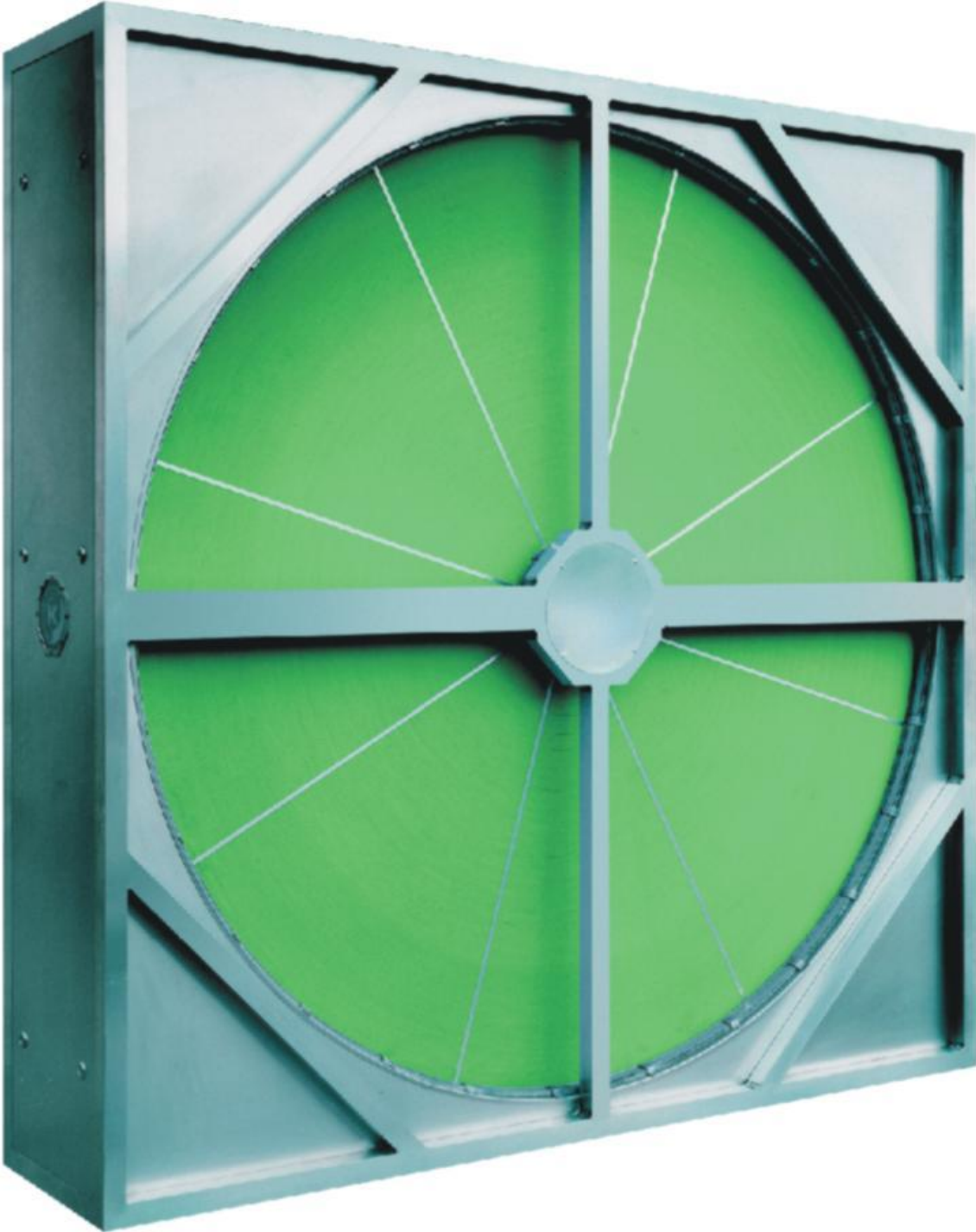
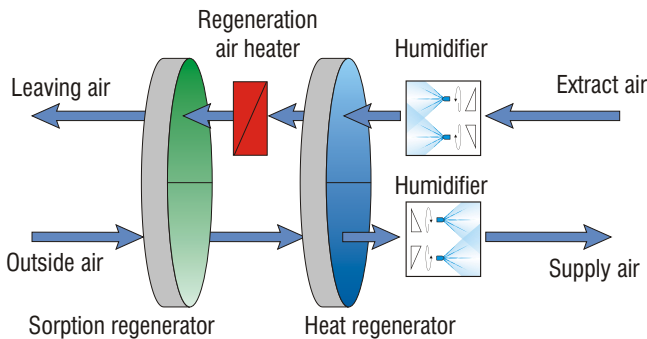


