Drying and Impregnating Equipment
The quality of impregnation, besides the selection of the impregnating agent, is largely determined by the method of impregnation. Higher demand of quality, ever more frequently requires the preparation and processing of impregnation agents under vacuum. Only processing under vacuum can reduce residual moisture and gas content to a minimum. Modern impregnating processes, which result in the best mechanical and dielectric properties of the insulation, are operating exclusively under vacuum. The degree of customization in the application and the individual selection of process and impregnating agent are met with a similar degree of custom tailoring of our hardware solution.

Decades of experience, close cooperation between customer and supplier as well as our complete chain of services make sure that our engineers in R&D, design, and manufacturing will create drying and impregnating equipment that exhibits efficiency in production, consistency and repeatability of processing, high quality in the final product. This results in modern equipment consisting of components of highest quality, using the most modern technologies, which we as supplier of vacuum equipment develop ourselves exclusively, as a service to our customers.

Three families of drying and impregnation equipment are available:
- Standard Impregnating Equipment;
- Compact Impregnating Equipment;
- Drying and Impregnating Equipment.

In order to achieve the highest degree of impregnation and products of best possible quality the following impregnating agents are processed in sealed, environmentally friendly systems:
- Insulating oils;
- Varnishes;
- Resins;
- Waxes.

customer driven technology!
Compact Impregnating Equipment

Compact impregnating equipment is used to impregnate small components. Because of the need for only a shallow impregnating vessel, storage and impregnating vessel can be incorporated into the same vessel placed on top of each other. Feeding of the impregnating agent is performed by pressure difference or gravity. Impregnating agents, which require high temperatures to reach the viscosity desired, can also be processed in this kind of equipment.

Drying and Impregnating Equipment

The main purpose for this kind of equipment is to process paper insulated components such as: transformers, capacitors, bushings, etc. which require the reduction of residual moisture in the paper, before impregnation, to levels of approximately 0.01%. Before this drying operation is performed under vacuum, the insulation needs to be heated quickly and uniformly. Depending on the individual requirements of parts and process, the heat is introduced either as radiation, convection or thermal conduction. After the parts have been dried the tank is flooded and the parts are impregnated under vacuum. The efficiency of the impregnation is increased by applying air pressure onto the level of liquid.
Drying and Impregnating Equipment

Impregnating Equipment with Feeder Pumps

Impregnating systems with feeder pumps are state-of-the-art technology and represent the most advanced equipment concept. A feeder pump is used, if large components are to be impregnated, or if temperature-sensitive impregnating agents of highest value like epoxy and silicone resins, etc. are applied. Pump technology is chosen also, when the consumption of impregnating agent is rather low, and when individual impregnation processes are carried out in larger successive cycles.

The impregnating agent is transported both to the impregnating vessel and back into the storage vessel by means of a special feeder pump. Further downstream in the heat exchanger, the impregnating agent is heated up to the temperature required to reach the appropriate viscosity while transporting it to the impregnating vessel, and is cooled down to storage temperature again when it is flowing back into the storage vessel. This recooling extends the usable life of the impregnating agent for future processing.

Advantages:
- Feeding speed infinitely adjustable and always exactly defined;
- Heating-up of impregnating agent only immediately before impregnation;
- On-demand system; this means, only the amount of impregnating agent actually needed is heated up;
- Unused material sees low thermal stress by cooling it down while returning it to the storage vessel;
- Max. usable life of unused material;
- Continuous renewal of impregnating agent by circulation through a degassing unit;
- Storage vessel always kept under vacuum, no re-absorption of gas;
- Use of fine filters in the system;
- Best possible quality of impregnation;
- Long maintenance intervals.

Impregnating Equipment with Pressure Difference

Impregnating systems with pressure difference are recommended, if the impregnating agent does not need any heat rise, and when individual impregnation processes are carried out within short intervals. They should also be the first choice, if insensitive impregnating agents were applied, which are consumed in large quantities and replaced continuously.

The impregnating agent is transported from the storage vessel to the impregnating vessel and back by application of vacuum, atmospheric pressure or pressure difference, generated by excess pressure. If the impregnating agent needs to undergo thermal treatment, it is advisable to split up the quantities to be stored to two or more vessels in order not to expose all the stored amount to thermal stress.

Advantages:
- Low investment;
- Easy control;
- Low energy consumption;
- Short transport times for impregnating agent;
- Smaller systems may be delivered completely mounted;
- Simple start-up on site;
- Low demand on the operating personnel’s qualification;
- Long maintenance intervals.
Compact systems are used for treating small components like coils, transformers, etc. The impregnating chamber and the storage vessel are arranged on top of each other. The impregnating chamber is flooded by pressure difference and drained by gravity after impregnation. These systems are completely assembled including all requested options like agitator, cooling coil, exhaust ventilation, etc. Standard impregnating chambers are available with diameters 500; 650; 800; 1,000 and 1,250 mm. Their height may be adapted to the local conditions and/or the size of the parts.

**Advantages:**
- Low investment;
- Little space required;
- Easy handling;
- No assembly required;
- Mobility;
- Long maintenance intervals.

