PRACTICAL KNOWLEDGE GUIDE

DEHUMIDIFICATION

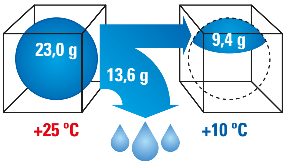
EVERYTHING YOU NEED TO KNOW!

TROTEC
AT WORK.

HUMIDITY – ABSOLUTE OR RELATIVE

DEHUMIDIFICATION

PRACTICAL INFORMATION ON THE DIFFERENT SYSTEMS AND THEIR APPLICATION POSSIBILITIES



Water vapour content of the air:

At a temperature of 25 °C, one cubic metre of air can absorb max. 23 g of water; this would correspond to a humidity level of 100 %.

If the air cools down to 10 °C due to contact with cold surfaces, it can only absorb 9.4 g.

The excessive moisture then condenses to water on the cooler surfaces.

An ideal room climate is not only the basis of comfort but also a prerequisite for the value retention of humidity-sensitive furniture and the protection against moisture damage, mould formation and corrosion.

Two factors are decisive for these climate conditions: the room temperature and the relative humidity.

As illustrated in the comfort chart at the top of page 3, we feel most comfortable at temperatures between 20 and 22 °C and a relative humidity of 40 to 60 %. Climate conditions beyond these values are perceived as unpleasant by most people.

Moreover, too high humidity levels can cause the most varied types of damage. Often, the first visible warning signs are damp articles of clothing, a musty smell and stained walls (mould stains) or sprouting potatoes in basements.

For example, did you know that mould can already form at 70 % humidity – and rust at just 60 %?

If it is not controlled, the humidity level in a room can fluctuate significantly and rarely reaches the ideal values on its own – and it additionally also depends on the season and climatic conditions outdoors.

Influence of the room temperature on the water absorption capacity of the room air						
Room temperature		25 °C	20 °C	15 °C	10 °C	5 °C
EXAMPLE 1 Constant relative humidity	Relative humidity	80 %	80 %	80 %	80 %	80 %
	Water content of the room air	18.4 g/m³	13.8 g/m³	10.2 g/m³	7.5 g/m³	5.4 g/m³
EXAMPLE 2 Constant water content	Water content of the room air	5.4 g/m³	5.4 g/m³	5.4 g/m³	5.4 g/m³	5.4 g/m³
	Relative humidity	23.5 %	31.3 %	42.1 %	57.5 %	80 %

COMFORT CHART (according to Leusden and Freymark)

Temperature	0 %	10 %	20 %	30 %	40 %	50 %	60 %	70 %	80 %	90 %	100 %
26 °C	uncomfortable	uncomfortable	uncomfortable	still comfortable	still comfortable	uncomfortable	uncomfortable	uncomfortable	uncomfortable	uncomfortable	uncomfortable
24 °C	uncomfortable	uncomfortable	still comfortable	still comfortable	still comfortable	still comfortable	still comfortable	uncomfortable	uncomfortable	uncomfortable	uncomfortable
22 °C	uncomfortable	uncomfortable	still comfortable	still comfortable	comfortable	comfortable	comfortable	still comfortable	uncomfortable	uncomfortable	uncomfortable
20 °C	uncomfortable	uncomfortable	still comfortable	still comfortable	comfortable	comfortable	comfortable	comfortable	still comfortable	uncomfortable	uncomfortable
18 °C	uncomfortable	uncomfortable	uncomfortable	uncomfortable	still comfortable	still comfortable	comfortable	comfortable	still comfortable	uncomfortable	uncomfortable

Relative humidity

comfortable — still comfortable — uncomfortable, dry or humid

THEORY FIRST, PRACTICE SECOND

A basic knowledge of the subject of humidity is rather helpful for keeping your rooms ideally dry. The air cannot absorb an unlimited amount of water. There is a saturation limit, i.e. a maximum amount of water vapour that can be absorbed by the air in absolute terms. This is the absolute humidity, given in grams of water per cubic metre of air.

On that basis, the water vapour content that is actually dissolved in the air in relation to the water vapour quantity that the air could maximally absorb at the respective temperature is referred to as the "relative humidity" (RH).

This means that if the room air's relative humidity amounts to 50 %, for instance, exactly half of the maximum amount of water possible for the current temperature is dissolved in the air.

It is just a matter of temperature

The water absorption capacity of the air therefore always depends on the prevailing temperature. The cooler the air, the less water it can absorb. This is illustrated in the chart on page 2 on the basis of five temperature values.

In example 1, the relative humidity remains 80 %, whereas the corresponding absolute water content in the air fluctuates considerably depending on the temperature.

In example 2, the amount of water contained in the air in absolute terms remains identical, which is why the relative humidity increases while the temperature drops.

We have to admit that this is quite a complex matter – and it becomes even more complicated in view of the fact that corrosion, rotting and mould formation are only promoted by the **relative** humidity, and never by the **absolute** water content of the air.

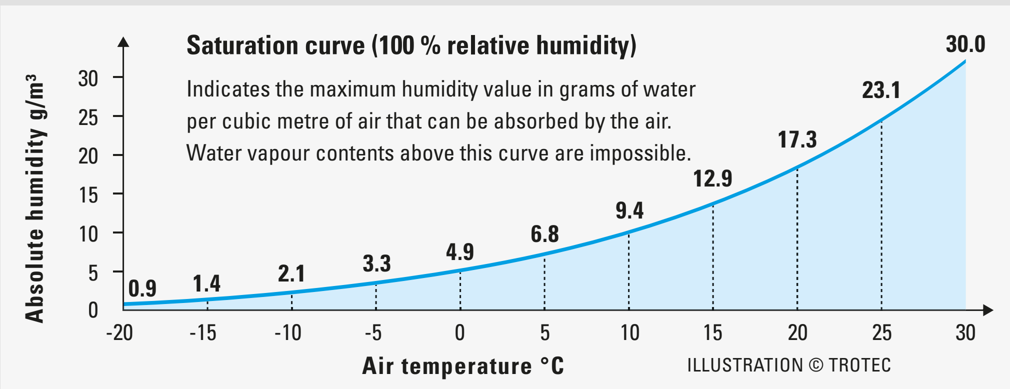
Only relative is absolutely relevant

So as demonstrated in example 2: at a room temperature of 5 °C and a water content of 5.4 g/m³ the relative humidity level would be 80 % – at which even metal corrodes – entailing the risk of mould formation, whereas the same water content at a room temperature of 25 °C leads to a relative humidity of only 23.5 %, which represents a much too dry room climate that irritates the respiratory system.

