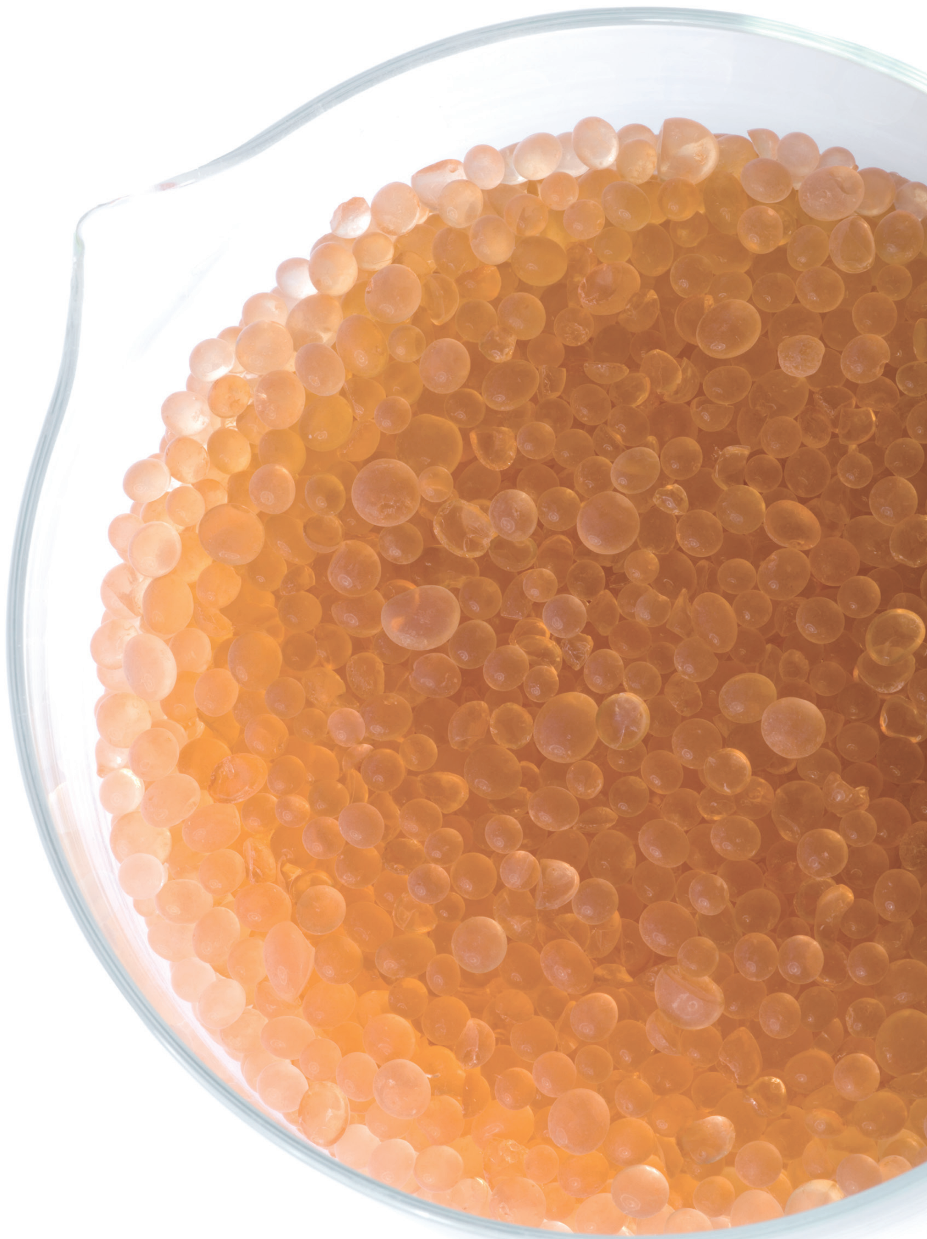
Dry and safe

Drying agents from EMD Millipore.



EMD Millipore is a division of Merck KGaA, Darmstadt, Germany

EMD Millipore drying agents help protect your valuable goods! Products and goods must often be protected against moisture and mould formation, both on long transport routes as well as during their storage. EMD Millipore offers a comprehensive selection of different drying agents for this purpose and many other applications in laboratories.

Drying agents

Contents

Advantages

- **Reliable:** EMD Millipore drying agents help to minimize the effects of moisture on products. This maintains the original condition and prevents follow-up costs caused by any damage.
- **Convenient:** EMD Millipore drying agents are user-friendly and easy to handle. This prevents time being wasted.
- **Economical:** Protection using EMD Millipore drying agents increases the longevity of your products. This helps to reduce costs.

www.emdmillipore.com/drying-agents

Safety and reliability

Safety and environment

In the drying agents product group, too, EMD Millipore offers products which support the goal of sustainable environmental protection and safety. For example, silica gels with or without orange or brown gel indicators are offered as an alternative to silica gel with blue gel indicator, which is presumably carcinogenic.

Safety information

When using drying agents, one must be aware of the potential dangers involved. Both acid and basic drying agents can be corrosive and magnesium perchlorate can explode, as can sodium and potassium on contact with certain organic substances resp. with water or chlorinated hydrocarbons. In the case of drying agents that develop hydrogen during the drying process, drying must be carried out in a well-ventilated fume chamber. Blue gel, due to the presence of cobalt chloride, can have a carcinogenic effect (R-phase 49 – may cause cancer by inhalation). Filling and emptying should thus always be carried out in a fume chamber.

Drying rate

The intensity only indicates the theoretically achievable residual value for water; it may take a long time for equilibrium to be reached. Thus, if a high degree of efficiency is to be achieved, rapid water uptake is important.

The uptake rate is determined by the following steps:
- The H_2O molecules must be able to leave the material to be dried and must traverse a path to the drying agent.
- The molecules must be able to diffuse into the reactive centers of the drying agent.

Whilst the user can influence the first two points with his experimental setup, the manufacturer of the drying agent must take the following parameters into account if the third point is to be optimized:
- Particle size,
- Pore size and pore distribution,
- Prevention of deactivation of the surface during the drying process.

The ideal drying agents are those where the above parameters do not significantly change during the water adsorption process, e.g. SICAPENT®, magnesium perchlorate, molecular sieves, silica gel, aluminium oxide and calcium hydride. However, many drying agents tend to clump during the water absorption process, disintegrate or form a syrupy layer over unused product. This is a disadvantage when working with gases in drying towers; they tend to become blocked or channels are formed through which the gas flows but in an incompletely dried state.

Capacity

The capacity of a drying agent is defined by the mass of water adsorbed per 100 g anhydrous substance. Example: 1 kg drying agent of capacity 20 % can adsorb 200 g of water. The residual water content of heavily loaded drying agent is higher than that of less loaded agent. On the other hand, drying agents are more heavily loaded by gases or liquids with higher water content. Exception: drying agents such as $CuSO_4$ which form defined hydrates maintain a constant water vapor partial pressure until the next hydrate stage is formed, independent of the mass of water adsorbed.

Regeneration

Some drying agents can be regenerated. To do this, the drying agent is heated to restore its equilibrium. Due to the fact that water is absorbed rapidly, regenerated drying agents must be filled and stored well away from moisture.

Applications

The user-friendly drying agents from EMD Millipore are suitable for a wide range of laboratory applications, for example for drying gases, liquids and solids. With such a wide variety of grain and packaging sizes, you are sure to find the suitable drying agent, either for the classic method of static or dynamic drying processes.

Products with no tendency towards clumping are particularly suited for the dynamic drying process including, for example, calcium hydride, magnesium perchlorate, aluminium oxide, silica gel, or molecular sieves.

