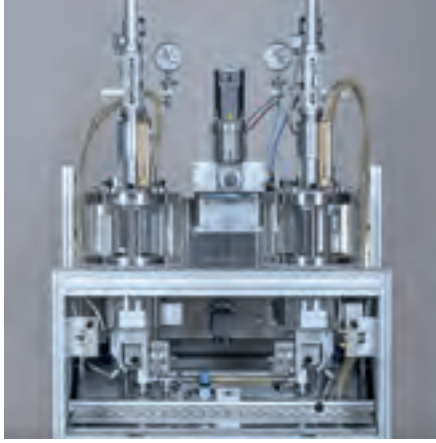
Process technology for the processing of casting and impregnating materials

An overview of the HÜBERS technologies in preparation, mixing and dosing

HÜBERS





Our product range

Systems and machinery for

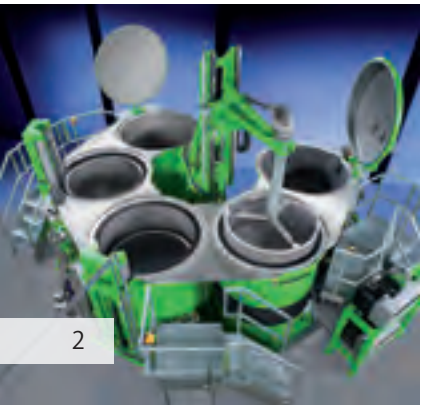
- **Preparation and formulation**
- **Mixing and dosing**
- **Casting**
- **Automatic Pressure Gelation (APG)**
- **Silicone Processing – SVT**
- **Vakuum Direct Infusion – V-DIT**
- **Impregnation**
- **Laboratory and special applications**

as well as

- **Clamping machines and molding tools**
- **Oven and cooling systems**
- **Storage and conveyor equipment and other peripherals**





What it‘s all about:

HÜBERS is a specialist and one of the world leaders in system engineering for casting and impregnation applications. The process technology for the preparation, mixing and dosing of epoxy, polyurethane and polyester resin systems as well as LSR and RTV silicones is a core part of our business. You might say it is our „key skill“. Our customers in the fields of electrical, electronics, medical, automotive and aerospace engineering, and other industries around the world manufacture different products on our systems – from diodes to high-voltage insulators.

Our know-how, which we improve on a daily basis, and many years of experience enable us to fall back onto a wide range of proven and fully developed technologies. It also allows us to continue to find new approaches and solutions for the unique needs of our customers.

Accordingly, our systems are extremely versatile regarding the specific designs, including for example

- Shaping techniques: casting, Automatic Pressure Gelation (APG), injection, infusion
- Environmental conditions during shaping: atmosphere, vacuum, vacuum pressure
- Filling quantities of parts to be produced: from a few milligrams, for example for chip underfilling, to several tons for wind turbine blades
- Integration and automation of upstream and downstream processes, such as: material storage and conveyance, formulation, handling of molds and semi-finished products as well as preheating, curing and cooling systems
- Production capacity: from laboratory scale on to small and medium series, and from there to automated large-volume production.

In this brochure we can therefore only give you a brief insight into our core technologies, selected layout alternatives and additional options – that is, it represents the „technological intersection“ of our systems.

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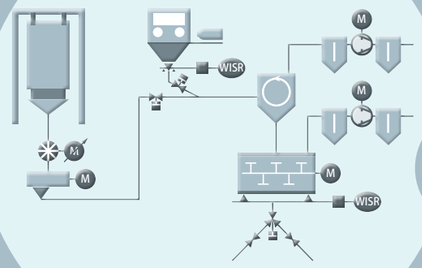

Option: Self-formulation

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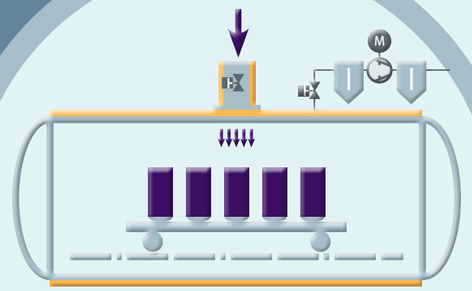

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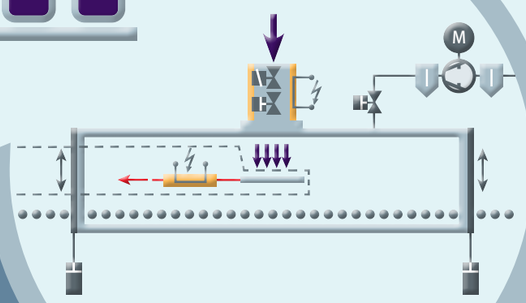

