



NEDEX MOLECULAR SIEVE PRESENTATION

www.nedexgroup.com

What is molecular sieve?



Molecular Sieves are drying agents that extract water from a wide range of materials; procure dryness in any environment by reducing the moisture amount existing in air. They are used in various form in many different manufacturing industries such as insulating glass, packaging, food, pharmaceuticals etc. Each sector has its own specific requirements and these properties must be considered in order to achieve the highest efficiency of molecular sieves.

NEDEX is the only brand in the world that focused on Insulating Glass while other brands are trying to meet the needs of very different industries with the same molecular sieves.

Today, **NEDEX** is producing nearly 30% of the molecular sieve world market, used in more than 55 countries, with a team of 500 people.

About 250.000.000 square meters of glass are produced a year, which contain **NEDEX** molecular sieves.



NEDEX Molecular Sieves



ZEOLAN-K



EN1279:2018

AWAC >16% at RH 9%

LOI < 1.7%

NANOMOL-C



EN1279:2018

AWAC >16% at RH 9%

LOI < 1.7%

NANOMOL



EN1279:2018

AWAC >11% at RH9%

LOI < 1.7%

MULTIMOL



AWAC >20% at RH 32%

LOI < 6%

MOLECULAR SIEVE

ZEOLAN- K
NANOMOL-C
NANOMOL
MULTIMOL

- High water adsorption capacity
- Low gas desorption
- Optimized density
- Low packaging losses
- Low dust level
- Low adsorption speed
- Great granulation



ZEOLAN-K is a mixture of 3A synthetic zeolites and natural binders. It is comparable with other zeolite based desiccants, however its low dust level and high density are important features.

NANOMOL-C is a mixture of calcium oxide containing natural desiccants and natural binders. It is produced with an in-house technique, features are no waste gases and water, low adsorption speed and high efficiency.

NANOMOL is a mixture of calcium oxide containing natural desiccants and natural binders. It is a good alternative to NANOMOL-C with its much lower adsorption speed to keep the product always fresh.

MULTIMOL is a mixture of calcium oxide containing natural desiccants and natural binders. It is easy to use, provides big cost savings with ideal IG life expectations.

EVALUATION OF AN ADSORBENT

CaO based and Zeolithe Based Desiccants

Multimol/Nanomol/Nanomol-C and Zeolan-K

Adsorption is the adhesion of atoms, ions, or molecules from a gas, liquid, or dissolved solid to a surface. This process creates a content of the adsorbate in the crystal structure of the adsorbent.

Adsorption is usually described through isotherms, that is, the amount of adsorbate on the adsorbent as a function of its partial pressure (if gas) or concentration (if liquid) at constant temperature. The quantity adsorbed is nearly always normalized by the mass of the adsorbent to allow comparison of different materials.

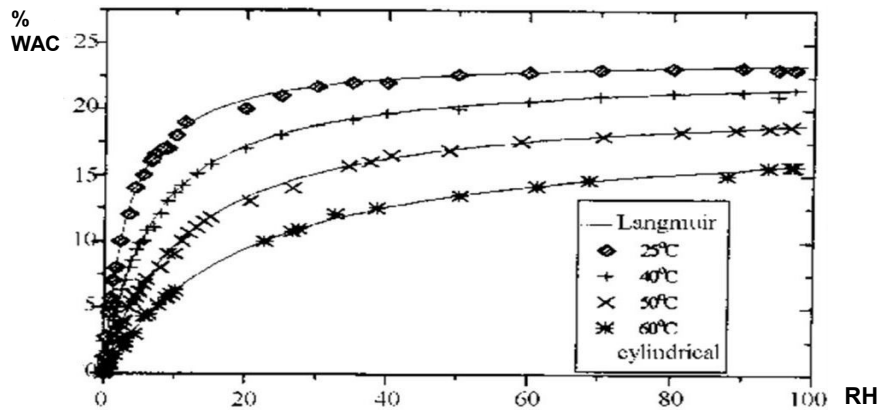


Diagram 1: Isotherms of 4A-Zeolithe powder for different temperatures



Zeolithe powders reach their full adsorption capacity at low relative humidities, like RH32 and stop adsorbing further by increased humidities. Their total water adsorption capacity is approximately 24% by weight for a 4A zeolite powder.

