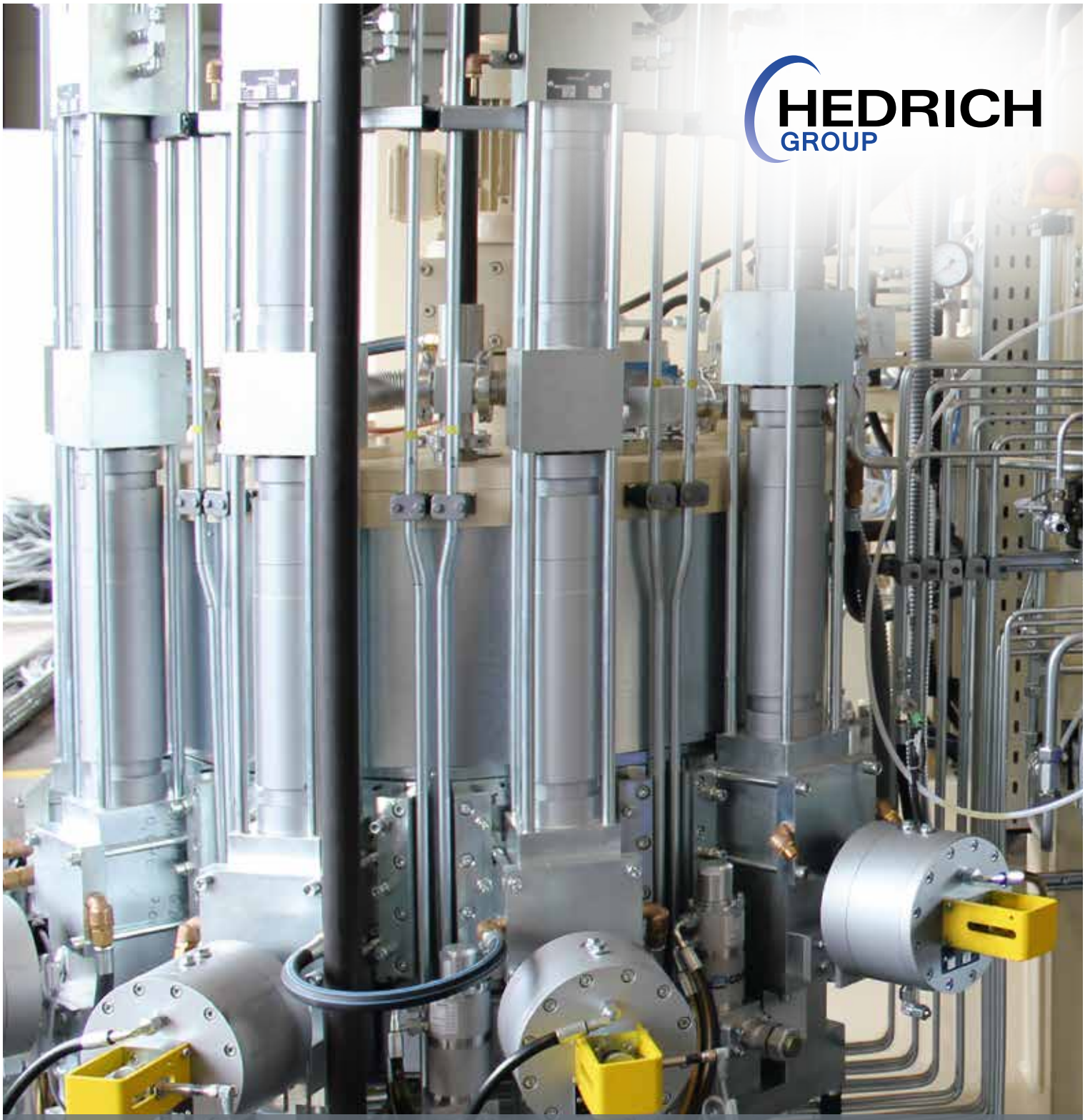

HEDRICH GROUP

SETTING THE PACE

in Vacuum Equipment Engineering.

TOP EXPERT SOLUTIONS

Setting the pace in vacuum equipment engineering.

CONTENTS

Joachim Schulz, CEO HEDRICH GROUP

»OUR CUSTOMERS WANT SOLUTIONS THAT MATCH SPECIFICALLY WITH THEIR INDIVIDUAL NEEDS.«

Joachim Schulz
CEO HEDRICH GROUP

Providing significant surplus values to our customers, beyond the actual product properties and the price, this is what you get in a partnership with HEDRICH.

↗ **The Total Benefit of Usership (TBU) is deemed top-priority issue by us; we are focusing on that in all our acting in our relationship with you, our customers. For the technical analysis and advice before order placement, the ideal equipment design and customer communication throughout the project as well as the draft of a customized maintenance schedule.**

As you can see, our chain of products and services in our German or Chinese plants is comprehensive. There we have in store for you the optimum solution for every application – uniquely fitting and customized.

EFFICIENCY

Tangible surplus in many ranges.

01 MORE TECHNOLOGY

No matter whether your product is insulated by a cast resin system, by liquid silicone rubber or an oil/paper application, HEDRICH always provides the optimum solution for your requirements to an efficient vacuum process.

02 MORE INNOVATIONS

Permanent innovations are setting the pace to a growing productivity of our customers, providing more process safety and high reliability in the equipment availability.

03 MORE SERVICE

Our worldwide network of experts with own service locations, e.g. in Germany, China and India as well as long-term partners grant comprehensive service. Just to mention a 24h availability at seven days a week with shortest response times as well as staggered service packages with variable spare parts and maintenance scope.

04 MORE COMPETENCE

One of our strongest competences is the processing of all insulating media: from highly filled to unfilled cast resin systems via the oil/paper sector to highly viscous silicones. The products of our customers are used in most various ranges: the electrical, electronics, wind energy and automotive industry as well as in the composite, pharma and medical sector.

05 MORE PERFORMANCE

Considerably increased performance in equipment technique is achieved by our customers with processes that suit their demands. Starting with the high-pressure dosing pump technology via the "MTB cast resin technology" (Multi Top Benefit) with an output of 9 t/day to our low-frequency drying with up to 70 % of energy saving.

TREND-SETTER

Innovations are demand and reality for HEDRICH.

The passion to create innovations and first-class quality, this is our ambition every day. Trusting in the know-how, experience and creativity of our engineers, who develop – in cooperation with our customers – pacemaking products. This means real expert solutions that hit the mark by functionality, precision and high quality.

- **1978** | First thin-film degassing mixer for filled cast resin systems
- **1980** | The world's first manufacturing of a composite hollow insulator on a VOGEL clamping unit
- **1980** | The world's first vacuum solid-resin casting equipment according to the APG process
- **1990** | The world's first full-ceramic dosing pump with reversible piston
- **1994** | The world's first vacuum casting equipment applying high-pressure dosing pumps
- **1995** | The world's first continuous degassing of filled, highly viscous cast resin components
- **1996** | First vapour phase equipment with fall-film evaporation and the possibility to distill the kerosene in parallel
- **2000** | The world's first fully continuous formulation and degassing equipment, Generation 3, for both-sided highly filled, highly viscous cast resin components
- **2004** | The world's first vapour phase equipment with subsequent cooling of the active part and assembly in dessert climate
- **2008** | The world's first automatic machine with vacuum chamber (turning and tilting) to manufacture high-voltage cable sleeves made of silicone
- **2012** | The world's first vacuum infusion equipment for direct infusion of rotor blades for wind energy systems
- **2014** | The world's first vacuum casting equipment for manufacturing medium-voltage instrument transformers on clamping units with fully automatic loading and unloading of the parts by robots
- **2016** | Latest MTB vacuum casting equipment (Multi Top Benefit) for more cost-saving formulation and degassing of highly filled cast resin components tripling at the same time today's standard preparation capacity

1978 · 1980 · 1990 · 1994 · 1995 · 1996 · 2000 · 2004 · 2008 · 2012 · 2014 · 2016

For more information → **www.hedrich-innovation.com**

SERVICE

in its most advanced and efficient way.

Burkhard Klappert
Head of Service
HEDRICH vacuum systems

Our permanently increasing desire for innovations in vacuum equipment engineering and more than 50 years of experience in all ranges of the impregnating and insulating technique are the basis for our expert knowledge and your security for high-quality products.

Even beyond the start-up of the equipment we are with our customers throughout the whole machine life of our equipment, granting maximum productivity and safety in their production with regular maintenance services. With our top expert solutions you will win – in any case.

HEDRICH GROUP

- CUSTOMIZED SERVICE PACKAGES 01
- EXPERT TRAINING PROGRAMS 02
- WORLDWIDE SERVICE NETWORK 03
- 24/7-SERVICE HOTLINE 04
- 40 SKILLED SERVICE MEMBERS WORLDWIDE 05

QUALITY

Premium systems “made by HEDRICH”.

Long-lasting and reliable equipment
“For more than four years, we have been using a HEDRICH vacuum pressure gelation equipment in our production. Its great reliability, top quality of the produced parts and the trouble-free operation have convinced us to have found the right partner in HEDRICH”.

Roman Ivanov
ELTECHNIKA
Russia

Most innovative equipment on the market
“Permanent improvement of our equipment technique and increase of our productivity require nonstop activities in innovation. HEDRICH has been and is an ideal partner for us to develop and realize innovations together. Being one step ahead of our competitors, this is the common aim in our partnership”.