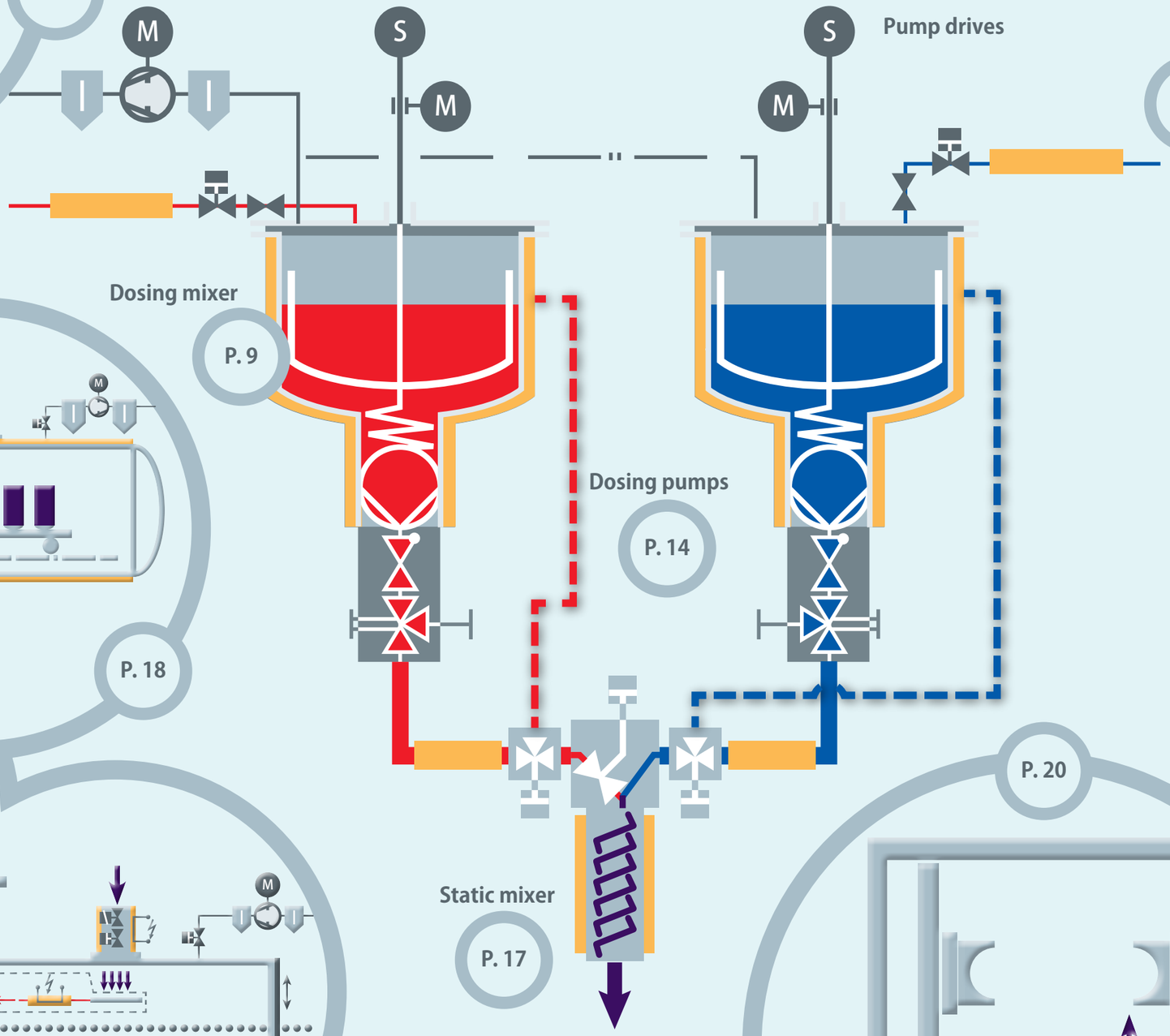

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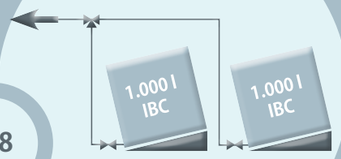
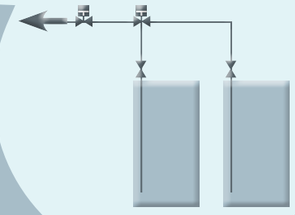


Delivery containers for liquid components



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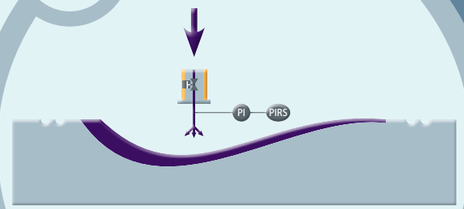