# Examples of the use of the SECO Desiccant/enthalpy regenerator



**KLINGENBURG**  
ENERGY RECOVERY

# Use of the Sorption Regenerator for the classic DEC



At high outside-air humidities (sultriness), SECO achieves better dehumidification than silica-gel rotors at the same regeneration temperature  
 Sorption regenerators are usually the investment-intensive components; on the other hand, the price/performance ratio is improved in the case of SECO  
 No risk of icing  
 DEC installations are pure outside-air installations; they do not require any Re-circulating air

## Description of the Installation

The SECO has the task of dehumidifying the outside air to such an extent that a sufficiently great temperature reduction of the supply air can be achieved by the downstream components in the form of the indirect and direct evaporative cooling.

If the installation is correctly designed, it is possible to achieve a supply air temperature of about 19 - 20°C (66 - 68°F). Because of the fans, additional heat which must be taken into consideration when the volumetric flow rates are stipulated is input into the process.

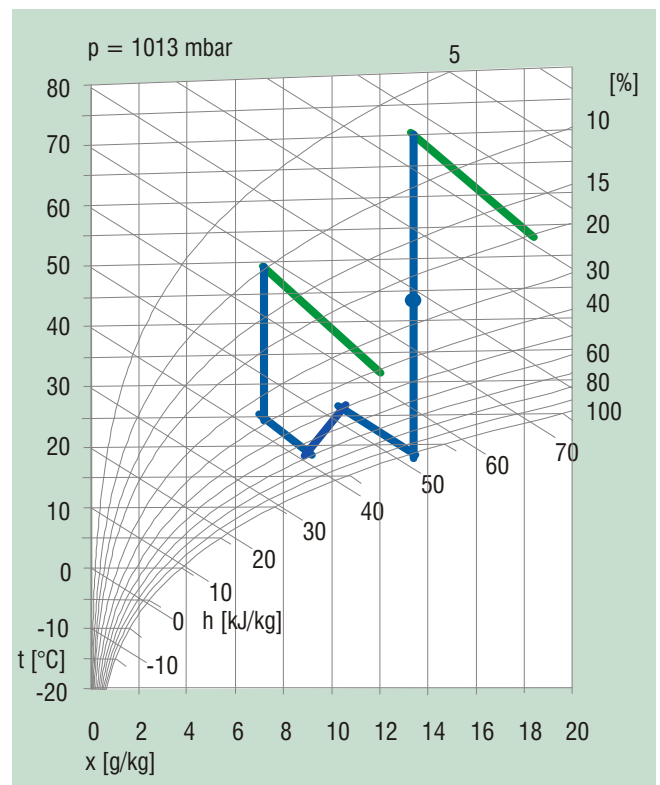
Because of the brush seal used on the SECO and on the heat regenerator as well, the total leakage of such an air-conditioning system is about 2 - 3 %. The leakages can be reduced further by installing purging zones.

## Applications

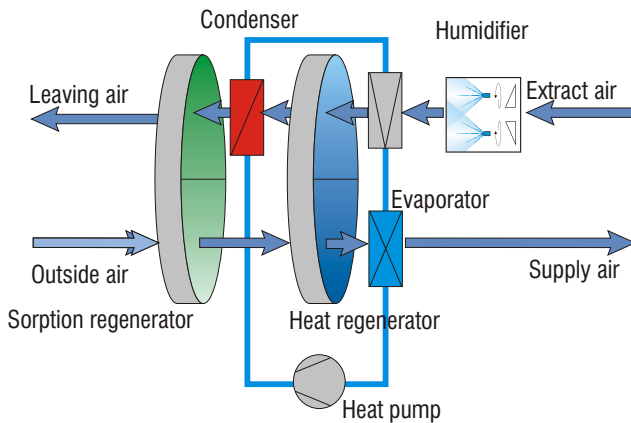
- Lecture hall
- Office and administration buildings
- Printing shop
- Hotels

