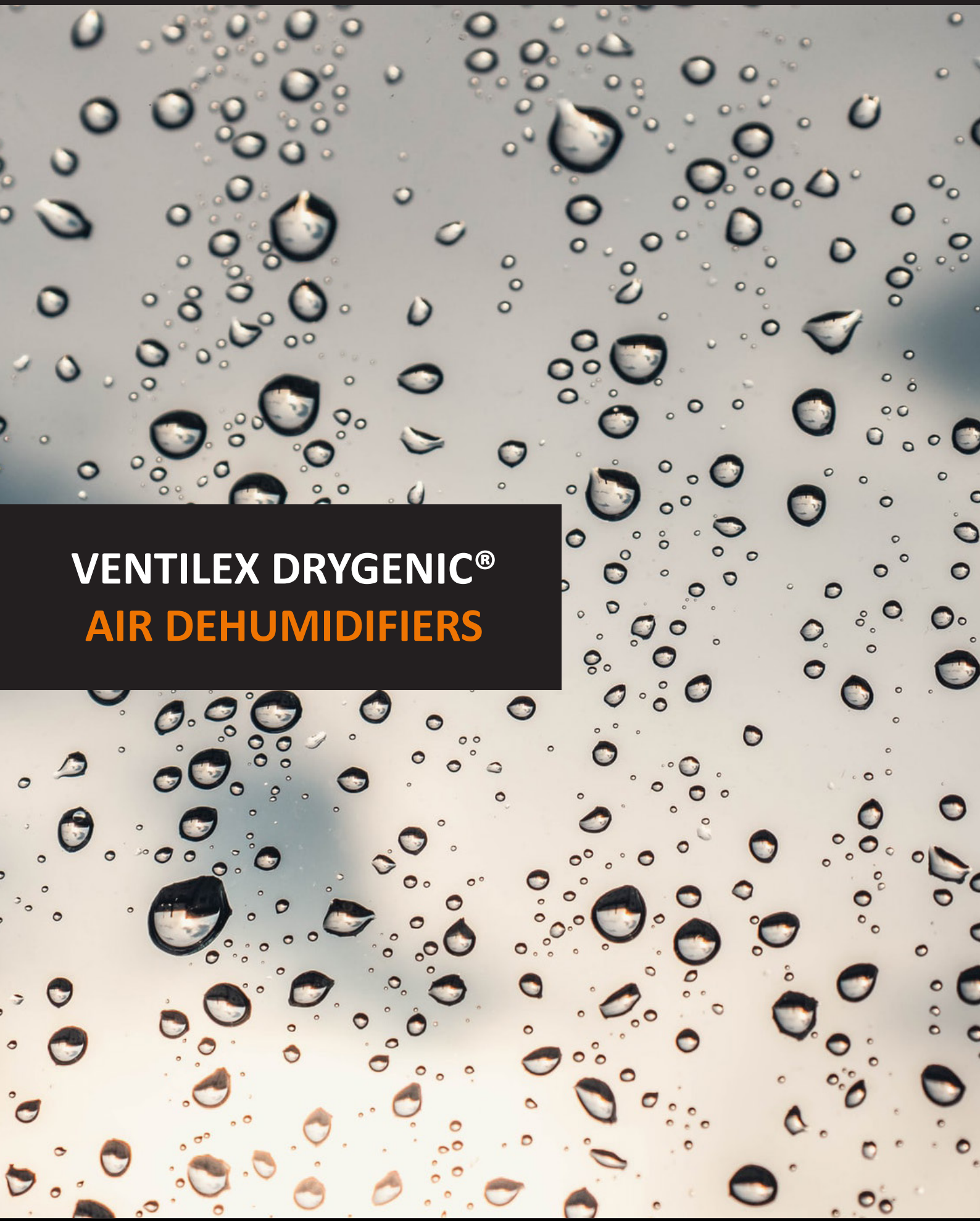
Ventilex



VENTILEX DRYGENIC®
AIR DEHUMIDIFIERS

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1 THE VENTILEX DRYGENIC® AIR DEHUMIDIFIERS