Vacuum Direct Infusion

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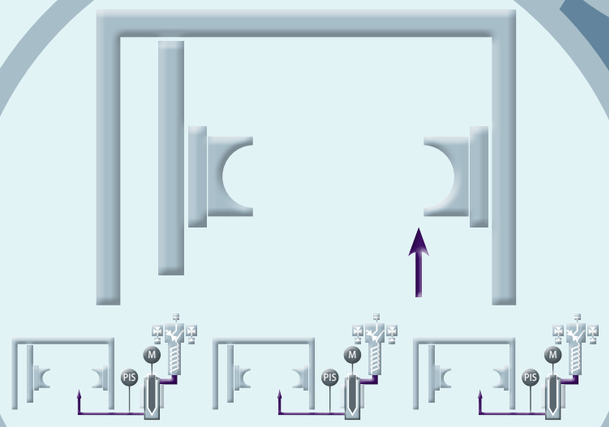


Automatic Pressure Gelation (APG), silicone injection

Your advantages at a glance

Our work pursues three main objectives: quality, efficiency and flexibility – for the benefit of your production. The advantages of our technologies and the implementation options in all parts of the systems prove how we consistently pursue these goals:

Vacuum dosing mixer

- Optimal degassing
- Gentle mixing, thorough homogenization
- No sedimentation
- Heatable/temperature-controlled design possible
- Easy maintenance and cleaning
- Easy access to process-relevant system components without emptying the container

Dosing pumps, drives and control

- Completely synchronous operation of the pumps
- Constant feed pressure
- Exact adherence of the mixing ratio through highest dosing accuracy
- Mixing ratio, casting quantity and casting speed are individually programmable and monitored

Option: Continuous preparation

- Uninterrupted operation without pre-mixer groups possible
- Compact vessel sizes, even for large quantities or central supply of several casting stations

Electronic dosing control

- Direct, visual monitoring of all current process parameters; deviations from nominal values are reported
- Traceability of the process course
- Maximum process reliability
- Perfect quality assurance for dosing

Option: Self-formulation

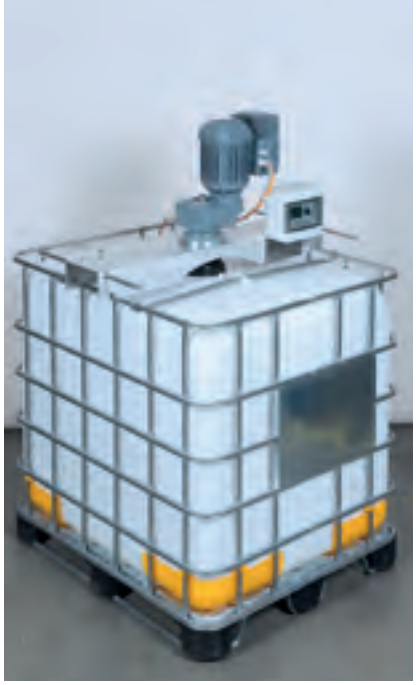
- Modules for all requirements of storage, pre-treatment, conveyance, preparation and introduction of additives of any kind

Static mixer

- Wear-resistant, low-maintenance
- Vacuum-tight, free of dead space
- Perfect homogenization, constant temperature and viscosity of the reactive mass
- Minimal amounts of reactive mix
- Short cycle times
- Solvent-free cleaning with resin component
- Large range of possible operating temperatures
- Can also be used for disproportionate mixing ratios and different viscosities
- Temperature-controlled design possible

Dosing pumps

- Pressure loss-free, highest dosing accuracy
- Wear-resistant and maintenance-free even when filled with abrasive casting resins
- Working under vacuum; no re-accumulation of gases in the material during dosing
- Short set-up times for the change of casting materials due to rapidly exchangeable modules




Formulation and preparation

The formulation and preparation of material components include all process steps up to the production of the reactive mix. These are essentially the feed of basic materials from the delivery containers and, if applicable, the addition of fillers and further additives – such as coloring agents, accelerators or flexibilizers – as well as proper degassing and homogenization of the materials.

Formulation and preparation create the basic prerequisites for the quality of the parts to be produced. Every detail of our system process technology is therefore according to the strict adherence to the process parameters. It also offers alternative layouts and expansion options, and therefore comprehensive design possibilities for process economics.

When using pre-formulated sedimenting material, measures against the sedimentation of additives, especially filler, must be taken in the delivery containers already. This is carried out by our stirring modules for barrels and Ecobulk containers.

If filler and other additives are added later, a preceding formulation line is necessary. Again HÜBERS provides system solutions for all requirements.

In each case, the material components are vacuum-sucked resp. conveyed into separate preparation vessels – the dosing mixers – then degassed and mixed under vacuum. Thus, the use of all types and sizes of delivery containers is possible.