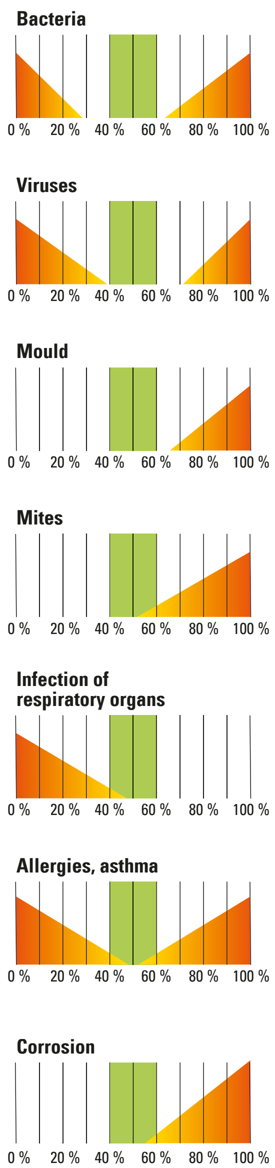
In this climate mould and rust would not stand a chance even though the room air still contains the same amount of water, namely 5.4 g/m³.

So all that matters is regulating the relative humidity level in a controlled manner. The absolute amount of moisture being withdrawn from the air is irrelevant; only the relative humidity level is important!

A basic understanding of these physical correlations is a crucial factor for implementing an effective dehumidification solution adapted to your application.



Influence of the relative humidity on human biological interactions:

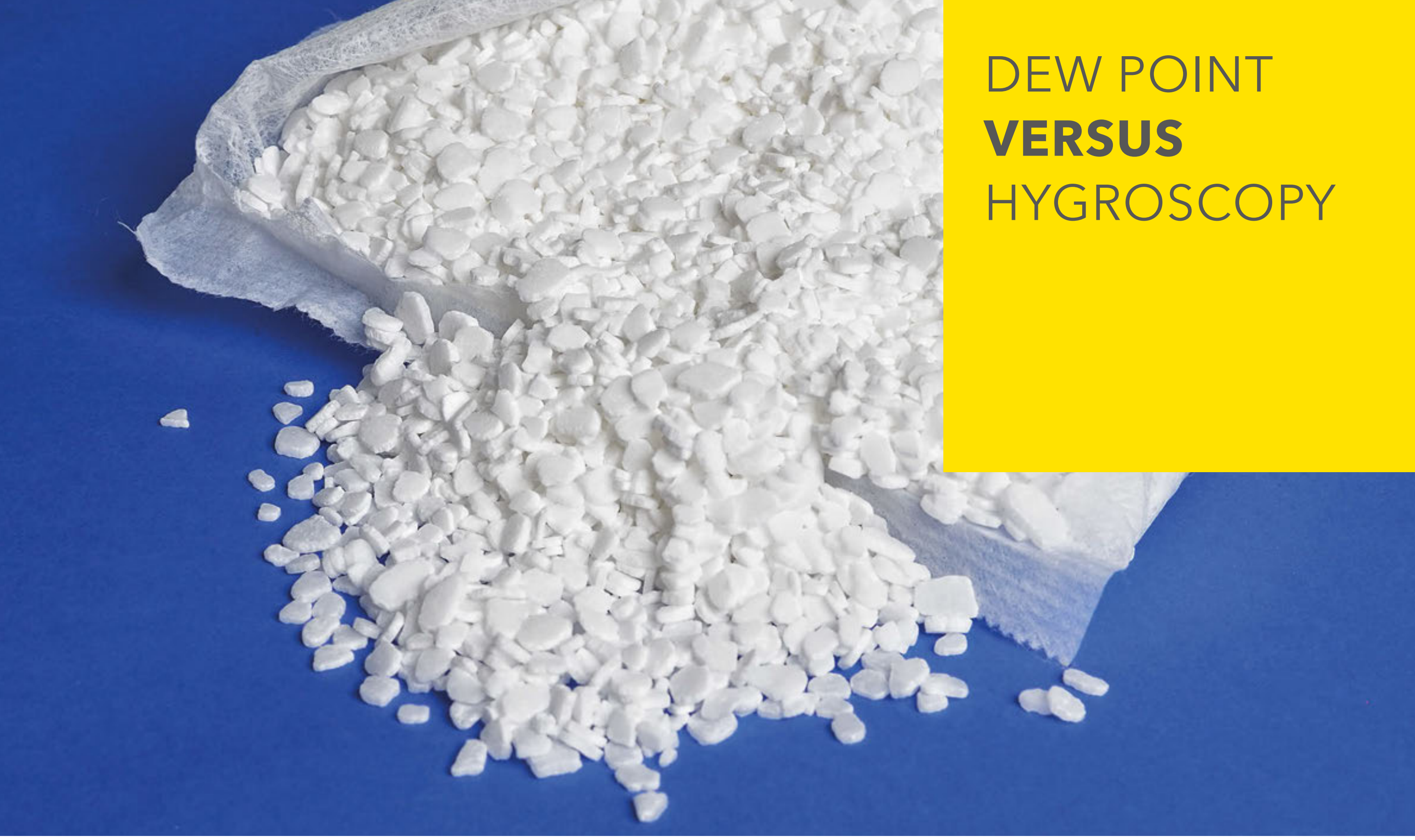


Healthy and pleasant room humidity level

Formation of biological organisms and interactions with human or environment

Representations according to Scofield/Sterling diagram

DEW POINT **VERSUS** HYGROSCOPY



The figure above shows the content of a typical refill pouch for passive dehumidification by means of granules. These disposable pouches usually contain highly hygroscopic salts such as calcium chloride serving as a drying agent that can withdraw moisture from the room air by desiccation.

In direct comparison with electrical dehumidification units with hot air regeneration, the cost-benefit ratio of such solutions is extremely poor.

Desiccant bags are mainly used for protection against temporary humidity damage during transport, for instance for shoes, electronic equipment, suitcases, bags or medicinal products.