Ventilex DryGenic® Air Dehumidifiers are used to provide cool, dehumidified and decontaminated air for certain processes and/or process rooms. The DryGenic principle is simplicity itself. The dehumidifying systems are based on the drying properties of a liquid hygroscopic solution called DrySol. A Ventilex DryGenic dehumidifier can supply air with a relative humidity ranging from 20 to 50 % RH. Dew-points as low as - 30°C can easily be achieved. This is a very flexible system. The air temperature and humidity are controlled simultaneously in the process. Pre-cooling, after-cooling and after-heating are usually not required. Ventilex DryGenic dehumidification systems are specifically designed to use low levels of energy and to minimize total energy consumption. The DryGenic system maintains the air at a constant, precise humidity level, regardless of weather conditions or load variations. Using our Ventilex DryGenic system for air dehumidification usually results in a substantial saving on the running costs of the plant and on the investment in cooling equipment.

The benefits

- Cooling and heating takes place outside the unit
- Can use relatively cheap coolants, such as well water, river and cooling tower water
- Units made of industrial heavy-duty plastic, very long life span
- Vertical air flows (VPT), counter current flow (air-DrySol) or horizontal air flows (HPT)
- Low running costs
- High efficiency
- Can operate as a humidifier too
- Energy savings
- Microbiological decontamination
- Performance reliability
- Precise humidity and temperature control

Great air volumes and moisture removal

The Ventilex DryGenic® Air Dehumidifier is able to handle great air volumes: 9,000 - 140,000 m³/h

It also removes large moisture contents:
144 - 2,000 kg/h

2 PRINCIPLE OF OPERATION

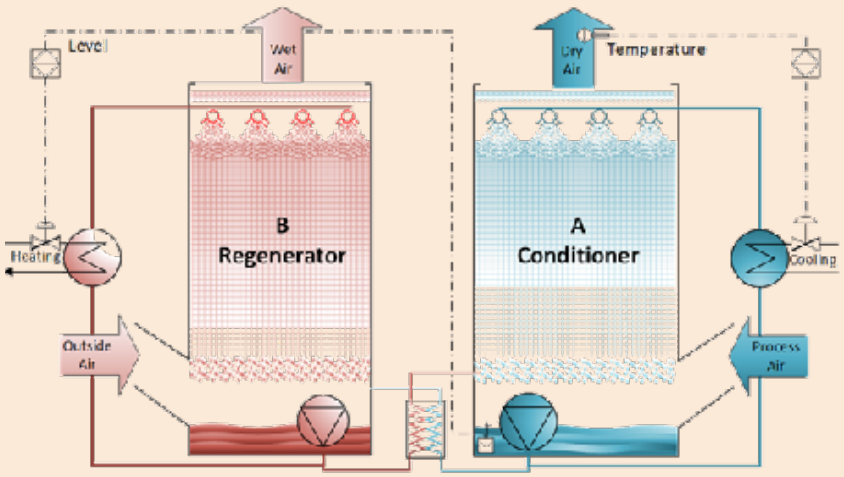

Figure 1: Ventilex DryGenic system

A Ventilex DryGenic® system consists of two essential components: a conditioner and a regenerator, each with its own pump, see fig. 1. For cooling, dehumidification and decontamination of the air, the system utilizes a hygroscopic liquid called DrySol®. Besides the DrySol temperature, the concentration of DrySol determines the absorption capacity.

The conditioner

From the conditioner pump unit, the DrySol® is pumped through a DrySol cooler to the spray nozzles above the packing (contact surface), see fig. 1, on the right of the drawing. The outside or return air to be conditioned passes through this packing where it comes into close contact with the DrySol. Because of this contact with the cold DrySol, the air is cooled down and the moisture in the air is absorbed by the DrySol.

After this process, the dry and cool air passes through a droplet eliminator section which separates DrySol droplets from the air stream.

Because of the moisture absorption, the DrySol level in the pump unit rises and, consequently, the DrySol concentration decreases. In order to maintain the same absorption capacity, the solution must be regenerated, in other words the amount of moisture removed from the conditioned air must be evaporated from the DrySol again. This is accomplished in the regenerator, the second component of the DryPac

The regenerator

The regenerator also contains a contact surface over which DrySol, heated by a DrySol heater, is sprayed. The moisture which is picked up in the conditioner will now evaporate from the DrySol sprayed in the regenerator. Outside air, waste air from a process or in some cases air from a technical area is blown through the regenerator by a fan. This air picks up the moisture and is discharged into the atmosphere (outside).

