on external contractors to process organic and fair-trade cocoa beans into cocoa butter, cocoa liquor, and cocoa powder. “As our business continued to grow ever larger, our dependence on outside contractors became very high. That’s why we decided to build our own cocoa processing plant,” explains David Yersin.

This move brought many advantages. “The goal was also to increase our credibility with customers,” says Simon Yersin, Head of Cocoa at PRONATEC. “Now that we cover this value-added step ourselves in Switzerland, we occupy a completely different position in relation to our customers. All the planning and production are under our control and we can shape it the way we want. This enables us to respond more flexibly to their needs, especially for small batch production. We are the only supplier that can make this possible.”



“AS OUR BUSINESS CONTINUED TO GROW EVER LARGER, OUR DEPENDENCE ON OUTSIDE CONTRACTORS BECAME VERY HIGH. THAT’S WHY WE DECIDED TO BUILD OUR OWN COCOA PROCESSING PLANT.”

DAVID YERSIN

CEO and owner of PRONATEC AG

The Bühler cocoa processing plant, which was designed in close cooperation and coordination with the PRONATEC team, is one of the most advanced plants established worldwide. The advantages lie in the consistently high quality of the roasting and grinding of the cocoa beans into cocoa liquor and further processing into cocoa powder and butter.

Automation is crucial since PRONATEC works with a batch separation process for traceability. It was included in the project at an early stage because the entire structure is different from other plants.

“The efficiency of the plant at the Swiss site, along with the uncompromising standard of 100 percent organic certification, was of utmost importance for PRONATEC from the very beginning,” explains Joachim Essig, Head of Sales Cocoa & Malt at Bühler. “Fully integrated automation, small-scale batch production, batch separation, and full traceability were already important topics in the initial



A sample of cocoa taken from the Tornado roaster.

discussions in mid-2018, as were gentle handling of raw materials, food safety, and the highest hygienic design standards.”

But before PRONATEC decided on the new plant, a thorough decision-making process was carried out. “Because we used to have the beans processed by contractors in Europe, we knew the upstream and downstream costs, but we were not familiar with the processing costs,” says Simon Yersin. “We received excellent and exceptionally quick support from Bühler with the necessary analyses and information, which enabled us to calculate and assess the entire business concept. This in turn helped us to decide in favor of the Swiss location.”

PRONATEC is the first company in Switzerland to produce all three organic cocoa semi-finished products: cocoa liquor, butter, and powder. “It’s very important that we can maintain proven flavor profiles that we have developed over the years. At the same time, the new roaster also gives us the opportunity to develop new products,” explains David Yersin.

The Bühler Tornado roasting system is at the heart of the plant. It allows flavors to be retained or removed depending on the roasting profile. “Our experience with the Tornado roaster has been very

The beans are broken in the winnower and the shells are separated from the nibs.



“ALL THE PLANNING AND PRODUCTION ARE UNDER OUR CONTROL AND WE CAN SHAPE IT THE WAY WE WANT. THIS ALLOWS US TO RESPOND MORE FLEXIBLY TO CUSTOMER NEEDS.”

SIMON YERSIN

Head of Cocoa at PRONATEC AG



PRONATEC AG is the first company in Switzerland to produce all three organic cocoa semi-finished products, namely cocoa mass, butter, and powder.

positive. We appreciate the high flexibility,” says Yannick Rihs, Plant Manager at PRONATEC. “Once it’s set up, the level of reproducibility is very high. The advantage of the Tornado is that each batch can be roasted differently.”

Essig shares Rihs’ enthusiasm about the machine. “The Tornado roaster sets new standards in the cocoa industry. It’s designed for 24-hour operation, including weekends. The Tornado has been on the market for many years. It’s the most frequently installed roaster for cocoa, it’s very flexible and fully automated. A robust device all around.”