Gottfried Schuster
Ritz Instrument Transformers
Germany

Promises are kept
“Our demands on a business alliance: “To keep one´s promise!” And in this respect, HEDRICH deeply convinced me. Their expert advice, reliable adherence to schedules during the entire manufacturing process and timely execution of delivery and commissioning have convinced us of our long-term commitment with HEDRICH. Because of the very good experience made in the past we have decided to realize the expansion of our plant with additional HEDRICH equipment.”

Richard M. Pokorski
S&C Electric Company
USA

SOFTWARE & AUTOMATION

Generating surplus by efficiency and effectivity.

The segment of HEDRICH “software & automation” has specialized in innovative automation and control solutions and services. The sophisticated modularity of our software structures enables our customers to a more efficient, more comfortable and safer equipment control, granting shorter start-up and maintenance times.

However, the customer does not only benefit from new equipment but also when updating existing, older equipment that we enhance with advanced software and solutions for modern equipment controls.

Certified Rockwell Solution Provider
HEDRICH was selected as one of just few certified Rockwell automation solution providers in Germany. In cooperation with Rockwell we support our customers in integrating their control and IT environments to increase their production capacity. All automation products used are optimally compatible and are all offered by one source.

Rockwell Automation Solution Partner

Cooperation with Rockwell in the industrial and process automation has been established very successfully over many years. Together we have been realizing both standard and customized solutions – fast and favourable.

CHAIN OF PRODUC TS AND SERVICES

for customized solutions.

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TOP EXPERT SOLUTIONS
Setting the pace in vacuum equipment engineering.

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- APG VACUUM PRESSURE GELATION EQUIPMENT
- VACUUM SHOT DOSING EQUIPMENT
- VACUUM INFUSION EQUIPMENT

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04
- VACUUM PRESSURE IMPREGNATING EQUIPMENT

05
- VACUUM PUMPING UNITS

At a glance:

EQUIPMENT FOR CAST RESIN INSULATION

Wherever reactive resin systems are processed, this is where our design for preparation, mixing and dosing is implemented. Based on our decades of experience and in close cooperation with users, material suppliers and testing labs, we have permanently developed and perfected our vacuum systems for cast resin insulation.

To name just a few of our innovations let us introduce the on demand principle for on-the-fly degassing and our patented on-the-fly formulation units for a continuous preparation of the desired cast resin system.

ADVANTAGES OF CAST RESIN INSULATION EQUIPMENT

- Batchwise or continuous degassing of highly viscous and filled cast resin components
- HEDRICH dosing pump portfolio for unfilled and highly filled cast resin components
- HEDRICH UFC flow heater
- HEDRICH robot arm casting nozzle
- HEDRICH on-the-fly formulation and degassing
- Patented online dosing supervision applying the highly precise Coriolis measuring principle
- Competitive single-line OTF-F/OTF-D systems
- Industry 4.0 capable software communication with superior and parallel computer systems

→ VACUUM RESIN CASTING EQUIPMENT

For the vacuum casting of components, HEDRICH manufactures casting chambers that are individually adaptable both in size and shape to the products to be cast. The equipment can be provided with conventional preparation mixers or as modern continuous on-the-fly formulation and degassing systems. The high shear forces in all mixing systems ensure optimum wetting of the fillers.

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→ VACUUM PRESSURE GELATION EQUIPMENT (APG)

The process of the automatic pressure gelation (APG) is ideal for components of large lot sizes, among them insulators, switch gear parts or instrument transformers. The moulds are pressure tight and fixed in a clamping unit. Casting is done mainly under atmospheric pressure. Optionally, pressure gelation is also possible under vacuum or with SF6 gas.

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→ VACUUM SHOT DOSING EQUIPMENT

For manufacturing sensitive electronic components, HEDRICH develops fully automatic casting lines. The components are optimally insulated under vacuum, excluding faults, at maximum output. Highest flexibility is another feature due to the casting nozzles, which are arranged inside the vacuum casting chamber, allowing three dimensional positioning of the pour-in point.

P. 24

→ VACUUM INFUSION EQUIPMENT

For the casting of rotor blades for wind energy systems and high-quality composite parts, HEDRICH has developed vacuum infusion equipment, which operate fully automatically and under permanent vacuum. The process is not only characterized by very high quality of the final products but also contributes to increasing the production by minimum waste and material loss.

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Vacuum Resin Casting Equipment

HEDRICH vacuum resin casting equipment can be provided both with conventional thin-film degassing mixers for batchwise preparation or with modern, continuous on-the-fly formulation and degassing systems. The high shear forces in all HEDRICH mixing systems grant optimum wetting of all filler types. For the casting of components under vacuum, HEDRICH manufactures casting chambers that are individually adaptable both in size and shape to the products to be cast. The supplying scope ranges from the manually chargeable casting chamber to the fully automatic tunnel-type casting tank with transport systems for liquid and solid resin applications.

ADVANTAGES OF VACUUM RESIN CASTING EQUIPMENT

- Batchwise DEM or continuous OTF degassing possible
- HEDRICH dosing pump design depending on the application: ceramic, high-pressure or gear-type dosing pump
- Hydraulic or motor synchronized dosing pumps
- Highest material flow rate of 24 t/day
- Integrated SF6 filling and recovery system
- Competitive single-line OTF-F/OTF-D systems
- Industry 4.0 capable software communication
- Online dosing supervision applying the highly precise Coriolis measuring principle

→ EFFICIENT DEGASSING

The HEDRICH thin-film degassing mixer (DEM) is preferably used to fast and efficiently degas higher and high viscous cast resin systems, containing abrasive fillers. A good wetting of the filler as well as perfect degassing (gas and moisture extraction) of the cast resin components are the most important factors for a perfect insulation.

→ AGAINST WEAR

The dosing pistons and sleeves of the HEDRICH dosing pumps consist of oxide-ceramic materials (silicon carbide). As a result, their service life is very long, and can even be extended by the intelligent design. A 180° turn allows the dosing piston to be used again for exact dosing. The sturdy, hydraulic drive grants long-term operation.

→ IDEALLY WETTED

One of the highlights is the fully continuous formulation with low mass volume and high shear rates, achieving a homogeneous cast resin pre-mixture within short. Combined with the downstream OTF on-the-fly degasser, high-quality cast resin materials are generated in continuous operation. With the ideal filler grain wetting and the optimum degassing degree, they provide best insulation properties for medium and high voltage applications.

→ CONTROLLABLE ALL-OVER

The range of the robot arm covers the whole cross section of the casting tank. The movement can be controlled manually via joystick or automatically by a casting program. The smooth design allows easy cleaning in case of maintenance. The arm is completely heatable/coolable up to the casting nozzle. By cooling-down the cast resin compound, reactivity can be slowed down. So, in many cases a purging of the equipment can be avoided during production interruptions.

APPLICATIONS

- **Cast resin transformers**
- **Current and voltage transformers**
- **Insulating parts for medium and high voltage switch gears**
- **High voltage bushings**

APG Vacuum Pressure Gelation Equipment

Besides vacuum casting, HEDRICH also manufactures equipment for the automatic pressure gelation (APG). This process has proven its excellence especially for components with large lot sizes, such as insulators, switch gear parts and instrument transformers. The moulds are pressure tight and fixed in a clamping unit. A batchwise and continuous process is possible. Casting is done mainly under atmospheric pressure. Optionally, pressure gelation is also possible under vacuum or with SF6 gas.

ADVANTAGES OF APG VACUUM PRESSURE GELATION EQUIPMENT

- HEDRICH full-ceramic or high-pressure dosing pumps depending on the application
- Fully automatic vacuum pressure gelation production line for electric drives
- Patented fully automatic APG production with integrated screen processing
- Multi-injection process for the casting of components with large part weights
- Material flow rate up to 10 t/day
- Patented online dosing supervision applying the highly precise Coriolis measuring principle
- PreCHECK™ filling and pressure test of the dosing pumps already before casting
- Connecting possibilities of up to 20 clamping units to one preparation system
- Patented casting process with subsequent pressure gelation tunnel oven system
- UFC technology to reduce cycle times and increase quality

→ FAST AND CONTINUOUS

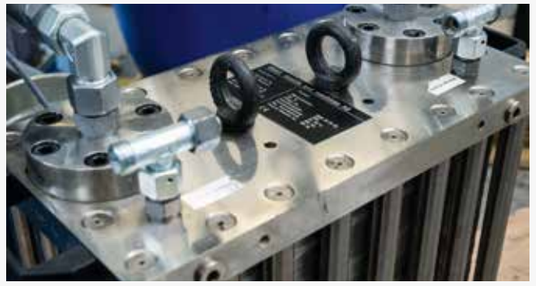
The OTF on-the-fly degasser achieves a very fast homogenization and degassing of filled epoxy resins after one single pass through. Short degassing and mixing time within a few minutes due to high shear forces between the stirring combs as well as degassing in thin layers. The degassing quality can be observed and inspected at any time through sight glasses in the OTF as well as the buffer vessel.

→ POWERFUL AND PRECISE

The high-pressure dosing pumps are driven hydraulically. This means that the energy source already provides a linear movement as the pump itself and thus excludes the risk of inaccuracies. Filler portions as high as with no other pump can be reached. The extremely wear-resistant design of the high-pressure dosing pumps ensures very long service lives.

→ UFC – THE PRODUCTIVE TURBO

The patented HEDRICH UFC technology allows to achieve very short gelation times. The cast resin compound is heated up by the HEDRICH developed UFC (Ultra Fast Compound) heater immediately before entering the moulds. So, we can grant a shortening of the gelation time with highest quality and resulting improved productivity of each clamping unit up to 50 %.