## Advantages

- Use of waste heat, in summer unused district heating or solar energy
- Air conditioning without refrigeration engineering
- No cooling tower required
- Reduction in the connected electrical load
- Saving in humidifier capacity in winter as a result of humidity recovery
- Higher heat recovery in winter



# Sorptive Air Dehumidification in Combination with Heat Recovery and a Refrigerating Machine with Waste-Heat Utilisation (DEC Cascade)



## Description of the Installation

The SECO dehumidifies the outside air to such an extent as is necessary for compliance with the humidity of the supply air. A considerably lower dehumidification capacity and thus lower regeneration temperatures are required in comparison with the classic DEC installation.

The supply air is cooled down sensibly to about 16 - 18°C (61 - 64°F) by the direct evaporator of the heat pump. As a rule, there are thus no capacity restrictions in comparison with conventional air-conditioning engineering.

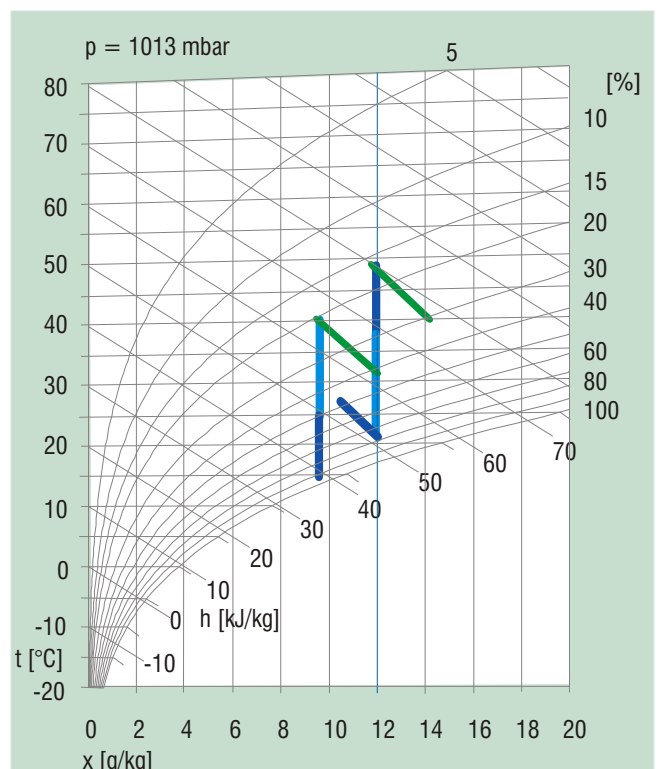
The thermal regeneration of the SECO takes place using the condenser heat. As a result of the internal cold/heat coupling, considerably better primary-energy utilisation is achieved than in the case of conventional air-conditioning processes. It is advantageous to use the indirect evaporative cooling in the transitional periods with high temperatures and low humidities.

## Applications

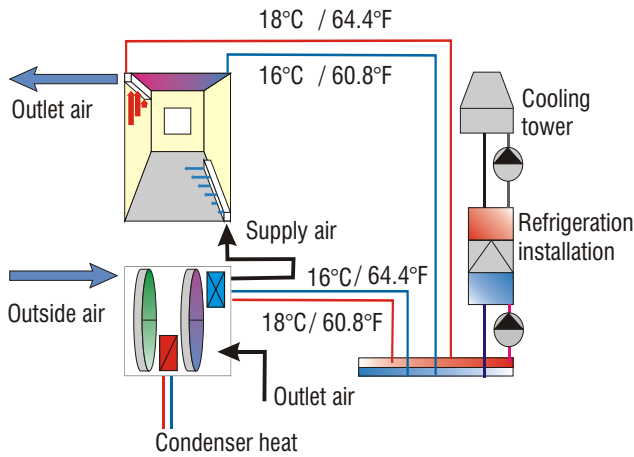
Lecture hall  
Office and administration buildings  
Hotels