At very low relative humidities like RH10 they can adsorb at 25°C nearly 18 %by wt; and at 60°C only 7% by wt (as shown in the Diagram 1) . By heating up zeolithes from 25°C to 60°C nearly 60% of adsorbed water is desorbed.

EVALUATION OF AN ADSORBENT

CaO based and Zeolithe Based Desiccants

Multimol/Nanomol/Nanomol-C and Zeolan-K

In **Diagram 2**, we see that CaO is adsorbing by all humidity conditions 40-50% more humidity than zeolites. Following table shows how much better are the CaO crystals than Zeolithe crystals in their adsorption capacities:

In **Diagram 3**, the adsorption speeds of zeolithe and CaO are given. During 3 hours air contact we see that Zeolithes lose 95% of their adsorption capacity whereas CaO crystals lose only about 10% of their adsorption capacity.

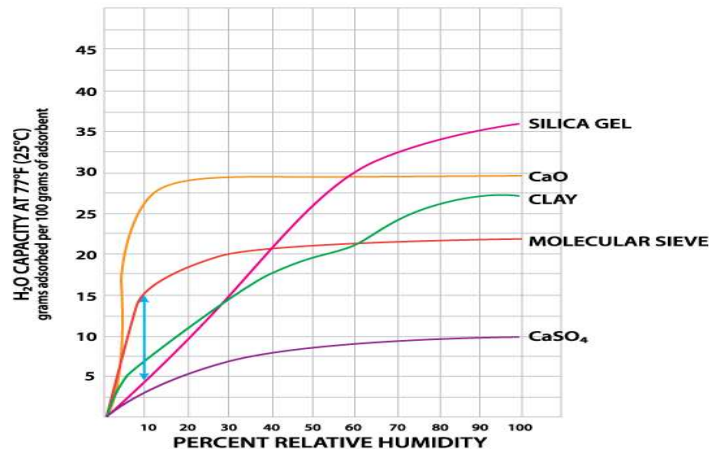


Diagram 2: Isotherms of different desiccants at 25° Celsius for water

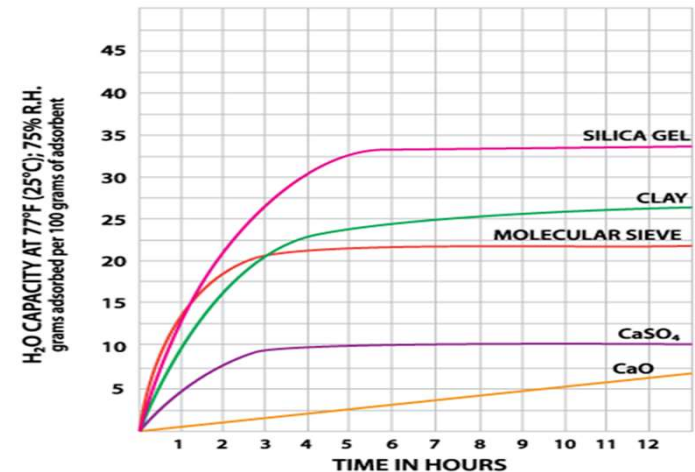


Diagram 3: Adsorption speed of different desiccants at 25° Celsius and 75% relative humidity

EVALUATION OF AN ADSORBENT

CaO based and Zeolithe Based Desiccants



SUMMARY

Calciumoxid is a better water adsorber. At all relative humidity conditions they adsorb much higher quantities of water and consequently they have also lower dew points which are important for IG applications. Their adsorption speed is much less than of the zeolithes, but they are still fast enough to adsorb humidity during production process of IG units as well during water penetration into the cavity of IG units (see attachment about the adsorption speeds).