Continuous monitoring for quality

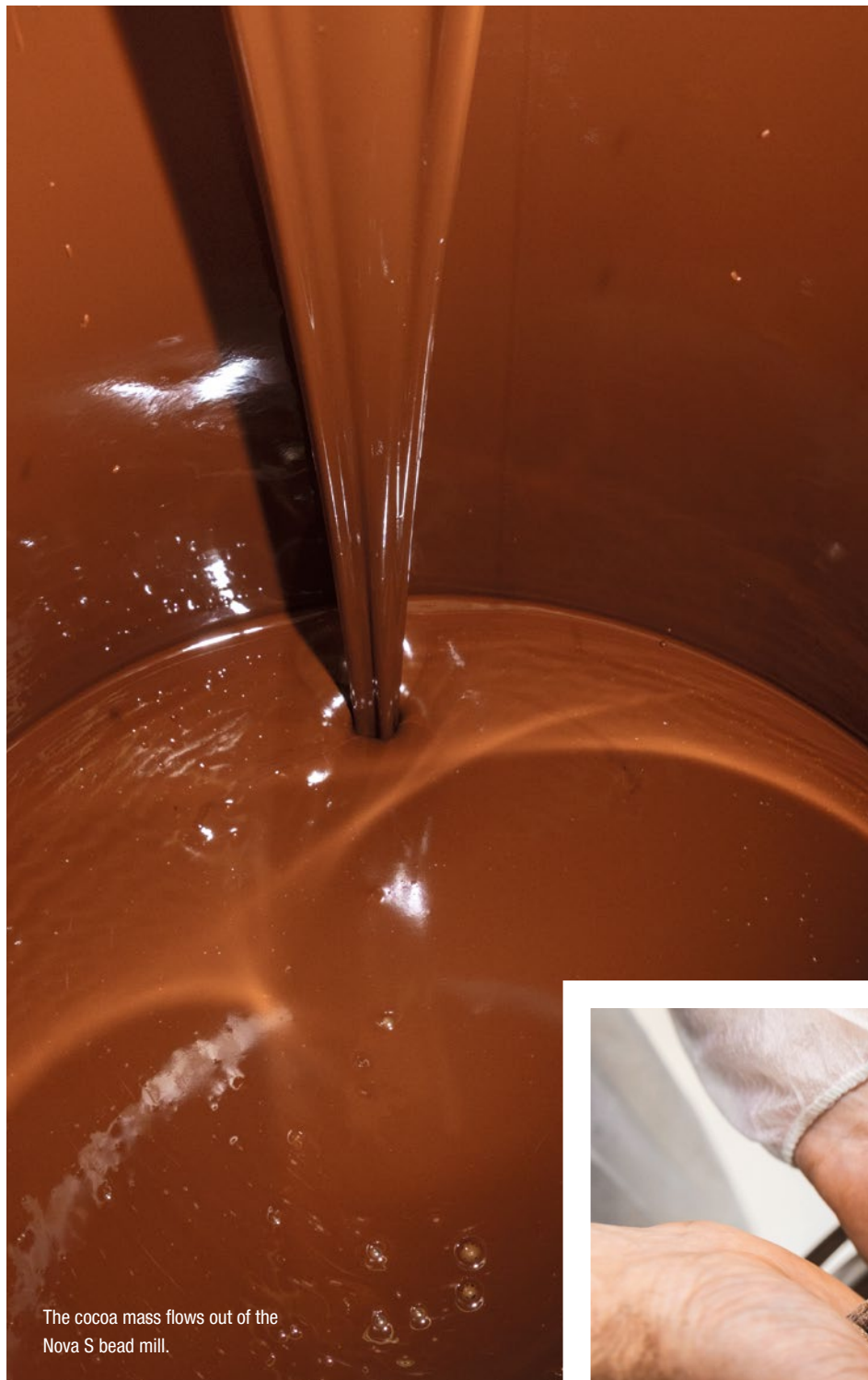
The processes are continuously monitored in the control room, at the heart of the processing plant. In addition, the PRONATEC team continuously tests the quality of the cocoa products produced in its own laboratory. Bühler’s MultiTherm application can be used, for example, to determine the crystallization properties of cocoa liquor and cocoa butter, which are important quality criteria in chocolate production.