DEHUMIDIFICATION METHODS

TWO TECHNIQUES – ONE OBJECTIVE: A CONTROLLED REDUCTION OF EXCESSIVE HUMIDITY

Before going into the details of the two dehumidification methods, we first have to dispel a myth:

Heating makes the air warmer, not drier

Heating is certainly not among the dehumidification methods! It is true that warm air can absorb more water than cold air. Thus, by heating the room air with a constant water content, the relative humidity level of this warm air would indeed be reduced at first.

But the hotter the air, the more it is surrounded by cold surfaces on which the moisture condenses. After all, heating alone cannot make moisture disappear – and therefore the water content of the air remains the same.

To withdraw moisture from the room air effectively and permanently, the only technical solution available is dehumidification, either by condensation or desiccation.

Condensation versus desiccation

All devices offered on the market with designations such as refrigerant dryer, condenser dryer, condensation dehumidifier, electric or Peltier dehumidifier are based on the principle of condensation.

On the other hand, there are technologies for desiccant dehumidification. These include the still widely advertised granules. However, truly effective, permanent dehumidification can only be achieved with this method when using electrical devices with hot air regeneration, more commonly known as desiccant dehumidifiers.

It is just a matter of technology

Even if many device designations on the market may vary, the devices usually belong to either of the two groups, and their names provide information on the dehumidification technology used.

Leaving aside the granules, the procedure is the same for all electrically operated devices: ambient air is sucked in by a fan, moisture is withdrawn from the air inside the device, and drier air is emitted into the room, which continuously mixes with the more humid room air until the desired humidity level is reached.

However, the dehumidification methods as well as the fields and limits of application of both device groups differ considerably.

CONDENSATION

As already shown in the saturation curve on page 3, the water absorption capacity of the air solely depends on its temperature. The lower the temperature, the less water can be bound by the air.

But what happens if the air enriched with water cools down abruptly, for example due to contact with a colder surface?

In this case, the saturation limit of 100 % RH is exceeded and the air can no longer bind the excessive moisture, which consequently condenses on the cold surface and turns into water.

Even air has to blow off steam sometimes

Since the water vapour condenses to water at this temperature limit, it is referred to as the dew point. You certainly know this phenomenon from cold glass bottles in the summer on which condensate forms, or from fogged window panes in the winter as well as bathroom mirrors while you are taking a shower. Even the foggy morning dew is a visible sign of moisture-saturated cold air.

So when air cools down, it can absorb less water vapour and the excessive moisture condenses on the colder surfaces.

This is the physical principle condenser dryers – also known as refrigerant dryers – are based on. They cool down the air flowing through the device to below its dew point and withdraw the moisture contained therein by condensation on a cold surface.

The market offer for refrigerant dryers ranges from powerful condenser dryers with compressor technology – so-called refrigerant compression dryers – to extremely compact electric or Peltier dehumidifiers with a low absolute energy demand, however, also a considerably lower active power and a substantially poorer energy balance.

Simply put, electric dehumidifiers require four times more energy than compressor devices to draw one litre of water from the air.

DESICCATION

While the dehumidification process is based on the dew point in case of condensation dryers, desiccant dehumidifiers use the principle of sorption. Here, the vapour pressure gradient between the humid air and a hygroscopic sorption agent is used for water withdrawal from the air.

This category also includes dehumidification granules, although they are at best suited for keeping the inside of small, closed containers dry.

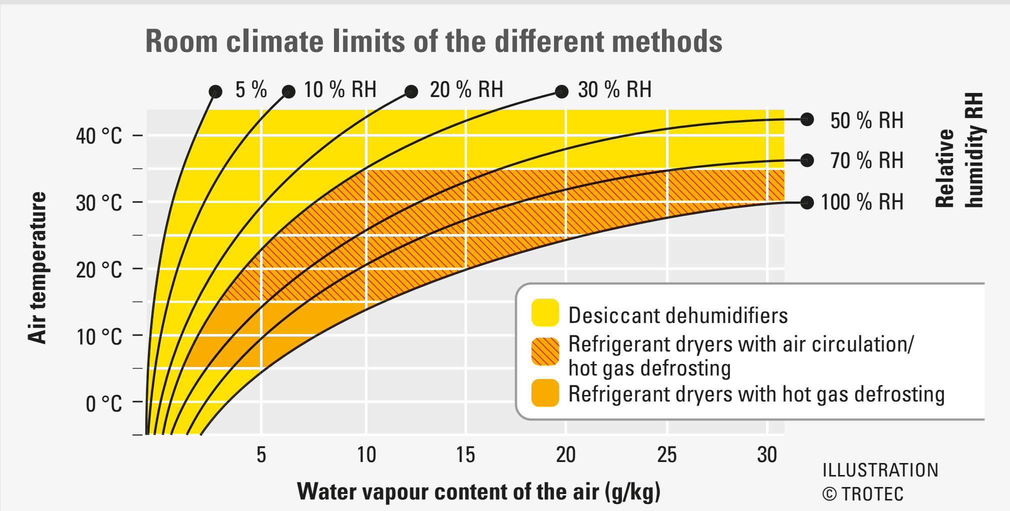
Granules – a rather bland solution

The original and main purpose of these pouches is to temporarily protect moisture-sensitive goods during transport and storage. Everyone knows the little bags that come in new handbags, electronic devices, pharmaceuticals or clothing.

Therefore, granules do not serve as a true alternative to dehumidifiers. Moreover, they are an uneconomical single-use solution requiring the user to regularly buy fresh granule bags for the receptacle since the granules are not regenerated. Much like a sponge, the desiccant permanently absorbs water from the air and must be replaced as soon as it is saturated – a highly cost-intensive and environmentally harmful procedure in the long run.