Extra energy savings

DrySol is exchanged between both pump units. This in order to maintain a constant DrySol concentration in the conditioner pump unit. Hot concentrated DrySol flows from the regenerator to the conditioner pump unit; cold diluted DrySol flows from the conditioner back to the regenerator pump unit. Between these two flows, heat is exchanged in the DrySol heat interchanger, so that cooling and heating energy will be saved.

3 CONTROLS

In order to maintain a constant air temperature and humidity, it is necessary to control the concentration and temperature of the DrySol®. The system is fitted with 3 control loops:

- Temperature control of the dry air;
- DrySol concentration or level control;
- Maximum DrySol temperature control.

3.1 Temperature control of the dry air

The dry air temperature, which is supplied into the process, is controlled by means of a PLC system: a programmable logic controller. A temperature sensor, mounted in the air duct, is connected to this controller.

The dry air temperature can be changed by adjusting the set point. The control valve of the DrySol cooler controls the amount of cooling media which flows through the DrySol cooler. In this way the dry air temperature is kept constant.

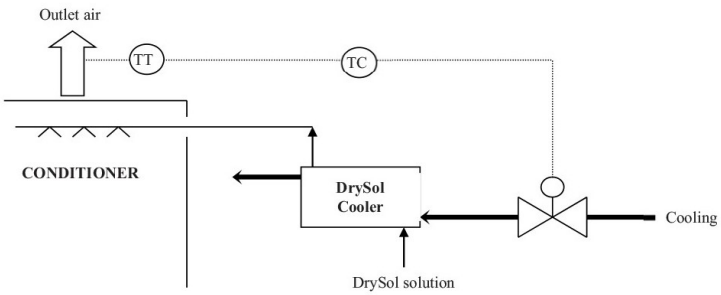

Figure 3: temperature control of dry air

3.2 DrySol concentration or level control

The concentration of the DrySol directly corresponds with the level in the pump tank of the conditioner. The conditioner pump tank is therefore, equipped with electronic level controller. When the conditioner is absorbing moisture, the level in the pump tank will increase. The level controller gives its signal to the PLC.

The regenerator control valve which controls the amount of heat to the DrySol heater, is operated by this PLC. More or less heating has a direct effect on the amount of water which evaporates in the regenerator and therefore controls the level/concentration in the pump tank of the conditioner.

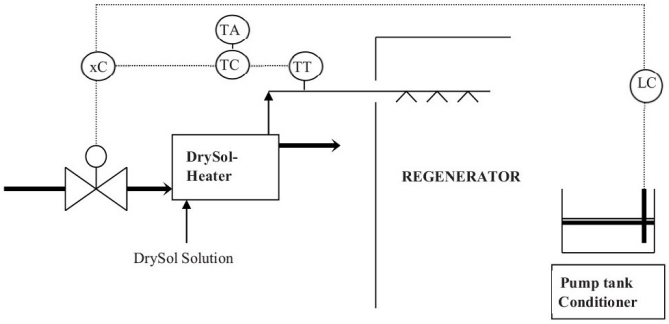

Figure 2: DrySol concentration or level control

3.3 Min. and max. DrySol temperature control

In order to prevent the industrial plastic construction (PP or HDPE) from excessive thermal tension, the DrySol spray temperature is limited to a minimum and maximum temperature on both the conditioner and the regenerator side. This temperature is controlled by the PLC via multiple temperature sensors, which are mounted in the DrySol piping of the regenerator and the conditioner(s).

4 FLEXIBILITY

Seperate conditioners and regenerators

If desired, DryGenic regenerators can be located remote from the conditioner. Conditioners are often located in the space adjacent to the conditioned space and the regenerator is located in the building's utility or boiler room. Since one regenerator can handle multiple conditioners, substantial savings could be achieved when one regenerator unit is used with multiple conditioners. Up to 10 conditioners can operate with a single regeneration system.