“This real-time controlling ensures the quality of PRONATEC’s products and also has a major impact on the energy efficiency of the plant,” Stefan Linder, Project Director at Bühler, says. “The high demands of the plant in terms of automation and energy efficiency were challenging and exciting. Ultimately, all our customers benefit from the findings.”



Bühler’s MultiTherm can be used to determine the crystallization property of cocoa mass and cocoa butter, which are important quality criteria in the production of chocolate.





The cocoa mass flows out of the Nova S bead mill.



A PRONATEC AG employee checks the quality of the cocoa beans.

VIDEO



Watch the video about PRONATEC's modern cocoa processing plant.

**“WE CERTAINLY CHALLENGED BÜHLER,
BUT WE WERE ABLE TO FIND GOOD
SOLUTIONS TO ALL CHALLENGES.
THE COMMISSIONING WENT SMOOTHLY
AND EVEN OUR MOST OPTIMISTIC
EXPECTATIONS WERE MET.”**

MICHAEL GRETHER

Project Manager at PRONATEC AG

The mandatory requirement for energy efficiency was taken into account in the system design and implementation, such as the separation of temperature zones, installed heat recovery systems, and efficient insulation. Furthermore, the team focused on emissions in the planning phase right from the start. This was necessary to enable the highest standards to be met in terms of environmental compatibility alongside all safety requirements. For example, a state-of-the-art exhaust air after-treatment system was installed to prevent unpleasant smells.

Organic as a challenge

The project was so challenging because it was so out of the ordinary; this is a small plant that must produce at a high level of efficiency and meet all the requirements of strict organic labels, such as batch separation.

“PRONATEC has invested a lot of time and energy in preparation right from the start,” says Michael Richard, Project Manager at Bühler. “We did trials in the pilot plant at Bühler. We held workshops to understand the special requirements of an organic plant and incorporate them into the process. This helped us design, install, and commission a complete processing plant in just two years, all in an existing building.”

For Michael Grether, the Project Manager at PRONATEC who supervised the development from the beginning, the cooperation was also extremely positive: “We certainly challenged Bühler, but we were able to find good solutions to all challenges. The commissioning went smoothly and even our most optimistic expectations were met, which allowed us to begin production so early.”

INFO


PRONATEC
PRONATEC AG*Winterthur and Beringen, Switzerland*

Founded in 1976.



PRONATEC specializes in certified organic cocoa products, sugar, vanilla, and spices. Around 100 employees work in Switzerland, and about 300 employees work in subsidiaries in the countries of origin of its raw materials.



PRONATEC'S customers comprise the global food industry, food wholesalers, and the cosmetics industry.



Bühler is the complete plant supplier of PRONATEC's site in Beringen.

For David Yersin, it was clear from the beginning where and, above all, with whom the plant should be built. “We are a Swiss company that will produce in Switzerland, with a Swiss machine builder on our side. As an innovative market leader, Bühler was the only remaining option for me after a short evaluation phase,” says Yersin with great conviction.

Two core elements of the plant, the Tornado cocoa nibs roaster and the Nova S bead mill, are manufactured by Bühler in Appenzell, Switzerland, which is perfectly aligned with PRONATEC's philosophy in terms of quality and having a local partner. “As an SME, the plant was a big investment for us,” says David Yersin. “However, we are already noticing that quality and the fact that we produce regionally are becoming more and more important to many of our customers. So for us, it is an investment in the future.”

Since October 2022, PRONATEC's organic cocoa processing facility has been operating in three shifts. “A large part of the revenue has already been secured,” says Simon Yersin. “We've also left a lot of space for future projects, which we hope to fill with more Bühler equipment.”