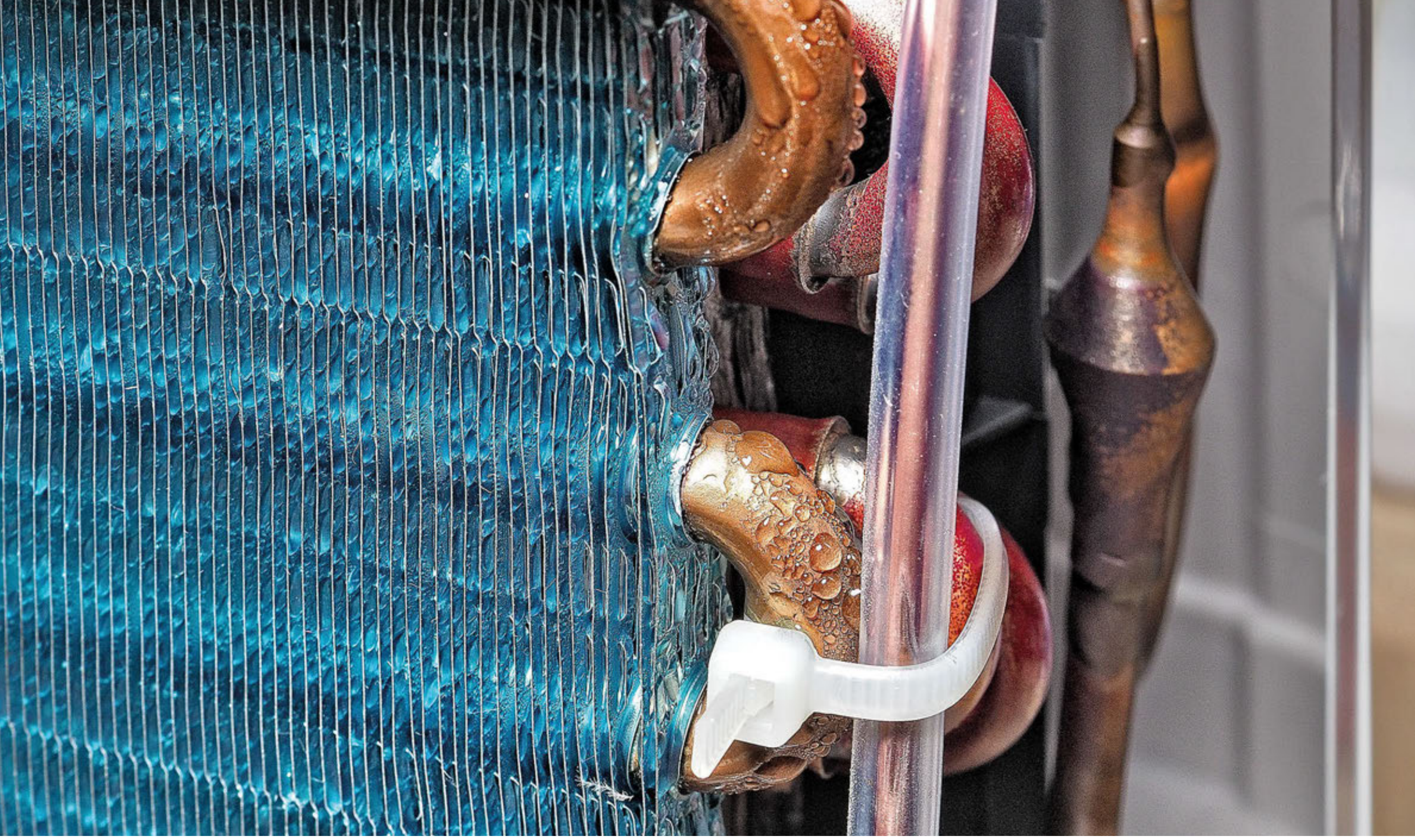
The case is different with electrical devices with hot air regeneration. They have an integrated, rotating desiccant wheel coated with highly hygroscopic materials such as silica gel or lithium chloride that withdraw the water molecules from the sucked in air flowing through the desiccant wheel.

To ensure that the desiccant wheel can take up moisture continuously, the latter must be given off again in some way. This is done by hot air generation: hot air is guided through a regeneration zone of the desiccant wheel and uses its thermal energy to remove the water vapour previously bound in the rotor from the silica gel.



Whether a hot shower, the morning dew or cold drinks, condensation is omnipresent in everyday life. Damp air reaches a colder environment or surface and condenses – the functional principle of refrigerant dryers.

Cat litter, too, works on the principle of desiccation. The extremely hygroscopic material soaks up any type of humidity and must be changed regularly.



Refrigeration drying live: the room air that is taken in is cooled to below its dew point at the dehumidifier's cold evaporator and water condenses on the fins and refrigerant line.

TECHNICAL DIFFERENCES AND FUNCTIONAL PRINCIPLE

CONDENSER DRYERS WITH COMPRESSOR TECHNOLOGY

Since most dehumidification tasks at home are carried out at temperatures between 12 and 25 °C, and thanks to its excellent ratio of price, performance and energy efficiency, this refrigerant dryer is among the most frequently used dehumidifiers in the private sector and building industry.

Compressor-operated condenser dryers work on the same principle as a refrigerator. The device houses a compression refrigeration system conveying a refrigerant through two heat exchangers – a condenser and an evaporator.

Made possible by abrupt cold shock

By means of a compressor and an expansion valve, the refrigerant is exposed to changing pressures within this closed circuit, which results in the gas heating up on the condenser side during compression, and abruptly cooling down far below the room temperature on the evaporator side during decompression.

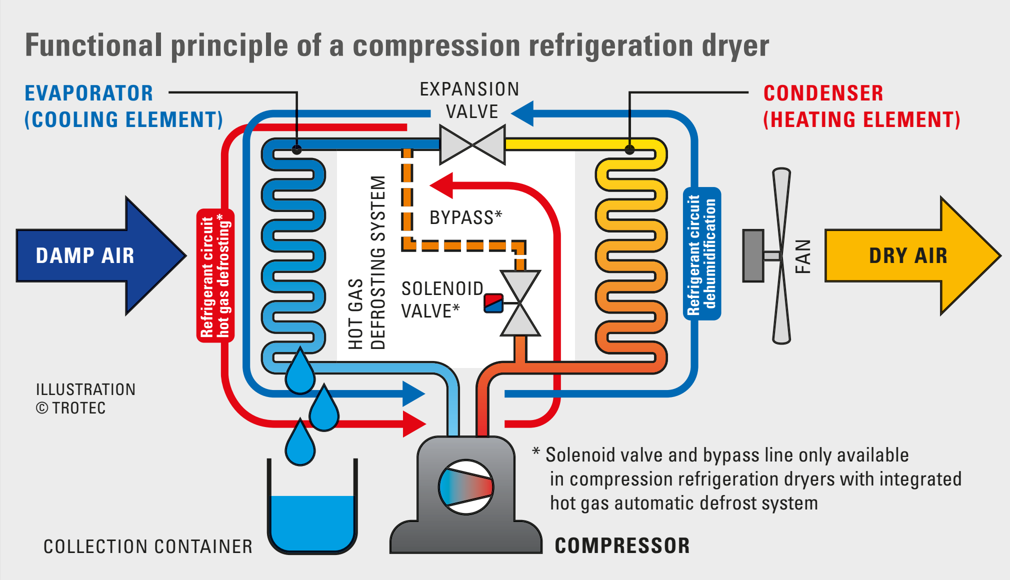
At the evaporator, the temperature is literally brought to a full stop – the air is abruptly cooled to below its dew point temperature, the moisture bound in the air condenses and turns into drops of water dripping into a collection container. The cold, dry air is now guided through the hot condenser, absorbs heat and then flows back into the room as dry, warm air before taking up moisture again.