Combination systems

The combination possibilites are endless - some on available water and others on refrigeration - and can be combined to maintain specific air moisture contents in different processes, rooms or areas.

Advantages of remote generators

- Because the units are separate, the possibility of cross leakage between wet and dry airstreams is eliminated.
- Performance reliability is consistently high.
- Several conditioners may be coupled to a single and remote regenerator. This provides greater system design flexibility.
- Reduces ductwork, utility piping, maintenance and installation costs.
- Less floor space required for complete system, typically, 10% to 40% floor space savings.

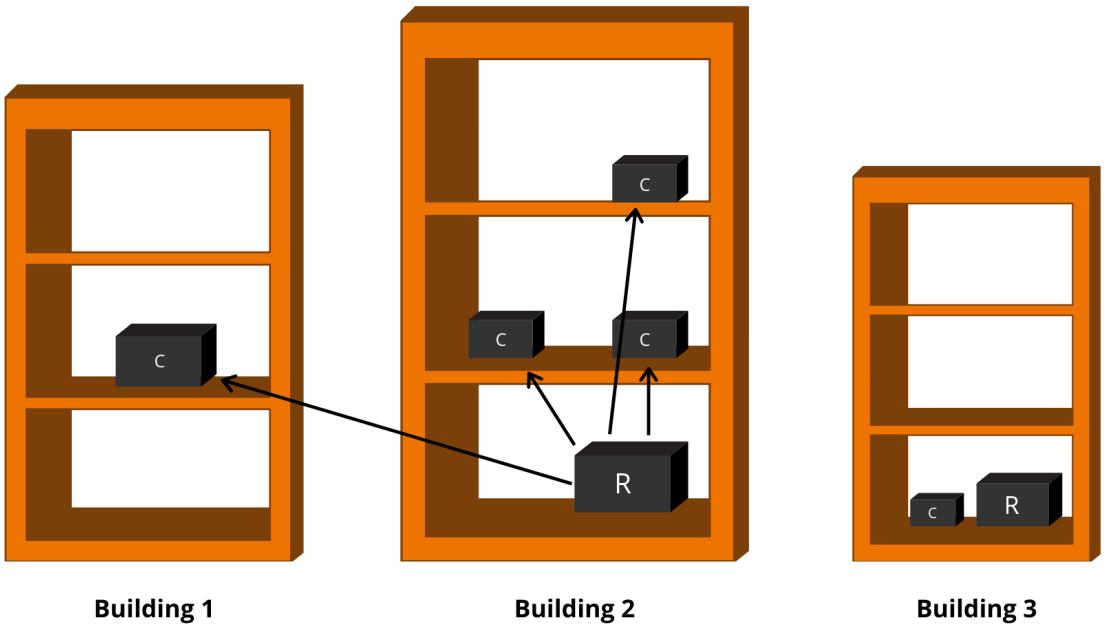

Figure 4: multiple conditioners on a single regenerator, or one conditioner on one regenerator

5 VENTILEX DRYGENIC® AIR DEHUMIDIFIER OPTIONS

The following items are part of the 'standard' delivery:

- DryGenic conditioner incl. pump and cooler.
- Dry air fan
- DryGenic regenerator incl. pump and heater.
- Regenerator exhaust fan.
- DrySol transfer measuring equipment.
- Level and temperature control system including sensors, cooling and heating control valves.
- Control panel with PLC and Graphic Control Display (HMI). Including a motor control cabinet (MCC) with electrical starters, fuses, switches, transformers etc. for fans and pumps.
- The required charge of DrySol.
- The erection and starting up of the plant.

The following equipment is optional, but is required for a complete system installation and can be ordered separately:

- DrySol piping
- DrySol/Drysol interchanger for extra energy savings.
- Equipment to enable use of the system as a humidifier (if applicable).
- Enthalpy control
- The electrical wiring and connections.
- Pre- or after-conditioning of the air with controls (if applicable).
- The air ducts, grills, filters, dampers, sound boxes, insulation and the Polypropylene regenerator outlet duct.
- The cooling and heating plant with piping, insulation and controls.
- Service to keep the system run for years and years.