In case of particularly high material throughputs, several containers or even tank storage of each component can be connected with the system, in order to prevent production interruptions during container change.

Vacuum dosing mixer

The key elements of material preparation are the dosing vessels, from which the dosing is carried out under vacuum into the mixing device for the production of the reactive mix.

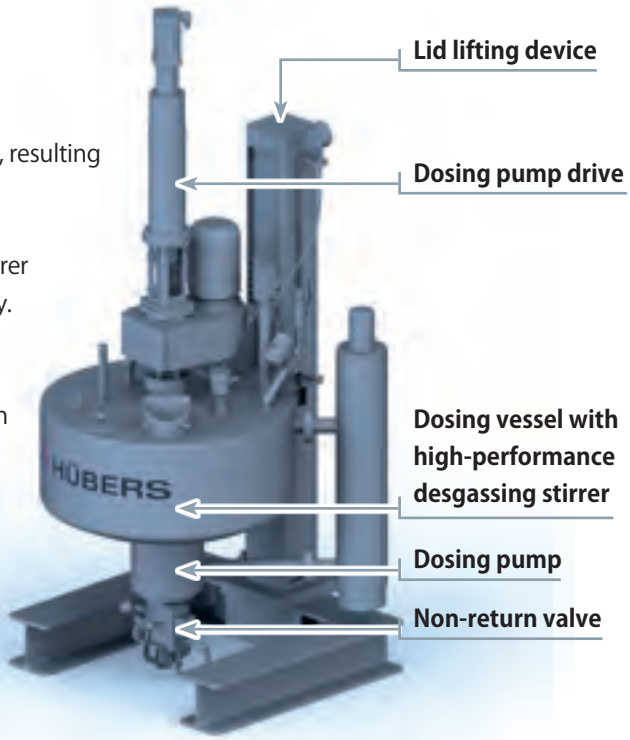
Basically, the preparation under vacuum is recommended for all materials, since each mass contains certain amounts of humidity, evaporating gases and/or air at the time of delivery. Remaining amounts of these substances in the material have negative effects on the dosing as well as the mechanical and electrical properties of the final product. The material preparation under vacuum is therefore one of the characteristic features of the HÜBERS technology.

The preparation in the dosing mixer can take place discontinuously or continuously. The continuous preparation principle offers special advantages for quality assurance and production logistics at the customer.

The technology

- Vessels with large diameter and low height, resulting in a large surface of the component mass
- Pneumatic lid lifting
- The special shape of the slowly rotating stirrer is optimally adapted to the vessel geometry.
- The vessels remain constantly and reliably under vacuum during the entire process.
- Optionally, the containers can be fitted with heating, cooling or temperature-control.

The result: consistently degassed and optimally prepared material components, regardless of their viscosity.



Option: Continuous preparation

In conventional systems, the filling of the preparation vessel is in batches: After the complete consumption of a batch of prepared material, the vessel is being refilled. Subsequently the new material is prepared. During these steps, prepared material is not available. The best possible continuous process can only be achieved by the use of separate pre-mixers.

For some productions this is not critical, since other process steps lead to a discontinuous overall process anyway – for example the charging and evacuation of large casting chambers. In many other cases however, a continuous material preparation means very significant cost advantages, since it allows for uninterrupted production.