More information about sustainable protection
www.emdmillipore.com/protection

Safety and environment – characteristics

▶ For easy detection, safety and/or sustainable characteristics of our products are highlighted with this symbol.

Drying methods

Drying methods

Non-sensitive solids can be dried at higher temperatures in a drying cabinet. However, drying at room temperature in a desiccator or at higher temperatures using a drying pistol is more gentle. Application of a vacuum facilitates the diffusion of the water molecules from the solid to the drying agent; the drying rate is hence somewhat faster.

Static drying

In the classical drying of liquids, the drying agent is added, the whole allowed to stand, stirred (e.g. with a magnetic stirrer), shaken or boiled under reflux (details can be found in relevant textbooks of organic chemistry). It is important that the liquid is moved in such a way that it comes into contact with the drying agent.
The liquid is then filtered or decanted. Should compounds be formed due to reaction with the water, these must be subsequently removed by distillation.

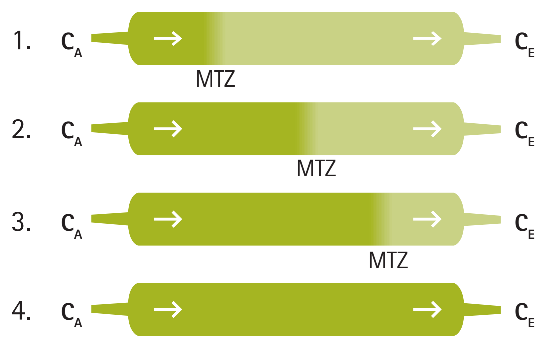
The frequently used drying agents calcium chloride, potassium carbonate, sodium sulfate and calcium sulfate have a medium drying effect only on solvents when used statically. Drying agents such as sodium or the earth-alkaline oxides, however, are not as efficient as often thought due to their reactive surfaces being relatively small and in addition covered by a coating that hinders access of water molecules. In addition, as laboratory accidents are relatively frequent with these materials, they should not be used for this purpose.

Dynamic drying

In order to increase the drying rate and to achieve better utilization of the drying agent, liquids and gases can be passed through drying towers or drying tubes filled with a drying agent. However, if diffusion and flow rate are not to be hindered, the drying agents used should not be susceptible to clumping or deliquescence. For this reason, drying agents such as calcium hydride, magnesium perchlorate, aluminium oxide, silica gel and molecular sieves are particularly suitable. Untreated phosphorus pentoxide tends to clump when in contact with water and is thus normally unsuitable for dynamic drying. SICAPENT®, however, is a drying agent where P_2O_5 has been coupled to an inert carrier; it remains flowable also when loaded 100 % and allows gases to flow through without resistance.

The drying process can be optimized by using a drying agent of small particle size. In this way, the surface area can be significantly increased and hence the column length and packing decreased. However, it should be taken into account that the flow rate is reduced due to the greater flow resistance in the column.

The diagram shows a drying process for gases using silica gel in a drying column: An orange gel turns colorless when loaded with water. The moist gas enters the column at the left hand side with water content C_A and leaves it on the right in a dry condition C_E; however, at this point, the gas contains more than the minimum residual water achievable with the drying agent in question. The drying agent in the left hand part of the column is already loaded to the maximum with water and is in equilibrium with the moist gas entering. The actual drying process – the transfer of water from gas to silica gel – takes place in the segment known as the "Mass Transfer Zone – MTZ". Over the drying period, the MTZ migrates towards the right hand side of the column (steps 2, 3, 4) until it reaches the end and the moist gas leaves. In order to avoid the gas leaving, the gas flow is interrupted well in time; this has the effect that a small part of the column remains unutilized. However, such dynamic drying procedures are mostly better than static ones. (This is shown in the general calculation on the next page.)



Drying process for gases using silica gel in a drying column.

Calculations

General calculation of relative humidity of the atmosphere: The absorptivity of the atmosphere for humidity increases with the temperature until saturation. 1 m^3 air at 11°C is saturated with 10.0 g water, at 20°C with 17.3 g, at 30°C with 30.4 g and at 40°C with 51.2 g.

Calculation of the amount of drying agent required: 1000 l gas containing 10 mg/l water are to be dried at 25°C to a residual water content of 1 mg H_2O/l.
1000 l x 10 mg H_2O/l - 1000 l x 1 mg H_2O/l = 9 g H_2O are to be adsorbed.

Calculation of the required amount of drying agent for static drying: At the end of the drying process, the residual water content of the gas is in equilibrium with the drying agent. The loading of the silica gel necessary to achieve the desired residual water content can be taken from the table in the ordering information of silica gel, page 272:
1 mg H_2O/l residual water ≙ loading of 5.2 g H_2O / 100 g silica gel.
To absorb 9 g H_2O, 9/5.2 x 100 g = about 200 g silica gel are required.

Calculation of the required amount of drying agent for dynamic drying: In this case, the greater part of the drying agent is in equilibrium with the water content of 10 mg/l of the gas flowing into the column. Thus, a higher loading – about 20 g H_2O / 100 g silica gel – is possible than in the case of static drying where the entire drying agent is in equilibrium with the low residual water content. Even if in the case of dynamic drying half of the drying agent remains unutilized, 100 g are sufficient compared with 200 g for static drying.

As the flowing gas has much less contact with the drying agent than with the static method, the much lower values for residual water content as cited in the literature for static drying are not quite achieved. If such low residual water content is to be achieved, it is necessary to connect a further column with a more effective drying agent. If the gas is circulated over a drying column in a closed room, even if dynamic, only the capacity of a static method can of course be achieved.

Calculation of the column diameter: Based on the flow rate and the given volume flow (volume/time unit), the smallest allowable column cross-section can be calculated.
Example: 3.6 l of 2-propanol per hour are to be dried (= 3600 ml / 60 min).
At a flow rate of 10 cm/min* the minimum cross-sectional area is 6 cm^2 corresponding to approx. 30 mm diameter.

*** Experimentally determined value**

Definitions

Column dimensions

In order to be able to utilize the drying agent to the full, the Mass Transfer Zone [MTZ] and the length of non-utilized column must be kept to a minimum.

Narrow columns have proved to be of advantage in this case:

- For gases, a ratio for length to diameter of greater than 5 is recommended. Columns filled with beads or granular silica gel should be at least 1 m long.
- For liquids, columns of 60 cm in length and 2 – 3 cm in diameter to 2 m and 6 cm respectively are recommended (for further details, see »drying of solvents«).

To determine the necessary column volume, the required amount of drying agent should be divided by the bulk density. Example: 100 g silica gel of bulk density of 70 g / 100 ml have a volume of 143 ml.

Flow rate

However, the ratio length to cross-section should not be so large that high flow rates result as this would lengthen the MTZ considerably. Recommended flow rates (bases on the free cross-section of the column) for gases: 5 – 15 m per minute, for liquids: 2.5 – 30 cm per minute. These values have been established experimentally as being optimal.

Drying gases

Gases should be dried using the dynamic method (see »drying methods«). Very moist gases should first be dried using a drying agent of high capacity: CaH_2, $CaSO_4$, $Mg(ClO_4)_2$, molecular sieve, H_2SO_4, or silica gel. Fine drying can then be attained using phosphorus pentoxide, SICAPENT®, CaH_2, $Mg(ClO_4)_2$ or molecular sieve. Further details are contained in the section describing the relevant drying agents.