## Advantages

- Use of the waste heat from the condenser for regeneration purposes
- Saving in humidifier capacity in winter
- Higher heat recovery in winter
- Lower regeneration temperature than silica-gel rotors
- No risk of icing
- Refrigerating capacity of the heat pump only approx. 30 - 40% of the total refrigerating capacity of the cascade
- The refrigerating capacity is reduced to about 50% as a result of the omission of the latent energy and of the humidification of the outlet air
- Omission of a restriction on the temperature of the supply air by integrating a sensitive temperature-reduction system
- Omission of the cooling tower
- Achievement of lower room-air humidities in summer for better thermal comfort in comparison with the conventional air-conditioning process control with utilisation of the air dehumidification by dropping below the dew point
- Utilisation of the indirect evaporative cooling during a large part of the year without any additional drive energy for the cold/heat coupling

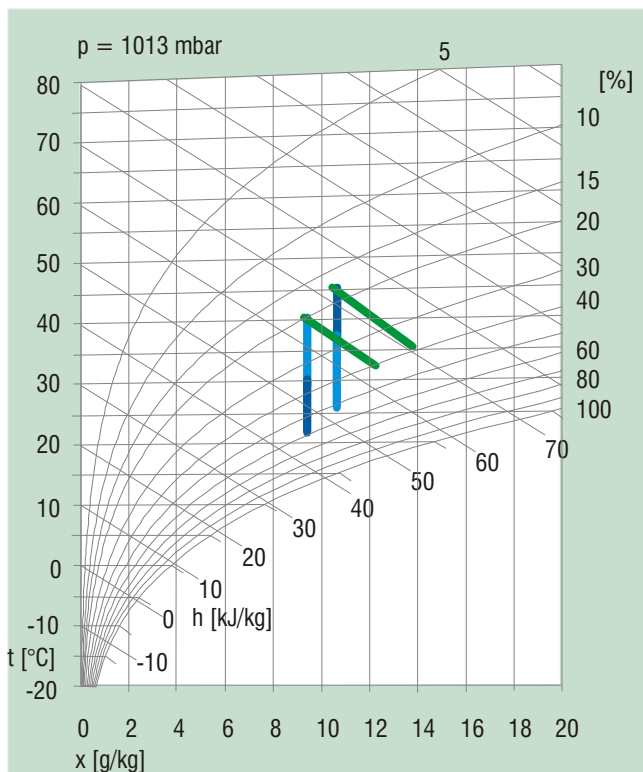


# Sorptive Dehumidification in combination with Heat Recovery and Cold-Water Production for Cooling ceilings



## Description of the Installation

The SECO dehumidifies the outside air to such an extent as is necessary for compliance with the humidity of the supply air. A considerably lower dehumidification capacity and thus lower regeneration temperatures are required in comparison with the classic DEC installation. Since the cooling load is actually dissipated from the room via cooling ceilings, the outside air may be input in the form of source air with relatively high supply air temperatures. The thermal regeneration of the SECO takes place using the condenser heat from the cold water production. As a result of the internal cold/heat coupling, considerably better primary energy utilisation is achieved than in the case of conventional air-conditioning processes.