BÜHLER TECHNOLOGISTS

AT

YOUR

SIDE






TEXT: STUART SPEAR
PHOTOS: FABIO REICHMUTH



Bühler's value lies in its generations of processing experience. It is the Bühler technologists that translate that knowledge into practical advantage so that our customers can maximize performance and quality. We meet some of the people who are the face of Bühler, traveling the globe building those all-important relationships that are so critical to successful business partnerships.



Emily Cardoso works in the highly competitive and high-tech area of precision optics.

“WHAT GOES ON INSIDE THE MACHINE IS PURE PHYSICS AND CHEMISTRY, AND EACH OF OUR CUSTOMERS NEEDS A UNIQUE SOLUTION THAT IS VERY SPECIFIC TO THEIR REQUIREMENTS.”

EMILY CARDOSO

Mechanical Engineer Bühler Leybold Optics

“As the name suggests, the role of the technologist is to understand the technology and so to know what is going on inside the machine,” says Cardoso. “For example, in my field a customer might want to save energy by changing the pumps that create the vacuum. My role is to do the calculations to see whether with this speed limit and this pumping limit it is achievable without compromising standards.”

Leybold Optics operates in a range of markets. For example, it produces the machines that apply coatings to architectural glass that help reduce the energy costs of heating and cooling. Ophthalmic and precision optics, the markets that Cardoso supports, includes optical solutions that enable face recognition in mobile phones, sensors for the car industry, diagnostic solutions within the life sciences, and coating technology for the semiconductor industry. It is a highly complex, fast evolving, and competitive sector. Technical upgrades along with energy and waste reduction are the most common customer requirements as research and development drives competition. Cardoso describes working in very high-tech sterile environments requiring strict protocols with high levels of security as companies protect their competitive advantages.

“Precision optics is a really high-tech business,” explains Cardoso. “What goes on inside the machine is pure physics and chemistry, and each of our customers needs a unique solution that is very specific to their requirements.”

Cardoso supports customers globally. Working in such a diverse and non-standardized sector means that her technical expertise is needed to formulate service contracts or support sales teams when dealing with highly specialized engineering solutions. One role that she finds particularly rewarding is when a customer has a totally new production requirement.

“This is where it can get really exciting because we are not limited by standardization and so we end up working in partnership with the customer discovering what is possible,” explains Cardoso.

NO MATTER WHAT contractual relationship companies have with each other, it's human relations that ultimately drive successful business partnerships. Wherever you are in the world and whatever your business, when you buy a Bühler solution you receive expert technical support, either remotely or on site, for as long as it takes to resolve production challenges.

Different Bühler businesses may have different titles for their customer support teams, but they all have one thing in common: these technical experts have an invaluable insight into and knowledge of your industry. They have spent years on the front-line seeing how companies operate in real time, the challenges they face, and the solutions available to them. What may be a new difficulty for the customer, is something a technologist may have seen in many different iterations in plants operating in all corners of the world. They have the skills and knowledge to make sure the inevitable challenges that arise in any manufacturing process are resolved as painlessly and efficiently as possible.

The role of the technologist

Emily Cardoso is a mechanical engineer who joined Bühler Leybold Optics in Alzenau, Germany as a technologist five years ago, specializing in optics. She is a problem solver who offers a mix of service upgrades, sales support, and retrofit upgrades.



LEYBOLD OPTICS

MILLING SOLUTIONS

Guido Thalmann supports milling customers from initial installation to full operation.



“IN MY VIEW, THE MOST IMPORTANT QUESTION FOR A MILL IS: ‘WHAT IS TOO MUCH DIGITALIZATION AND WHAT IS TOO LITTLE?’ THE SKILL IS FINDING THE RIGHT BALANCE.”

GUIDO THALMANN

Process Expert Milling Solutions at Bühler

Generational knowledge

In the more traditional business sphere of milling, technological change has also profoundly impacted the industry. However, the pace of change is less frantic. Guido Thalmann, Process Expert for Bühler Milling Solutions has decades of experience of the milling industry.