The following items are part of the 'standard' delivery:

- Standard design: all the components are located on the same floor and in one technical area. As an option the regenerator can be located remote from the conditioner. In general, more controls are required, sometimes it is necessary to select other pumps and fans.
- Conditioner and regenerator in modular form for installation transport reasons.

6 CONSTRUCTION AND MATERIALS

Generally speaking, our dehumidification systems operate 24 hours a day, almost every day of the year. Therefore, the choice of construction materials is very important. Our systems are made of Polypropylene (PP) or high density Polyethylene (HDPE). These industrial plastics make the system a reliable air dehumidifier with a long life span. The strength of the units has been tested with an under- and overpressure of 2,500 Pa and is resistant to temperatures between -20 and 95°C. For the lower temperature range, we use high density Polyethylene (HDPE).

The DryGenic® conditioner can optionally be produced double skinned and isolated to prevent condensation on the outside wall.

DryGenic regenerators are made of Polypropylene. Regenerators can operate using hot water or steam. For extra rigidity the conditioners and the regenerators are reinforced with steel bars (wrapped in PP or HDPE). All the systems are engineered and manufactured according to the CE regulations. We will prepare an CE declaration for each system.

7 THE SYSTEMS

Ventilex offers two DryGenic air dehumidification systems: the Polykath (skid mounted unit) for up to 25,000 m³/h air volume, and the DryPac (custom-made) system for >20,000 m³/h. In the following chapters, we will discuss the specifications of these two.

7.1 SPECIFICATIONS POLYKATH (SKID MOUNTED UNIT)

The Polykath (skid mounted unit) has the following dimensions and operating weights:

Type	Air flow (m³/h) min.	Air flow (m³/h) max.	H_2O removal (kg/h)[3]	Length (mm) [2]	Width (mm) [2]	Height (mm) [2]	Oper. weight (kg)[1]	Inlet air flow regenerator (m³/h)	DrySol charge (liter)[2]
PS	9,000	12,000	144	3,950	1,685	3,675	1,500	3,350	350
PM	13,400	18,000	216	5,250	1,685	3,765	2,250	4,900	500
PL	18,000	25,000	300	6,490	1,685	3,875	3,150	6,500	750

Table 1: Dimensions/specifications of the Polykath

[1] The operating weights mentioned contain the following components: the unit, frame, DrySol piping, pump, DrySol, packing and spray nozzles. Excluded are the piping, fan and ductwork.

[2] Exact dimensions of the DryGenic system depend on detail engineering of the project.

[3] H_2O removal is based on typical outside air conditions and available heating medium temperature

Figure 5: Polykath (skid mounted unit)

Our Polykath system is an energy-saving installation, that operates on the latest technology. Are you curious to the amount of electrical energy used? This is shown in table 2.

Type	Conditioner fan (kW²)	Regenerator fan (kW²)	Conditioner pump (kW²)	Regenerator pump (kW²)
PS	7.5	3	3	2.2
PM	11	5.5	5.5	4
PL	18.5	7.5	7.5	5.5

Table 2: Electrical energy consumption

7.2 SPECIFICATIONS DRYPAC (CUSTOM-MADE)

The DryGenic Dehumidifier DryPac always consists of a conditioner and a regenerator. The Ventilex DryGenic® conditioners are constructed in two different versions: the vertical unit (VPT) and the horizontal unit (HPT). The regenerators are available as standard (vertical).

VPT

HPT

Regenerator

7.2.1 VTP CONDITIONERS

The vertical conditioners have the dimensions and operating weights as shown in table 3. The dry air outlet duct must be placed on top of this conditioner, meaning the actual height will be higher.