The lower speed is a big advantage for CaO-based desiccants, because during IG production. The air contact before the unit is sealed can be up to 3 hours, and after three hours air contact zeolithes lose already 95% of their adsorption capacity, whereas CaO based desiccants lose only less than 10% of their capacity.

The biggest advantage of CaO-based desiccants is that they are not so temperature sensitive like zeolithes, so they lose only 10% of adsorbed water by temperatures around 60°Celsius.

At very low relative humidities like RH10 they can adsorb at 25°C nearly 27 %by wt; and at 60°C only 3%by wt is released.

RH	CaO	Zeolite	CaO more than Zeolite
10	27	18	50%
30	29	20	45%
50	29	21	38%

Table 1: Adsorption capacities (weight%) of CaO and Zeolithe at different humidities

- **Zeolithes have about 40-50 % lower adsorption capacity than Calciumoxide at all humidity levels**
- **and they lose 95% of their capacity within 3 hours air contact**

Multimol/Nanomol/Nanomol-C and Zeolan-K Comparison



Advantages of Zeolan-K in comparison to other zeolith based desiccants:

By using the insulating glass industry dedicated production process Zeolan-K has up to 15% higher density and followingly up to 15% higher adsorption capacity in a specific volume. Zeolan-K speed is reduced by using adapted binders and lose up to 50% less adsorption capacity than other common sieves in the market during air contact after opening the packages. These two features guarantee twice as long expected IG-life than a standard zeolithe based desiccant, which are produced for dynamic drying processes and not for insulating glass industry.

Advantages of Multimol/Nanomol/Nanomol-C in comparison to Zeolan-K:

Multimol/Nanomol/Nanomol-C contain Calciumoxide crystals which are much better adsorbents than zeolithes as explained in the first part of the paper. Calciumoxid is modified by a NEDEX-specific process in such a way that adsorption speed is increased in comparison to calciumoxide. Natural calciumoxide adsorbs only 29% by higher humidities, NEDEX CaO-based desiccants reach adsorption capacities up to 44%. So CaO based NEDEX desiccants have following advantages towards Zeolan-K:

- **50-80% higher water adsorption capacity**
- **50-80% lower gas desorption levels**
- **much lower adsorption speed by air contact**
- **up to 10% higher density**

Multimol/Nanomol/Nanomol-C and Zeolan-K Comparison



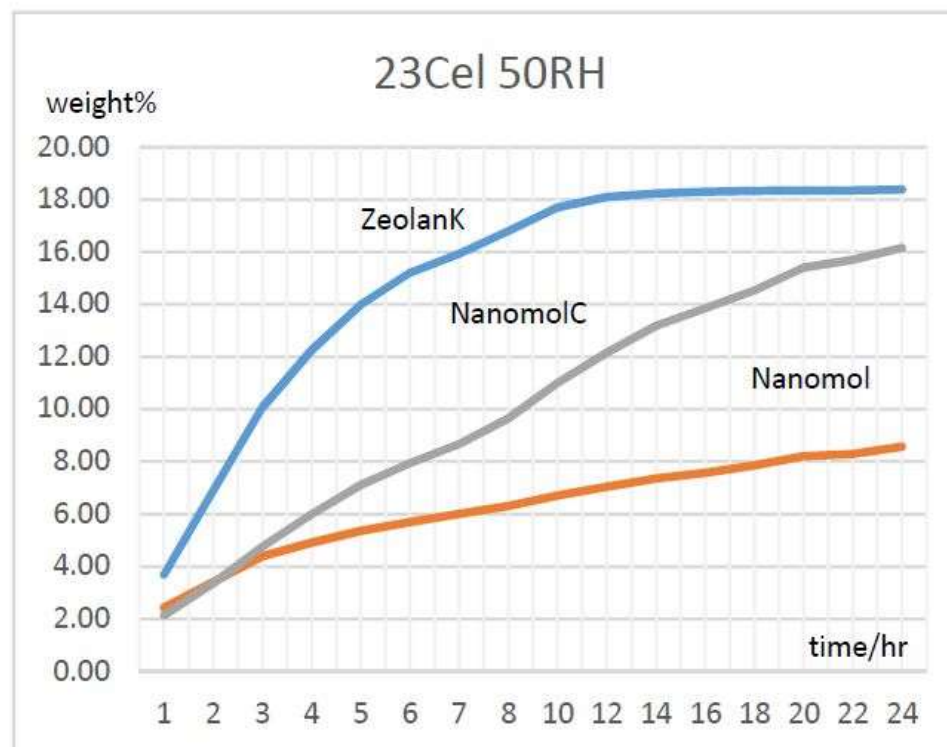
Criteria	Zeolite based Desiccants		Zeolan-K		Multimol/ Nanomol		Nanomol-C		Silicagel	
Adsorption capacity at low humidities RH9%	16%	●●	16%	●●	11%	●	19%	●●●	5%	●
Adsorption capacity at medium humidities RH32%	18%	●●	18%	●●	22%	●●●	32%	●●●	15%	●●
Adsorption capacity at high humidities RH50%	20%	●●	20%	●●	28%	●●●	44%	●●●	25%	●●●
Adsorption at RH75% after one hour	15%	●	10%	●●	1%	●●●	3%	●●●	15%	●
Capacity loss at RH75% for one hour	75%	●	50%	●●	3%	●●●	7%	●●●	60%	●
Adsorption capacity by elevated temperatures 60Cel RH50%	7%	●	7%	●	24%	●●●	28%	●●●	8%	●
Density / gr/ltr	740	●	840	●●	950	●●●	900	●●●	700	●
Gas desorption / (ml/100gram)	30	●●	15	●●	10	●●●	10	●●●	>>30	●
Chlorides	yes	●	yes	●	no	●●●	no	●●●	no	●●●
Environmental pollution in production	bad	●	bad	●	good	●●●	good	●●●	bad	●