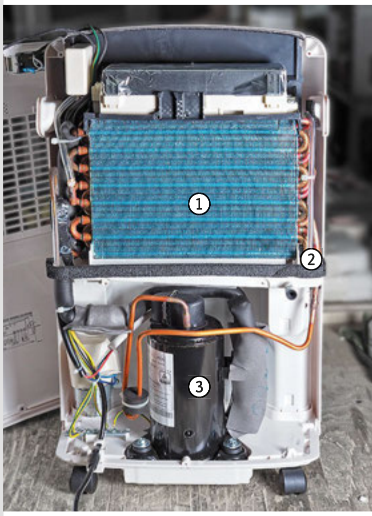
Ice doesn't stand a chance

Depending on the ambient temperature and humidity level, the evaporator can be extremely cold and there might be icing at its surface at room temperatures below 15 °C.

An increasing formation of ice virtually "clogs" the fins (icing) and reduces the device's dehumidification capacity.

This is why all compressor-operated condensation dehumidifiers are equipped with mechanisms for regular evaporator defrosting – usually by means of air circulation or hot gas, see types of defrosting on page 7. If there was no defrosting by air circulation or hot gas, the evaporator (cooling element) would freeze completely over time until a full-fledged "ice wall" would make any kind of air flow impossible.





A refrigerant compression dryer opened for servicing shows the heat exchanger integrated in the upper part of the device with the evaporator (1) at the front, on the cold surface of which the air condenses, and the channel (2) behind it serving to discharge the accumulated condensate into the water collection container. The compressor (3) for the refrigerant is integrated in the bottom part of the device.

TYPES OF DEFROSTING IN COMPRESSION REFRIGERATION DRYERS

AIR CIRCULATION DEFROSTING

With this method, defrosting usually takes place electronically in a time- or sensor-controlled manner by means of air circulation, which is why it is often referred to as electronic or electric defrosting:

if an increasing amount of ice forms at the evaporator, the compressor switches off and starts the defrosting process while the fan usually keeps running and circulates warm room air around the evaporator to remove the ice.

This technique has proven itself and works quite well in heated surroundings above approx. 15 °C.

If, however, such dryers are used in cooler environments – below 15 °C –, the surface temperature of the evaporator is below 0 °C. This leads to an intense ice formation at its surface, which must be defrosted almost permanently in case of air circulation defrosters as they require much more time for defrosting.

In cold surroundings like these, regular dehumidification becomes nearly impossible with dehumidifiers equipped with an air circulation defrost system as the devices are almost constantly busy defrosting themselves!

This is why – from an economic point of view – refrigerant dryers with an air circulation defrost system are almost always a good solution for all operating conditions in warm rooms with moderate air temperatures above 15 °C.

HOT GAS DEFROSTING

Dehumidifiers that are designed to be used in cooler rooms are equipped with a hot gas defrost system based on the bypass procedure instead of an air circulation defrost system.

Here, the hot refrigerant gas of the compression circuit is used actively for fast and effective defrosting. As soon as ice starts to form, a special solenoid valves opens automatically and redirects the hot gas from the compressor directly to the evaporator (instead of to the condenser) via a bypass. The valve closes again after defrosting is completed so that dehumidification operation can be continued via the regular refrigerant circuit.

Unlike air circulation defrosting, hot gas automatic defrosting allows for drastically shorter defrost phases of only a few minutes, which is an essential requirement for effective dehumidification in low-temperature surroundings such as unheated rooms. After all, the actual dehumidification process only takes place when defrosting is not in progress!

For the dehumidification of unheated rooms at temperatures that can sometimes be below 15 °C, dehumidifiers with hot gas automatic are therefore always better suited and more efficient than devices with air circulation defrost function despite identical compressor performance. At temperatures of more than 15 °C, however, the capacity of these two dehumidifier types is increasingly assimilating until being virtually identical above temperatures of approx. 18 °C.

Conclusion: Refrigerant dryers with a hot gas defrost system are versatile all-rounders since their defrost system enables operation at ambient temperatures ranging from 5 °C to 35 °C. This is why the devices can be used variably in warm and cold rooms – both in the summer and in the winter. For process-related reasons, the use of a device with an air circulation defrost system, on the other hand, is only reasonable at temperatures between 15 °C and 35 °C from an economic and energetic point of view.

Exemplary comparison showing the size of a typical Peltier element as used in the small electric dehumidifiers.

The illustration on the right shows an open electric dehumidifier with a Peltier element behind a screwed off refrigeration unit.

Trotec's ultra-compact Peltier dehumidifier TTP 2 E – just as small as an A5 sheet of paper and almost noiseless.

Side note:

In order to upgrade a Peltier dryer in a way that it has the same power as a refrigerant dryer, it would be necessary to install 40 or 80 Peltier elements in parallel in one single device – depending on the desired dehumidification capacity of e.g. 10 or 20 litres in 24 hours.

This would not only tremendously increase the dehumidifier's dimensions, but also its power consumption. Alternatively, you could of course distribute 40 or 80 individual Peltier devices throughout the room. Certainly an eyecatcher ☺.