Drying agents

for solvents with low water absorption capacity

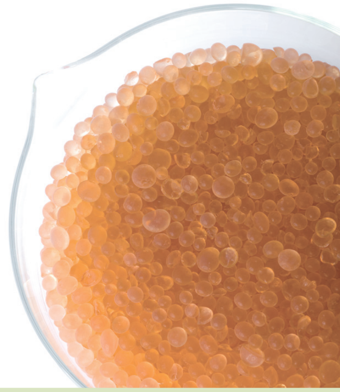
Solvents with a low water-absorbing capacity can generally be dried using static methods; they should be allowed to stand in their reservoirs for up to several days with occasional shaking in contact with a suitable drying agent (e.g. 100 – 200 g molecular sieve (MS) per liter solvent).

The residual water content that can be attained with molecular sieves (MS) is less than 10^{-4} percent by weight corresponding to 1 ppm = 1 mg H_2O = approx. 0.05 mmol H_2O per liter solvent. 250 g molecular sieve can dry more than 10 l hydrophobic solvent whilst becoming 14 – 18 % loaded with H_2O. Of course, dynamic drying as described in textbooks can also be used.

When drying hydrophobic solvents dynamically with aluminium oxide, silica gel or molecular sieve, the flow rate should be up to 30 cm per minute. In this way, using a column of diameter 2.5 cm and 5 cm^2 cross-section, up to 6 l per hour can pass through. Columns of diameter 2.5 cm and a length of 60 cm containing some 200 g of molecular sieve have proven useful for such applications.

For many applications, the specially dried SeccoSolv® solvent is suitable.

More information ▶ »Accuracy you can count on. Tailor-made solvents in tailor-made packaging« W.282105



Drying agents

	Solvents	$CaCl_2$ – Calcium chloride	CaH_2 – Calcium hydride	CaO – Calcium oxide	Distillation	K_2CO_3 – Potassium carbonate	KOH – Potassium hydroxide	$LiAlH_4$ – Lithium aluminium hydride	Molecular sieve 0.4 nm	Molecular sieve 0.5 nm	Na – Sodium	Na_2SO_4 – Sodium sulfate	P_2O_5 – Phosphorus pentoxide
A	n-Amyl acetate					•				•			
	n-Amyl alcohol								•				
	Aniline						•			•			
	Anisole	•	•		•					•	•		
B	Benzene	•	•		•					•	•		
	Benzyl alcohol				•					•			
	Bromobenzene	•			•					•			
	Bromoform	•								•			•
	tert-Butyl methyl ether		•					•		•	•		
C	Carbon disulfide	•											•
	Carbon tetrachloride	•			•				•				•
	Chlorbenzene	•			•					•			
	Chloroform	•							•				•
	Cyclohexane	•					•		•	•			
	Cyclopentane		•					•		•	•		
D	n-Decane		•					•	•				
	1,2-Dichlorobenzene	•			•					•			
	Dichloromethane	•							•				
	Dichloroethane	•			•					•			
	Diethyl ether	•	•					•	•		•		
	Diethyl ketone					•			•				
	Diethylene glycol dibutyl ether	•	•						•		•		
	Diisoamyl ether		•					•	•		•		
	Diisopropyl ether	•	•						•		•		
	Dipropyl ether		•					•	•		•		
E	Ethyl methyl ketone					•			•				
H	n-Heptane		•					•	•		•		
	n-Hexane		•					•	•		•		
I	Isoamyl alcohol			•		•				•			
	Isobutyl methyl ketone	•				•				•			
	Isooctane		•					•		•	•		
N	Nitrobenzene	•			•					•			•
	Nitropropane	•			•					•			•
P	n-Pentane		•					•	•		•		
	Petroleum ether, petroleum, petroleum benzene	•					•	•		•			
T	Tetrachloroethylene				•	•				•		•	
	Toluene	•	•		•				•		•		
	1,1,1-Trichlorethane	•			•					•			
	Trichloroethylene				•	•				•		•	
	1,1,2-Trichlorotrifluoroethane		•						•				
X	Xylene	•	•		•				•		•		

Drying agents

for solvents with medium to unlimited water adsorption capacity

H_2O + drying agent $\rightleftharpoons$ H_2O / drying agent / compound (1)
H_2O + solvent $\rightleftharpoons$ H_2O solvated (2)
Solvent + drying agent $\rightleftharpoons$ Solvent / drying agent / compound (3)

Due to the competitive reactions (2) and (3), the attainable residual water contents are some 1000 times higher than in air – unless drying agents such as calcium hydride are used where no equilibrium exists due to one of the products (in this case H_2) leaving the equation.

In general, residual water values of 10^{-3} % by weight are adequate. Further drying is no longer meaningful, in particular if the dried solvent is refilled under air: even if poured quickly, the H_2O content increases from $1 \cdot 10^{-3}$ to $2\text{-}4 \cdot 10^{-3}$ %. A further source of contamination with water is e.g. non-greased ground glass, e.g. in desiccators, through which significant amounts of water vapor can diffuse. Suitable drying agents are recommended in the listing below. As conventional drying with chemical agents is adequately described in textbooks of preparative organic chemistry, only dynamic drying with the help of water-miscible solvents and molecular sieves (MS) is described here.

The following values can be attained using this method:
Residual water content: 0.001 – 0.005 % weight H_2O in the solvent
Capacity: at a desired residual water content of max. 0.001 %, the molecular sieve used may not be loaded greater than:

Diethyl ether	14 g H_2O / 100 g molecular sieve
Ethyl acetate	6 g H_2O / 100 g molecular sieve
Dioxane	4 g H_2O / 100 g molecular sieve
Pyridine	2 g H_2O / 100 g molecular sieve

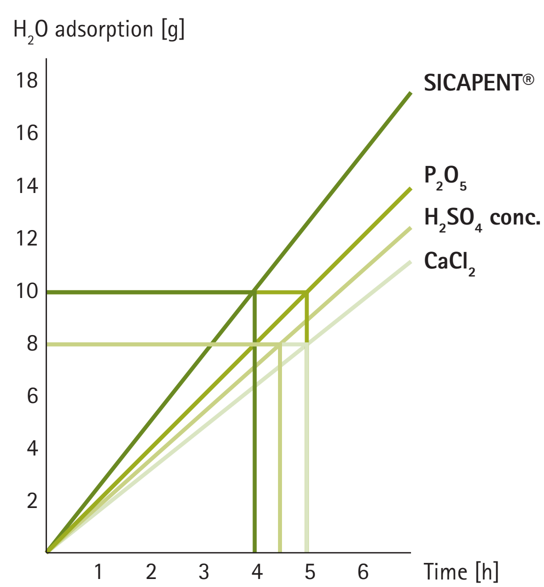
Loading: depends on the reaction equation (2) of solvents