Table 2: Properties of Adsorbents

Adsorption speed comparison of 3 different Sieves



		1902221211	1908015105	1905111307
		ZeolanK	Nanomol	NanomolC
Size		0,5-0,9	0,5-0,9	0,5-0,9
23 °C, 50%RH	1	3.69	2.43	2.13
	2	6.89	3.41	3.36
	3	10.07	4.40	4.76
	4	12.26	4.91	6.00
	5	13.99	5.36	7.10
	6	15.20	5.70	7.94
	7	15.94	6.01	8.68
	8	16.80	6.30	9.65
	10	17.70	6.70	11.00
	12	18.11	7.04	12.15
	14	18.24	7.36	13.18
	16	18.30	7.58	13.86
	18	18.34	7.86	14.53
	20	18.36	8.20	15.40
	22	18.36	8.29	15.71
	24	18.39	8.57	16.16



ZEOLAN-K adsorbs 2 times more than NANOMOL-C in 3 hours.

CONCLUSION



By using the insulating glass industry dedicated production process of **NEDEX** Zeolan-K has up to 15% higher density than similar desiccants. In same volume Zeolan-K has up to 15% higher adsorption capacity.

Drying process in an IG unit is a static process, this means the desiccant will be used only for one time and no generation of desiccant at the beginning or at the end is possible. IG life is depending on the quality of the sealants and of course on the adsorption capacity of the desiccants in the spacers. The cavity in the spacers are limited with the geometry of the spacer and the geometry of the IG unit.

By introduction of warm edge spacers the cavities became up to 40% less than comparable aluminium spacer systems. Wall thicknesses of warm edge spacers of 1 mm reduce the cavity volume drastically (up to 40% less cavity for 12 mm spacers).

The ideal desiccants for such applications should have following characteristics:

- **Low initial moisture**
- **High density**
- **Low adsorption speed**
- **High water adsorption capacity**

Calcium-oxide based desiccants are designed for static water adsorption processes and therefore the preferred choice for IG units. Zeolite based desiccants are designed and used for dynamic drying applications, and therefore not as good for insulating glass application.