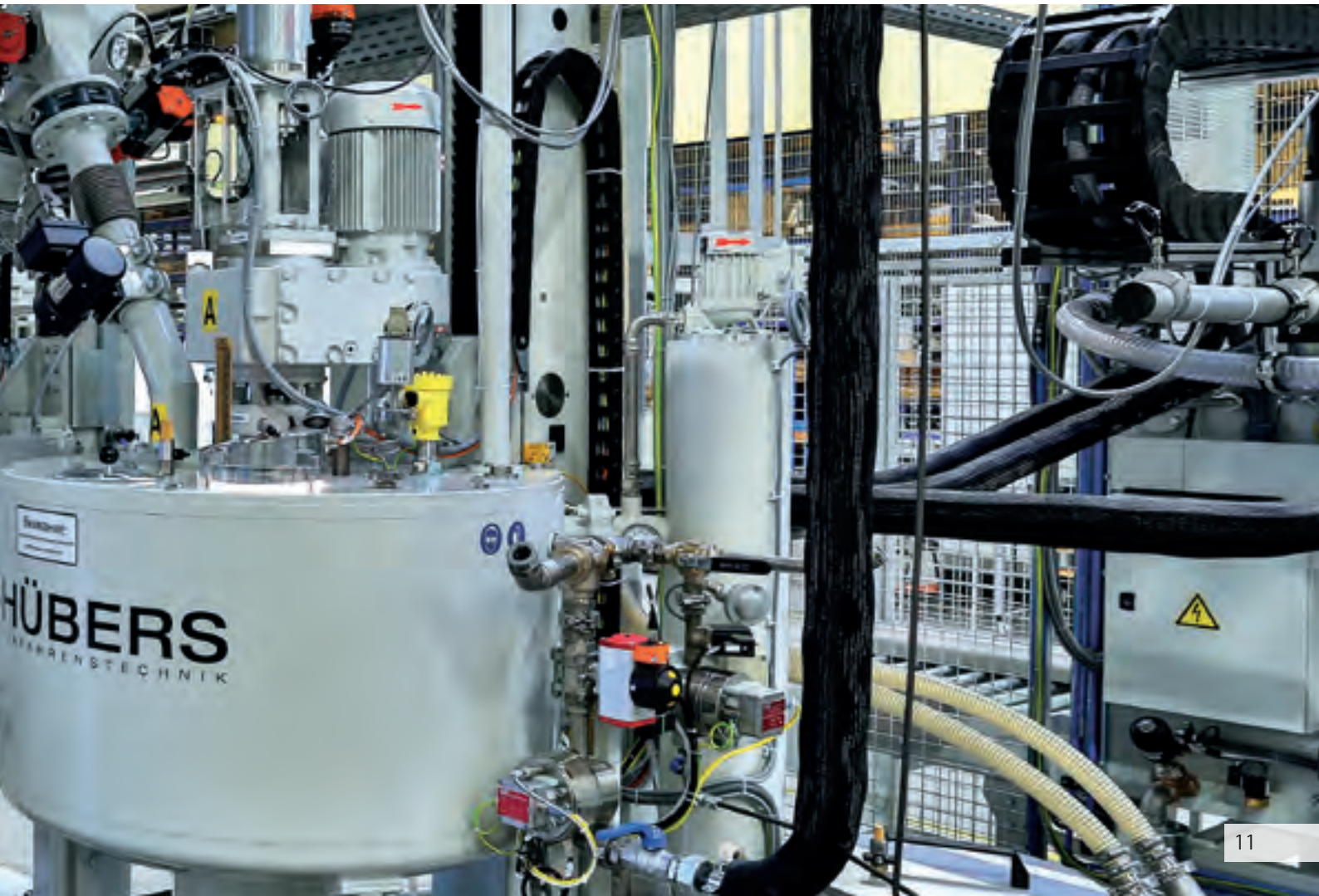
With our method of continuous preparation, this is achieved reliably and without pre-mixers: Perfectly prepared homogeneous material is constantly available at the dosing pumps at the bottom of the dosing mixers.

The technology

- New material from the delivery containers is continuously sucked into the dosing mixers. If applicable, the material is heated in the feeding line.
- A thorough degassing of the new material on the surface is achieved through the vacuum in the container.
- During its slow sinking through the vessel, the degassed new material is carefully mixed and homogenized with the vessel's entire material content.

The HÜBERS technology for continuous preparation has been proven in practice since its invention in the year 2000. It is in operation in around 250 systems worldwide for various applications.

Another major advantage of continuous preparation reveals itself in the production of parts with very large filling quantities, such as hollow core insulators or rotor blades for wind turbines: The vessel size is not determined by the amount of material needed, but only by the dwell time required for the preparation of the material in the mixing vessel. HÜBERS systems therefore provide optimal material preparation in very compact sizes.



Equipment for material pre-treatment and self-formulation

Of course, the overall arrangement of our mixing and dosing systems depends on the individual production requirements of the customer.

For customers who do not work with pre-formulated material, we offer all the machines and devices for their own material pre-treatment and formulation – no matter to which materials and which preparatory stages it goes.

- Storage and dosing containers for powdery fillers and coloring agents
- Conveying and metering technology for the controlled dispensing of powdery, granulated and liquid components to the preparation devices, including viscous and highly abrasive materials
- Filler-drying for the pre-treatment of fillers under vacuum and, if applicable, temperature
- Storage tanks for liquid components, e.g. resin, hardener, accelerator and flexibilizer
- Melting vessels for materials delivered in highly viscous or solid state

Dosing and mixing

The production of the reactive mix is a crucial step in the process chain in several respects:

The exact adherence of the mixing ratio and the mixing quality have a direct impact on product quality. For sensitive products smallest deviations or variations in the mixing ratio and smallest defects in the homogeneity of the mix can already lead to reject production.