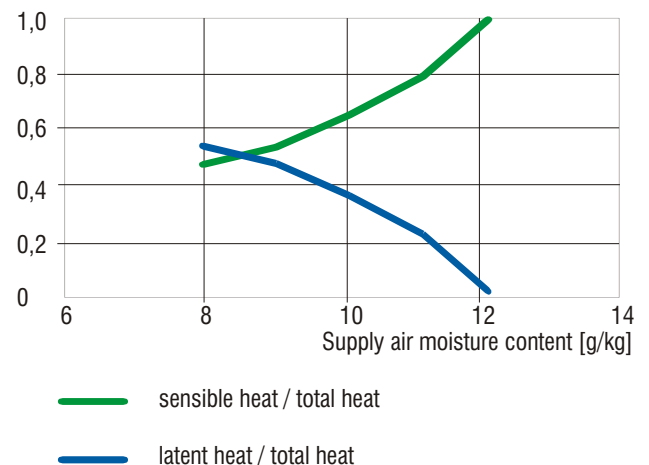


## Applications

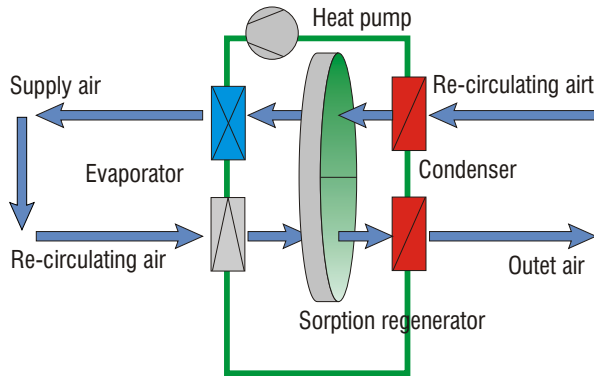
- Lecture hall
- Office and administration buildings
- Hotels
- Fair sites with central cold-water production

## Advantages

- Use of the waste heat from the condenser for regeneration purposes
- Utilisation of the reverse humidity as humidifier capacity in winter
- Higher heat recovery in winter
- Lower regeneration temperature than silica-gel rotors
- No risk of icing
- The volumetric flow rate can be reduced to the hygienically necessary proportion of outside air
- The capacity figure of the refrigerating machine is improved by up to 25 %
- The refrigerating capacity can be reduced to about 50 % as a result of the omission of the latent energy



# Use of the Sorption Regenerator for Technological Dehumidification Tasks in Combination with Cold/Heat Coupling



## Description of the Installation

The regeneration air flow is heated up in the condenser, absorbs humidity in the regeneration sector and is cooled and dehumidified in the downstream evaporator.

The second partial air flow is admixed upstream of the fan and is guided through the dry sector of the sorption wheel. Humidity is released on to the wheel during this process. The dehumidified total air flow absorbs the residual condenser heat of the second condenser and is blown to the outside.