	Solvents A-M	Water adsorption [g H_2O/100 g solvent]	Ca – Calcium	$CaCl_2$ – Calcium chloride	CaH_2 – Calcium hydride	CaO – Calcium oxide	$CuSO_4$ – Calcium sulfate	Distillation	K_2CO_3 – Potassium carbonate	KOH – Potassium hydroxide	Mg – Magnesium	MgO – Magnesium oxide	$MgSO_4$ – Magnesium sulfate	Molecular sieve 0.3 nm	Molecular sieve 0.4 nm	Molecular sieve 0.5 nm	Na – Sodium	Na_2SO_4 – Sodium sulfate	P_2O_5 – Phosphorus pentoxide
			Drying agent																
A	Acetic acid	∞					•												
	Acetone	∞							•					•					
	Acetonitrile	∞		•					•					•					•
	Acetylacetone	∞							•						•				
	tert-Amyl alcohol	14				•										•			
B	1-Butanol	20						•	•						•				
	2-Butanol	44						•	•							•			
	tert-Butanol	∞				•										•			
	n-Butyl acetate	2.9											•		•				
C	Cyclohexanol	11				•										•			
	Cyclohexanone	8.7							•							•			
D	Diethylene glycol	∞						•							•			•	
	Diethylene glycol diethyl ether	∞		•	•											•	•		
	Diethylene glycol dimethyl ether	∞		•	•											•	•		
	Diethylene glycol monobutyl ether	∞		•	•											•	•		
	Diethylene glycol monoethyl ether	∞		•	•											•	•		
	Diethylene glycol monomethyl ether	∞		•	•											•	•		
	N,N-Diethylformamide	∞			•			•								•			
	N,N-Dimethylformamide	∞			•			•							•				
	Dimethyl sulfoxide	∞			•			•						•					
	1,4-Dioxane	∞		•	•										•		•		
E	Ethanol	∞				•					•	•		•					
	Ethanolamine	∞								•				•					
	(2-Ethoxyethyl)-acetate	6.5							•						•			•	•
	Ethyl acetate	9.8							•						•			•	•
	Ethylene glycol dimethyl ether	∞			•			•							•				
	Ethylene glycol	∞						•							•			•	
	Ethylene glycol monobutyl ether	∞						•											
	Ethylene glycol monoethyl ether	∞						•											
	Ethylene glycol monomethyl ether	∞						•											
	Ethyl formiate	∞											•		•			•	
F	Formamide	∞				•								•				•	
G	Glycerol	∞						•											
H	1,1,1,3,3,3-Hexafluoro-2-propanol	∞													•				
I	Isobutanol	15	•			•			•		•				•				
M	Methanol	∞				•					•	•		•					
	Methyl acetate	8				•			•						•				
	Methyl formiate	24							•						•			•	•
	Methyl propyl ketone	3.6							•						•				
	Methyl pyridine	∞								•					•				

	Solvents N-Z	Water adsorption [g H_2O/100 g solvent]	Drying agent	Ca – Calcium	$CaCl_2$ – Calcium chloride	CaH_2 – Calcium hydride	CaO – Calcium oxide	$CuSO_4$ – Calcium sulfate	Distillation	K_2CO_3 – Potassium carbonate	KOH – Potassium hydroxide	Mg – Magnesium	MgO – Magnesium oxide	$MgSO_4$ – Magnesium sulfate	Molecular sieve 0.3 nm	Molecular sieve 0.4 nm	Molecular sieve 0.5 nm	Na – Sodium	Na_2SO_4 – Sodium sulfate	P_2O_5 – Phosphorus pentoxide
P	1,2-Propanediol	∞					•					•	•			•				
	1,3-Propanediol	∞					•					•	•			•				
	1-Propanol	∞					•					•	•			•				
	2-Propanol	∞					•					•			•					
	Pyridine	∞					•					•	•		•					
T	Tetraethylene glycol	∞									•					•				
	Tetrahydrofuran	∞				•					•					•				
	Triethanolamine	∞									•						•			
	Triethylene glycol	∞							•							•			•	
	Triethylene glycol dimethyl ether	∞							•											

Water absorption rate of some drying agents

Experimental: 100 g SICAPENT® or 75 g of other drying agents were placed in a vacuum desiccator alongside a dish of water. After 1 h the increase in weight of the drying agents were established using gravimetric analysis. The results obtained are shown in the figure.



Examples of flow rate

The flow rate for water-miscible solvents should be less than 10 cm/minute. This corresponds to max. flow rates of:

Flow rate	Column diameters
50 ml/min	25 mm
70 ml/min	30 mm
200 ml/min	50 mm

Solvent	Initial water content [% by weight]	Residual water content [% by weight]	Quantity of solvent dried [l]	Type [nm]
Acetonitrile	0.05 – 0.2	0.003	3 – 4	0.3
Benzene	0.07	0.003	>10	0.4
Chloroform	0.09	0.002	>10	0.4
Cyclohexane	0.009	0.002	>10	0.4
Dichloromethane	0.17	0.002	>10	0.4
Diethyl ether	0.12	0.001	10	0.4
Diisopropyl ether	0.03	0.003	10	0.4
Dimethylformamide	0.06 – 0.3	0.006	4 – 5	0.4
1,4-Dioxane	0.08 – 0.3	0.002	3 – 10	0.5
Ethanol	0.04	0.003	10	0.3
Ethyl acetate	0.015 – 0.2	0.004	8 – 10	0.4
Methanol	0.04	0.005	10	0.3
2-Propanol	0.07	0.006	7	0.3
Pyridine	0.03 – 0.3	0.004	2 – 10	0.4
Carbon tetrachloride	0.01	0.002	>10	0.4
Tetrahydrofuran	0.04 – 0.2	0.002	7 – 10	0.5
Toluene	0.05	0.003	>10	0.4
Xylene	0.045	0.002	>10	0.4

▶ **Dynamic drying of solvents with molecular sieves using a column of 25 x 600 mm (250 g molecular sieve) or of 50 x 2,000 mm (2 kg molecular sieve).**

Amount of solvent dried

The amount of dry solvent obtainable for solvents that are readily miscible with water cannot be accurately given as this is dependent on the initial water content which is mostly unknown. However, if the solvent is dried statically to a low H_2O content (e.g. with approx. 100 g of molecular sieve, enough for 1 l of solvent), the subsequent dynamic process can be used to dry 10 l of the solvent to 0.001 – 0.002 % weight using 200 g of molecular sieve. For drying the strongly hygroscopic alcohols methanol, ethanol and 2-propanol to 0.002 % weight of residual water, however, some 2 kg of 0.3 nm molecular sieve is necessary. Column dimensions: ø 50 mm, length 2 m. An overview of the attainable drying effect with a series of water-saturated solvents is given in the table above.

Practical procedure

It should initially be checked whether, in addition to water, the solvent to be dried is adsorbed by the molecular sieve. To do this, place 10 – 20 beads in a test tube along with several ml of the solvent. Significant increase in temperature – in certain circumstances even boiling – indicates co-adsorption according to (3). If this is the case, either a molecular sieve of smaller pore size, where there is no co-adsorption, should be used or the flow rate should be reduced to max. 2.5 cm per minute. The appropriate pore sizes where no further co-adsorption takes place are given in the table.

Initially the solvent should be applied to the column slowly until the entire column has been wetted within 15 – 30 minutes. As a rule, the first fraction collected contains an increased water content; this should either be discarded or re-applied to the column. In the case of fresh molecular sieve, the first fraction may contain some particles and be somewhat turbid; this fraction should either be disposed of or filtered.