The mix is reactive, that means

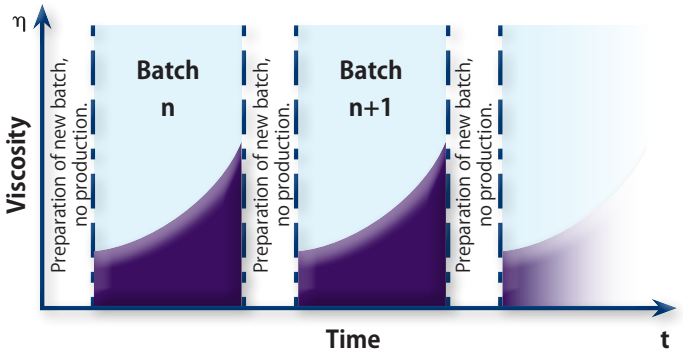
... it must be consumed efficiently, otherwise the material is wasted.

... that the viscosity increases exponentially, any delay in the processing leads to the deterioration of the mechanical and electrical properties of the parts produced.

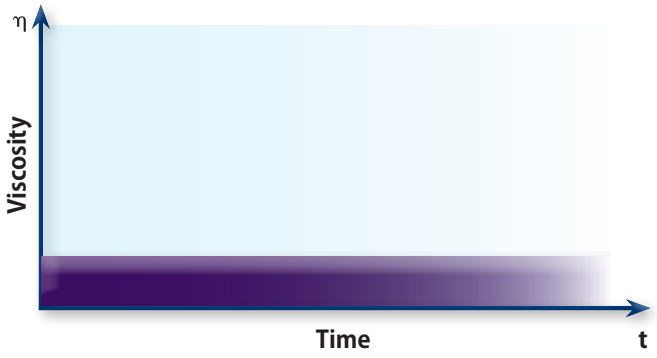
Instead of producing the reactive mix in batches, HÜBERS systems therefore mix resin and hardener in the respective smallest amount needed, immediately prior to processing the mix. This is achieved through the interaction of our pump and drive technology with our static mixer.

Development of the viscosity of the reactive mix ...

...when mixed in a batch mixer



...when using the HÜBERS technology.



Apart from the exact adherence and reliable reproducibility of the mixing parameters, HÜBERS dosing and mixing technology provides significant advantages for production management and productivity:

- Continuous operation without interruptions due to the preparation of new material batches
- Instant start of production at the start of shifts; after interruptions production can be easily resumed
- Shorter cycle times through higher processing temperature of the casting material
- No sedimentation problems

Dosing pump drives

Dosing pumps

Dosing pumps

The dosing pumps ensure the transport of the components into the static mixer. Here a precise dosing, wear resistance and leak tightness is especially important. HÜBERS piston dosing pumps work independent of gravity and with absolutely no pressure loss.

Depending on the application, also vacuum-tight gear pumps or combinations of piston and gear pumps are used.

Optionally full-ceramic piston dosing pumps are used. This design is even more resistant to the physical strain by the pumped materials and is therefore especially recommended for the processing of highly abrasive materials.

Drives and control

The accurate dosing of components for the production of the reactive mix requires a precise synchronicity of the pumps and strict compliance of the flow and the mixing ratio. Electronically controlled single drives offer maximum control and monitoring functions of all casting parameters.

The technology

- Brushless servo motors with high-performance resolvers
- Drive shaft through vessel lid and stirrer axle of the dosing mixer, 6-fold vacuum sealing of the drive channel
- Connection of the pumps in master-slave configuration
- Permanent monitoring of the synchronicity through electronic surveillance of the pump pistons' traveling distances
- Control, monitoring and programming via graphical user interface on a touchscreen

HÜBERS plants have all the characteristics and performance features needed for Industry 4.0. Our systems can communicate with production management / ERP systems. The control system processes data from higher-level processes, converts it accordingly, returns its own order-related data, thus creating a transparent overall process. For integration in a „smart factory" at the customer's site, there is merely the need to set up the interfaces.

Alternative: Central drive

As an alternative to the system of electronically controlled single drives, a mechanically controlled central drive can be used. The setting of the mixing ratio is done by manual adjustment.

Due to its simple structure, this drive system is the most economical solution for „robust" productions with a relatively small number of variable parameters and a constant mixing ratio.

Electronic dosing control

The quality of the mix can be controlled via the real-time data collection of the dosing pressures. Our Dosing Control Unit (DCU) analyzes the current process data independent from the system controls and thus provides full monitoring of the actual pressure profiles.

The DCU monitors dosing pressure, quantity and time of the pumps. In case of dosing disruptions and deviations from the mixing ratio, the process is stopped automatically, and the cause is displayed on the screen.

The technology

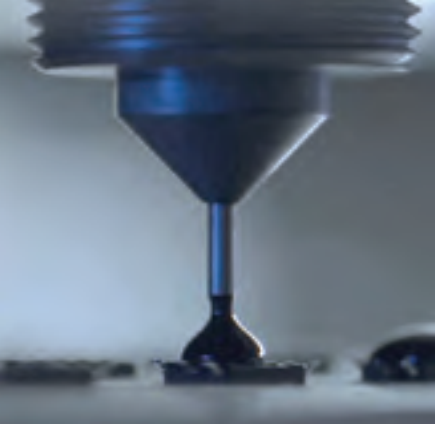
- The pumps' pressure curves are monitored during each dosing stroke.
- The data is displayed on the screen in real-time.
- Deviations are reported immediately.
- The data is logged.
- In case of faults, the process is stopped automatically and the root-cause is analyzed.