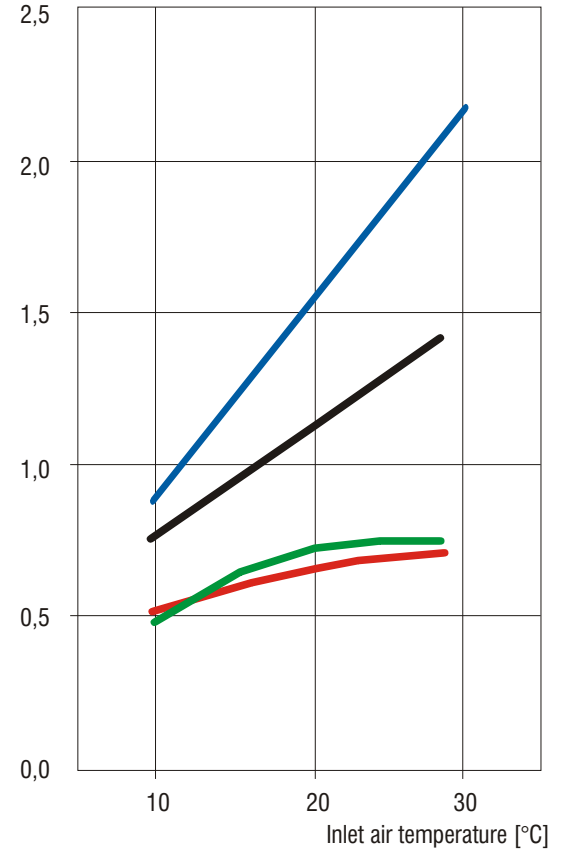
## Applications

Indoor swimming pools  
Material drying  
Conservation

## Advantages

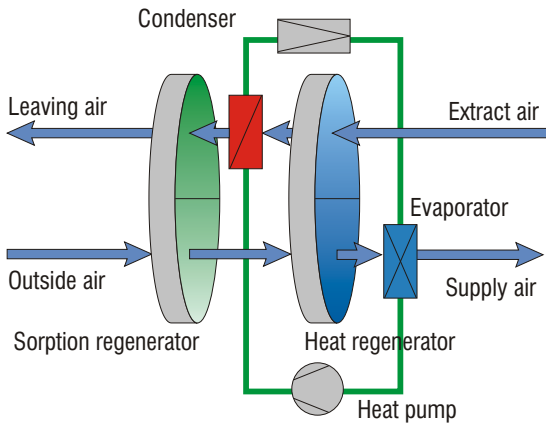
Use of the waste heat from the condenser for regeneration purposes  
No risk of icing  
Better conditions for the heat pump by shifting the operating point into the area of high relative air humidities and higher temperatures  
The alteration of the area ratio between the process air and the regeneration air leads to smaller heat pumps  
Ready-to-plug-in devices can be manufactured without any connection for outside air

specific dehumification capacity [kg/kWh]



- Refrigerating machine air dehumidifier
- Sorption air dehumidifier
- Sorption air dehumidifier
- Hybrid air dehumidifier

# Sorptive Air dehumidification in combination with Heat Recovery and a Refrigerating Machine with Waste-Heat Utilisation



In winter, there is a series connection of the SECO and the heat wheel as humidity and heat recovery with very high efficiencies.

## Applications

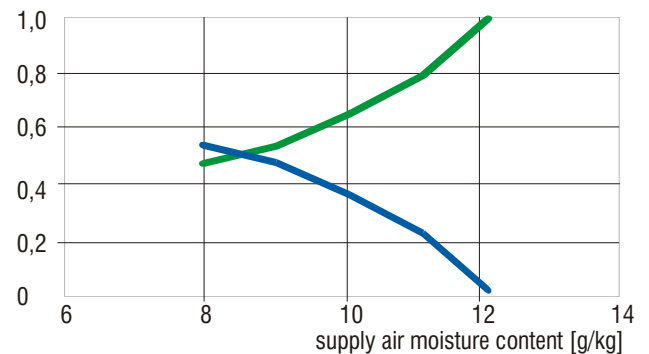
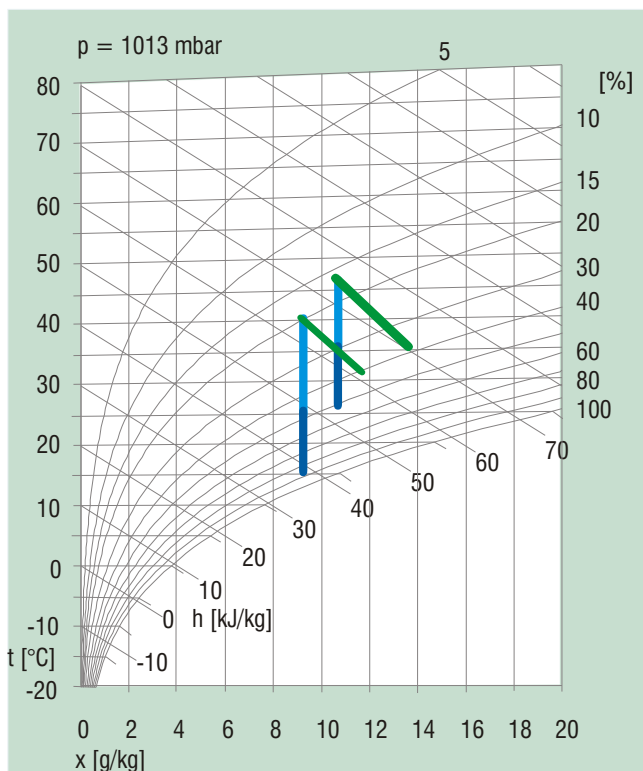
- Lecture hall
- Office and administration buildings
- Hotels
- Restaurant

## Advantages

- Use of the waste heat from the condenser for regeneration purposes
- Higher heat recovery in winter
- Lower regeneration temperature than silica-gel rotors
- No risk of icing
- The capacity figure of the refrigerating machine is improved by up to 25 %
- The refrigerating capacity can be reduced to about 50 % as a result of the omission of the latent energy