→ FULLY AUTOMATIC PRODUCTION

The robot is provided with a multifunction gripper arm to take over the complete process from loading and unloading of the mould as well as cleaning after demoulding and preparation for the next casting cycle. One robot can be used to operate several clamping units.

APPLICATIONS

- **Insulating parts for medium and high voltage switch gears**
- **Current and voltage transformers**
- **Stators and rotors of high-capacity motors**
- **Medium voltage bushings**
- **Insulators**

Vacuum Shot Dosing Equipment

HEDRICH develops special casting equipment for the highly precise potting of electronic components under vacuum. Vacuum shot dosing systems are, amongst other applications, dedicated to casting automotive ignition coils, sensors or small transformers. The partially or fully automatic equipment can either be employed as stand-alone solution or supplied as complete line including continuous throughfeed ovens and plasma treatment.

ADVANTAGES OF VACUUM SHOT DOSING EQUIPMENT

- Highest flexibility by 3D positioning system
- PreCHECK™ filling and pressure test of the dosing already before casting
- Full-ceramic dosing pistons with longest service life
- 3-chamber vacuum casting tank for max. productivity
- Inside or downstream TopOff casting with automatic measurement of the cast resin compound level
- Casting of cast resin with abrasive fillers

→ MAXIMUM FLEXIBILITY

The HEDRICH 3D positioning system provides highest flexibility in production irrespective of height, width or geometrically variable part sizes. The casting nozzles are moved to the component and not vice versa. The up-to-the-rim filled parts are moved as little as possible to avoid spilling of the casting compound. Simultaneous movement of casting nozzles and pallets optimizes the casting process, thus minimizing the cycle times.

→ FAULTLESS DOSING

Most dosing supervision systems only detect a fault in the filling quantity during casting, thus generating unnecessary waste by casting errors. The new HEDRICH PreCHECK™ system, however, recognizes an improper dosing of the cast resin components yet before casting. Therefore, waste is avoided.

→ EXTREMELY STURDY

The casting nozzles of all HEDRICH shot dosing systems are provided with ceramic-made closing pins as standard. These extremely wear-resistant closing pistons grant very long service life with a highly precise and drip free casting.

→ DETAILED PROTOCOL

To increase the process quality assurance, all component-specific casting parameters are stored in a database system, enabling a detailed retraceability of each cast component.

APPLICATIONS

- **Ignition coils**
- **Sensors**
- **Electronic small parts**
- **Small transformers**
- **Electric motors**

Vacuum Infusion Equipment

The HEDRICH "VIA" line has already established itself successfully on the wind energy market, offering significant advantages for the production of high-quality composite components compared with other manufacturing processes. The consequent process under vacuum considerably increases the product quality, so cost-intensive reworking becomes completely obsolete. Constant quality on highest level along with minimization of production and disposal costs for material loss are the features to make the fully automatic HEDRICH vacuum infusion concept become the most efficient solution for high demands on the composite market.

ADVANTAGES OF VACUUM INFUSION EQUIPMENT

- ↗ World's innovation: completely fully automatic vacuum casting of rotor blades without reabsorption of gas of the prepared cast resin components
- ↗ Quality improvement by less air accumulation
- ↗ Shorter mould occupation times and thus increase of production by abt. 10 %
- ↗ Elimination of additional post-curing times
- ↗ Minimization of cast resin disposal costs
- ↗ Less material consumption by lower safety margins
- ↗ Separate degassing of resin and hardener for quality improvement
- ↗ Casting quantities up to 70 kg/min
- ↗ Technology for infusion also applicable for the pressure gelation technology

→ RIGHT PERFECT

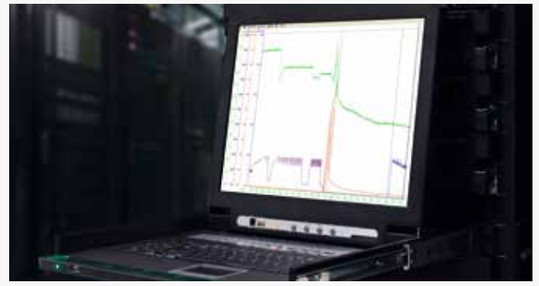
Throughout the whole infusion process, the carrier matrix is continuously kept under vacuum, thus avoiding enrichment with gases. The result is a significant increase of the product quality and no costs necessary for machining. Additional post-curing times are also eliminated, and support productivity by a multitude.

→ INTELLIGENT INFUSION

The filling and mixing station [INFUCUBE] contains a softbag to control the cast-resin refill process as required. This softbag is refilled automatically depending on the quantity consumed. So, there is just a minimum amount of remaining reactive material available at the end of the infusion process. Contaminated parts as hoses, softbag and static mixer are very low-priced one-way consumables.

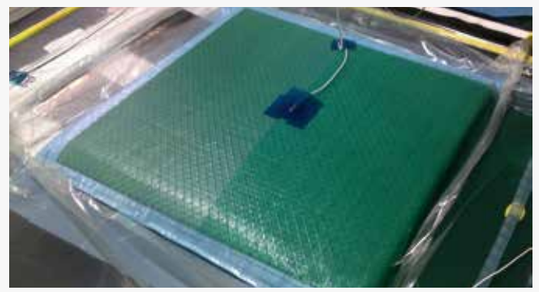
→ CONSTANT QUALITY

The HEDRICH "VIA" line provides a system to measure the residual moisture of fibre and core components, dry them under vacuum until a freely defined residual moisture degree is reached and then infuse the compound automatically. This fully automatic process saves time, energy, man-power and grants reproducibility of highest quality requirements.



→ OPTIMALLY WETTED

The HEDRICH preparation concept ensures at any time the proper quantity of perfectly prepared cast resin compound for steadily optimally dehumidified fibre and core components. The finished product thus holds the desired density in structure and a maximum stability.



APPLICATIONS

- **Wind energy systems**
- **Aerospace industry**
- **Structure parts**
- **Automotive**
- **Boat building**
- **Composite components**

At a glance:

CLAMPING UNITS, MOULDS, MIXING AND DOSING SYSTEMS

made by vogel

VOGEL has specialized in clamping units, moulds, mixing and dosing systems as well as customized equipment for the manufacturing of insulation parts made of epoxy resin and liquid silicone rubber (LSR) for the electrical and automotive industry. Since the APG process was invented in the early 1970s, VOGEL has been demonstrating technical capability with view to the respective equipment, e.g. the first equipment for the automatic shielding of composite insulators with liquid silicone rubber (LSR). Nowadays, the machines and systems by VOGEL moulds & machines AG are found at the highest technical level. Almost all large manufacturers of medium and high voltage equipment worldwide are among the range of customers.

ADVANTAGES OF CLAMPING UNITS, MOULDS AND MIXING AND DOSING SYSTEMS

TOP EXPERT SOLUTIONS
Setting the pace in vacuum equipment engineering.

- More than 45 years of experience in developing and manufacturing clamping units and moulds
- Complete equipment (clamping units, moulds and dosing systems) from one source
- Customized competent advice and reliable service
- Comprehensive references of satisfied customers worldwide
- Comprehensive optimized and standard machine and equipment designs
- Development and realization of projects according to customer's specific needs
- Nonstop innovation for the technical benefit of the customers

→ CLAMPING UNITS

■ APG clamping units ■ LSR clamping units

Available in different sizes and designs, the clamping units are well suitable for the manufacturing of small parts and small batches as well as large-scale complex components and high numbers of pieces. All pieces of equipment can be supplied with heating plates in appropriate size. They may be provided either with pressure cylinders centrally behind the mould or with pull cylinders arranged laterally.

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→ MOULDS

VOGEL develops and supplies all types of moulds for the processing of the following materials: cast resin in vacuum casting and APG process as well as liquid silicone rubber for various kinds of insulation of electric components and for insulators of electric systems. Designed according to the special requirements to the product and material, the moulds are characterized by high precision and long service life.

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→ LSR-MIXING AND DOSING SYSTEMS

■ Type DosilOne Advanced ■ Type DoskoSil

The systems have been developed for the processing of liquid silicone rubber (LSR), fitting the individual customer and process requirements. Fast filling speeds of even high viscous material, a VOGEL booster system, preheating devices and the on-the-fly degassing are features for optimum performance in material preparation.

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→ SPECIAL EQUIPMENT AND SOLUTIONS FOR AUTOMATION

Based on many years of experience in development, design and manufacturing of moulds, clamping units and mixing and dosing systems, VOGEL also is a competent partner for automated solutions in the APG and silicone process; the spectrum ranging from fully automatic production solutions for cable accessories in LSR to the fully automatic encapsulation of electric motors in APG.

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APG Clamping Units

VOGEL clamping units for the APG process are reliable, extremely sturdy and long-lasting. Each machine has been manufactured with great care and according to the state-of-the-art technology. The versatile and sophisticated functionality as well as extendibility of the machines founds the ideal basis to also meet all future requirements as well as production methods growing more and more complex and fast.

ADVANTAGES OF APG CLAMPING UNITS

- Modular extendibility (tilting around 1 or 2 axes, core pullers, etc.)
- Highest stability, precision and long service life
- Best accessibility from both sides
- Clear intuitive control
- Special equipment as vacuum chamber, slide, quick-clamp system
- All components made by renowned manufacturers – worldwide availability of spare parts
- Fixed, inside-arranged piping and wiring as well as attached hydraulics
- Easy and fast setting-up as well as start-up
- Positioning of all axes via linear encoder systems
- Free programming directly in the control

→ MODULAR EXTENDIBLE

The modular arrangement of the machines allows to adapt the equipment exactly to the customer's needs. For example, the core pullers (top, bottom, lateral) and the tilting of the machine around one or two axes can be integrated as option or installed later. It is also possible to provide the unit with a quick-clamp system for fast and easy mould change.

