

Ventilation Drying

Prevention of Condensation Damage in Transformers





GIEBEL FilTec GmbH

Formation of Condensation

Avoidance by Dehumidification

Function on Transformers

Use Cases and References

Products and Services

Areas of Application





Team



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"I am here for you, for all technical questions regarding the use of an adsorber as well as project inquiries."

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"I take care of all your questions and requests about desiccants and prepare the offer for you."

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"I am here for you, for all questions concerning website, social media, brochures, images & merchandise."

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Functionality

Transformer oil or insulating oil is used in transformers, for spark quenching, lubrication and cooling.

Air intake from the environment

Passive air exchange due to temperature fluctuations



Humidity

Absolute Humidity

Content of water vapor <u>Relative Humidity</u> Percentage to maximum humidity



Content of water: At 25 °C and 90% rF \rightarrow 20,7 g/m³ At 20 °C and 80% rF \rightarrow 13,8 g/m³ At 15 °C and 60% rF \rightarrow 7,7 g/m³



Dew Point



The temperature at which the humidity will condensate

Dew point in the ambient air At 15 °C and 90% rF → 23,1 °C At 20 °C and 80% rF → 16,4 °C At 15 °C and 60% rF → 7,3 °C



 $dT = 1,9^{\circ} C$ $dT = 3,6^{\circ} C$

 $dT = 7,7^{\circ} C$

Process Water Entry



1. Transformer WITHOUT Adsorber



3. Sucking in humid air



2. Environment with humid air



4. Pressing out humid air

Formation Condensation Water



5. Condensation and water absorption → Emergence of condensation inside Water content must be <u>below the</u> <u>saturation point</u> of the oil.





Damages as a Result



"Water leads to hydrolysis of the cellulose paper in the transformer, thus lowering its degree of polymerization."

Consequences:

- Defective seals Oil loss due to leaks.
- Winding damage
- Mechanical damage to the boiler/chassis
- Rusty / silted active part
- Aged, contaminated insulating oil



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Troubleshooting Adsorber

Adsorption of water, thereby lowering the humidity and the dew point.

 \rightarrow Prevention of condensation!



Avoid Water Ingress



1. Transformer WITH Adsorber



3. Drying the sucked humid air



2. Environment with humid air



4. Regeneration with dry air

Dry Oil



| ANALYSENERGE | BNISSE | | Aktuelle Probe | | Frühe |
|----------------------|---------|-------|----------------|------------|------------|
| LABORNUMMER | | | 3812201 | 3950498 | 3812199 |
| GESAMTBEWER | TUNG | | i | i | |
| Untersuchungsdatun | n | | 27.01.2020 | 29.11.2019 | 28.06.2019 |
| Datum Probenentna | nme | | 23.01.2020 | 26.11.2019 | 24.06.2019 |
| Datum letzter Ölwech | hsel | | 26.11.2019 | 16.07.2019 | 18.12.2013 |
| Nachfüllmenge seit V | Vechsel | | - | - | 20 |
| Laufzeit seit Wechse | 4 | | - | - | - |
| Laufzeit gesamt | | | - | - | - |
| Öl gewechselt | | | Ja | - | Ja |
| VERSCHLEIß | | | | | |
| Eisen | Fe | mg/kg | 4 | 16 | 38 |
| Chrom | Cr | mg/kg | 2 | 9 | 27 |
| Zinn | Sn | mg/kg | 0 | 0 | 0 |
| Aluminium | A | mg/kg | 0 | 1 | 1 |
| Nickel | Ni | mg/kg | 0 | 0 | 0 |
| Kupfer | Cu | mg/kg | 1 | 2 | 7 |
| Blei | РЬ | mg/kg | 0 | 0 | 0 |
| Molybdän | Mo | mg/kg | 0 | 0 | 1 |
| Antimon | Sb | mg/kg | 1 | - | |
| Mangan | Mn | mg/kg | 0 | 0 | 1 |
| PQ-Index | - | | < 25 | < 25 | < 25 |
| VERUNREINIGUN | G | | | | |
| Silizium | Si | mg/kg | 1 | 3 | 11 |
| Kalium | к | mg/kg | 1 | 4 | 15 |
| No. 1 | No. | marka | <u> </u> | 0 | 12 |
| Wasser K. F. | ppm | | 33 | 67 | 118 |

Probe und Deckel



5. Dew point not reachable, no water → No condensation inside, dry oil

Mode of Action



Humidity after Adsorber average 10% rH

- Water content: 1,7 g/m³
- Dew point: -12,5 °C





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Adsorption



- Wasser molecules are bound in the pores
- Adsorption is based on **attractions** (Van der Waals forces)
- Van der Waals forces are **solvable again →** Desorption
- Maximum load, until equilibrium!

