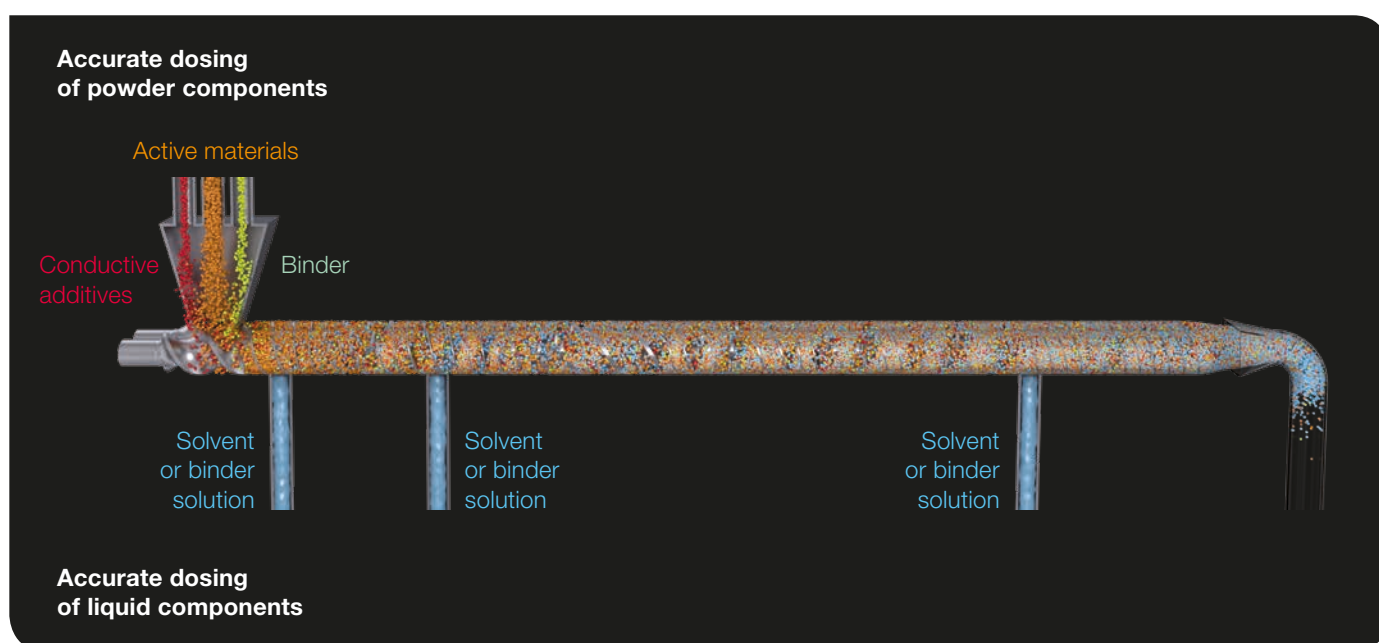


**Efficient
continuous
electrode slurry
production.**

Large-scale electrode slurry production.

Fully continuous mixing technology.

A crucial process step in the production of batteries is the preparation of the electrode slurries. Our fully continuous mixing process for lithium-ion electrode-slurry production meets the need for large-scale battery manufacturing and offers significantly lower investment and operation costs.



Continuous mixing technology

The continuous mixing process is based on a twin-screw mixer, which combines the basic operations of continuous raw material dosing, pre-mixing, kneading, fine-dispersing and degassing in a single device.

In a conventional batch mixing system, this process comprises two steps. First, the pre-weighed liquid and solid components are added, followed by subsequent distribution of the solid components in the liquid phase.

In order to achieve the required homogeneity at macroscopic and microscopic level, several hours of process time are typically required. By contrast, the continuous mixing process consists of controlled continuous dosing of all

liquid and solid components and micro-distribution of the solid particles in the liquid phase.

Since a large part of the mixing work is performed by continuous dosing of the raw materials, the residence time in the continuous mixer is usually less than one minute.

