

## THE SCIENCE BEHIND 3A MOLECULAR SIEVE TECHNOLOGY

Engineered to remove moisture. Designed to protect transformers. Built for reliability.



### CHEMISTRY OF 3A MOLECULAR SIEVE

3A Molecular Sieve is a synthetic, crystalline aluminosilicate material with a uniform pore size of  $\sim 3$  Ångström (0.3 nm).

#### Chemical Composition

General formula:  $M_{2/n}O \cdot Al_2O_3 \cdot xSiO_2 \cdot yH_2O$

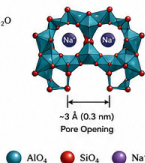
Where M = Sodium (Na<sup>+</sup>)

n = Valency of cation (1 for Na<sup>+</sup>)

Structure: Sodium aluminosilicate with a highly uniform microporous structure.

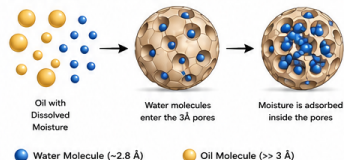
#### Key Points

- Pore size:  $\sim 3$  Å (0.3 nm)
- Shape: Crystalline, spherical beads
- Color: Off-white to beige
- Odor: Odorless
- Non-toxic and non-hazardous



### WHY 3A MOLECULAR SIEVE REMOVES MOISTURE?

3A Molecular Sieve has a precisely controlled pore size of  $\sim 3$  Å (0.3 nm). Water molecules ( $\sim 2.8$  Å) can enter the pores, while larger molecules (oil, additives, gases) cannot.



### HOW MOISTURE GETS TRAPPED INSIDE THE BEADS?

#### 1 Attraction

Water molecules are attracted to the hydrophilic sites (Na<sup>+</sup>) inside the pores.



#### 2 Adsorption

Water molecules are strongly adsorbed on the internal surface of the pores through ion-dipole attraction and hydrogen bonding.



● - - Ion-Dipole Attraction  
- - - Hydrogen Bond

#### 3 Retention

Once adsorbed, water molecules remain tightly held and cannot exit under normal operating conditions.



### WHY THIS MOISTURE WON'T GET OUT OF BEADS?

- Strong adsorption energy: Water molecules are held by strong ion-dipole attraction and hydrogen bonding.
- Uniform micropores: The narrow 3 Å pores restrict the movement of water molecules.
- Thermal stability: Stable up to high temperatures ( $>250^\circ C$ ).
- No desorption at service conditions: Under normal transformer oil operating conditions, the beads will not release the moisture back into the oil.



Moisture remains strongly adsorbed under normal operating conditions and is only released during high-temperature regeneration ( $>250^\circ C$ ).

### EFFICIENCY OF 3A MOLECULAR SIEVE



Highly efficient and reliable moisture adsorbent.

- Typical water adsorption capacity: 18 - 22% by weight (depending on operating conditions).
- Maintains very low outlet moisture levels (sub-ppm).
- Operates continuously until equilibrium loading is reached.
- Long service life with consistent performance.

### ENVIRONMENT & DISPOSAL SAFETY



3A Molecular Sieve is an inert aluminosilicate material.

- Composed primarily of Silicon, Aluminum, Oxygen and Sodium.
- Contains no hazardous chemicals, no cellulose fibers and does not generate harmful decomposition products.
- Disposal should follow local industrial waste regulations and any oil contamination requirements.
- Not classified as hazardous material.

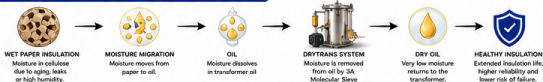
### WHY 3A MOLECULAR SIEVE IS BETTER THAN CELLULOSE BASED MOISTURE FILTERS?

3A MOLECULAR SIEVE	VS	CELLULOSE BASED FILTERS
Very high moisture capacity		✗ Low moisture capacity
Removes down to very low ppm		✗ Limited removal to moderate ppm
Not affected by oil quality or oxidation		✗ Affected by oil oxidation and breakdown products
No microbial growth		✗ Prone to microbial growth
Thermally stable ( $>250^\circ C$ )		✗ Thermal degradation risk
Longer service life		✗ Shorter service life
Consistent & predictable performance		✗ Performance varies with oil condition
Regenerable in industrial applications		✗ Typically disposable

### DRYTRANS WORKING PRINCIPLE - CONTINUOUS MOISTURE REMOVAL & OIL CLEANING



### HOW DRYTRANS MANAGES MOISTURE EQUILIBRIUM



### KEY TAKEAWAY



Drytrans continuously removes moisture from transformer oil and helps maintain oil-paper equilibrium, extending transformer life, improving reliability and reducing risk of costly failures.