Calcium oxide desiccants have following advantages:

- **High density** gives the possibility to fill more mass of desiccant into the spacer cavity.
- **Low adsorption speed** helps to save available adsorption capacity during production (AWAC).
- **Low gas desorption** will minimize the pressure fluctuations caused by temperature changes in IG unit, which will have consequently less vapour penetration into the IG cavity.
- They keep adsorbed water also by high temperatures (IG internal temperatures can reach up to 90°C) in their body, so that the internal volume gets not humid because of desorption of water at higher temperatures. Chlorides in zeolithe based desiccants can cause corrosion on glass coatings at high humidity and high temperatures.

ENVIRONMENTAL ISSUES

During production process of Zeolithes, appr. 22 tons water/ton zeolithe is polluted, whereas calciumoxide production is completely dry process, and no waste water is discharged. No waste-water pollutants are generated during the production of Calcium Oxide desiccants and it does not need to be shipped over long distances, it is locally mined.



PACKAGING/ GRANULE SIZES/ CERTIFICATIONS



ZEOLAN-K

PACKAGING

Carton boxes	25 kgs, filled at 70-100°C, vacuum / no vacuum
Metallic barrels	160/170 kgs, filled at 70-100°C, no vacuum
Big bags	650 kgs, in textile with inliner fabricated big bags filled at 70-100°C, no vacuum

GRANULE SIZES

0.5-0.9 mm	automatic filling / for spacer width<8mm
1.0-1.5 mm	manual filling

CERTIFICATIONS

ISO	ISO 9001 registered / ISO 14001 registered / ISO 18001 registered
EN CERTIFICATION	EN 1279-2:2018 TÜV Rheinland-Report Nr. 89216155-01 and 89216155-11 EN 1279-3:2018 TÜV Rheinland-Report Nr. 89216155-07 and 89216155-17 EN 1279-4:2018 TÜV Rheinland-Report Nr. 89216381-01
OTHER	Cekal, RAL, ASTM (USA,Canada), GOST (Russia), EcoVadis,Applus, AENOR,UNI Mark

NANOMOL-C

PACKAGING

Carton boxes	25 kgs, filled at 70-100°C, vacuum / no vacuum
Metallic barrels	160/170 kgs, filled at 70-100°C, no vacuum
Big bags	650 kgs, in textile with inliner fabricated big bags filled at 70-100°C, no vacuum

GRANULE SIZES

0.5-0.9 mm	automatic filling / for spacer width<8mm
0.9-1.3 mm	manual filling

CERTIFICATIONS

ISO	ISO 9001 registered / ISO 14001 registered / ISO 18001 registered
EN CERTIFICATION	EN1279-2:2018 TÜV Rheinland-Report Nr. 89216155-02 and 89216155-03 EN1279-3:2018 TÜV Rheinland-Report Nr. 89216155-06 and 89216155-15 EN1279-4:2018 TÜV Rheinland-Report Nr. 89216381-01
OTHER	GOST (Russia), EcoVadis, Applus

NANOMOL

PACKAGING

Carton boxes	25 kgs, filled at 70-100°C, vacuum / no vacuum
Metallic barrels	160/170 kgs, filled at 70-100°C, no vacuum
Big bags	650 kgs, in textile with inliner fabricated big bags filled at 70-100°C, no vacuum

GRANULE SIZES

0.5-0.9 mm	automatic filling / for spacer width<8mm
1.0-1.5 mm	manual filling

CERTIFICATIONS

ISO	ISO 9001 registered / ISO 14001 registered / ISO 18001 registered
EN CERTIFICATION	EN1279-4:2018 TÜV Rheinland-Report Nr. 89217408-01
OTHER	GOST (Russia), EcoVadis ,ASTM (USA,Canada), AENOR

MULTIMOL

PACKAGING

Carton boxes	25 kgs, filled at 70-100°C, vacuum / no vacuum
--------------	--

GRANULE SIZES

1.0-1.5 mm	manual filling
1.0-2.0 mm	manual filling
1.4-2.0 mm	manual filling

CERTIFICATIONS

ISO	ISO 9001 registered / ISO 14001 registered / ISO 18001 registered
OTHER	GOST (Russia), EcoVadis



THANK YOU

info@nedexgroup.com