Lower investment costs

Due to high productivity (up to 2,500 l/h), the continuous mixing process can replace multiple batch mixers with a single, fully continuously operated production line. As a result, the required investment can be significantly reduced for large-scale production installations.

Lower operation costs

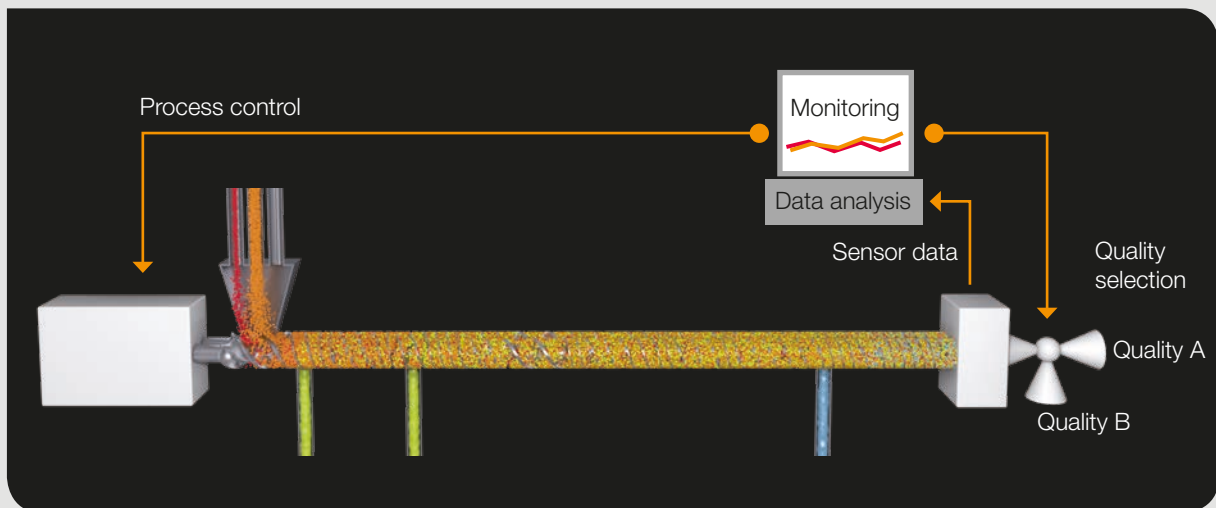
Compared to batch mixers, the continuous mixing process requires three times less specific energy input to achieve the same product properties. Furthermore, thanks to a smaller footprint, the necessary dry room volume can be significantly reduced for the continuous mixing system.

As a result, the energy consumption needed to maintain the dry room climate is much lower than for conventional batch mixing systems.

The high degree of automation of the continuous mixing system can reduce the manpower required to operate the plant by 50%.

Customer benefits:

- Significantly lower investment costs due to economies of scale
- Reduced operating costs thanks to energy savings, a high degree of automation and less manpower required
- Enhanced reproducibility and controllability of product properties
- More consistent product quality thanks to inline quality control

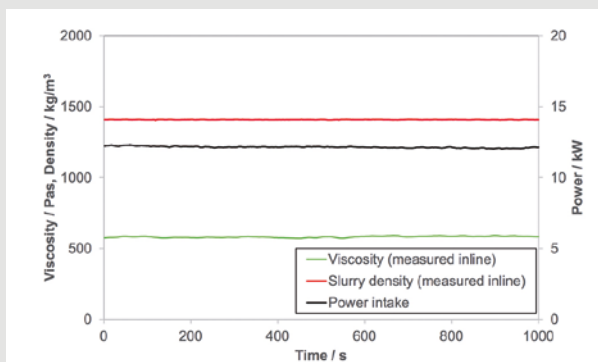


QuaLiB™ inline quality control expert system

The quality control expert system QuaLiB™ takes process control to the next level: It enables inline monitoring and control of the electrode slurry parameters. All critical process parameters such as viscosity, density, raw material flow rates, temperatures, pressures and power consumption are continuously monitored. Overall, this yields improved recipe accuracies, enhanced process control and better traceability.