Ordering information Drying agents A-C

Absorption tube	CAS No.	Content	Packaging	Ord. No.
Absorption tube for H_2O (molecular sieve 0.3 nm with indicator)	–	3 units	Plastic can	**1.06107.0003**

Absorption tubes

Calcium [Ca]	CAS No.	Content	Packaging	Ord. No.
Calcium granular particle size about 2 – 6 mm	7440-70-2	100 g	Glass bottle	**1.02053.0100**
		500 g	Glass bottle	**1.02053.0500**

For drying	Alcohols
Application	During the drying process, insoluble metal hydroxide is initially formed followed by metal alcoholate, which is soluble in alcohol. Hence, subsequent to drying, the solution must be distilled.
Capacity	Stoichiometric

Calcium chloride [$CaCl_2$]	CAS No.	Content	Packaging	Ord. No.
Calcium chloride anhydrous powder Reag. Ph Eur	10043-52-4	500 g	Plastic bottle	**1.02378.0500**
		2.5 kg	Plastic bottle	**1.02378.2500**
Calcium chloride anhydrous, granular ~ 1 – 2 mm	10043-52-4	1 kg	Plastic bottle	**1.02379.1000**
		5 kg	Plastic bottle	**1.02379.5000**
Calcium chloride anhydrous, granular ~ 2 – 6 mm	10043-52-4	1 kg	Plastic bottle	**1.02391.1000**
		5 kg	Fibre carton	**1.02391.5000**
		25 kg	Fibre carton	**1.02391.9025**
Calcium chloride anhydrous, granular ~ 6 – 14 mm	10043-52-4	1 kg	Plastic bottle	**1.02392.1000**
		5 kg	Fibre carton	**1.02392.5000**
		25 kg	Fibre carton	**1.02392.9025**

For drying	Acetone, ethers, numerous esters, aliphatic, olefinic, aromatic and halogenated hydrocarbons, neutral gases.
Unsuitable for drying	Alcohols, ammonia, amines, aldehydes, phenols, several esters and ketones: these compounds are bound by $CaCl_2$.
Application	Drying of liquids, filling drying tubes; not suitable for the drying of fast-flowing gases as pore diffusion is hindered due to deliquescence during water uptake.
Residual water content in air	0.14 mg H_2O/l to 16 % H_2O content | 0.7 mg H_2O/l to 32 % H_2O content | 1.4 mg H_2O/l to 65 % H_2O content
Capacity	98 %
Regeneration	At 250°C in a drying oven

Calcium hydride [CaH_2]	CAS No.	Content	Packaging	Ord. No.
Calcium hydride for synthesis, ~ 1 – 10 mm	7789-78-8	100 g	Glass bottle	**8.02100.0100**
		500 g	Glass bottle	**8.02100.0500**

For drying	Gases, organic solvents, including ketones and esters.
Unsuitable for drying	Compounds with active hydrogen, ammonia, alcohols.
NB	Can explode in reaction with water!
Application	As calcium hydride is a very effective drying agent and reacts vigorously with water, the substances to be dried should contain only low amounts of water. In reaction with water, hydrogen is released (always work in a fume hood!) according to the equation $CaH_2 + H_2O \rightarrow 2 H_2 + CaO$. The fine voluminous powder formed may block drying towers. CaH_2 is superior to sodium as a drying agent as it possesses a much larger surface area. The CaO formed does not adhere to the CaH_2 surface and itself acts as a drying agent. $CaO + H_2O \rightarrow Ca(OH)_2$.
Disadvantage	Due to the higher activity and reactivity than Na, CaH_2 is less stable if stored incorrectly. Hence, once the package has been opened, it should be stored in a desiccator.
Residual water content in air	<0.00001 mg H_2O/l
Capacity	Stoichiometric

Calcium oxide [CaO]	CAS No.	Content	Packaging	Ord. No.
Calcium oxide from marble small lumps ~ 3 – 20 mm	1305-78-8	1 kg	Plastic bottle	**1.02109.1000**
		25 kg	Fibre carton	**1.02109.9025**

For drying	Neutral and basic gases, amines, alcohols, ethers.
Unsuitable for drying	Acids, acid derivatives, aldehydes, ketones, esters.
Residual water content in air	0.003 mg H_2O/l
Capacity	Limited as the surface is coated with a less permeable layer, especially in the presence of CO_2.

Copper sulfate [$CuSO_4$]	CAS No.	Content	Packaging	Ord. No.
Copper(II) sulfate anhydrous for analysis EMSURE®	7758-98-7	250 g	Plastic bottle	**1.02791.0250**
		1 kg	Plastic bottle	**1.02791.1000**

For drying	Low fatty acids, alcohols, esters.
Unsuitable for drying	Amines, nitriles, ammonia.
Residual water content in air	1.4 mg H_2O/l
Regeneration	Above 50°C under vacuum.
Advantage	Can be used as indicator: Colorless anhydrous copper(II)sulfate becomes blue as copper(II)sulfate 5-hydrate.

Ordering information Drying agents D-M

Desiccant sachets [SiO_2]	CAS No.	Content	Packaging	Ord. No.
Desiccant sachet 10 g silica gel with humidity indicator (orange gel) sachet: 7 x 9 cm	–	50 units	Metal can	**1.03804.0001**
Desiccant sachet 100 g silica gel with humidity indicator (orange gel) sachet: 15 x 14 cm	–	10 units	Metal can	**1.03805.0001**
Desiccant sachet 250 g silica gel with humidity indicator (orange gel) sachet: 15 x 20.5 cm	–	10 units	Metal can	**1.03806.0001**
Desiccant sachet 3 g silica gel with humidity indicator (orange gel) sachet: 4 x 7 cm	–	100 units	Metal can	**1.03803.0001**
		1000 units	Fibre carton	**1.03803.0002**
▶ Further desiccant sachets, e.g. 500 g, on request.				

For drying	Humidity
Application	Sachets filled with silica gel protect valuable and sensitive products from the effects of moisture. Packed along with sensitive machine components and tools, they prevent corrosion during storage and transport. Sachets maintain the function of sensitive optical, electrical and electronic components and instruments.
Capacity	Silica gel has a high adsorptive capacity for moisture: 20 % of its own weight at 25°C and 80 % relative humidity.
Indicator change in orange gel	At approx. 7 – 10 g adsorbed H_2O / 100 g silica gel, the color change is from orange to colorless.
Regeneration	Silica gel (orange gel) can be regenerated in a drying oven at 130 – 140°C. Desiccant sachet only up to 80°C, because the adhesive of the bag can melt.

Desiccant sachets

Lithium aluminium hydride [$Li(AlH_4)$]	CAS No.	Content	Packaging	Ord. No.
Lithium aluminium hydride – powder, for synthesis	16853-85-3	25 g	Metal can	**8.18875.0025**
Lithium aluminium hydride – tablets, for synthesis	16853-85-3	25 g	Metal can	**8.18877.0025**

For drying	Hydrocarbons, ethers.
Unsuitable for drying	Acids, acid derivatives (chlorides, anhydrides, amides, nitriles), aromatic nitro compounds.
Application	$Li(AlH_4)$ reacts vigorously, on occasion explosively, with water whilst releasing hydrogen. Hence, the solvents to be dried should have a very low initial water content.
Capacity	Stoichiometric

Magnesium [Mg]	CAS No.	Content	Packaging	Ord. No.
Magnesium, turnings acc. to Grignard for synthesis	7439-95-4	250 g	Metal can	**8.05817.0250**
		1 kg	Metal can	**8.05817.1000**
Magnesium powder particle size about 0.06 – 0.3 mm	7439-95-4	1 kg	Metal can	**1.05815.1000**

For drying	Alcohols
Application	Magnesium turnings must be activated with iodine prior to use. During the drying process insoluble metal hydroxide is initially produced, followed by metal alcoholate, which is soluble in alcohol. Thus after drying, distillation is necessary.
Capacity	Stoichiometric

Magnesium oxide [MgO]	CAS No.	Content	Packaging	Ord. No.
Magnesium oxide for analysis	1309-48-4	100 g	Plastic bottle	**1.05865.0100**
		500 g	Plastic bottle	**1.05865.0500**

For drying	Alcohols, hydrocarbons, basic liquids.
Unsuitable for drying	Acid compounds.
Residual water content in air	0.008 mg H_2O/l
Regeneration	At 800°C

Magnesium perchlorate [$Mg(ClO_4)_2$]	CAS No.	Content	Packaging	Ord. No.
Magnesium perchlorate hydrate [about 83 % $Mg(ClO_4)_2$], desiccant, about 1 – 4 mm	64010-42-0	500 g	Metal can	**1.05873.0500**

For drying	Inert gases, air; adsorbs ammonia as strongly as water.
Unsuitable for drying	Numerous solvents in which it is soluble, e.g. acetone, dimethyl formamide, dimethyl sulfoxide, ethanol, methanol, pyridine, organic compounds.
Application	In drying towers for the drying of rapid flowing gases; with increasing H_2O loading the packing becomes looser. $Mg(ClO_4)_2$ can be removed easily as it does not stick to the walls.
Residual water content in air	0.0005 mg H_2O/l to 10 % H_2O content | 0.002 mg H_2O/l to 32 % H_2O content
Capacity	48 %, corresponding to 6 moles crystal water.
Safety information	Explosion risk when in contact with a reducing atmosphere, in particular in the presence of acids or compounds that can be hydrolyzed to form acids. $Mg(ClO_4)_2$ may only be heated in vessels made of inorganic materials.
Regeneration	At 240°C under vacuum.

