

## Periodic Dehydration VS. Online Continuous Moisture Management

### Understanding the Difference Between Correcting Symptoms and Managing the Cause

Moisture is widely recognized as one of the most destructive contaminants in oil-filled power transformers. It reduces dielectric strength, accelerates cellulose aging, increases dielectric losses, promotes bubble formation during overload conditions, and ultimately shortens transformer life.

Utilities have traditionally relied on periodic oil dehydration or filtration campaigns to control moisture. While these activities can temporarily improve oil test results, they often fail to address the primary moisture reservoir inside the transformer—the cellulose insulation.

As transformer fleets age and asset replacement costs continue to rise, the industry is increasingly moving toward **online continuous moisture management** as a long-term asset preservation strategy.



#### KEY TAKEAWAY



Periodic dehydration removes moisture from oil.

Continuous moisture management removes moisture from the insulation system.



#### Where Is the Moisture Actually Located?

A common misconception is that moisture exists primarily in transformer oil.

#### In reality:

- Approximately 95–99% of total moisture resides within cellulose insulation.
- Only a small fraction remains dissolved in the oil.
- Moisture continuously migrates between paper and oil depending on temperature and loading conditions.



The oil effectively acts as a transport medium, while the insulation paper serves as the moisture reservoir.



Therefore, reducing moisture in the oil alone does not necessarily mean the transformer has become dry.



#### Periodic Dehydration: How It Works

Traditional dehydration systems are typically connected to the transformer for a limited duration during maintenance periods.

#### The process generally:

- 1 Extracts oil from the transformer.
- 2 Removes dissolved moisture from the oil.
- 3 Returns treated oil back to the transformer.



As the oil becomes drier, moisture gradually migrates from paper to oil until a new equilibrium is reached.



#### Benefits

- ✓ Immediate reduction in oil moisture content
- ✓ Improvement in oil breakdown voltage (BDV)
- ✓ Reduction in relative saturation (%RS)
- ✓ Useful after oil contamination events
- ✓ Suitable for corrective maintenance



#### Limitations

- ✗ Moisture remains trapped within cellulose insulation
- ✗ Moisture continues migrating back into the oil
- ✗ Oil moisture levels often rebound
- ✗ Drying effect gradually diminishes
- ✗ Long intervals before the next dehydration campaign



In many cases, utilities observe improved laboratory results immediately after treatment, only to see moisture levels increase again months later. **The transformer is not truly dry; the moisture has simply redistributed.**



## Periodic Dehydration vs. Online Continuous Moisture Management

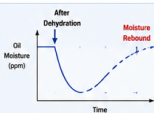
Different approach. Different outcome. Dramatically different long-term impact.

### 1. PERIODIC DEHYDRATION (Temporary)



#### What happens next?

- Moisture in paper migrates back to oil.
- Oil moisture levels gradually increase.
- Moisture equilibrium returns.
- Effect is temporary until the next dehydration.



### 2. ONLINE CONTINUOUS MOISTURE MANAGEMENT (Permanent)



#### What happens over time?

- Moisture continuously migrates from paper to oil.
- System continuously removes moisture from oil.
- Paper moisture gradually reduces.
- Lower and stable moisture equilibrium is achieved.
- Insulation life is significantly extended.



### COMPARISON SUMMARY

Parameter	Periodic Dehydration (Temporary)	Online Continuous Moisture Management (Permanent)
Operation	Temporary	Permanent (24/7)
Transformer Shutdown	Often Required	Not Required
Moisture Removal from Oil	High (Short Term)	Continuous
Moisture Removal from Paper	Limited	Progressive & Continuous
Moisture Rebound	Common	Significantly Reduced
Monitoring Capability	Usually Temporary	Continuous Online
Asset Life Extension Potential	Moderate	High
Sustainability Impact	Limited	Significant

### WHY CONTINUOUS MOISTURE MANAGEMENT MATTERS



#### SLOWS INSULATION AGING

Lower moisture levels reduce cellulose hydrolysis and preserve Degree of Polymerization (DP).



#### IMPROVES DIELECTRIC PERFORMANCE

Reduces dielectric losses, increases breakdown voltage margin and improves overall insulation reliability.



#### REDUCES FAILURE RISK

Minimizes bubbling risk, thermal faults and moisture-induced breakdowns.



#### EXTENDS TRANSFORMER LIFE

Prolongs useful life and defers costly replacement investments.

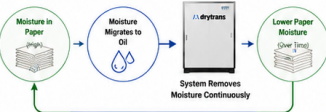


#### SUPPORTS SUSTAINABILITY

Extending asset life reduces emissions, material consumption and environmental impact.

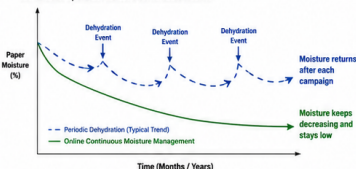
### HOW CONTINUOUS MOISTURE MANAGEMENT WORKS

Moisture naturally migrates from cellulose paper to oil based on temperature and load. The DryTrans system continuously extracts and removes this moisture, maintaining a low and stable moisture level in oil, which in turn drives moisture out of the paper over time.



### THE ONLY WAY TO ACHIEVE LOWER PAPER MOISTURE

Continuous operation delivers continuous results.



### CONCLUSION

Periodic dehydration improves oil condition temporarily. Online continuous moisture management improves insulation condition permanently. When the goal is asset longevity, reliability, and sustainability — continuous is the only way forward.