→ STABLE AND PRECISE

All machines are provided with a very sturdy and warp resistant machine frame, which is optimized for the occurring changes in load. The massive moving carriage suspends from precision guidances, ensuring absolute parallel closing as well as clean and smooth opening of the sensitive clamped casting moulds.

→ VERSATILE AND INTUITIVE

Thanks to the modern and intuitive control, just one click is necessary to change the screen and edit parameters quickly. Functions such as cylinder positions, heating parameters (temperatures and PID values) and hydraulic pressures are clearly visible. All process-relevant steps can be selected from a library and stored as program along with the other parameters.

→ MINIMUM SERVICE REQUIRED

The simple and modern mechanical machine arrangement minimizes the necessity for maintenance and repair. No components are used that are subject to excessive wear. Therefore, the down times per year as well as costs arising for maintenance and service are very low.

APPLICATIONS

- **Current and voltage transformers**
- **Switch housings with and without integrated vacuum tube**
- **Insulating parts for medium and high voltage switch gears**
- **Switching rods**
- **Insulating tubes**
- **Bushings of all kinds**

LSR Clamping Units

VOGEL clamping units for the casting of liquid silicone rubber (LSR) are based on the proven principle of the APG clamping units. Therefore, they are in the same way reliable, sturdy and built for maximum clamping force. Each machine is designed so that it can take up even huge moulds up to several tons without any problem. The intelligent principle and free accessibility from both sides allow to manufacture insulators with lengths that exceed the machine width by a multitude. The machines can be loaded by means of simple, manual crane systems or most advanced fully automatic handling systems to put in the several meters-long insulators and rods and mount even moulds weighing tons easily and safe.

ADVANTAGES OF LSR CLAMPING UNITS

- Highest stability, precision and long service life
- Best accessibility from both sides
- Modular extendibility (fully automatic handling units, mould crane and crane for parts handling)
- Clear intuitive control, freely programmable
- Pour-in systems for individual or multiple casting
- Special equipment such as hydraulic quick-clamp systems and vacuum chambers for the arrester production
- Heating of the moulds – electrically and by means of heating/cooling units
- All components made by renowned manufacturers – worldwide availability of spare parts

→ POWERFUL AND SENSITIVE

All machines have a generously dimensioned rigid machine frame, which is optimized for taking-up tools up to 8 tons per mould half. The massive moving carriage suspends from reinforced precision guidances and can be adjusted according to the weight. This allows parallel closing as well as clean and smooth opening of the clamped moulds.

→ COMFORTABLE AND SAFE

Employing modern safety switch devices allows to operate the machine without any disturbing protective fences. This ensures easy and uncomplicated charging of the moulds with the composite tubes and rods, which can be up to 20 m long.

→ QUALITY BY PRESSING A BUTTON

Just one click on a button is necessary for the modern, intuitive control to change a screen and edit parameters quickly. All functions as cylinder positions, heating parameters (temperatures and PID values) and hydraulic pressures are clearly split up. The process-relevant steps can be selected from a library and stored as program along with the other parameters.

→ LESS WEAR – LESS COSTS

Thanks to the simple, modern mechanical arrangement, maintenance and service is minimized. No components are used that are subject to excessive wear. Therefore, the maintenance and down times per year as well as costs arising for maintenance and service are very low.

APPLICATIONS

- **Hollow insulators up to 1,100 kV**
- **Long-rod insulators up to 400 kV**
- **Arresters**
- **Encapsulation of cable sleeves up to 500 kV**
- **Direct shielding of bushings**
- **Manufacturing of cable sleeves and accessories**

Moulds for APG AND LSR

VOGEL moulds – either for APG process or silicone applications (LSR) – are dedicated to highest precision and reliability. Every single mould has exactly been adapted to the machine, granting high-quality components from the beginning. The moulds are designed and developed by means of technically most advanced 3D CAD systems. They meet the requirements on production, which are growing more and more complex and fast.

ADVANTAGES OF MOULDS FOR APG AND LSR

- Manufactured for highest precision and extremely long service lives
- Designed and developed in close cooperation with the customer resp. engineer of the component to be manufactured
- Maintenance and user friendly setup
- Easy assembly and handling
- On request, modular arrangement to allow different parts to be manufactured with one mould
- Electric heating, heating/cooling and cooling integrated into the mould
- Intelligent pour-in and vent systems

→ LONG SERVICE LIFE AND PRECISION

With the modern mould arrangement it is possible to manufacture faultless dimensionally stable parts from the first shot. Each mould exactly fits the customer's requests and provides a convenient, easy handling in perfect correlation with the clamping unit. Thanks to high-quality materials and high-tech thermal treatment, the moulds' service life is very long.

→ MODULAR AND EXTENDIBLE

If requested, different – even complex – components can be manufactured with just one mould. The flexible APG moulds employ exchange inserts or variable mould bricks. Every mould can have one or several independently moving core pullers. The modern block arrangement of the LSR moulds allows a short, easy change-over of insulators of various lengths.

→ DIRECTLY OR INDIRECTLY

All moulds – both for APG and LSR – can be equipped with direct heating or be heated indirectly via the heating plates of the machine. The moulds for LSR can either be brought to the required temperature electrically via heating cartridges or by means of heat/cool channels via external heating/cooling units.

→ TECHNICALLY MATURED

The applied materials and high surface quality result in a considerable reduction of the maintenance and cleaning efforts when changing the mould. In order to increase productivity, a mould may have up to eight cavities.
As a matter of course we consider sophisticated pour-in systems as well as fully automatic demoulding and moulding systems.

APPLICATIONS

- **Current and voltage transformers, bushings and post insulators**
- **Arresters**
- **Switch housings with and without integrated vacuum tube**
- **Insulating parts for medium and high voltage switch gears**
- **Hollow insulators up to 1'100 kV; long-rod insulators up to 400 kV**
- **Manufacturing as well as encapsulation of cable sleeves up to 500 kV**

LSR Mixing and Dosing System Type DosilOne Advanced

The VOGEL mixing & dosing system type DosilOne Advanced processes liquid silicone rubber (LSR) with a shot volume of up to 140 l and a filling speed up to 70 l/min. The components are filled into the mould by means of two independent hydraulically powered cylinders through a static mixer. The integrated dosing quality supervision system avoids the production of waste – by checking before filling.

ADVANTAGES OF LSR MIXING AND DOSING SYSTEM TYPE DOSILONE ADVANCED

- High precision of the mixing ratio of component A and B
- Compact and space-saving arrangement
- Minor installation effort
- Easy and quick exchange of barrels
- Venting of the follow-up plates and pumps after barrel exchange
- Administration of up to 30 filling profiles
- Easy disassembly and cleaning of the static mixer
- Low remaining quantities in the barrels
- High precision of the absolute filling amount
- Switching-off via pressure sensor in the mould possible
- Energy efficient due to standby mode of the hydraulic system
- Remote access and remote maintenance possible
- Little maintenance effort

→ ALWAYS DOSED PRECISELY

Via the integrated dosing quality supervision system, the independent hydraulically powered dosing cylinders check before every filling process that the material is filled completely and excluding air. Any occurring faults are solved automatically. Before releasing for dosing, the entire system is pressurized to a predefined pressure level, granting a uniform start of both dosing cylinders.

→ FAST AND FORCEFUL

The VOGEL booster system can fill moulds in one shot with up to 70 l/min and 140 l. Components of large volumes up to 140 l can be filled into a highly heated mould before the vulcanization process starts, within 2-3 min, thus shortening process times enormously and minimizing cooling-down and heating-up times.

→ FLEXIBLE CONTROL

Specially developed VOGEL controls and software provide highest flexibility in selecting the filling profiles. Up to 30 different processes can be filed. Via several interfaces of the integrated control, up to four consumers can be operated at the same time.

→ ERGONOMIC DESIGN

The compact, space-saving and ergonomic arrangement of the DosilOne allows easy and comfortable operation as well as an easy and safe handling when exchanging the barrel of the filling station. All piping and wiring is integrated into the equipment, and external supply connections are accessible so as to ensure that the equipment is ready for use at any location within the shortest possible time without major assembling.

APPLICATIONS

Mixing and dosing of liquid silicone rubber (LSR) for the:

- **Manufacturing of hollow insulators**
- **Manufacturing of long-rod insulators**
- **Manufacturing of cable sleeves**
- **Direct shielding of bushings**

LSR Mixing and Dosing System Type DoskoSil

The VOGEL mixing & dosing system type DoskoSil for the continuous mixing and dosing of liquid silicone rubber (LSR), 2K adhesive materials and 2K epoxy systems processes even abrasive materials up to a viscosity of 500,000 mPas. As standard, the equipment is capable of feeding the material from 20 l and 200 l barrels. The components are filled into the mould by means of two independent hydraulically powered double-acting plunger pumps through a static mixer.

ADVANTAGES OF LSR MIXING AND DOSING SYSTEM TYPE DOSKOSIL

- Dynamic degassing system for highest efficiency
- High precision even at different viscosities
- Corresponding to the machine directive 2006/42/E
- Compact and space-saving arrangement
- Venting of the follow-up plates and pumps after barrel exchange
- Administration of up to 30 filling profiles
- Easy disassembly and cleaning of the static mixer
- Low remaining quantities in the barrels
- High precision of the mixing ratio of component A and B
- High precision of the absolute filling amount
- Switching-off via pressure sensor in the mould possible
- Energy efficient due to standby mode of the hydraulic system
- Remote access and remote maintenance possible
- Minor maintenance effort

→ DYNAMICALLY PREPARED

The dynamic material degassing unit is the optimum solution for the degassing of low, medium and highly viscous liquid silicone rubbers (LSR). The special design allows the material to distribute on thin, permanently renewing layers. This technology ensures – especially when manufacturing high voltage components – an efficient and high-quality material preparation.