Magnesium sulfate [$MgSO_4$]	CAS No.	Content	Packaging	Ord. No.
Magnesium sulfate anhydrous for analysis EMSURE®	7487-88-9	1 kg	Glass bottle	**1.06067.1000**
		25 kg	Plastic drum	**1.06067.9025**

For drying	Almost all compounds including acids, acid derivatives, aldehydes, esters, nitriles and ketones.
Residual water content in air	1.0 mg H_2O/l
Regeneration	At 200°C in a drying oven.

Ordering information Drying agents M

Molecular sieves	CAS No.	Content	Packaging	Ord. No.
Molecular sieve 0.3 nm beads ~ 2 mm[1)]	1318-02-1	250 g	Plastic bottle	**1.05704.0250**
		1 kg	Plastic bottle	**1.05704.1000**
		10 kg	Bucket, plastic	**1.05704.9010**
Molecular sieve 0.3 nm beads, with moisture indicator ~ 2 mm[1)]	–	250 g	Plastic bottle	**1.05734.0250**
		1 kg	Plastic bottle	**1.05734.1000**
Molecular sieve 0.3 nm rods ~ 1.6 mm (1/16")	1318-02-1	250 g	Plastic bottle	**1.05741.0250**
		1 kg	Plastic bottle	**1.05741.1000**
		10 kg	Bucket, plastic	**1.05741.9010**
Molecular sieve 0.4 nm beads ~ 2 mm Reag. Ph Eur	1318-02-1	250 g	Glass bottle	**1.05708.0250**
		1 kg	Glass bottle	**1.05708.1000**
		10 kg	Bucket, plastic	**1.05708.9010**
Molecular sieve 0.4 nm beads, with moisture indicator ~ 2 mm	–	250 g	Glass bottle	**1.05739.0250**
		1 kg	Glass bottle	**1.05739.1000**
Molecular sieve 0.4 nm rods ~ 1.6 mm (1/16")	1318-02-1	1 kg	Plastic bottle	**1.05743.1000**
Molecular sieve 0.5 nm beads ~ 2 mm	1318-02-1	250 g	Glass bottle	**1.05705.0250**
		1 kg	Glass bottle	**1.05705.1000**
Molecular sieve 1.0 nm beads ~ 2 mm	1318-02-1	1 kg	Glass bottle	**1.05703.1000**

▶ **1) Molecular sieves with 0.3 nm bead form (105704) and with indicator brown gel (105734) are suitable for use in Karl Fischer titrators.**

Molecular sieves are suitable for drying practically all gases and liquids. They can be used in desiccators, drying tubes, for keeping absolute solvents dry, filling columns for drying gases or solvents and for selective adsorption. (e.g. phosgene from chloroform).

Advantages

- Easy-to-use: Practically chemically inert, non-toxic, no disposal problems, dried liquids can be decanted.
- High adsorption capacity even with low water content of the substance to be dried.
- High adsorption capacity even at high temperatures.
- High adsorption affinity for polar and unsaturated organic molecules; however, H_2O is always preferentially adsorbed.
- Selective adsorption: only molecules that can pass through the pores are adsorbed.

Molecular sieves – continued

Temperature

Molecular sieves absorb H_2O whilst essentially maintaining their capacity at temperatures where both aluminium oxide and silica gel begin to release water. Between 0 and 150°C, the capacity decreases gradually from 23 to 7 % with a residual water content of 10 mg H_2O/l.

Residual water content in air

Min. 0.0001 mg H_2O/l at 25°C. The less loaded a molecular sieve is the more intensively it dries. The supplied original packed molecular sieve contains approx. 1 – 2 % water. This tends not to interfere with the drying process. However, if the requirements of the drying process are high, the substance must be activated as described under »regeneration«.

Typical values for molecular sieve 0.4 nm

Loading [g H_2O/100 g molecular sieve]	Residual water content [mg H_2O/l]
1	0.0001
3	0.001
6	0.01
15	0.1
20	0.5

Capacity

15 – 24 % at 25°C. If low residual water content is to be attained, the capacity can only be partially utilized (see table above): At a desired residual water content of 0.01 mg H_2O/l, the loading may not exceed 6 g H_2O / 100 g molecular sieve.

Indicator

The indicator (brown gel) changes from brown to yellowish at a H_2O uptake of approximately 7 – 10 g / 100 g molecular sieve.

Regeneration

This can be carried out as often as required; the max. regeneration temperature is 450°C. Molecular sieves can be dried in a drying oven above 250°C to a water content of 2 – 3 g / 100 g. The remaining water can be removed at 300 – 350°C using a vacuum oil pump (10-1-10-3 mbar), whereby, as is usual, a cold trap containing carbon dioxide coolant or liquid air should be connected. Water pumps, due to their high partial water vapor pressure, are completely unsuitable for this purpose. For safety reasons, molecular sieves that have been used to dry solvents should be freed from possible solvent by mixing with water prior to regeneration. Molecular sieves with moisture indicator should not be heated above 150°C.

Chemical and physical properties

Molecular sieves are crystalline, synthetic zeolites. Their crystal gratings are similar to a cage with numerous hollow spaces. The cavities are accessible from all sides by pores of exactly defined dimensions: depending on the type of molecular sieve, these can be 0.3, 0.4, 0.5 or 1.0 nm in diameter. If, due to heating, the water in the hollow spaces is removed, the material becomes an extremely active adsorbent. However, only those molecules are adsorbed that are small enough to pass through the pores (sieve effect).

Pore diameter	Type	Composition	Structure
0.3 nm	3A	Potassium sodium aluminium silicate	Zeolite
0.4 nm	4A	Sodium aluminium silicate	Zeolite
0.5 nm	5A	Sodium and calcium aluminium silicate	Zeolite
1.0 nm	13A/X	Sodium aluminium silicate	Zeolite

Physical properties

The molecular sieve crystallites obtained by hydrothermal manufacture are formed into rods and beads using 1 – 2 % clay as a binding agent. Vibration caused by transport may bring about some abrasion which collects in the first fraction during dynamic drying.

