

The importance of moisture management

Transformers are commonly manufactured using cellulosic-based insulation materials which have an affinity for absorbing moisture – it's in their DNA ...

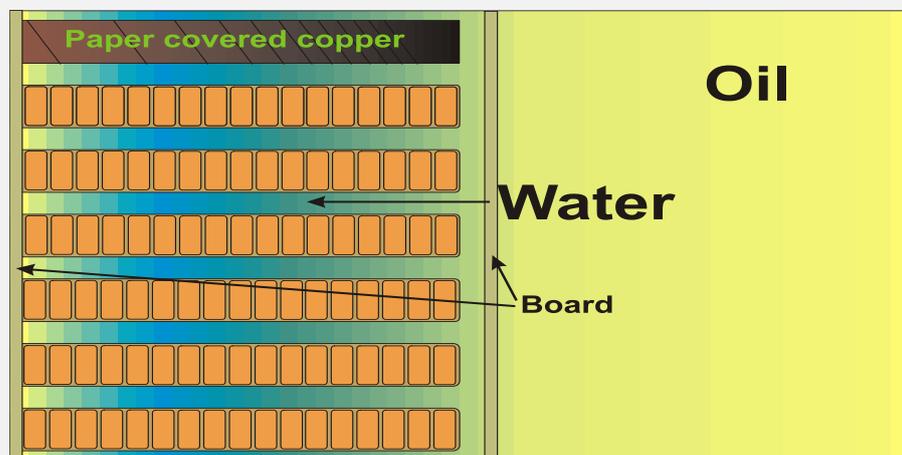
Furthermore, mineral oil (specifically) is severely impacted by moisture which will significantly reduce dielectric strength. Moisture can be present in either a dissolved or free-suspension state. Both conditions will have disastrous effects on the normal operation of a transformer.

High moisture content in paper will cause a process called 'depolymerisation' at which point degradation starts to occur. This will cause the paper to rapidly age and the transformer will not reach its expected life span. The rule of thumb – double the moisture - half the life!

Moisture in oil can cause other damage and in a worst case scenario, under adverse conditions a flashover can occur due to the oil's inability to provide the necessary electric strength.

As the oil heats up, the moisture in the paper is driven out into the oil – as the oil cools the moisture is absorbed by the paper.

If the paper contains an elevated amount of moisture a problem arises – as the insulation drives the moisture out into the oil there is a delay in the oil's ability to absorb it thus producing a low dielectric in low oil flow areas of the transformer. This can cause a flashover and the demise of a transformer.



Oil purification – removing moisture and improving dielectric strength

Stripping the moisture from the paper is a relatively simple process and does not take long. However, cleaning the oil is only a small part of the problem - the bigger issue is the moisture that is lodged in the paper. There are a few methods for removing moisture from the transformer's oil. The most common method is to use a coalescer (a device that thinly spreads the oil to remove moisture from the surface of the oil) and a vacuum to remove the moisture. Heat is used to make the process faster and more efficient - the oil is heated to drive the moisture from the insulation into the oil; in doing so drying the insulation to some degree. Another method uses a filter to remove moisture but no heat. Lastly, there is an option which uses a special kerosine vapour process to remove the moisture from the paper.

Three purification methods

These three methods are the mainstay for getting the insulation dry, but the method of extraction of the oil is a key driver. Each method has its pros and cons.

- **Heat and vacuum** will remove the moisture from the oil and improve the dielectric strength and will also remove some of the particulate matter found in the oil. The volume of oil matters - the greater the volume the higher the cost. Always test the oil after the process for both dielectric strength and moisture content, but also test the dissolved gases. Using vacuum will remove most of the gases. It is especially important to ensure the sample is taken from the transformer and not from the oil processor return outlet! Then test it again after seven days.
- **Filtration** is a passive process; although it can be done online while the transformer is in service, there are some risks. Basically, the filter will pump oil through a bed of media that will absorb moisture. The amount of moisture that may be removed can vary and will depend on the operating temperature being elevated and how saturated the filter cartridges are. In essence is better to use filtration as a long term solution, permanently fitted. With low level AI, the unit can filter when there is too much moisture and stop when desired criteria are achieved.
- A **vapour phase** is one of the best methods of drying the insulation. However, it is also the most expensive method with the active part of the transformer requiring removal. The insulation and oil are treated separately and thus the unit must be taken out of service.

The bottom line

Prevention is better than cure. It is costly to dry transformers and transformer oil. A strategy of keeping the transformer dry is a priority. Effective drying tactics are important in the maintenance and preservation of the insulation system. Keeping the oil dry goes a long way.