→ INDEPENDENT OF VISCOSITY

The VOGEL LSR mixing and dosing system type DoskoSil contains hydraulically powered double-acting plunger pumps to ensure a uniform material flow, constant mixing ratio as well as precise filling speeds and filling volumes for highly viscous materials and components with different viscosity.

→ EFFICIENTLY VENTED

Fully automatic venting of the follow-up plates and fully automatic purging of the double-acting plunger pumps grant thorough venting after a barrel exchange with minimum material consumption and without impacts due to operator faults. So, both error rate and material waste are reduced.

→ FREELY PROGRAMMABLE

The purpose-developed DoskoSil control and software provide highest flexibility in selecting the filling profiles. Up to 30 predefined filling profiles are freely programmable and can supply up to four consumers at the same time. Communication with the clamping unit or the mould carrier is effected via several interfaces of the integrated control.

APPLICATIONS

- **Manufacturing of hollow insulators**
- **Manufacturing of cable sleeves**
- **Direct shielding of bushings**
- **Manufacturing of long-rod insulators**
- **Manufacturing of components for cable sets**
- **Encapsulation of electric components**

Special Equipment and Solutions for Automation

Our experience in machine, mould and equipment engineering as well as the process technique for the manufacturing of components according to the APG process or silicone process are the basis for innovative and practicable automation solutions. Our philosophy is "from specialists – from one source – from the start". Yet when designing the product, VOGEL is available to you with great experience in order to gain best conditions for an efficient production launch-out with high quality manufacturing later.

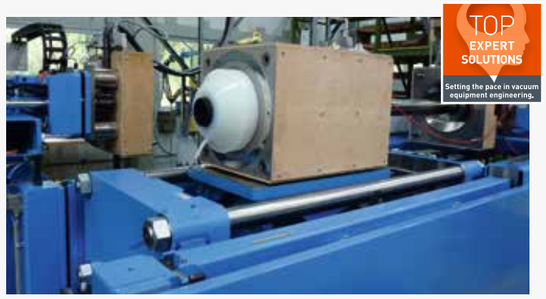
ADVANTAGES OF SPECIAL EQUIPMENT AND SOLUTIONS FOR AUTOMATION FROM VOGEL

TOP EXPERT SOLUTIONS
Setting the pace in vacuum equipment engineering.

- Many standard and proven solutions available for automation
- Corresponding to the machine directive 2006/42/E
- Own long-term experience in machine, mould and equipment engineering
- Experience in process technique for APG and silicone process
- From development, manufacturing, start-up to service – all from one source

→ TIME-OPTIMIZED MANUFACTURING

For the manufacturing of cable sleeves up to 500 kV, VOGEL provides a fully automatic production equipment. The applied moulds hold integrated pressure and temperature sensors to monitor an optimum filling and vulcanization process and are swiveled as necessary for optimum filling. This equipment reduces the manufacturing time by 50 % compared with other commonly available processes.



→ FULLY AUTOMATIC MANUFACTURING

For manufacturing electric drives, VOGEL has developed a fully automatic system that loads and unloads as well as preheats components, casts them and finally post-cures. The modular arrangement allows an extension in steps as well as mixing production of several types.

→ CONSTANT MIXING AND DOSING

VOGEL always grants a homogeneous mixing ratio for highly viscous filled materials (e.g. 2K adhesive materials) as well as at very different viscosities of the components. The permanent circulation under vacuum excludes sedimentation, and a steadily proper mixing quality of the components is ensured.

→ AUTOMATION OF PROCESSES ON STANDARD CLAMPING UNITS

To optimize processes, VOGEL provides a great number of automation solutions for the standard clamping units – such as handling systems for loading and positioning the GFK pipes when manufacturing composite insulators in multi-shot process, loading slides for loading and unloading and automations with robots for mould cleaning and parts handling.

APPLICATIONS

- **Automatic casting of electric drives**
- **Manufacturing of high voltage cable accessories up to 500 kV**
- **Robot-based automation solutions**
- **Parts handling for shielding of hollow insulators**
- **Dosing and mixing of highly viscous and abrasive materials (adhesive material, epoxies, etc.)**

At a glance:

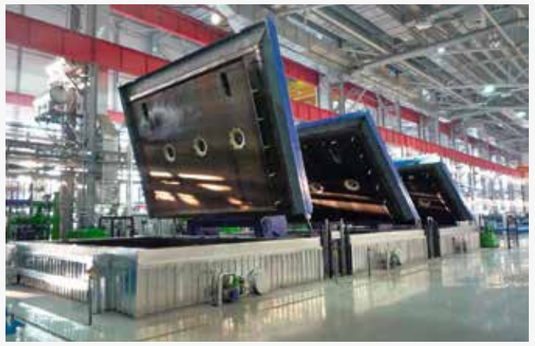
EQUIPMENT FOR OIL/PAPER DRYING AND STABILIZATION

HEDRICH offers a variety of drying technologies for different applications. Only carefully dried insulation materials ensure a trouble-free function of electric high-performance components and slow down the aging process. The materials used to insulate transformers such as oils and cellulose are hygroscopic. It is therefore important to minimize moisture to guarantee dielectric strength and dimensional stability.

ADVANTAGES OF EQUIPMENT FOR OIL/PAPER DRYING AND STABILIZATION

TOP EXPERT SOLUTIONS
Setting the pace in vacuum equipment engineering.

- Vacuum oil purification equipment with indirect heating and large degasser for effective drying of insulating oils
- Vacuum hot air drying equipment with uniform heat distribution as cost-effective option for windings, distribution transformers and smaller power transformers
- Vacuum nitrogen drying equipment for reduced drying times; also as upgrade of existing vacuum hot air drying equipment
- Vapour phase drying equipment with external evaporator – a must for drying power and high-performance transformers
- Vacuum low-frequency drying equipment for distribution, medium voltage and power transformers for shortest drying and filling times
- Mobile vacuum low-frequency drying equipment for effective drying during the repair of power transformers in the field
- Vacuum drying and filling equipment for high-voltage capacitors – as batch-type or continuous equipment
- Vacuum drying and impregnating equipment for high-voltage cables
- Isostatic pressing devices for length stabilization of windings and shrinkage compensation of active parts already during the drying process



→ VACUUM HOT AIR DRYING EQUIPMENT

The mature technology of these systems provides excellent drying results. So the drying time compared to drying equipment without vacuum is reduced by nearly half. This is achieved by an optimum and uniform heat distribution through fans and air baffles and the complete heating of the autoclave by heat transferring oil.

| P. 46

→ VACUUM NITROGEN DRYING EQUIPMENT

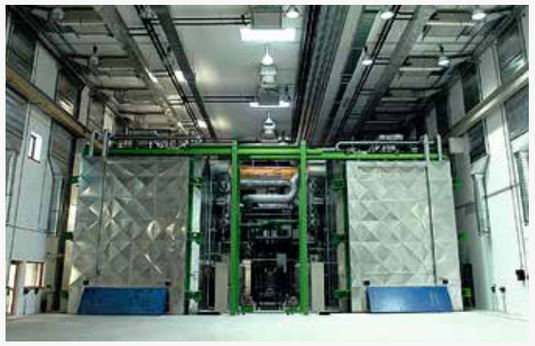
Nitrogen instead of air – this is the principle of the vacuum nitrogen drying equipment of HEDRICH. The new process is characterized by higher drying temperatures, significantly reduced drying times and only minor depolymerisation of the insulation material. This process can be used for new drying equipment but can also be retrofitted on existing vacuum drying equipment because of the modular concept.

| P. 48

→ LOW-FREQUENCY DRYING EQUIPMENT

To ensure a fully automatic production of distribution transformers of different sizes in medium and large quantities, HEDRICH has developed its low-frequency drying equipment. The simultaneous heat treatment and vacuum drying ensure short process times. Low vacuum in the complete process guarantees optimum drying qualities and minimum depolymerisation losses of the insulation.

| P. 50



→ VAPOUR PHASE EQUIPMENT

Vapour phase systems are preferably used for the production of power transformers and other high-voltage components. The highly energy-efficient technology, using kerosene, only requires half of the time compared with drying processes using air. This is ensured among others by the external fall film evaporator, the patented system of condensate accumulation as well as innovative regulating and control components.

| P. 52

→ VACUUM DRYING AND IMPREGNATING EQUIPMENT

Drying and impregnating systems are mainly used to process oil/paper-insulated components such as instrument transformers, capacitors, bushings and other electric components. After the components to be processed have been dried, the impregnation is performed by filling with insulation liquid under vacuum.

| P. 54

→ VACUUM OIL PURIFICATION EQUIPMENT

Whether in stationary or mobile design, the vacuum oil purification systems of HEDRICH are characterized by a large vacuum degassing stage and an efficient pumping speed of the pumping unit. To avoid cracking as well as local overheating, the insulation oil is heated up indirectly via a heat exchanger with hot water as heating medium.

| P. 56

→ VACUUM CABLE IMPREGNATION EQUIPMENT

Specialized in the impregnation of signal and HV/DVDC energy cables, HEDRICH ensures absolute process reliability with its equipment. For processing kilometers of HVDC energy cables, the large cable impregnation systems are equipped with a sturdy, reliable vacuum pumping unit with high pumping speed, low ultimate vacuum as well as special condensers and exhaust devices.

| P. 58

→ ISOSTATIC PRESSES

Using isostatic presses during the drying of transformer windings ensures that shrinkage of the insulation is compensated. Different pressing tools – adapted to various winding sizes – are available. A computer control system coordinates and controls the pressing operation according to the entered parameters like pressing force, holding and waiting times and pressure increase.

| P. 60

Vacuum Hot Air Drying Equipment

In a comparison between vacuum hot air drying systems and conventional drying systems that are only operated at atmospheric pressure without vacuum, one characteristic clearly stands out: The drying time is reduced by nearly 50 %. HEDRICH vacuum hot air drying equipment can be used for many applications, achieving excellent drying results based on its mature technology.