Based at the company headquarters in Uzwil, Switzerland, he is the start-up engineer on typically large-scale milling operations globally. His role is to get customers from the point of installation to full operation by training staff, setting the machine parameters, setting the software, and resolving all those teething problems that inevitably arise with a new installation. He can spend up to a year at a customer site, returning home every three months to recharge his batteries.

Thalmann started his apprenticeship in milling in 1974. He was recruited and trained during the time when René Bühler was Chairman of Bühler's Board of Directors. “I remember René telling us that when we visit a customer, we must always remember that we are the calling card of the company,” says Thalmann. He believes it is a piece of advice that stands to this day. When he walks into a new plant it is his years of experience that cement the Bühler brand. He understands that he is an expression of generations of acquired milling knowledge.

In recent years he has been setting up mills in Venezuela, the Middle East, Bangladesh, the United States, and Australia. Not only is Thalmann able to support customers with a wealth of knowledge acquired from different operating practices globally, but he also has a historical perspective on the industry. Having been a front-seat witness to the changes to the milling industry, he has watched as the old milling skills have disappeared, with smaller mills being consolidated into larger milling operations.

In recent years the most profound change in the milling sector has been the arrival of digital processing technology. While it can be a major benefit to producers, he cautions that it all comes down to how it is applied. “My advice to anyone setting up a mill is to keep it simple. In my experience, when people become unsure of what they are doing it is usually because things have become too complicated,” says Thalmann. “In my view, the most important question for a mill is: ‘What is too much digitalization and what is too little?’ The skill is to find the right balance.”

Combining expertise across fields

Guido Siegrist has a similar role to Thalmann but works in Bühler's Value Nutrition business. Based in Uzwil, he sets up pasta plants for customers to optimize all the production parameters. When going to big pasta companies, he often works alongside the customer's own experts. With new operations, he provides more of his support, expertise, and advice. For example, the raw materials used have a major influence on the quality of the final product. In the search for the perfectly uniform pasta shape, it is important to understand this.

"For customers who are relatively new to the business or may have been badly advised by other companies in the past, my job is to show them where and how they can optimize their processes to get the best end product. That can involve managing expectations. Total uniformity is just not possible. Sometimes I have even shown them their competitor's pasta to demonstrate this," says Siegrist.

It is in situations such as this that Siegrist falls back on his 33 years of experience with Bühler in the pasta industry, working both in machine manufacturing and plant commissioning. He travels the globe supporting producers wherever pasta is eaten. "Every commissioning job is different and even now I am still learning new things. No single recipe works for every customer, so it's always a



Guido Siegrist applies his knowledge as a machine specialist and food scientist to set up pasta plants.

VALUE NUTRITION



"EVERY COMMISSIONING JOB IS DIFFERENT AND EVEN NOW I AM STILL LEARNING NEW THINGS. NO SINGLE RECIPE WORKS FOR EVERY CUSTOMER."

GUIDO SIEGRIST

Process Expert Value Nutrition at Bühler



“THINGS CAN GET COMPLEX WHEN 50 MACHINES NEED TO INTERACT WITH EACH OTHER, AND EVERYTHING NEEDS TO COME TOGETHER IN ONE PROCESS. IT INVOLVES A LOT OF TEAMWORK.”

GILBERT MÜLLER

Senior Process Engineer Chocolate & Coffee at Bühler

Gilbert Müller gets involved with chocolate industry customers early on in the sales process to understand their needs.

challenge,” says Siegrist, who considers himself a blend of food scientist and machine specialist. “For the first 10 years I was working on the manufacture of the machines and then I learned the food science on the job from every plant I commission.”

Managing complex interrelations

In the chocolate industry customers have their own closely guarded recipes and so it often takes a team of technologists and food scientists, sometimes working in one of Bühler’s Application & Training Centers, to see how the recipe mix can be best achieved on Bühler solutions.