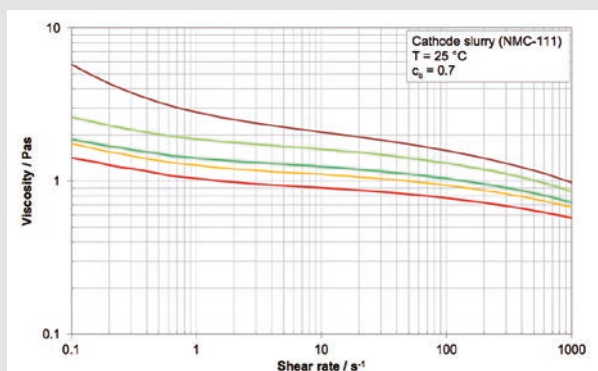
Process stability and process control.

Bühler technology for superior slurry properties.



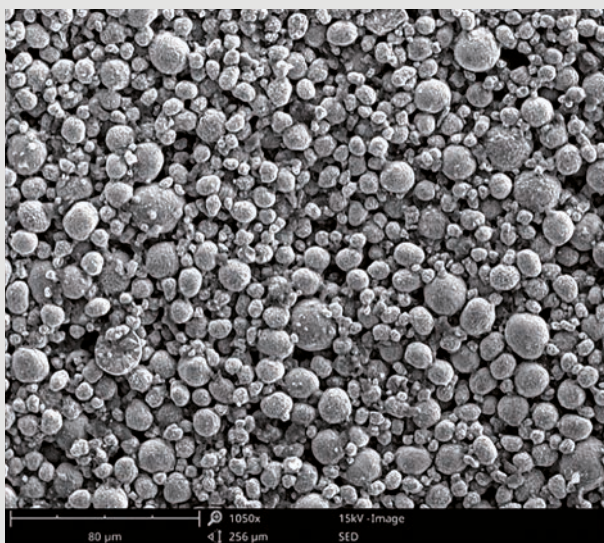
Excellent process stability

Greatest powder- and liquid-dosing accuracy accounts for superior process stability and constant slurry properties, as batch-to-batch variations are eliminated.



Optimized rheological behavior of battery slurries

Our continuous slurry mixing technology provides numerous options for tweaking the rheological behavior of battery slurries by adjusting the operating parameters without making any changes to the slurry formulation.



Controlled dispersion of active material and conductive additives

Battery slurries processed on our continuous mixing systems show homogeneous dispersion of active materials and conductive additives. Carbon Black agglomerates are distributed homogeneously without being damaged. This can be attributed to the process conditions being optimized for each of our customers' formulations.