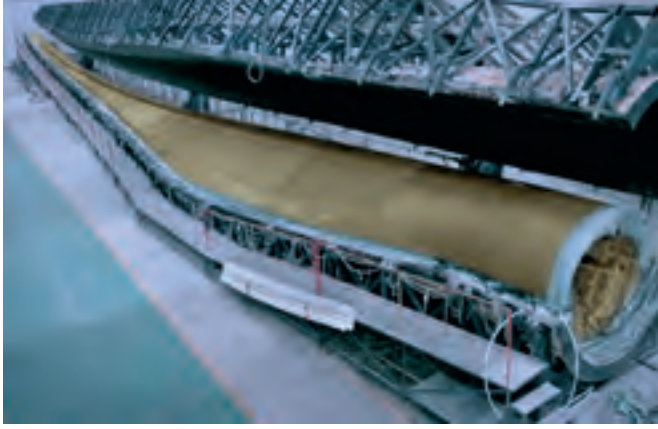
Static mixer

The static mixer mixes the material components to create the reactive mass. It consists of individual high-grade steel segments which are joined together perfectly into a guide tube sealed vacuum-tight. In each segment, the number of component striations is quadrupled. The mix of two components after 13 segments e.g. comprises 130 million striations. Thus, the homogeneity of the reactive mix is guaranteed.

Component flushing valve

Directly in front of the static mixer is the HÜBERS flush valve, with which the hardener side is closed to flush the static mixer with the resin component. The valve reliably prevents the entry of hardener into the mixer during flushing. Therefore there is no formation of plugs or deposits, but a fast and reliable, solvent-free cleaning of the static mixer with a small amount of material. The flush valve is also used in material systems with components other than resin and hardener, for example liquid silicones. The particular characteristic of the system determines which component is used for flushing.





Overview of casting and moulding techniques

The production of the reactive mix via the mixing device in the respective smallest amount needed also represents the transition from the mixing and dosing stage to the actual part production stage.

The production techniques can be fundamentally divided into the categories of casting, injection and infusion. Each in turn offers a number of design alternatives for the respective specific procedure.

Casting

During casting, the material is poured directly into a workpiece or in a mostly open mold through a casting nozzle. The casting can be carried out under vacuum or under atmosphere or sequentially under both vacuum and atmosphere. Then, the cast material is gelled and cured usually under temperature.

In addition to the mixing and dosing system, complete casting systems can include casting chambers and oven systems for preheating workpieces or molds and for gelation and curing of the cast parts.




The amount of material to be dosed and cast for each component varies between a few milligrams for microelectronic components and several hundred kilograms for MRT coils. The quantities to be produced and the capacities to be maintained can also be varied. We take these scopes into consideration with our various mixing and dosing plants in our micro, compact and epsilon series.

All of the process steps from mould handling to curing are integrated and automated in circulation casting lines. These plants are mostly used for mass production.

Automatic Pressure Gelation and silicone injection

The most important shaping techniques for the production of electrical parts are the Automatic Pressure Gelation for epoxy, polyurethane and polyester resin systems and for LSR and RTV silicones the silicone injection in conjunction with Silicone Vacuum Treatment (SVT).

Here, the material components are directly conveyed, via the static mixer, into a mold, which is held together by a clamping machine.

In the mold, the reaction is carried out under pressure, temperature and mostly atmosphere. The injected material displaces the air from the mold. For special applications, the mold can also be evacuated.

The shrinkage resp. the expansion of the material in the mold is compensated by the system. Thereby, voids and unintended cavities in the parts are avoided.

SVT

The SVT process developed by HÜBERS is particularly advantageous for silicone processing: The vacuum pretreatment of the material components ensures that no air pockets in the material have to be crushed during mould filling, as is the case with conventional processes that use high internal mould pressures. The low internal mould pressure used in the SVT process prevents the material from being pressed out between the mould halves, thus also preventing material wastage and the forming of „flash“ on the parts.

Product applications for Automatic Pressure Gelation resp. silicone injection are mostly insulation components for medium and high voltages, such as bushings, parts for gas-insulated switchgear (GIS), transformers, long-rod and hollow core insulators and cable accessories.

Vacuum Direct Infusion

V-DIT

During vacuum infusion, resin is infused into a lay-up of glass or carbon fibres. The fibres are initially layed up in the mould, covered with a vacuum foil and then evacuated. The resin is then infused into the mould to impregnate the fibres.