Gilbert Müller, based in Uzwil, is Senior Process Engineer in the Chocolate & Coffee business. He gets involved with the customer early on during the sales process as part of the technical support team. He is also responsible for commissioning new plants or new processes, which means he sometimes sets up a plant based on his own technological recommendations.

“In the chocolate industry the best-case sales and quotation process is when the sales team, food technologist, and process engineers are working together in a forward-looking manner to match the customer’s variables like fat content, cocoa

powder, and sugar to process and machine,” explains Müller. “Of course, when you find you are commissioning a plant that you designed the flow sheet for, that is when you really get direct feedback on your own design.”

Müller works closely with food technologists and commissioning engineers. When product quality is not what was expected, it takes both knowledge of the machine processes and of food science to work out where things might have gone wrong. In this industry the complexity lies in the interfaces between different production processes. “Things can get complex when 50 machines need to interact with each other, and everything needs to come together in one process. It involves a lot of teamwork between different specialists,” says Müller.

When commissioning bakery goods, using chocolate as an ingredient in the subsequent processes, Müller might get involved in every stage from raw materials to packaging, wherever the chocolate can have an impact on product processing. This means that he sometimes visits a plant for over a year, spending a couple of months on site and returning when needed. In such an interrelated food manufacturing process one change can have implications throughout the plant and require on-going support.

Livia Thalmann, who started in the Swiss apprenticeship scheme, works for customers in the die-casting industry.



“IT’S IMPORTANT I GET ON WITH PEOPLE ON SITE VERY QUICKLY BECAUSE I NEED THEIR HELP, SO I THINK YOU NEED A PARTICULAR TYPE OF PERSONALITY TO DO THIS JOB WELL.”

LIVIA THALMANN

Field Service Technician Die Casting at Bühler



DIE CASTING

Time is money

With the growth in electrical vehicle sales has come increasing demand for die casting. These solutions supply structural car parts made from molten aluminum to the large car manufacturers. Bühler’s die-casting solutions are installed into production cells and work seamlessly with other manufacturing processes like sprayers, presses, and construction robots. They produce highly accurate and ever-larger lightweight structural car parts such as chassis sub-units, shock towers, longitudinal members, tailgates, or battery housings.

Livia Thalmann is a Field Service Technician for Bühler’s Die Casting business, based in Uzwil, Switzerland. She joined the team from the Swiss apprenticeship scheme. Her role is to install new machines, fit upgrades, and service existing machines. During installations she is part of a team of two or three, but when she is fixing a problem, she operates on her own to minimize the cost to the customer. This is a highly pressurized industry so the time between the customer’s first call and her arrival on site must be kept to a minimum. It also requires a high degree of cooperation as she works with technologists from other companies supporting other cell processes as well as in-house technical support teams.

“When I arrive, the customer is often very stressed because they cannot solve the problem themselves. They need to get the machine operating fast, so everything is very time sensitive. Most

die-casting machines operate 24 hours a day. They lose money if they are not operating,” Thalmann says. “I have to calm things down, step back, and work on a plan. I will already have an overview of the problem because I have been talking to our support teams. Last month I arrived at a Swiss customer and found the problem in 10 minutes because I had a plan in place and knew it was one of three things.”

When things are not solved so quickly then situations can become tense. An important part of the customer support role is therefore interpersonal skills. To operate efficiently on site requires cooperation and everyone pulling together. “It’s important I get on with people on site very quickly because I need their help, so I think you need a particular type of personality to do this job well,” says Thalmann. Understanding how different cultures communicate is also key. Sometimes getting to the root of an issue in a plant is difficult, but Thalmann takes the time to ask questions until she can determine the source of the problem.

Thalmann also keeps an eye out for ways of minimizing waste, with a view to reducing the impact on the environment. “Many of our customers work in very energy intensive industries,” she explains. “From my perspective on the plant floor, I can sometimes see savings that could be made. For example, it is not necessary to heat the die while I am working. I like to highlight the opportunities to optimize processes.”