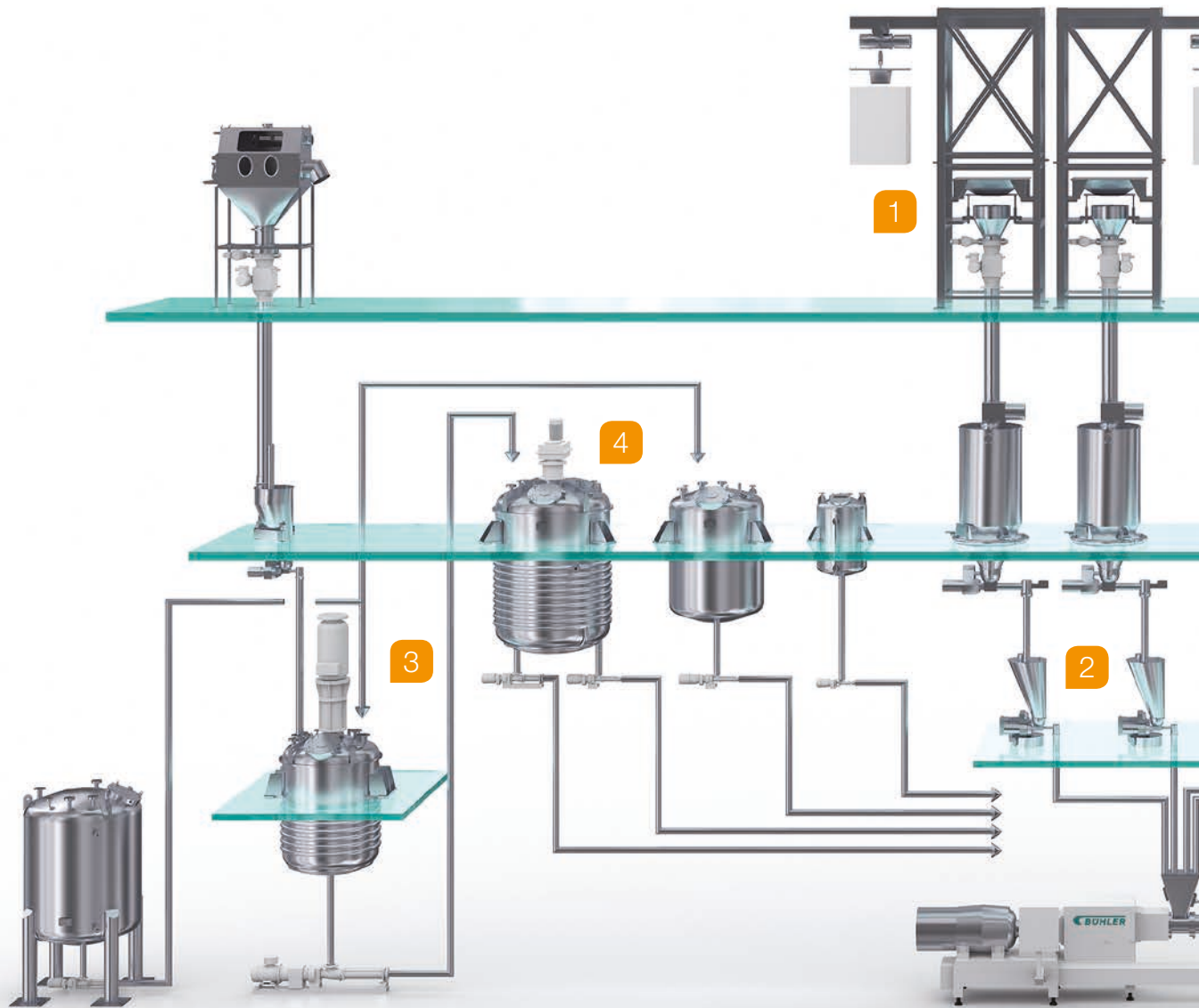


Fully continuous mixing system



Degassing tanks

The production plant at a glance. **From intake to the final product.**



1

**Powder intake –
(various
containment
levels possible)**

2

**Highest accuracy
gravimetric
powder dosing**

3

**Binder
production
(wet process)**

4

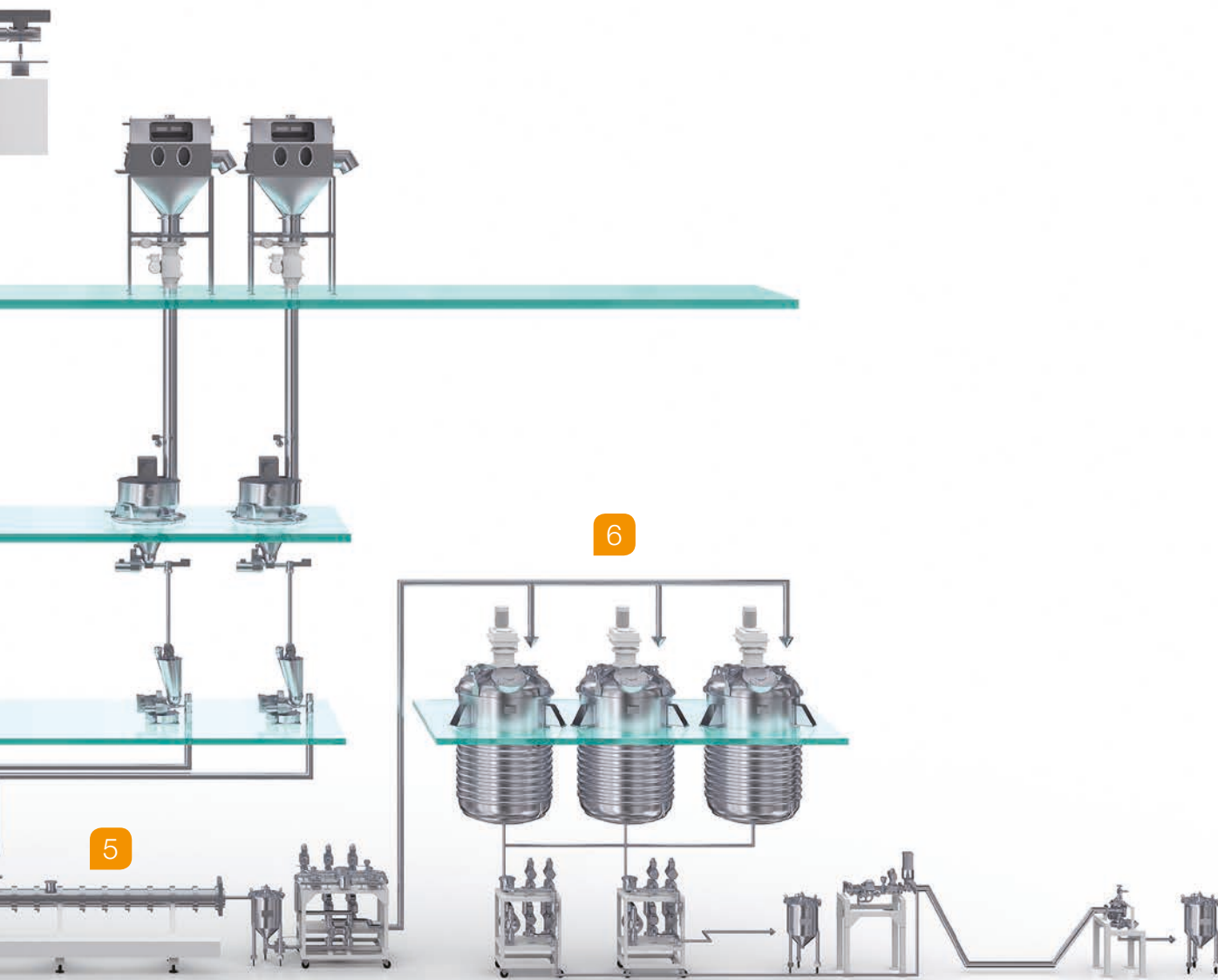
**Highest
accuracy
liquid dosing**

5

**Continuous
mixing of all
components**

6

**Storage
and
degassing**



Process and product optimization and development. **Bühler battery application labs.**

We operate our own battery testing facilities and laboratories worldwide for process demonstration and optimization purposes with regard to product quality, yield, throughput and energy requirements.



Professional trials

Processes can be tested and optimized at our own test facilities for battery applications in Europe and Asia. Trials are conducted by our experienced battery process specialists together with you.

The facilities are designed for tests at lab and pilot scale. The results provide an insight into the required dimensioning of your potential plant and allow efficient and realistic optimization of the product and process.

In addition, the Bühler Central Laboratory at our headquarters in Uzwil (Switzerland) is the ideal point of contact for special analysis talks, training and method development for your laboratories.

You also benefit from interdisciplinary exchange with other areas of expertise within the Bühler Group and from close collaboration with universities and research institutes worldwide.