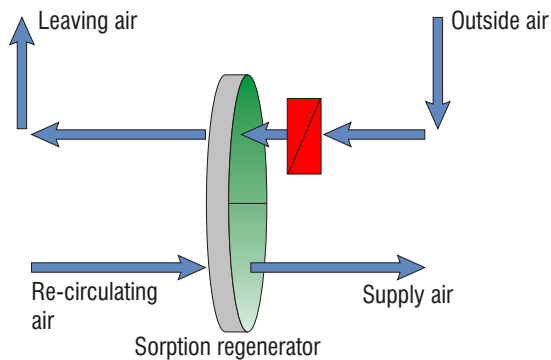
## Description of the Installation

The SECO dehumidifies the outside air only to such an extent as is necessary for compliance with the humidity of the supply air. Because of the use of the sensible cooling, there is a possibility of achieving almost any demanded supply air temperature. However, it must be borne in mind in this respect that, in certain circumstances, the use of a cooling tower or of a second condenser in the volume flow of leaving air may become necessary since too much condenser heat is available. In comparison with the DEC cascade, there is the disadvantage that, because of the omitted outlet air humidifier, indirect evaporative cooling cannot be used for a large amount of the time.



- sensible heat / total heat
- latent heat / total heat

# Sorptive Air Dehumidification in the Re-circulating-Air Drying



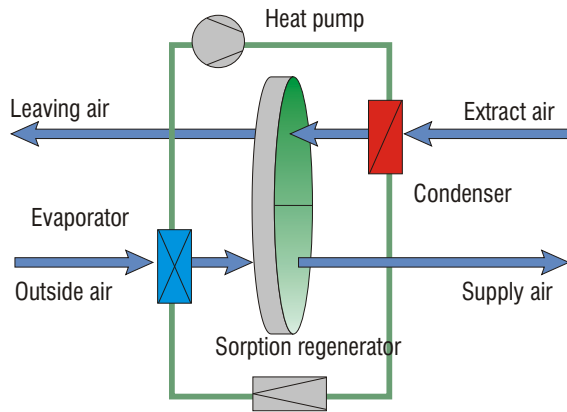
## Description of the Installation

The SECO has the task of dehumidifying the circulating air to such an extent that the humidity of the room air is gradually reduced as the air is recirculated. The ratio between the circulating air and the regeneration air is adjusted according to the technical outline conditions. In general, the ratio will be between 2 and 3. Outside air which is heated up via a damper register is used for regeneration purposes. The humidity-laden leaving air is discharged into the atmosphere once again.

## Advantages

- Use of waste heat; in summer, unused district heating or solar energy
- Dehumidification without refrigeration engineering
- Reduction in the connected electrical load when heat is used
- At high outside-air humidities (sultriness), SECO achieves better dehumidification than silica-gel rotors at the same regeneration temperature
- Sorption regenerators are usually the investment-intensive components; on the other hand, the price/performance ratio is improved in the case of SECO
- No risk of icing
- The scope of maintenance is less than in the case of refrigerating machines

# Sorptive Air Dehumidification with Precooling by a Refrigerating Machine



## Description of the Installation

The refrigerating machine precools and dehumidifies the outside air via the evaporator. In this respect, the operating regime is set in such a way that operation consistently takes place above the freezing point. It is thus possible to avoid any icing of the evaporator. The SECO then has the task of dehumidifying the outside air to such an extent as is necessary as a result of the low dew-point temperatures demanded. The ratio between the outside air and the regeneration air is adjusted according to the technical outline conditions. The sketched shape in which equal volumetric flow rates are achieved represents a typical application. It is thus possible to ensure not only the dehumidification but also an adequate supply of fresh air. The outlet air which is heated up via a damper register or with the waste heat from the condenser of the refrigerating machine is used for regeneration purposes. The humidity-laden leaving air is discharged into the atmosphere.

## Advantages

- Use of the waste heat from the condenser for regeneration purposes
- No risk of icing
- Better conditions for the heat pump by restricting the precooling and dehumidification to temperatures above 0°C (32°F)
- As a result of the upstream refrigerating machine, it is possible to achieve lower dew-point temperatures.

We reserve the right to introduce technical changes and alterations without prior notice / 11-2008



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