ADVANTAGES OF VACUUM HOT AIR DRYING EQUIPMENT

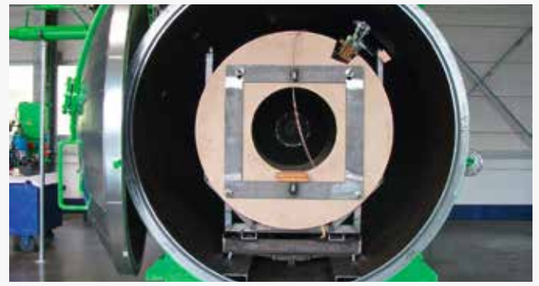
- Control of circulating air to be exchanged by a moisture sensor
- Optimized and uniform heat distribution through fans and air baffles
- All-around heating of autoclave by means of heat transferring oil, including door
- Further reduction of the drying time up to 75 % by additional use of a current heating device to heat the windings.
- Loading by air cushion vehicle or trolley
- Online registration of dew point and water rate during the fine vacuum phase

→ CONTROLLED AIR GUIDANCE

In the air circulation system, the heat transferring medium air is circulated by means of fans between the heated autoclave wall and air baffles so that the air is heated up and conducted to the parts to be dried which are uniformly dried. The exchange of air enriched with water vapour is efficiently controlled by a moisture sensor.

→ CUSTOMIZED DESIGN

HEDRICH constructs its drying equipment according to customer requirements to achieve optimum and energy-efficient drying performances. Depending on the application, round or rectangular autoclaves are used. Also for vacuum pumping units with oil-sealed or dry-compressing backing pumps, HEDRICH meets the specific customer requirements and designs optimum solutions.



→ TIME REDUCTION BY CURRENT HEATING

For reducing the drying time, the vacuum air circulation drying systems can additionally be provided with a direct current heating. This solution is preferably used to dry windings. The combination of resistance heating and air circulation heating ensures a faster and more uniform heating thus increasing the energy efficiency.

→ UNIFORM HEATING

HEDRICH heats the complete autoclave with all surfaces, including top, bottom, rear wall and door. The temperature is controlled via different heating circuits with manual control valves. The typical heating medium is heat transferring oil that is pumped through U-shaped pipes welded on the autoclave. With smaller autoclaves, heating is also possible through electric heating plates installed at the outside.

APPLICATIONS

- **Distribution transformers**
- **Power transformers**
- **High-voltage instrument transformers**
- **High-voltage bushings**
- **Components for transformers**
- **Transformer windings**
- **Traction transformers**

Vacuum Nitrogen Drying Equipment

The new process of HEDRICH uses nitrogen instead of air for the drying operation. Thus, higher drying temperatures and faster heating times can be reached and the drying times can be significantly reduced. The conventional drying technology using air as heat transferring medium has the disadvantage that the drying temperature needs to be limited because of the existing atmospheric oxygen in order to avoid excessive depolymerisation.

ADVANTAGES OF VACUUM NITROGEN DRYING EQUIPMENT

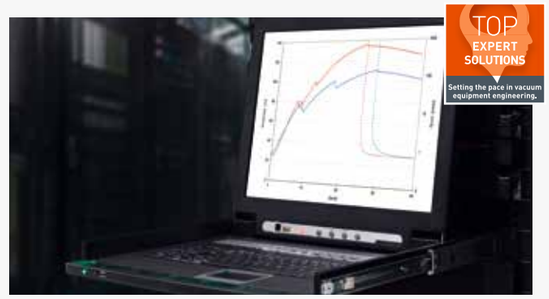
- ↗ 30 – 40 % shorter drying times compared with the vacuum hot air drying equipment
- ↗ 15 – 20 % higher drying temperatures
- ↗ Optimization of existing conventional HEDRICH vacuum hot air drying equipment
- ↗ Auto-adaptation to adjust the drying process to the batch size
- ↗ Energy-efficient equipment concept
- ↗ Minor depolymerisation of the insulation paper
- ↗ Minimization of the nitrogen to be exchanged to save energy
- ↗ Online registration of dew point and water rate during the fine vacuum phase

→ REVOLUTIONN_2

Through the use of nitrogen instead of air as heat transferring medium, the process happens without exposure to air. This allows higher temperatures, faster heating times and a significant reduction of the depolymerisation rate of the insulation. At the same time considerably shorter drying times are achieved.

→ HIGHER TEMPERATURES

The use of nitrogen allows to increase the drying temperature by 20 °C so that the drying times can be significantly reduced. The effectivity and productivity of the drying systems can be considerably increased.



→ AUTO-ADAPTATION OF PROCESS

Optimizing the process steps allows a further reduction of the drying time. After the specific transformer data have been entered, the process control unit selects the optimum program and, by means of different sensors, optimizes the duration of the intermediate pressure reductions, the exchange of the nitrogen saturated with water vapour as well as the fine vacuum phase.

→ IDEAL FOR RETROFIT

Not only new drying systems can be equipped with the innovative drying by nitrogen, a retrofit is also possible on existing vacuum hot air drying systems. A modular concept guarantees fast retrofitting including optimization of the control unit with auto-adaptation of the process.

APPLICATIONS

- **Distribution transformers**
- **Power transformers**
- **High-voltage instrument transformers**
- **High-voltage bushings**
- **Components for transformers**
- **Transformer windings**
- **Traction transformers**

Low-frequency Drying Equipment

HEDRICH systems with direct electric low-frequency heating are designed for fully automatic production of medium and large volume production of different transformer sizes and types. The high flexibility in the batch occupancy is unique just in the production of distribution transformers. Parallel heat treatment and vacuum drying allow to achieve shortest process times. The complete process is performed under low vacuum thus ensuring significantly improved drying quality and reduced depolymerisation of the insulation material compared with conventional drying processes.

ADVANTAGES OF LOW-FREQUENCY DRYING SYSTEMS

- Special low-frequency converter technology for heating under vacuum
- No air flushing necessary to avoid corrosion
- Minimum depolymerisation and aging of the insulation
- Low residual moisture in the insulation
- Very short drying and oil filling times are possible
- Online temperature determination during low-frequency electric heating
- Complete drying and oil impregnating process under vacuum
- Pressure testing and leakage detection equipment for hermetically closed transformers
- Most efficient and fully automated process
- Expandability of equipment to increase production capacities
- Automated database query of process and transformer data
- Stationary and mobile low-frequency systems available

→ SPECIAL CONVERSION

The drying process of the insulation material of distribution transformers under vacuum is significantly accelerated by the use of a low-frequency heating. With specifically developed converters, HEDRICH uses sinusoidal low-frequency heating currents to meet the high requirements for the heating conditions caused by the vacuum.

→ VACUUM FROM THE BEGINNING

From the pre-drying the complete process takes place under vacuum. For transformers with a high portion of insulation material nitrogen is additionally used for heat transfer in most cases. Because of the higher insulation temperatures without atmospheric oxygen aging of paper insulation is minimized.

→ FLEXIBLE EXPANDABILITY

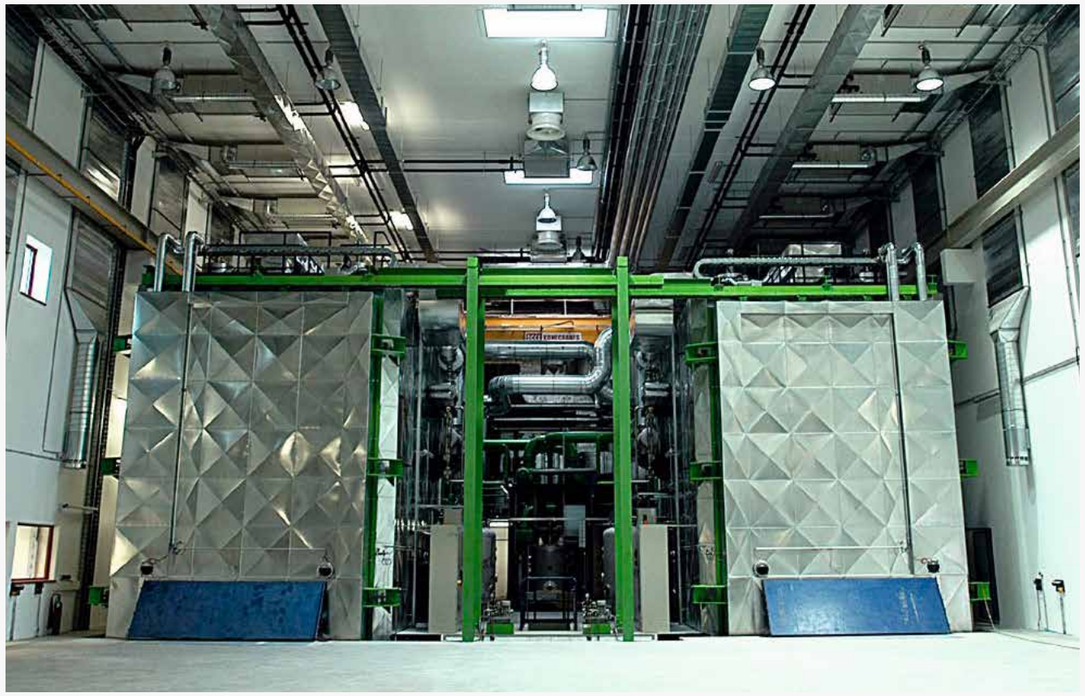
The HEDRICH low-frequency equipment concept is expandable from the addition of individual heating units to the upgrade by another production line. So a basic equipment can be subsequently extended without need to replace the essential components like heating units, control system and vacuum pumping unit.