Cutting-edge equipment

The dry room environment (DP -40 °C) enables processing of moisture-sensitive materials, such as NCA, nickel-rich NCM or next generation solid-state battery materials.

Cutting-edge analytical methods allow accurate evaluation of the electrode slurry mixing process and the resulting products. This includes, for example, rheology and particle size distribution measurements, scanning electron microscopy, electrode adhesion testing or electrical conductivity measurements.

Support in every phase of the project.

Global technology partner to the battery industry.



Support from start to finish

Our global team provides full support in all phases of your project and beyond. This includes:

- Process development
- Engineering
- Manufacturing
- Process automation
- Installation
- Start-up
- Training
- Customer services

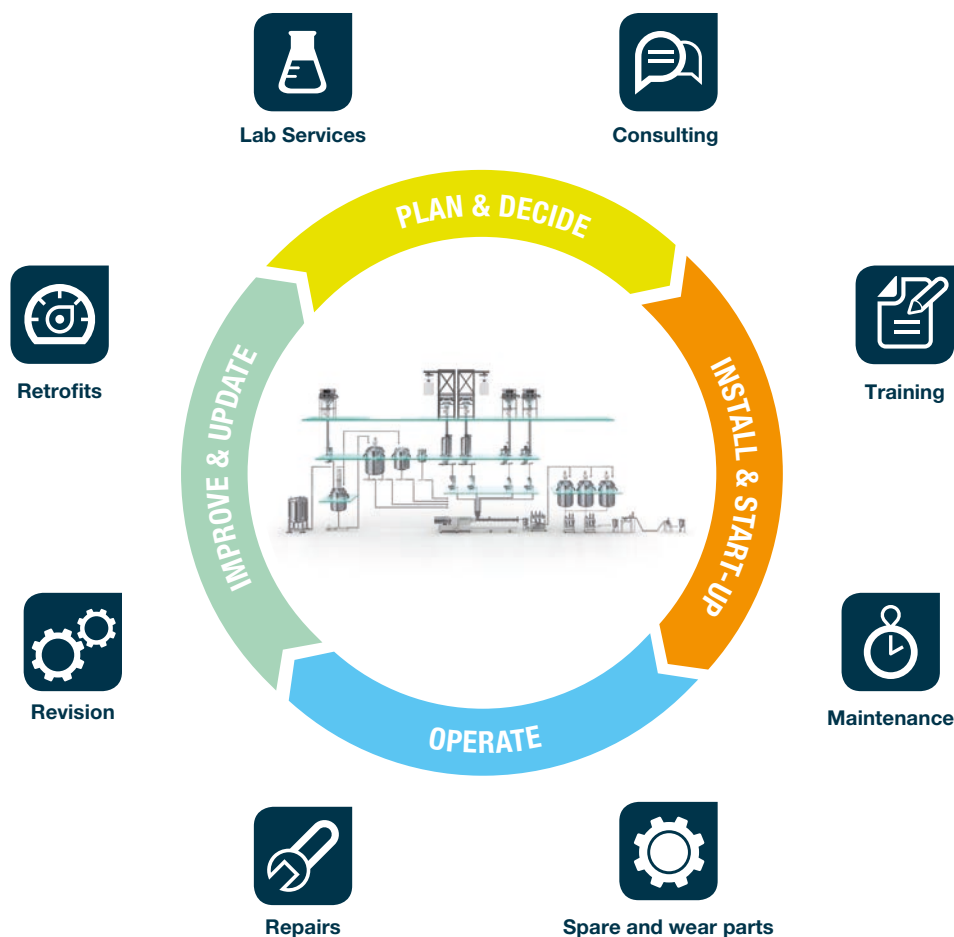
Plant engineering

Thanks to their efficiency, durable design, ease of use and maximum raw-material yield, Bühler systems are always a good investment, and pay for themselves quickly. With everything from energy-efficient plants right through to complete production facilities, we ensure sustainable processes.

