Components, Systems and Service for Transformers.
HYDAC

Your Professional Partner for the Optimization of Transformers.

With over 5,500 employees worldwide HYDAC is one of the leading suppliers of fluid technology, hydraulic and electronic equipment. Our wide range of products, combined with our expertise in development, manufacturing, sales and service will overcome the most diverse challenges associated with optimizing and extending the service life of transformers.

Our quality and environment certification to ISO 9001/2000 and ISO 14001 denote first class quality and responsible management of our resources.

Global and yet local.
With 40 overseas companies and over 500 distributors and service partners, HYDAC is your reliable partner worldwide.

System solutions.
One supplier.
One contact.
Wherever you need us, we are there to help you find the most effective solution – for every application, from components to a complete system.

Worldwide specifications and approvals.
HYDAC in the Building and Operation of Transformers.

The components and systems developed by HYDAC offer many advantages for the building and operation of transformers – the principal ones being:

- Monitoring of the oil condition
- Reliable servicing and cooling of the insulating oil
- Effective protection of the insulation
- Increase in operational reliability
- Significant extension of the service life of transformers

Sectors and Applications

Energy production
- Gas and coal-fired power stations
- Hydroelectric power stations
- Nuclear power plants
- Wind turbines

Energy distribution

Industry
- Paper industry
- Steel industry
- Automotive industry
- Chemical industry

Applications
- Servicing the insulating oil
- Monitoring the insulating oil
- On-load tap changer filtration
- Cooling

Size of the transformers
0.5 – 100 m³ oil volume

Capacity of the transformers
From 0.2 - 1,500 MVA

Transformer applications
- Power transformers
- Compensating throttle pumps
- HVDC transformers
- Phase shifter transformers
- Polytransformers
- Single-phase transformers

Influences which reduce the Service Life of the Transformer

- Electrical and electro-magnetic overstressing of the insulation (cellulose) and insulating oil
- Ageing, oxidation and hydrolysis of insulation (cellulose)
- Ageing, oxidation and hydrolysis of insulating oil
- Thermal effects due to load fluctuations
- Wear in the on-load tap changer

Consequences

- Gas formation due to degradation or electrical overstressing of the insulation (cellulose) and of the insulating oil
- Occurrence of water due to degradation of insulation (cellulose)
- Overheating of insulation (cellulose) and insulating oil
- Formation of acids due to ageing of the oil and cellulose
- Formation of particles in the on-load tap changer due to wear
- Reduction in the breakdown voltage caused by water, particles, gases and acids

"The insulation is the cause of most transformer breakdowns"

"The average age of transformers which failed due to insulation damage was 17.8 years – far below the expected lifetime of 35 to 40 years"

Condition Monitoring, Measuring Technology and Electronics

Conditions in the insulation oil can be monitored using sensors. Changes in an output condition, such as water content, oil cleanliness, temperature or pressure can be visualized and used as a basis for maintenance planning. Critical conditions in the transformer can be detected in good time and prevented.

Water and Solid Particles in Oil

- Fluid Monitoring Module FMM (Combination of AquaSensor AS 1000 and ContaminationSensor CS 1000).

Oil Condition

- HYDACLab® Oil condition sensor: relative change in dielectric constant, relative humidity and temperature.

- Temperature Switch ETS 3000.

Fluid Level

- Electronic Level Sensor ENS 3000.

Pressure

- Pressure Switch EDS 1700 For wall-mounting.

Temperature

- Plate Heat Exchanger, Gasketed.

Cooling

To ensure reliable and efficient removal of the heat on oil-cooled transformers.

- Oil/Air Cooler.

- Dry transformer: separation internal / external air by 2 Water / Air Coolers and a Water-Glycol Circulation.
Continuous Fluid Service
REDFOX* TransformerCare Unit TCU

Continuous and lifelong degassing, dewatering and filtration of the insulating oil ensures that the oxygen level, water level and particulate contamination in the transformer are kept uniformly low, which means the breakdown voltage of the insulation oil increases, the formation of acids is minimized and as a consequence operational reliability and the life expectancy of the insulation (cellulose) and of the insulating oil also increases.

Advantages of using the TCU
- Preserves the breakdown voltage of the insulation oil
- Reduces the oxidation and ageing of the cellulose
- Measures the gas formation rate
- Reduces the formation of gas bubbles in the transformer due to permanently low gas levels
- Expensive short-term regeneration measures can be avoided through lifelong servicing
- Increase in operational reliability
- Extends the remaining life of the transformer
Short-term Fluid Service

The REDFOX TransformerCare Unit TCU is the service unit for extending the service life of oil-filled transformers and reactors. The remaining life of the cellulose and therefore of the transformer can typically be increased by a factor of 3*.


Service life extension

In addition the TCU is used to monitor the humidity and the total gas level in the insulating oil. This means that an alarm can be triggered if there are significant changes.

Monitoring

In the dewatering and degassing unit of the TCU and of the gas volume removed per time unit. The total gas level in the oil is proportional to the measured pressure. After 3 months, steady conditions are reached. From this time, the gas formation rate can be determined.

Applications of the TCU

The volume of the gases removed using the TCU per time unit corresponds to the gas formation rate in the transformer. An interpretation, for example to DIN EN 60599*, is also possible, along the lines of the DGA (Dissolved Gas Analysis).

* DIN EN 60599 – Mineral-oil impregnated electrical equipment in service – Guide to the interpretation of dissolved and free gases analysis.

Determining the gas formation rate

The breakdown voltage (kV / 2.5 mm) as a function of saturation level (relative humidity) and the acid number (TAN).

Source: The Breakdown Voltage of Insulation Oil Under the Influences of Humidity, Acidity, Particles and Pressure.
M. Koch, M. Fischer, S. Tenbohlen, University of Stuttgart.

Simple gas discharge to determine the gas formation rate.

### Table: Gas Formation Rate

<table>
<thead>
<tr>
<th>Time (months)</th>
<th>Pressure [mbar (abs)]</th>
<th>Gas Volume Removed [l/24 h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>550</td>
<td>170</td>
</tr>
<tr>
<td>3</td>
<td>120</td>
<td>20</td>
</tr>
</tbody>
</table>

### Graph: Breakdown Voltage

- Without service (example with 20 years life expectancy for illustration purposes)
- Service started after 10 years, for example.
- With lifelong service

**Extension of the remaining life expectancy** of the insulation (cellulose) through continuous service. “The earlier the better”.

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Service unit for dewatering, degassing and filtration.

Source: The Breakdown Voltage of Insulation Oil Under the Influences of Humidity, Acidity, Particles and Pressure.
M. Koch, M. Fischer, S. Tenbohlen, University of Stuttgart.

Simple gas discharge to determine the gas formation rate.
Fluid Engineering and Service. Worldwide.

Analysis and Diagnostics.

70-80% of all breakdowns in hydraulic and lubrication systems are due to contamination of the fluids and components used. In practice, this is often not sufficiently recognized.

HYDAC offers a comprehensive range of easy-to-use measurement and analysis equipment to monitor fluid and component cleanliness.

Fluid laboratory vehicles are at your service worldwide.

Commissioning, Optimisation, Engineering.

As a systems and fluid service specialist, HYDAC provides a comprehensive fluid engineering concept: from cleaning, to complete maintenance packages, to system optimisation, HYDAC is your principal partner.

Our concern is to improve the operational availability of machines and hydraulic systems. Fluid engineering is the total package of technical and commercial services for the benefit of the customer.