→ CHECKED AND TESTED

Hermetically closed transformers have to meet increased requirements for the sealing of the transformer housing. The HEDRICH pressure testing and leakage detection equipment checks the seals, their seat, the housing and the welding seams by means of cyclically changing and constant overpressure phases. At the same time the varying overpressures enhance the impregnation quality.

APPLICATIONS

- **Distribution transformers**
- **Medium-voltage transformers**
- **Small and medium power transformers**
- **Power transformers after repair in the field**



Vapour Phase Equipment

The production process of power transformers would be unthinkable without the drying technology by means of kerosene (vapour phase process). But also for other high-voltage components this process is applied. With its outstanding heat transferring coefficients the drying time is nearly halved compared to traditional drying processes using air. This energy-efficient process also minimizes thermal damage to the insulating material.

ADVANTAGES OF VAPOUR PHASE SYSTEMS

- Unique – externally arranged fall film evaporator
- Energy efficient controlled condensation by extracting kerosene/water vapour
- Large collecting vessel for kerosene – optimal for drying repair transformers
- Complete heating of autoclave by heat transferring oil, including door
- Auto-adaptation to adjust the drying process to the batch size
- Integrated safety PLC to increase the process safety
- Vacuum-tight and maintenance-free angle valves
- Parallel distillation during the drying process
- Online registration of dew point and water rate during the fine vacuum phase
- Stationary and mobile vapour phase systems are available

→ FALL FILM EVAPORATOR

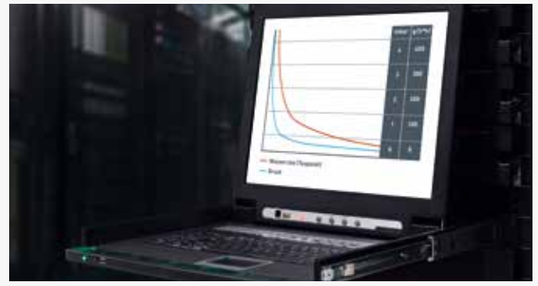
The fall film evaporator that is installed outside of the vacuum chamber ensures homogenous heating through droplet-free kerosene vapour. The distillation (separation kerosene from transformer oil washed out of the insulation) can take place in parallel without affecting the drying process. The transformer oils occurring in case of oil-impregnated repair transformers can therefore be immediately pumped off during the distillation process.

→ OPTIMAL ENERGY SUPPLY

With the patented system of condensate accumulation in the main condenser, the effective condensation surface is adjusted depending on the actually loaded parts (quantity of insulation, iron, copper etc.) so that only the kerosene portion condenses with water that is needed for fast drying. This construction guarantees that only the required energy is needed – a benefit to the total energy balance of the system and drying process.

→ ONLINE DETERMINATION OF RESIDUAL MOISTURE

HEDRICH was the first manufacturer to integrate into its vapour phase systems an electronic measuring instrument to determine the residual moisture of the parts to be dried. The sensors are constructed in such a way that the water diffuses through a gold membrane allowing only water vapour but no kerosene to pass and altering an applied electric field. The dew point is determined in comparison to an integrated calibration curve. A conversion into the water rate is possible.



→ HIGH-PERFORMANCE PUMPING UNIT

For high pumping speeds and a low ultimate vacuum HEDRICH developed the following solution for the vacuum pumping unit: use of liquid ring pumps with kerosene as sealing agent – combined with Roots pumps. This excludes the risk of kerosene condensation in the oil of conventional rotary vane pumps. When required, HEDRICH also delivers pump combinations with rotary vane pumps and dry pumps.

APPLICATIONS

- **Power transformers**
- **Distribution transformers**
- **High-voltage transformers**
- **High-voltage bushings**

Vacuum Drying and Impregnating Equipment

Modern and effective drying and impregnating systems providing the best dielectric and mechanical properties to the oil/paper insulated electric products are preferably operated using vacuum. This applies to the purification of the insulating oil as well as to the drying of the insulation. HEDRICH supplies vacuum drying and impregnating systems and oil purification units that are individually adapted to the requirements of oil/paper insulated electric products like instrument transformers, capacitors, bushings and other electric components.

ADVANTAGES OF VACUUM DRYING AND IMPREGNATING SYSTEMS

- Available as batch unit and continuous system
- Different possibilities of filling and filling height adjustment
- Complete heating of autoclave by heat transferring oil, including door
- Optimized arrangement of heating/cooling registers for short heating and cooling times
- Optimized arrangement of the capacitors on special loading systems
- Optimized heat distribution through fans and air baffles (continuous)
- Option to dry under nitrogen
- Special filling ports for complete filling of the capacitor
- Loading of autoclave in space saving 2-level version

→ TENFOLD PRODUCTIVITY

The continuous systems of HEDRICH allow to achieve high throughputs of more than 1,000 capacitors per week (90 to 120 capacitors per week in batch systems). A downstream automatic oil filling and pressure test is also possible with continuous systems.

→ INDIVIDUAL FILLING HEIGHTS

HEDRICH offers a multitude of different filling systems. The filling heights can be adjusted via a common open channel in the vacuum tank itself or on the outside according to the principle of communicating pipes. Individual filling vessels offer highest flexibility.

→ SETTING THE PATH FOR SUCCESS

With compact construction and shortest ways, the HEDRICH equipment concepts are the basic elements for maximum productivity. The loading systems are adapted to the respective products so that the resource productivity of the industrial useful area can be increased by an optimum arrangement of the products.

→ UNIFORM TEMPERATURE CONTROL

HEDRICH heats and cools the complete autoclave on all surfaces, including top, bottom, rear wall and door. The temperature is controlled via different heating circuits with manual control valves. The typical heating medium is heat transferring oil that is pumped through welded-on U-shaped tubes. For acceleration, heating/cooling registers can be integrated between the parts to be dried.

APPLICATIONS

- **High-voltage capacitors**
- **Voltage/current instrument transformers**
- **Capacitive voltage instrument transformers**
- **Bushings**
- **Oil/paper insulated electric components**

Vacuum Oil Purification Equipment

HEDRICH offers a wide range of standard oil purification systems. These are characterized by an indirect hot water heating to avoid cracking of the insulating oil, a large vacuum degassing stage and an efficient pumping unit. The systems can be built in stationary or mobile version and provided with different measuring sensors.

ADVANTAGES OF THE VACUUM OIL PURIFICATION SYSTEMS

- ↗ Hot water as heating medium to avoid cracking of the insulating oil
- ↗ Low residual moisture and residual gas content already after one pass
- ↗ High pumping speed of the vacuum pumping unit
- ↗ Extremely large degassing stage
- ↗ Condensation device for light oil fraction
- ↗ Safety separator for protection against foaming
- ↗ Measuring instruments for residual gas, residual moisture and oil throughput
- ↗ High heating power for optimum heating
- ↗ Stationary or mobile designs

→ NO OVERHEATING

To ensure a uniform heating of the insulating oil before the degassing operation, the oil is heated up by means of a heat exchanger. Hot water that is electrically heated in a closed circuit is used as heating medium. Local overheating in case of contact with insulating oils and thus the danger of cracking as caused by electric heating elements are avoided.

→ ONE PASS FOR ALL

The degassing stage is filled with special filling bodies and is provided with a large distribution cone at the inlet ensuring a large surface of the oil to be degassed. The vacuum pumping speed is optimally adapted to the degassing capacity. Whether with or without a Roots stage, different drying and degassing degrees can be achieved in one pass.

→ SECURED

For protection against foaming and ingress into the vacuum pumps, the oil purification systems are provided with a special separator. An additional water cooling allows to collect even low-boiling oil fractions and return them to the insulating oil.

→ EVERYTHING IN VIEW

All oil purification systems can be provided with measuring sensors for residual gas, residual moisture, temperature, vacuum and oil throughput for online recording and documentation of the quality of the purification.

APPLICATIONS

- **Mineral oils for transformers**
- **Synthetic oils**
- **Ester oils**
- **Castor oil**
- **Silicone oil**

Vacuum Cable Impregnation Equipment

HEDRICH cable impregnation systems are designed to dry and impregnate signal and HV/HVDC energy cables according to customer requirements. Based on 45 years of experience and more than 35 delivered cable impregnation systems, the comprehensive HEDRICH quality assurance management provides highest standards of quality, efficiency and reliability.