Bulk density	0.75 kg/l
Surface (BET)	800 m^2/g
Form supplied	Powder, beads (~ 2 mm), rods (~ 1.6 mm, ~ 3.2 mm)
Effective pore diameter depending on type	0.3, 0.4, 0.5 or 1.0 nm
Hollow space volume	0.3 cm^3/g
Specific heat	>0.8 KJ/kg
Heat of absorption per kg adsorbed water	4200 KJ

Ordering information Drying agents P-S

Phosphorus pentoxide [P_2O_5]	CAS No.	Content	Packaging	Ord. No.
di-Phosphorus pentoxide extra pure	1314-56-3	1 kg	Glass bottle	**1.00540.1000**
		25 kg	Plastic drum	**1.00540.9025**
di-Phosphorus pentoxide for analysis ACS, ISO, Reag. Ph Eur	1314-56-3	100 g	Glass bottle	**1.00570.0100**
		500 g	Glass bottle	**1.00570.0500**

For drying	Neutral and acid gases, saturated alipathic and aromatic hydrocarbons, nitriles, alkyl and aryl halogenides and carbon disulfide.
Unsuitable for drying	Alcohols, amines, acids, ketones, ethers, chlorinated and fluorinated hydrocarbons.
Residual water content in air	0.00002 mg H_2O/l to 25 % water absorption with SICAPENT®, corresponding to 2 mole H_2O per mole P_2O_5.
Capacity	P_2O_5: 40 % SICAPENT®: 33 %
Application note	On adsorbing water, phosphorus pentoxide becomes covered with a film of polymetaphosphoric acid which hinders the diffusion of H_2O molecules. This effect can be avoided by using SICAPENT® as the polymetaphosphoric acid formed from P_2O_5 and water is immediately adsorbed by the carrier substance. As a result, the drying agent is available as a fine, flowable granulate.
Regeneration	Not possible

Potassium carbonate [K_2CO_3]	CAS No.	Content	Packaging	Ord. No.
Potassium carbonate for analysis EMSURE® ACS, ISO, Reag. Ph Eur	584-08-7	500 g	Plastic bottle	**1.04928.0500**
		1 kg	Plastic bottle	**1.04928.1000**
Potassium carbonate for analysis EMSURE® ACS, ISO, Reag. Ph Eur	584-08-7	50 kg	Fibre carton	**1.04928.9050**

For drying	Ammonia, amines, acetone, nitriles, chlorinated hydrocarbons.
Unsuitable for drying	Acids, substances that tend to react when exposed to water-removing basic conditions.
Application	Drying liquids.
Regeneration	At 160°C; becomes finely powdered from 100°C.

Potassium hydroxide [KOH]	CAS No.	Content	Packaging	Ord. No.
Potassium hydroxide pellets for analysis EMSURE®	1310-58-3	500 g	Plastic bottle	**1.05033.0500**
		1 kg	Plastic bottle	**1.05033.1000**
		5 kg	Plastic bottle	**1.05033.5000**
		25 kg	Fibre carton	**1.05033.9025**
		50 kg	Fibre carton	**1.05033.9050**

For drying	Basic liquids, e.g. amines and inert and basic gases.
Unsuitable for drying	Acids, acid derivatives (chlorides, anhydrides, amides, nitriles).
Application	Drying liquids. Not suitable for drying fast-flowing gases as this hinders diffusion due to deliquescence. Can be used for drying gases if, apart from moisture, acid gas should be adsorbed.
Residual water content in air	0.002 mg H_2O/l

di-Phosphorus pentoxide

SICAPENT®	CAS No.	Content	Packaging	Ord. No.
SICAPENT® with indicator (phosphorus pentoxide drying agent for desiccators) on inert carrier material	–	500 ml	Glass bottle	**1.00543.0500**
		2.8 l	Glass bottle	**1.00543.2800**
Composition	25 % inert inorganic carrier substance and 75 % phosphorus pentoxide.			
Particle size of carrier	0.1 – 1.6 mm			
Bulk density	approx. 300 g/l			
Flowable up to	100 % water uptake			
Indicator content	0.1 %			
Water content / Indicator color	**H_2O content [%]**	**Indicator color of drying agent**		
	0	Colorless		
	20	Green		
	27	Blue-green		
	33	Blue		
Application note	The main advantage of using granulated drying agents is the ease of use. Even after significant water uptake (approx. 100 % of its own weight) the substance remains in particle form. Hence, subsequent to the drying process the drying agent can easily be removed from the vessel. SICAPENT® dries well due to its large surface area; it is some 20 % faster than simple phosphorus pentoxide. In other terms, 20 % more water is adsorbed in the same time.			
Application	Drying liquids, filling drying tubes. Due to its high intensity and granulate form, it is particularly suitable for drying fast-flowing gases in drying tubes.			
Safety information	On opening the bottle, fine particles of drying agent may spray out; hence when opening the bottle adhere to the instructions on the label and open carefully whilst wearing safety spectacles.			

Ordering information Drying agents S

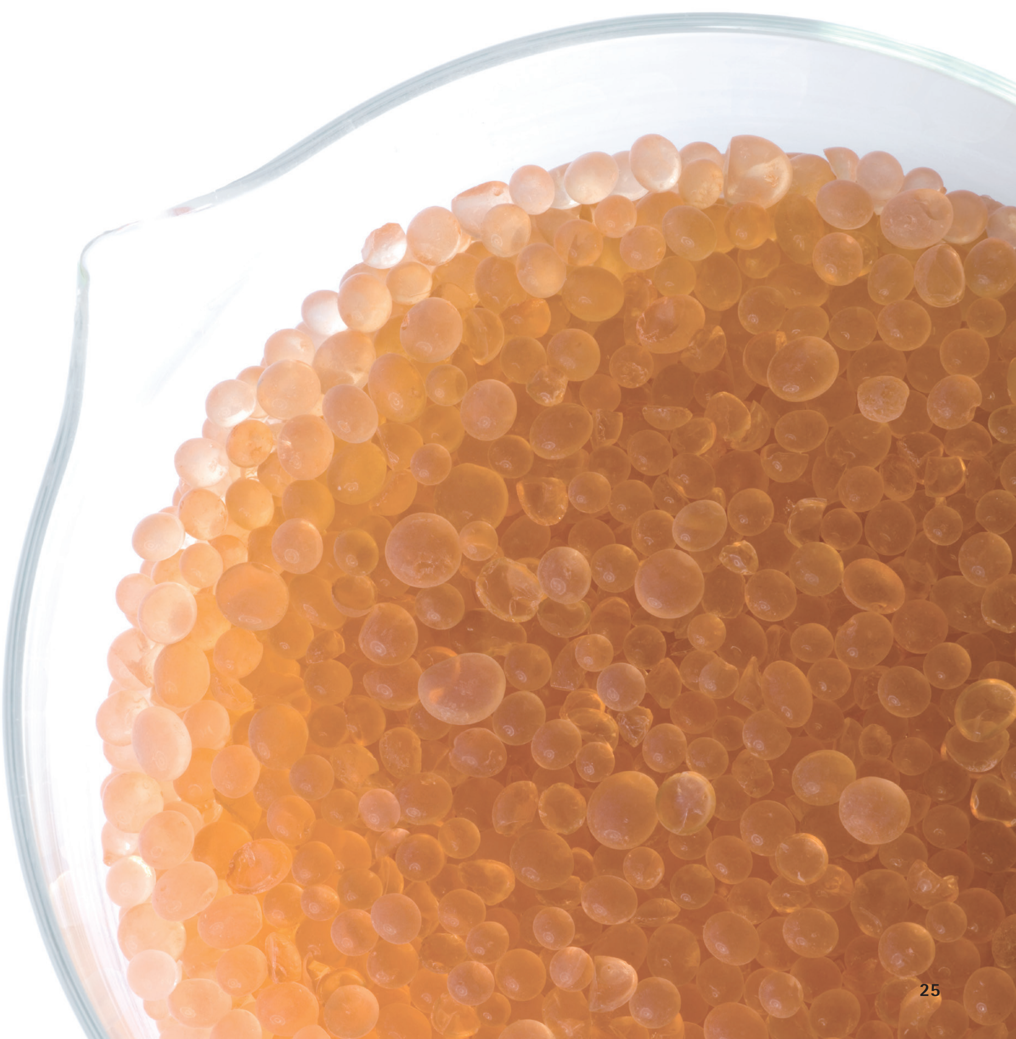
Silica gel [SiO_2]	CAS No.	Content	Packaging	Ord. No.
Silica gel granules, desiccant ~ 0.2 – 1 mm	7631-86-9	1 kg	Plastic bottle	**1.01905.1000**
Silica gel granules, desiccant ~ 2 – 5 mm	7631-86-9	1 kg	Plastic bottle	**1.01907.1000**
		5 kg	Plastic drum	**1.01907.5000**
Silica gel with moisture indicator (brown gel) desiccant ~ 1 – 4 mm	–	1 kg	Plastic bottle	**1.01972.1000**
		5 kg	Plastic bottle	**1.01972.5000**
		25 kg	Plastic drum	**1.01972.9025**
Silica gel with indicator (orange gel), granulate ~ 1 – 3 mm	–	1 kg	Plastic bottle	**1.01969.1000**
		5 kg	Plastic bottle	**1.01969.5000**
		25 kg	Plastic drum	**1.01969.9025**
Silica gel beads, desiccant ~ 2 – 5 mm	7631-86-9	1 kg	Plastic bottle	**1.07735.1000**