CONDENSER DRYERS WITH PELTIER TECHNOLOGY ALSO KNOWN AS ELECTRIC OR SEMICONDUCTOR DEHUMIDIFIERS

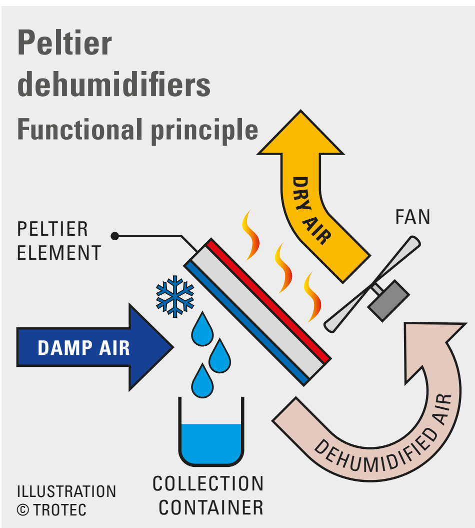
Just like in compressor-operated condenser dryers, a cold surface must be generated inside this type of dehumidifier. The temperature of this surface must lie below the dew point of the air so that water can condense on it.

Peltier dehumidifiers, however, do not use a compression refrigerant machine to dehumidify the room air but an integrated Peltier element – sometimes referred to as TEC (thermoelectric cooler).

These compact, thermoelectric converters are based on the eponymous Peltier effect which, if current flows between the two parts of the element's plate, causes one element side to become very hot and the other side to become very cold – with a temperature difference of up to 70 °C between the hot and cold side.

Peltier elements are ultra-compact and are used, for instance, in mini refrigerators, mobile camping coolers or for cooling PC elements.

Peltier condenser dryers have an integrated fan that sucks in the room air and guides it past the cold element side, where it is cooled to below its dew point, condenses at the surface and drips into a collection container.



The dry air is then guided past the hot element side, absorbs the heat and flows back into the room as warm, dry air.

For process-related reasons, condenser dryers with Peltier technology do not require any defrost system, which is why they can be designed to be extremely compact and very silent due to the lack of compressor noise.

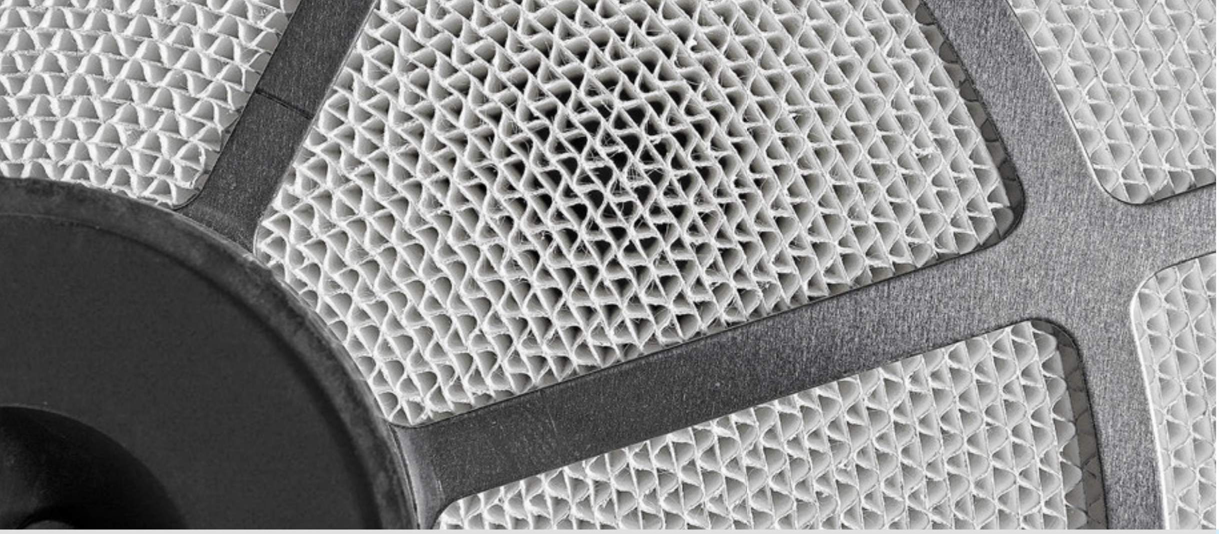
However, these dehumidifiers only have a relatively small operating range and low efficiency, which is only approximately maximally 25 % of the compressor efficiency, so that thermoelectrics are not an alternative to the widespread refrigeration compression technology. Also especially because the performance of single Peltier elements cannot be scaled to increasing values at will.

This is why comparative efficiency values – e.g. litres per kWh, as they can sometimes be found with competitive devices – should be taken with a grain of salt. It is like comparing apples to oranges, because Peltier dehumidifiers are not scalable and cannot achieve dehumidification performances anywhere near those of refrigerant dryers. In practice, a 24 hour dehumidification process will not yield more than a small glass of water (0.1 - 0.2 l).

Dehumidifiers with Peltier and compressor technology can only be compared to a limited extent since they were designed for different ranges of application.

Being a long-time leader in the mobile dehumidification market, we are of the opinion that Peltier devices are only suitable for closed rooms with very small dimensions (2 - 10 m³) and without any moisture input, for instance closets and shoe cabinets, pantries or small, windowless lavatories.

Peltier devices are not able to permanently dehumidify entire rooms, even if some advertisements may suggest so.



Detailed view of the desiccant wheel of the comfort desiccant dehumidifier TTR 57 E. The rotor is coated with silica gel, a desiccant with a very large hygroscopic surface.
In professional industrial desiccant dehumidifiers, each gram of this desiccant has a surface of more than 700 square metres. This means that less than 10 grams have a surface as large as an entire football pitch.

DESICCANT DEHUMIDIFIERS

INDUSTRIAL DEVICES WITH MOIST AIR DISCHARGE

Professional desiccant dehumidifiers are mostly used in the commercial and industrial sector, where large amounts of sometimes extremely dry air are required also at low temperatures. Both economically and technically, this can only be achieved using desiccant dehumidifiers.

Compared with solutions for private users, commercial desiccant dehumidifiers come with less comfort equipment and are instead designed to offer robustness, durability, a long lifetime and a high dry air flow rate. Not least owing to this high air flow rate, the moisture is not condensed inside these devices, but is blown out directly in the form of hot water vapour or discharged via a hose or channel connection – as you may know from your clothes dryer at home.