Silica gels



Messdaten GIEBEL FilTec GmbH

Regeneration Silica gel



Test data GIEBEL FilTec GmbH

Function on Transformers

Transformer cools down:

- Humid supply air from the environment
 - \rightarrow dehumidification





Transformer heats up:

 Oil-containing exhaust air from the system
→ Self-regeneration



Protection from Oil

Oil-containing exhaust air:

- Without activated carbon, an impregnation would take place
- Block the waterabsorbent pores
- Prevent further color change



Example Oil in Dehumidifier



Visibility Transformer State



Moisture present in the transformer!



Transformer dry inside!

Life Cycle Extension

Protection during downtimes. No unnecessary loading

→ Extension of the maintenance intervals!







Easy Maintenance - Reusable

- No oil template to replace
- No tools necessary
- Performed by one person
- No cleaning of several glass vessels



Recycling Cycle - Disposable





Returning to GIEBEL the loaded cartridge



Renewed use of the **reconditioned cartridge**







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Example Industrial Plant



Transformer boiler & tap changer Oil: insulating oil Power: 20 MVA Oil volume: 10 tons

→ Application
Adsorber TB-RV 5M for transformer boiler
& TB-RV 3M for tap changer

Example Research Facility



Rectifier Oil: insulating oil Power: 40 MVA Oil volume: 20 tons

→ Application Adsorber TB-RV 5L

Example Industrial Plant



Oil transformer Oil: insulating oil Power: 10 MVA Oil volume: 5 tons

→ Application Adsorber standing VV-RV 3L

Example Offshore



Oil transformer offshore Oil: insulating oil Power: 30 MVA Oil volume: 15 tons

→ Application Adsorber TM-RV 5M from Stainless steel

Example Transformer Station



Power transformers Oil: insulating oil Power: 20 MVA Oil volume: 10 tons

→ Application Adsorber TB-RV 5M

Example Transformer Station



Converter transformers Oil: insulating oil Power: 60 MVA Oil volume: 30 tons

→ Application
Adsorber TB-RV 5M for transformer
boiler & TB-RV 3M for tap changer

More Examples



IBCs



Barrels

Gears



Mobile Machines





Transformers

Storage tanks

















... and many more !!



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Selection Criteria Transformers

- Transformer
 - Power [MVA]
 - Oil volume [I]
 - Connection
- Environment
 - Humidity
 - Temperature

| Find the right size | |
|--|---|
| Adsorber for drying the supply air | |
| Please click on the power / oil volume below | |
| 0 - 5 MVA (up to approx. 2.500 ltr. oil) | + |
| 0 - 10 MVA (up to approx: 5.000 ltr. oil) | + |
| 10 - 30 MVA (up to approx. 15.000 ltr. oil) | + |
| 30 - 60 MVA (up to approx. 30.000 ltr. oil) | + |
| 60 - 100 MVA (up to approx. 50.000 ltr. oil) | + |

Customizable Solution

Flange connections DIN EN 50216-5:2002 + A3:2006

According to DIN 42562, DIN 42567 A, DIN 42567 B, DIN 42567 C with thread and others



Standard Dehumidifier



Special Dehumidifier



Adsorber

Operating materials

Valves

Rechargeable

Use according ATEX 2014

Offshore suitable

ME-RV

All common insulating oils Biodegradable oils

Accessories





Adsorbents



Silica gel (SiO2)

Air drying Indicator for color change (orange -> green / white) Capacity max. 37 Regeneration at 120°C



Activated Carbon (C)

Separation of oil particles No indicator (black) Large surface



Molecular Sieve (Sodium aluminium silicate)

Selective adsorption Strong binding to water No indicator (beige) Capacity max. 25% Regeneration at 300°C

Services



Customer label

Series call-offs can be supplied with your label



Refresh

Return of the adsorber cartridge

Plastic waste avoidance cycle



Sustainable



1. Reusable

Return of the adsorber cartridge

Plastic waste avoidance cycle



3. Rechargeable

No disposal of plastic housing

Inexpensive and easy to maintain





2. Long-term use

Robust metal housing for very long use

No plastic waste

4. Regenerable

Reusability of the desiccant

Regeneration in domestic oven



Thank you

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