For drying	Practically all gases and liquids.
Unsuitable for drying	Alkaline liquids (bases and amines). Orange gel: strong acid and basic gases, organic solvents.
Application	In a desiccator, for protecting moisture-sensitive substances during storage and transport and for maintaining the dryness of anhydrous solvents, packing drying towers for gases or solvents.
Application temperature	Up to approx. 65°C the capacity is practically temperature-independent. At higher temperatures the capacity decreases significantly.
Advantages of white gel	Practically chemically inert, non-toxic, no disposal problems, easy-to-handle. Dried liquids can simply be decanted.
Residual water content in air	Min. 0.02 mg H_2O/l, corresponding to a dew point of -55°C. The less loaded silica gel is with water, the more intensive it dries and the lower the residual water content.

Loading in g H_2O / 100 g	Residual water content mg H_2O/l
1	0.003
1.5	0.1
3.2	0.5
5.2	1
14	5
23	10
30	13

Capacity	20 – 27 % at 25°C. If low residual water contents is to be attained, the capacity may only be partly utilized (see table above): if the desired residual water content of 1 mg/l is to be attained, the loading may not exceed 5.2 g H_2O / 100 g silica gel.

Silica gel [SiO_2] – continued		
Indicator change in orange gel	At approx. 7 – 10 g adsorbed H_2O / 100 g silica gel, the color change is from orange to colorless.	
Indicator change in brown gel	At approx. 7 – 10 g adsorbed H_2O / 100 g silica gel, the color change is from brown to yellowish.	
Regeneration	**Regeneration Silica Gel**	**Temperature / duration in a drying oven**
	White-Gel	Approx. 100 – 180°C / approx. 3 hours
	Orange-Gel	Approx. 130 – 140°C / approx. 3 hours
	Brown-Gel	Approx. 120 – 150°C / approx. 3 hours
	Silica gel is no longer capable of drying	Above 500°C
Typical chemical and physical data	**Analytical data**	98 % SiO_2, remainder Al_2O_3, TiO_2, Fe_2O_3
	Indicator in orange gel	Iron salt
	Indicator in brown gel	Iron salt
	Bulk density	Approx. 0.7 kg/l
	Surface (BET)	700 m^2/g
	Particle size	0.2 – 1 mm, 1 – 3 mm, 2 – 5 mm
	Pore size	2.0 – 2.5 nm
	Specific heat	Approx. 1 KJ/kg°C
	Heat of adsorption per kg adsorbed water	3200 KJ



Ordering information Drying agents S-Z

Sodium [Na]		CAS No.	Content	Packaging	Ord. No.
Sodium rod diameter 2.5 cm (protective liquid: paraffin oil)		7440-23-5	250 g	Glass bottle	**1.06260.0250**
			1 kg	Glass bottle	**1.06260.1000**
Sodium rods (protective liquid: paraffin oil) for synthesis		7440-23-5	250 g	Glass bottle	**8.22284.0250**
			1 kg	Glass bottle	**8.22284.1000**
For drying	Ethers, saturated aliphatic and aromatic hydrocarbons, tertiary amines.				
Unsuitable for drying	Acids, acid derivatives, alcohols, aldehydes, ketones, alkyl and aryl halogenides; these can give rise to extremely vigorous, explosive reactions.				
Application	As sodium wire using a sodium press for drying liquids. Caution! Sodium reacts explosively with water. Sodium waste should be disposed of using a high-boiling alcohol e.g. tert-butanol.				
Capacity	Stoichiometric				
NB	Practically all solvents which can be dried with sodium can also be more intensively dried with calcium hydride.				

Sodium hydroxide [NaOH]		CAS No.	Content	Packaging	Ord. No.
Sodium hydroxide pellets for analysis EMSURE® ISO		1310-73-2	500 g	Plastic bottle	**1.06498.0500**
			1 kg	Plastic bottle	**1.06498.1000**
			5 kg	Plastic bottle	**1.06498.5000**
			25 kg	Fibre carton	**1.06498.9025**
			50 kg	Fibre carton	**1.06498.9050**
For drying	Basic liquids, e.g. amines and inert and basic gases.				
Unsuitable for drying	Acids, acid derivatives (chlorides, anhydrides, amides, nitriles).				
Application	Drying liquids. Not suitable for drying fast-flowing gases as pore diffusion is hindered by deliquescence. Can be used for drying gases if acid gas also has to be adsorbed.				
Residual water content in air	0.002 mg H_2O/l				

Sodium sulfate [Na_2SO_4]		CAS No.	Content	Packaging	Ord. No.
Sodium sulfate anhydrous granulated for organic trace analysis EMSURE®		7757-82-6	500 g	Glass bottle	**1.06639.0500**
Sodium sulfate anhydrous, coarse granules for analysis 0.63 – 2.0 mm EMSURE® ACS		7757-82-6	500 g	Plastic bottle	**1.06637.0500**
			1 kg	Plastic bottle	**1.06637.1000**
			25 kg	Fibre carton	**1.06637.9025**
Sodium sulfate anhydrous for analysis EMSURE® ACS, ISO, Reag. Ph Eur		7757-82-6	500 g	Plastic bottle	**1.06649.0500**
			1 kg	Plastic bottle	**1.06649.1000**
			5 kg	Plastic bottle	**1.06649.5000**
			25 kg	Fibre carton	**1.06649.9025**
For drying	Almost all compounds including fatty acids, aldehydes, ketones and alkyl and aryl halogenides.				
Application	Drying liquids; of average effect.				
Regeneration	At 150°C in a drying oven.				

Sulfuric acid [H_2SO_4]	CAS No.	Content	Packaging	Ord. No.
Sulfuric acid 95 – 97 % for analysis EMSURE® ISO	7664-93-9	1 l	Glass bottle	**1.00731.1000**
		1 l	Plastic bottle	**1.00731.1011**
		2.5 l	Glass bottle	**1.00731.2500**
		2.5 l	Safebreak btl.	**1.00731.2510**
		2.5 l	Plastic bottle	**1.00731.2511**
		25 l	Plastic container	**1.00731.9025**

For drying	Air, gases such as hydrogen chloride, chlorine, carbon monoxide, sulfur dioxide, hydrocarbons and inert gases.
Unsuitable for drying	Oxidizing gases such as hydrogen sulfides and hydrogen iodides and unsaturated and numerous other organic compounds.
Application	Sulfuric acid is used in wash bottles for drying gases or in open dishes in desiccators. To increase the surface area and to avoid the risk of burns.

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