Therefore, when choosing your device, make sure not to select an industrial unit for private use since the latter are not equipped with integrated water collection containers.

COMFORT DEVICES WITH CONDENSER

These devices designed for private use work on the same principle as desiccant dehumidifiers for commercial applications.

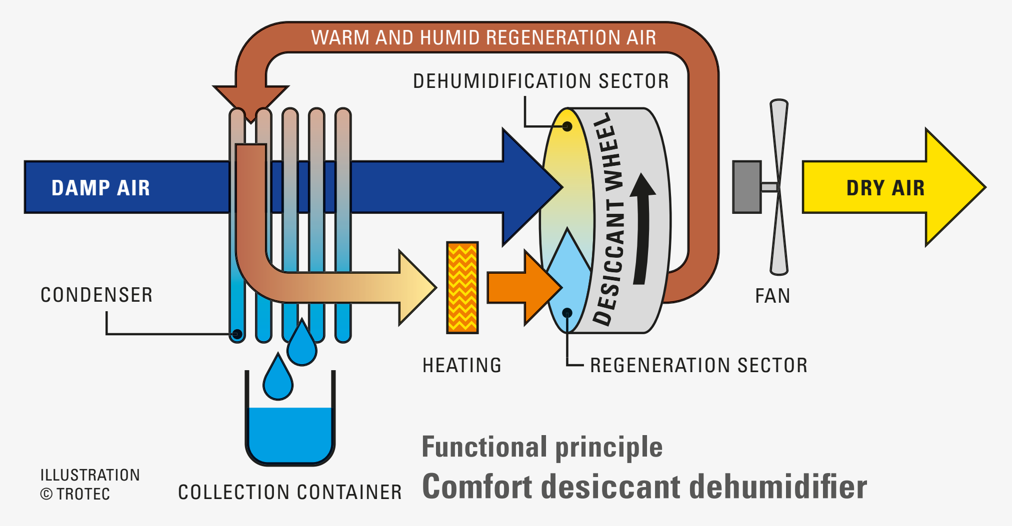
The sucked-in room air is guided through the dehumidification sector of a rotating desiccant wheel coated with a hygroscopic sorption agent on which the moisture from the air deposits. The dehumidified, dry air is then blown out into the room again.

To remove the water from moisture-loaded desiccant wheel, warm air heated by a heating element flows through a separate regeneration sector of the desiccant wheel in a continuous circuit. Owing to its temperature, the air can take up the moisture from the desiccant wheel and then guides it through a condenser element.

The cooler intake air simultaneously circulates around the condenser element, which is why the water inside the element condenses and drips into a water tank. The regeneration air is then refed to the heating element in a constant circuit to take up new moisture.

The figure above shows the inside of Trotec's TTR 300 including the desiccant wheel. Even though this industrial desiccant dehumidifier is very compact, it is not suited for typical applications at home due to the missing water collection container.

For such purposes, special comfort desiccant dehumidifiers such as the TTR 57 E with an integrated water collection container and washable air filter are available:



Functional principle
Comfort desiccant dehumidifier

DEHUMIDIFIER SELECTION – WHICH PROCEDURE FOR WHICH PURPOSE?

SELECTION FACTOR ROOM TEMPERATURE

The average air temperature in the room to be kept dry is the most important decision criterion for selecting a suitable dehumidifier.

High performance below 8 °C

In unheated basements, weekend homes or cooler rooms with an average room temperature below 8 °C during the wintertime, we recommend using a desiccant dehumidifier. Their functional principle makes it possible to keep environments permanently and effectively dry even at low temperatures.

Even if the temperature occasionally rises to 12 °C, these devices still work satisfactorily. Above 12 °C, however, their energy balance becomes worse and using them is no longer reasonable from an economic point of view.

All-rounders from 5 to 35 °C

As of an average room temperature of 8 °C, it is generally possible to use refrigerant dryers for dehumidification.

If the temperatures permanently drop below 15 °C during the winter months, it is absolutely necessary to use a device with a hot gas defrost system.

These all-rounders can be used variably throughout a very large temperature range, while using refrigerant dryers with an air circulation defrost system for dehumidification is only reasonable at average temperatures above 15 °C – see also figure on page 5.

SELECTION FACTOR OPERATING COSTS

When it comes to the cost-benefit effect and dehumidification performance in relation to power consumption, the compressor-operated condenser dryer can very clearly claim victory in almost all fields of application.

Peltier condenser dryers, on the other hand, are less expensive to buy and more energy-saving at first sight, but they are also characterized by a significantly lower dehumidification performance and an approx. 400 % higher power consumption for each litre of condensate that is dehumidified.

The power consumption of desiccant dehumidifiers can be up to 100 % higher in direct comparison with compression refrigerant dryers. However, the operating costs rather take a back seat when choosing a desiccant dehumidifier, since certain application requirements can only be realized using this type of dehumidifier.

SELECTION FACTOR EFFECTIVE RADIUS

Compressor refrigerant dryers – great for any room size

The larger the room to be kept dry, the more favourable becomes the use of a compressor refrigerant dryer. This device group offers the largest range of differently powerful fan/condenser combinations for private users.

To keep large rooms dry, the dehumidifier must be supplied with large amounts of damp air, which requires a powerful fan. And to dehumidify these air volumes effectively, the device's condenser must be equally powerful.

Therefore, when selecting a device, do not only pay attention to the room size suitability specified by the manufacturer, but also check these values for reasonability based on the air flow rate, power consumption and dehumidification specifications. A simple rule of thumb: There is no such thing as "many litres for only a few watts", even if this is something often insinuated by many providers ☺.

Peltier dehumidifiers – specialists for small volumes

Peltier dehumidifiers are no conventional room air dehumidifiers, for they were not designed to dehumidify entire rooms but rather to keep specific areas dry. The compact construction and silent operation predestine this device class to be used in closets and shoe cabinets, pantries or in some cases also in small, windowless bathrooms without much ingress of moisture (no shower), since Peltier dehumidifiers are on principle only suited for environments without any additional external moisture ingress (see "Infiltration" on page 11).

Granules

Such desiccants are mainly used to protect moisture-sensitive goods during transport and storage. Everyone knows these little bags that can be found in shipped goods such as electronic items, handbags, suitcases, shoes or medicinal products. Granule bags are very well suited for keeping such goods in confined containers dry.