The outstanding feature of HÜBERS' vacuum direct infusion technology V-DIT is the active delivery of the resin into the structure, without using buffer or transfer containers. The material pressure is controlled by sensors so that the optimum infusion speed is always maintained. Also in V-DIT systems both material components are continuously pre-degassed and the exact compliance with the mixing ratio is maintained through electronic monitoring.

The results are bubble and cavity-free components with short infusion times.

Direct vacuum infusion technology is used for the manufacturing of wind turbine blades and structural components used in the aerospace and automotive industries as well as in the boat building and construction industries.

Ring line systems

Regardless of the casting or moulding technique being used, HÜBERS systems give you the possibility to supply several casting / moulding stations with material from a single preparation and dosing system via ring lines. An SCU (Shrinkage Compensation Unit) or a PCU (Pressure Control Unit) is used in each station for this specific purpose. In these assemblies, the static mixer is followed by a plunger that precisely controls the material pressure used in the relevant moulding tool. They also allow continuous filling of the mould, regardless of the filling quantity of the component to be produced.

Overview of HÜBERS

With more than 80 years of experience, HÜBERS is a pioneer and specialist company in process technology for resin casting and impregnation technology. To date, app. 3,500 machines and systems have been delivered to 60 countries.

The global network today comprises service and sales offices in China and Japan as well as commercial agencies worldwide. However, the heart of our medium-sized, owner-managed family business has always been in Bocholt.

In addition to administration and sales, our headquarters is home to all the key areas: technical development, design, manufacturing, assembly and service.

Development center

In our fully equipped R&D center, individual process solutions are developed and tested. Thus process reliability during production at the customers' is guaranteed.

- In-house research and development
- Target-oriented development process in direct cooperation with customers and material suppliers
- Casting trials and prototype production
- Job order casting of small series

Design

The customers' specific requirements are incorporated into the systems' design. This includes the mechanical and electrical design as well as the design of the operation controls.

- Design of systems for use with all resin systems, viscosities, degrees of filling
- Consideration of expansion options and convertibility of the systems for other processes and/or products
- In-house planning and operator-specific programming
- Customer-specific version of the control software and user interface

Foto: Bayer AG

Manufacturing and assembly – Made in Germany

Our production is primarily based on quality in every detail, flexibility, high security and the smooth start-up for the customer.

- Large vertical integration of all process-specific components in our own factory: forming, welding, machining and control cabinet assembly
- Purchased parts from reputable suppliers with global service networks
- Prior to delivery: Complete assembly of the systems in Bocholt and strict operational testing under production conditions during acceptance trials by the customer

Service

Our service is exceptional, even before the delivery of the machines and systems. From the direct use of our development center by the customer during project planning phase, through to the operation during the acceptance trial. Our range of after-sales services, which is unparalleled by our competition, is offered consistently.

- Operator training at HÜBERS and/or at the customer
- Extensive technical documentation and practical manual
- Regular maintenance and monitoring of measuring equipment
- Flexible and fast supply of spare parts
- Mixing and dosing head maintenance with mail-in service
- Technical telephone hotline with standby up to 24/7
- Remote support online via Internet
- Worldwide service assignments by own technicians, very short reaction times

What can we do for you?

The basis for the process development and the design of our systems are the individual requirements of our customers.

Indeed, there are well-proven basic procedures and modules. The actual design of each system, however, is tailored exactly to your product – the systems are made to measure instead of off the shelf.

Because of this, there is no production requirement in the processing of casting and impregnating materials, which we could not meet with our technology.

The examples of our customers' products given on the right therefore only represent a relatively small part of what is being produced with our systems.

So: Challenge us with your product,
we are looking forward to it!

TÜVNORD
TÜV NORD CERT GmbH
ISO 9001
ISO 14001
tuev-nord.de

Examples of our customers' products

Medium and high voltage engineering
- Bushings
- Cable accessories
- Cast resin transformers
- GIS insulators
- Hollow core insulators
- Instrument transformers
- Long-rod insulators
- Post insulators
- Reclosers
- Surge arresters
- Vacuum interrupters

Electronics
- Capacitors
- Circuit board transformers
- Semiconductors

Electric drives
- Linear actuators
- Servomotors
- Stators and rotors

Automotive
- Hybrid drives
- Stators and rotors for eMobility applications
- Gearbox sensors
- High-temperature diodes
- Ignition coils
- Piezo injectors
- Tire pressure monitoring systems
- Turbocharging systems

Medical applications
- Eyeglass lenses
- MRI coils
- X-ray tubes

Further areas
- Composite parts for aerospace applications
- Sanitary equipment
- Wind turbine blades

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