Verena Mühlberger trials and sets up bead mills for businesses in a range of industries globally.



“THROUGHOUT THE ENTIRE PROCESS, FROM CONDUCTING TRIALS TO INSTALLING THE MACHINE, WE BUILD CLOSE RELATIONSHIPS WITH OUR CUSTOMERS, GIVING THEM A DEEPER INSIGHT INTO THEIR OPERATIONS.”

GRINDING & DISPERSING



VERENA MÜHLBERGER

Process Engineer Grinding & Dispersing at Bühler

Maximum performance

Verena Mühlberger agrees that technologists who work at customer sites globally need to be culturally sensitive. “In terms of character, I am rather direct. When I am working in a culture that is less direct, I adjust,” she says. “Being adaptable helps me to involve the customer in the process when conducting experiments. This means that I ask the customer what they think and what their experience has been or if they agree with the decisions I make regarding the process.”

Mühlberger is a Process Engineer in Grinding & Dispersing. Based in Uzwil, she trials and sets up bead mills globally for businesses involved in ink solutions, cosmetics, pharmaceuticals, coatings, and battery slurry. It is a diverse range of industries and she understands the requirements of each sec-

tor. Her role is to set up the machines and run the trials to ensure the customer is getting the desired high-quality product and performance from their bead mill. This is where Bühler’s generations of processing experience become apparent, and it applies to all the customer support teams that travel the globe supporting many very diverse industries.

“When we visit the customer, they get first-hand access to Bühler expertise. We are not just setting up the machines, we are giving them all our knowledge so they can achieve a first-class product at maximum productivity on their bead mill,” says Mühlberger. “Throughout the entire process, from conducting trials to installing the machine, we build close relationships with the customers, giving them a deeper insight into their operations. That is how they develop confidence in our knowledge, and it is why they come back to us for further product development and technical advice.”

ASIA'S CAPITAL OF FOOD-TECH START-UPS

SINGAPORE HAS BUILT UP one of the most exciting food-tech industries in the world – some call it Asia's food-tech capital. This moniker was strengthened in December 2020 when the tiny island nation became the first country in the world to give regulatory approval for the sale of cultured meat – animal meat grown in a bioreactor from live animal cell cultures. A few years later, founders around the globe are moving from their home countries to establish a base in the Lion City to pursue their dreams of developing sustainable proteins. As of 2022, 36 food-tech start-ups are headquartered in Singapore, and collectively they have raised over USD 214 million.

Globally, this sector is set to grow. Barclays bank has projected that the sustainable protein sector could be worth USD 140 billion within the next decade, accounting for roughly 10 percent of the USD 1.4 trillion global meat industry.

Singapore has been in the vanguard of this shift, serving as a living laboratory for sustainable proteins and a launch pad for global climate and food security solutions. Such efforts bring the city-state closer to achieving its “30 by 30” goal, which aims to build the agrifood industry's capability and capacity to sustainably produce 30 percent of the nation's nutritional needs locally by 2030.

Bühler plays an active role across the region and hosted a series of innovation days during 2022 in Ho Chi Minh City, Vietnam, and Seoul, South Korea for current and future customers looking for new business opportunities. We see major interest from the region in this sector, particularly from start-ups, which are at the forefront of innovation happening in the agrifood sector. We continue to build up our engagement with start-ups through our links with start-up accelerators, many of which have made Singapore their base.

Right at the heart of this thriving ecosystem is the Protein Innovation Centre, a state-of-the-art facility set up in partnership by Bühler and Givaudan to accelerate market entry for plant-based meat products. This facility has been fully utilized since its opening in April 2021 by customers from across the region who are developing new plant-based prod-

ucts with the use of wet or dry extrusion technology. What makes this facility unique is that we can help localize the products to the Asian palate. Decades of process technology expertise mean that Bühler can leapfrog available technology in the market and offer plant-based meat companies crucial differentiation when creating high-moisture extruded products.