But there are also larger bags combined with a receptacle available on the market as "dehumidifiers". Granules are, however, unsuitable for this purpose for several reasons.

On the one hand, their effect is limited to only a few cubic metres of ambient air and can only be noticed in areas without any additional external ingress of moisture (see "Infiltration" on page 11).

Furthermore, granule dehumidifiers are very expensive in relation to their drying performance since they are a single-use solution requiring the user to regularly buy new granule bags. Above that, granules remain silent and simply stop working once they are saturated with water. No pre-warning, no "tank full" message, simply no drying operation ☺.

Desiccant dehumidifiers – professional technology for small, cold rooms

Particularly in cool basements, unheated or only temporarily heated interior spaces, there is virtually no alternative to this device class.

Powerful compressor refrigerant dryers may also still operate quite effectively in environments with temperatures of at least 12 °C, but if the average room temperature constantly lies below 8 °C, desiccant dehumidifiers are able to reach the dehumidification performance required for dry keeping in a more efficient way.

Quick overview of application possibilities sorted by dehumidifier type	Condensation			Desiccation	
	Peltier (electrical)	Compressor		Granules	Desiccant wheel
		Air circulation	Hot gas		
Keeping very small closed areas dry (< 10 m³) without infiltration (moisture input)	■	□	□	■	□
Keeping rooms with temperatures from 0 to 8 °C dry	–	–	–	–	■
Keeping rooms with temperatures from 5 to 35 °C dry	–	–	■	–	□
Keeping rooms with temperatures from 15 to 35 °C dry	–	■	■	–	□
Construction drying	–	✷	✷	–	✷
Water damage restoration	–	–	✷	–	✷

– impossible; □ possible; ■ recommended; ✷ commercial types only, comfort dehumidifiers are not suited

LAST BUT NOT LEAST: **INFILTRATION**

What sounds like a term from a spy novel does not refer to the infiltration of hostile subjects, but of damp ambient air. For with regard to dehumidifier capacity calculation, "infiltration" refers to the external ingress of additional moisture into the room to be dehumidified.

Therefore, the infiltration factor plays an important role when calculating the dehumidification capacity required. After all, not only the air inside the room contains humidity. Additional moisture penetrates into the room from outside, for example due to the condition of the building's insulation, through door gaps, or when doors, windows etc. are opened.

TTK 100 E TTP 2 E TTR 57 E

Offering the world's largest range of dehumidifiers, Trotec has the ideal comfort dehumidifier for every demand. Representative for the variety of our devices the exemplary size comparison from left to right shows the condenser dryer TTK 100 E, which for example already achieves the whole daily capacity of a Peltier dehumidifier in 10 minutes, the ultra-compact TTP 2 E with Peltier technology and the adsorption dehumidifier TTR 57 E for cool, unheated rooms.

For instance, if you want to dehumidify a room with a temperature of 20 °C from a relative humidity of 80 % to 60 %, the water content must be reduced from 13.8 g/m³ (80 % RH) to 10.4 g/m³ (60 % RH), i.e. by 3.4 g per cubic metre of air.

This amounts to 340 g or ml in a room with 100 cubic metres of air, right? No. The moisture introduced from outside must also be taken into account.

If we assume an outdoor climate of 25 °C and 70 % RH, the water content of the outdoor air is 16.2 g/m³, i.e. 5.8 g more than inside. Casually speaking, this moisture would like to mix with the indoor air, which, however, happens only partially as the room is closed and well insulated. This is where the infiltration factor comes into play, which is 0.3 for well insulated rooms, for instance.

Hence, every hour 5.8 g/m³ x 100 m³ x infiltration factor 0.3 l/h = 174 g/h (0.174 l) would be introduced from outside, which corresponds to a daily water volume of 4.176 litres (0.174 l x 24) to be dehumidified.

"Moisture factory human being"

But additional moisture is also introduced from inside. As in the case of infiltration, this factor additionally increases the moisture load. A single pot plant adds about 150 ml of moisture to the room air every day. This is already more than a typical Peltier device can dehumidify on average within 24 hours. However, the moisture load factor becomes even more influential if persons are present.

During sleep, every human being produces approx. 50 ml of moisture per hour that is given off to the room air through the skin. This value increases to 70 ml during easy sedentary activities and exceeds 100 ml during household activities. The moisture ingress must therefore be taken into consideration when selecting a dehumidifier.

It goes without saying that you cannot use a Peltier device to keep a bedroom dry if two sleeping persons alone add 800 ml of moisture to the room air during eight hours of sleep, while a Peltier dehumidifier in practice has a dehumidification capacity of only maximally 300 ml in 24 hours, for instance. In the morning, the air would be more humid than on the day before.

Considering that up to 2 litres of water are emitted into the ambient air when cooking food and even 2.5 litres when taking a shower, it soon becomes clear that all applications involving an additional moisture load are a hopeless endeavour for Peltier devices or granules!

Therefore, when planning your requirements, always include power reserves for the additional moisture load.

The easiest way is to rely on Trotec's application recommendations for the respective device, for here all typical parameters of use are already taken into account.

Trotec GmbH

Grebbener Straße 7
52525 Heinsberg
Germany

Phone +49 2452 962-400
Fax +49 2452 962-200

info@trotec.com
www.trotec.com

Practical knowledge concerning dehumidifiers

Condenser dryer or desiccant dehumidifier, refrigerant compression or Peltier technology, air circulation or hot gas defrosting? If you are looking for the ideal device to provide an optimum room climate with perfect humidity values, you may easily lose track of things in view of the manifold options and techniques.

Benefit from the comprehensive overview of the device differences, functional principles and possible applications provided in this brochure.

After all, the Trotec Group is one of the prime international addresses for professional complete solutions regarding climate control and measuring technology for building diagnostics. We step up to both industrial customers and private end users.

We can offer our industry expertise acquired over many years, products of a high quality and a comprehensive range of services – all from a single source!

You have questions? We will be pleased to advise you personally and in detail. Feel free to contact us by phone or e-mail – we look forward to your inquiry.

TRT-BRPW-LUEN-WM-04-EN

TÜV SÜD ISO 9001

TROTEC
AT WORK.