ADVANTAGES OF VACUUM CABLE IMPREGNATION SYSTEMS

- Continuous and careful purification
- 2-stage special thin-film degasser to degas and dehumidify highly viscous cable compound.
- Temperature-controlled storage of the cable compound under vacuum up to 550 m³
- Use of proven feeder pumps for careful transport
- Use of safety heat exchanger
- Design of pipelines to convey cable compound with trace heating
- Impregnation systems for rotatable tank sizes up to 700 m³
- Controlled and recorded compliance of the heating and cooling phases
- Special condensers and exhaust devices for high water vapour quantities
- Automatic levelling of the filling level and control of the impregnation pressure
- 4-stage vacuum pumping units up to 30,000 m³/h; ultimate vacuum up to 10^{-4} mbar
- Easy cleaning of compound containing equipment parts
- Spray device to clean screw vacuum pumps

→ GUARANTEED RELIABILITY

With 45 years of operation and more than 35 delivered cable impregnation systems for signal and HV/HVDC energy cables HEDRICH can guarantee the process reliability. During the past 10 years HEDRICH could obtain a process reliability going far beyond the standard requirements and guarantee downtimes of a few hours with process times of more than 40 days.

→ PURIFICATION IN ONE PASS

The special filtering devices, feeder pumps and valves as well as the 2-stage HEDRICH thin-film degasser are exactly designed for the cable compound to be used. Highest purification qualities and optimum dielectric and mechanical properties are thus guaranteed already after one pass.

→ EFFECTIVE DRYING

The extremely sturdy and reliable vacuum pumping units with a pumping speed of up to 30,000 m³/h and low ultimate vacua in the range of 10^{-4} mbar are provided with special condensers and exhaust devices to effectively pump out the high quantities of water vapour emanating during the vacuum drying.

→ CLEAN IMPREGNATION

In case cable compound emanates, it is collected separately in special condensers and is pumped out without affecting the vacuum pump capacity. The pipes of the nearly maintenance-free, dry running screw vacuum pumps are easily cleaned by means of a spray device.

APPLICATIONS

- **HV/HVDC energy cables**
- **Oil/paper insulated special cable**
- **Purification of cable oil and cable compound**

Isostatic Presses

Short circuit currents may cause forces in the windings leading to deformation. To ensure that these forces can be absorbed by the windings, these need to be preloaded. The isostatic presses of HEDRICH reduce the plastic deformation component by pressing the winding during the drying process in the oven. They are optimally designed for being used in hot air and in vapour phase ovens.

ADVANTAGES OF THE ISOSTATIC PRESSES

- Design with several small cylinders on the upper pressing plate or with central cylinder
- Pressing tools adapted to the winding sizes
- Isostatic presses of active parts
- Mobile hydraulic unit to load and unload the pressing tools
- Length measurement systems to measure the shrinkage of the windings available as option

→ ISOSTATIC PRESS WITH CENTRAL CYLINDER

The core of this pressing process is a pulling central cylinder. This cylinder uniformly pulls the mobile upper pressing plate against the winding as well as the lower pressing plate thus stabilizing the winding. The operating pressure of the hydraulic unit is 250 bar. Pressing forces up to 3,200 kN are possible.

→ SEVERAL CYLINDERS FOR SMALL WINDING DIAMETERS

For windings with a small inside diameter a pressing tool with several small cylinders at the upper pressing plate is recommended. The smaller cylinder cross sections require larger hydraulic pressures to achieve a pressing force of up to 3,200 kN. In this case the hydraulic pressure is 500 bar.

→ AUTOMATIC CONTROL OF THE PRESSING PROCESS

A computer system controls the pressing process. The entered parameters are the ultimate force to be achieved as well as the pressing and holding times for reaching individual pressure increase curves. The pressing process takes place fully automatically. It is represented visually and can also be printed out.

→ LENGTH MEASUREMENT

To check the length variation of the windings during the pressing process, length measurement systems can be fixed to the pressing tools. Inductive way measurement has proved to be optimal. The control of the length variation serves among others as quality proof.

APPLICATIONS

- **For hot air and vapour phase systems**
- **Single windings**
- **Winding blocks**
- **Active parts**

At a glance:

VACUUM PRESSURE IMPREGNATION EQUIPMENT

For non-porous impregnation of most different components with an impregnating medium, HEDRICH supplies the appropriate customized equipment ranging from compact systems to complex solutions with additional components such as stirrer and cooling coils, exhaust devices or capacitance meters to control the impregnation.

The process is frequently used for electric components to ensure their electrical and mechanical properties. Here the vacuum pressure impregnation (VPI process) offers significant advantages compared with the impregnation at atmospheric pressure (immersion process). So the VPI process guarantees that all pores and the surface of the component are uniformly and completely wetted with impregnating medium and air inclusions are avoided.

ADVANTAGES OF THE VACUUM PRESSURE IMPREGNATION SYSTEMS

TOP EXPERT SOLUTIONS
Setting the pace in vacuum equipment engineering.

- For different impregnating media with varying viscosities
- Improved heat transport
- Noise reduction through avoidance of vibrations
- Enhancement of electrical and mechanical properties

Vacuum Pressure Impregnation (VPI Process)

Depending on the application and customer requirements, HEDRICH builds optimum equipment solutions for vacuum pressure impregnation. For this purpose, insulating media such as varnishes, oils, resins and waxes are used for non-porous impregnation of most different components. The parts to be impregnated are degassed and dried under vacuum and then impregnated with pressure application.

ADVANTAGES OF VACUUM PRESSURE IMPREGNATION (VPI)

- Customized and complex solutions available
- Simple design using pressure difference
- For different impregnating media with varying viscosities
- Improved heat transport
- Noise reduction through avoidance of vibrations
- Equipment versions with heating/cooling, feeder pump and measurement technology
- Enhancement of electrical and mechanical properties

→ COMPLEX SOLUTIONS

Depending on the requirements, the systems for vacuum pressure impregnation are provided with additional components such as e.g. stirrer, cooling coil, exhaust devices or capacitance meters to control the impregnation.

→ TRANSPORT BY FEEDER PUMP

The impregnating medium can alternatively be transported by a feeder pump from and to the impregnating vessel. An option is to additionally heat up the impregnating medium in the supply pipe and to cool it down again in the return pipe thus allowing to adjust the viscosity.

→ SIMPLE CONVEYANCE BY PRESSURE DIFFERENCE

Impregnating systems with transport by pressure difference are used when the impregnating medium does not need to be heated up. In most cases, the transport is performed under vacuum.

→ COMPACT SOLUTION

Compact systems can be used to impregnate small parts. In such cases the storage and impregnating tanks are arranged on top of each other. The impregnating medium is transported by pressure difference / gravity.

APPLICATIONS

- **Transformers**
- **Generators**
- **Cast metal housings**
- **Motors**
- **Sintered metal parts**

At a glance:

VACUUM PUMPING UNITS

A variety of applications in process engineering is performed by means of vacuum. For an optimum and efficient process flow, technically mature and reliable vacuum pumping units are needed. Besides the selection of appropriate vacuum pumps, the arrangement and combination with other components like condensers, measuring instruments and control valves play a key role. HEDRICH has more than 50 years of experience in the construction of pumping units and builds these units as part of its own equipment as well as for customized individual pumping units.

ADVANTAGES OF VACUUM PUMPING UNITS

TOP EXPERT SOLUTIONS
Setting the pace in vacuum equipment engineering.

- Application of pumps of renowned suppliers
- Pumping units with different pump technologies
- Pumping units with different ultimate vacua and pumping speeds, depending on the application
- Complete solutions for individual requirements

Vacuum Pumping Units

HEDRICH constructs and builds vacuum pumping units – for application in its own equipment or as independent units. HEDRICH uses vacuum pumps of renowned suppliers which are integrated in pumping units together with condensers, measuring sensors and electric control systems depending on the requirements and customer specifications.

ADVANTAGES OF VACUUM PUMPING UNITS

- Calculation and design according to requirements and customer specifications
- Complete construction and setup including condensers, measuring sensors and electric control system
- Use of vacuum pumps of renowned suppliers
- Explosion-proof pumping units for use in zone 1 and 2
- Application of different pump technologies

→ COMPLEXITY

The process-specific pumping units of HEDRICH do not only consist of vacuum pumps. They also include condensers as well as circulation systems for operating liquid as well as the measuring and control technology. The electric control system allows manual or automatic operation depending on the application or customer request.

→ PUMPING UNITS WITH OIL-SEALED BACKING PUMPS

In the most commonly used and most widespread design worldwide, the backing pumps are operated with special vacuum pump oil as sealing agent. By combining the pumping units with Roots pumps, they can be used for most different applications.

→ VACUUM PUMPING UNITS WITH DRY RUNNING BACKING PUMPS

In many production facilities dry running vacuum pumps – mainly screw pumps – established themselves in recent years. Since no condensation is to be expected because of the relatively high operating temperature, the pumping units are partly operated without condensers. However, for the use in hazardous areas special precautions apply.

→ VACUUM PUMPING UNIT WITH LIQUID RING PUMPS

Liquid ring pumps are frequently used, in particular in chemical industry. Besides water, other sealing agents can be used as operating media, like e.g. kerosene in the vapour phase process. In combination with Roots pumps, pumping units with high pumping speeds and good ultimate vacuum are thus created.

APPLICATIONS

- **Chemical industry**
- **Plastics industry**
- **General vacuum generation**
- **Transformer industry**
- **Metallurgy**

HEDRICH WORLDWIDE

So far but so close! Wherever you are on earth, you are in good company. HEDRICH products can be found in all parts of the world. Since 1970 we have been exporting our products to all continents. Our employees in plants in Germany, Switzerland and China as well as 30 sales agencies and representatives make up a worldwide sales network and a complete chain of services. Fast, unconventional contacting without any barriers due to different language is your great advantage when contacting us!

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