Apart from plant-based meats, Bühler is lowering the barrier to entry for companies to scale cultured food through The Cultured Food Innovation Hub, a Swiss-based partnership between Bühler, Givaudan, and Migros, Switzerland's largest retail company. The Hub supports start-ups to scale up – from bench top to industrial production – accelerating their food journeys.

To support precision fermentation and cellular agriculture companies on their path to commercialization, Eridia, Bühler's joint venture with biotech firm, ZETA, will be their partner in engineering food and feed biotechnology plants.

It is fantastic to be at the forefront of innovations in a company where we create opportunities to serve the sustainable food system, which results in multiplying excitement and energy across the region in the emerging sector of sustainable proteins.



Aparna Venkatesh, Collaborative Innovation Lead at Bühler Singapore

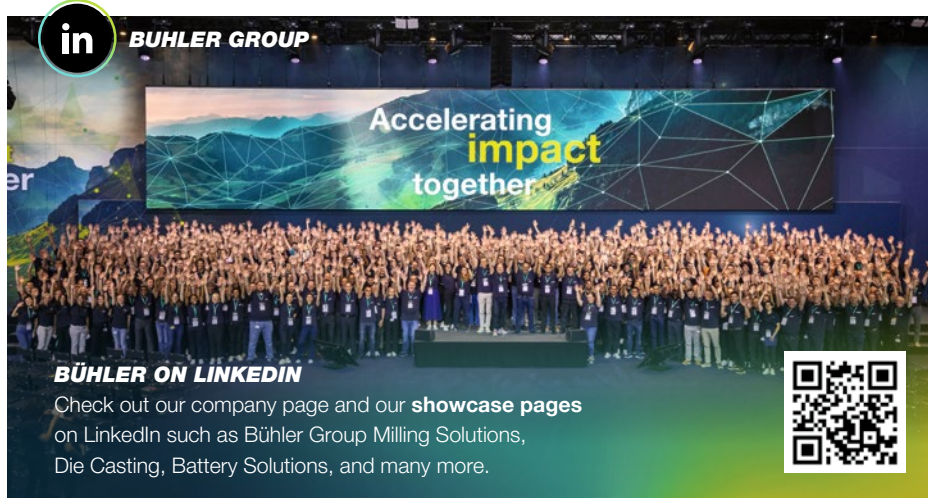
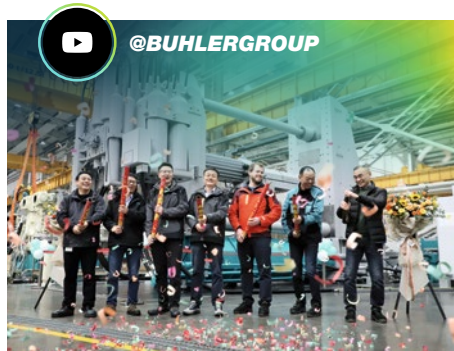
WEBSITE



Scan the QR code to find out more about the Protein Innovation Centre.

LET'S GET SOCIAL!

Stay up-to-date with the latest trends, innovations, and customer success stories from the Bühler world by following us on our social media channels. You are also welcome to tag us in your posts about how you work with our solutions.



BÜHLER ON LINKEDIN

Check out our company page and our **showcase pages** on LinkedIn such as Bühler Group Milling Solutions, Die Casting, Battery Solutions, and many more.



THE BÜHLER INSPIRATION HUB

Would you like to know more about the key trends impacting your industry? Visit our Inspiration Hub, where you will also find features and videos highlighting the inspiring work of our customers and partners around the world.



WHAT'S NEXT? Diagram #187

In the next issue we take a deep dive into the topic of food security, looking at the many ways in which our customers play a key role in ensuring that there is sufficient nutritious, safe, and affordable food for the world's growing population.



YOUR OPINION MATTERS TO US

We would love to hear what you think of Diagram so that we can make it even more relevant for you. Please send your feedback to:

✉ media.relations@buhlergroup.com

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