- Maximum availability and reliability
- Maximum sustainability, energy and cost efficiency
- Supply of complete solutions
- Equipment and services from a single source

Our service solutions.

Professional support for best results.



While your equipment and plant are operating, we are right there as your partner to support top results for your business. Our service solutions ensure the best possible availability and reliability, process stability, maximum energy, and cost efficiency.

Repair service – worldwide, 24/7

Our experts around the world stand ready to help in the event that a machine breaks down because of damage or if precision wanes. A closely-knit network of service stations ensures that a specialized technician can rectify your problem as quickly as possible. With subsidiaries and service stations in over 140 countries, we are always close to you.

Spare parts – quick and reliable

As a globally positioned producer, we place great importance on maintaining high availability of as many spare parts as possible – in fact, we guarantee parts supply for up to 10 years after purchase.

Bühler Group.

Significant supplier to the automotive industry.

Our Advanced Materials division

We want to contribute to protecting the climate through the use of energy-efficient vehicles, machines, and buildings – and this leitmotif plays an important role in the technologies, process solutions, and applications of our Advanced Materials division.

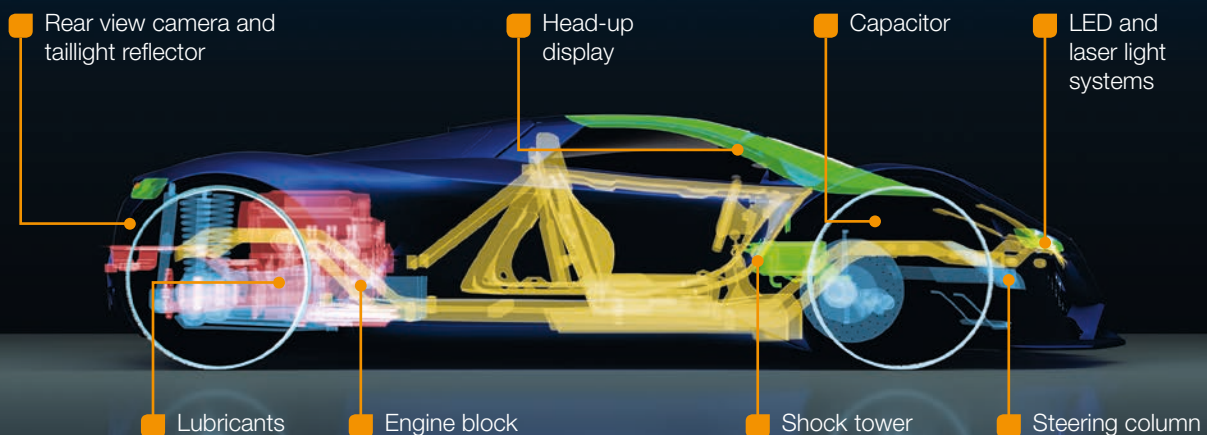
Lightweight aluminum or magnesium parts – manufactured on die-casting cells – reduce fuel consumption.

Vacuum-coated architectural glass for facades – produced on Leybold Optics equipment – makes buildings more energy-efficient.

Battery slurry – manufactured on equipment from Grinding & Dispersing – increases the range of electric vehicles.

The markets are extremely diverse, but Advanced Materials has one constant factor: mobility. The segment generates around 60% of its sales from the automotive industry.

Examples of automotive parts manufactured using Bühler process solutions



Bühler Group

The Bühler Group holds globally leading market positions in technologies and methods for processing grain into flour and feed, as well as for the production of pasta and chocolate, in die casting, wet grinding and surface coating. The group has over 11,000 employees and operates in more than 140 countries. The headquarters is in Uzwil, Switzerland.



Bühler AG

CH-9240 Uzwil
Switzerland

T +41 71 955 11 11
F +41 71 955 31 49

grinding.dispersing@buhlergroup.com
buhlergroup.com

190605_Battery_EN_A4