Electric components insulated with hygroscopic material must be dried before impregnation. To reach the optimum residual moisture of approx. 0.01% in a paper insulation, an operating vacuum up to the range of 10⁻³ mbar is necessary. Therefor, our equipment includes vacuum pumps or vacuum pumping units which are fit to meet the requested demands.

The heat required to evaporate the moisture under vacuum is supplied by radiation, convection, conduction or a combination of them. The kind of heating as well as the primary energy supply is determined when designing the equipment according to the specific needs of the customer.

After drying the components, they are impregnated under vacuum with the purified insulating agent, either by flooding the whole impregnating vessel or individually by filling the components in their own housing.

**Advantages:**
- Designed to meet highest demands;
- Both manual and fully automatic operation possible;
- No operating personnel needed during fully automatic operation;
- Almost excluding operating errors;
- Logging of process-related data possible according to DIN EN ISO.
- Purification of impregnating agent parallel to the drying process;
- Smaller systems may be delivered completely assembled;
- Excellent drying and impregnating quality;
- Long maintenance intervals.
Drying and impregnating equipment is designed combining a variety of different components according to the demands of the individual process. In addition the systems described above can be further customized by adding further accessories. We present to you the accessories for drying and impregnating equipment. Should there be any questions concerning any of these individual accessories, please do not hesitate to contact us.

### Accessories for Drying and Impregnating Equipment

<table>
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<tr>
<th><strong>Intercondenser</strong></th>
<th><strong>Capacitance-Meter</strong></th>
<th><strong>Insulating Agent Tester</strong></th>
<th><strong>Moisture-Meter</strong></th>
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<tr>
<td>Intercondensers with automatic condensate pump-out device are options for integration into our drying and impregnating equipment. This condenser is recommended, if larger quantities of moisture are involved when drying the components. Condensate is pumped out fully automatically under vacuum during drying, preventing any re-evaporation.</td>
<td>This device serves for monitoring the thorough impregnation of windings. It is in particular recommendable for impregnating equipment to treat large electric motors and generators.</td>
<td>In order to check the dielectric properties of the insulating agents, insulating agent testers may be used. For more information, refer to our brochure “Standard Purification and Reconditioning Plants for Insulating Oils ...”.</td>
<td>For determination of the residual moisture in the gas amounts extracted during drying, moisture meters are employed. Based on the measurements made with those appliances, the drying degree of the insulation can be ascertained. With moisture meters, the quality achieved can be monitored even better.</td>
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**Insulating Oil Condenser**

Insulating oil condensers are integrated into our drying and impregnating equipment, if oil-insulated components need aftertreatment.

**Residual Gas Content Meter**

Residual gas content meters are used in insulating agent purification equipment for determining the residual gas content in the purified insulating oil. For more information, refer to our brochure “Standard Purification and Reconditioning Plants for Insulating Oils ...”.

**Agitator for Storage Vessel**

To improve the mixing while re-filling or pigmenting impregnating agent, an agitator may be incorporated into the storage vessel.

**Vapour Extraction Devices**

The extraction device ensures the impregnating vessel to be blanketed with fresh air before opening it, and prevents vapours of impregnating agent from escaping into the atmosphere.
The gas warning system is recommended to serve as a safety device for monitoring explosive solvent concentrations.

**Explosion-proof Design**

Explosion-proof design of the equipment is advisable, if impregnating agents with solvents are processed, which may create explosive concentrations.

**Excess Pressure Design**

To accelerate and improve penetration of the impregnating agent into the windings, we recommend to design the impregnating equipment for excess pressure. In addition, residual gas absorption and dissolution is supported by this design.

**Insert with Special Coupling**

The impregnating systems manufactured by us can optionally be provided with an insert including special coupling to avoid the impregnating tank to be moistened by impregnating agent.

**Gas Warning System**

The gas warning system is recommended to serve as a safety device for monitoring explosive solvent concentrations.

**Residual Moisture Meter**

Even purified insulating oil does include a small portion of moisture. For determining this amount, a residual moisture meter may be employed. Such devices are mainly used in purification systems.

**Compressed Air/Nitroene Dryer**

The recipients are exposed to excess pressure by application of a compressed air or nitrogen drying equipment.

**Cooling Unit**

To extend the usable life of the impregnating agent, we quote for a cooling unit as an option for our impregnating equipment.

**Heating Unit**

An additional heating unit offers the advantage that the viscosity of the impregnating agent can be reduced before impregnation.
customer driven technology!

R&D, design and production of vacuum equipment from high quality components and most advanced technology; vacuum systems exactly adapted to our customers’ needs; our philosophy technology for the benefit of the customer.

Fulfilling your needs gives us the motivation to find innovative solutions. In this partnership, we contribute many new ideas based on hands-on experience.

140 employees at Hedrich in Germany, Switzerland, USA and China as well as 30 agencies ensure a worldwide distribution network and a complete system of services. Challenge us - with your individual requirements and make the same experience as more than 2,000 satisfied customers did before.

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