Type	Air flow (m^3/h) min.	Air flow (m^3/h) max.	Length (mm) [3]	Width (mm) [3]	Height (mm) [3]	Oper. weight (kg)[2]	Nom. pump power (kW)[1]	Nom. fan power (kW)[1]
VPT 1000	14,500	20,000	2,100	2,400	3,500	1,500	5	15
VPT 1500	22,000	30,000	2,800	2,400	3,500	2,250	7	18.5
VPT 2000	29,500	40,000	3,500	2,400	3,500	2,750	11	30
VPT 2500	36,750	50,000	4,300	2,400	3,500	3,200	11	30
VPT 3000	44,000	60,000	5,200	2,400	3,500	3,600	15	37
VPT 4000	59,000	80,000	6,600	2,400	3,500	4,600	21	55
VPT 5000	73,500	100,000	8,000	2,400	3,500	5,500	24	75
VPT 6000	88,000	120,000	9,400	2,400	3,500	6,500	28	90
VPT 7000	103,000	140,000	10,800	2,400	3,500	7,500	35	110

Table 3: Dimensions/specifications VPT conditioners

[1] Nominal powers listed are for typical installations. Actual pump and fan powers may be higher depending on performance requirements.
[2] The operating weights mentioned contain the following components: the unit, frame, pump, DrySol, packing and spray nozzles. Excluded are the piping, fan, ductwork and cabling.
[3] Exact dimensions of the DryGenic system depend on detail engineering of the project.

7.2.2 HPT CONDITIONERS

The horizontal conditioners have the following dimensions and operating weights:

Type	Air flow (m^3/h) min.	Air flow (m^3/h) max.	Length (mm) [3]	Width (mm) [3]	Height (mm) [3]	Oper. weight (kg)[2]	Nom. pump power (kW)[1]	Nom. fan power (kW)[1]
HPT 1000	14,500	20,000	2,100	2,400	2,900	1,500	5	15
HPT 1500	22,000	30,000	2,800	2,400	2,900	2,250	7	18.5
HPT 2000	29,500	40,000	3,500	2,400	2,900	2,750	11	30
HPT 2500	36,750	50,000	4,300	2,400	2,900	3,200	11	30
HPT 3000	44,000	60,000	5,200	2,400	2,900	3,600	15	37
HPT 4000	59,000	80,000	6,600	2,400	2,900	4,600	21	55
HPT 5000	73,500	100,000	8,000	2,400	2,900	5,500	24	75
HPT 6000	88,000	120,000	9,400	2,400	2,900	6,500	28	90
HPT 7000	103,000	140,000	10,800	2400	2,900	7,500	35	110

Table 4: Dimensions/specifications HTP conditioners

[1] Nominal powers listed are for typical installations. Actual pump and fan powers may be higher depending on performance requirements.
[2] The operating weights mentioned contain the following components: the unit, frame, pump, DrySol, packing and spray nozzles. Excluded are the piping, fan, ductwork and cabling.
[3] Exact dimensions of the DryGenic system depend on detail engineering of the project.

7.2.3 REGENERATORS

The different types of the regenerator are shown in table 5.

Type	Air flow (m^3/h) min.	H_20 removal (kg/h)[4]	Length (mm) [3]	Width (mm) [3]	Height (mm) [3]	Oper. weight (kg)[2]	Nom. pump power (kW)[1]	Nom. fan power (kW)[1]
10 P	5,400	280	1,900	1,465	3,500	1,200	3	3
15 P	8,100	380	2,600	2,075	3,500	1,450	5	5.5
20 P	10,700	510	2,300	2,400	3,500	2,000	7.5	5.5
24 P	12,900	600	2,400	2,400	3,500	2,200	7.5	7.5
30 P	16,200	900	2,700	2,400	3,500	2,500	9	9
36 P	19,300	900	3,000	2,400	3,500	2,800	11	11
48 P	25,800	1,200	4,100	2,400	3,500	3,500	15	15
60 P	32,200	1,500	5,100	2,400	3,500	4,100	20	15
72 P	38,700	1,800	5,900	2,400	3,500	4,650	25	22
96 P	51,600	2,400	7,300	2,400	3,500	5,700	30	30

Table 5: Dimensions/specifications regenerator

[1] Nominal powers listed are for typical installations. Actual pump and fan powers may be higher depending on performance requirements.
[2] The operating weights mentioned contain the following components: the unit, frame, pump, DrySol, packing and spray nozzles. Excluded are the piping, fan and ductwork.
[3] Exact dimensions of the DryGenic system depend on detail engineering of the project.
[4] H_20 removal is based on typical outside air conditions and available heating medium temperature

8 LAYOUT

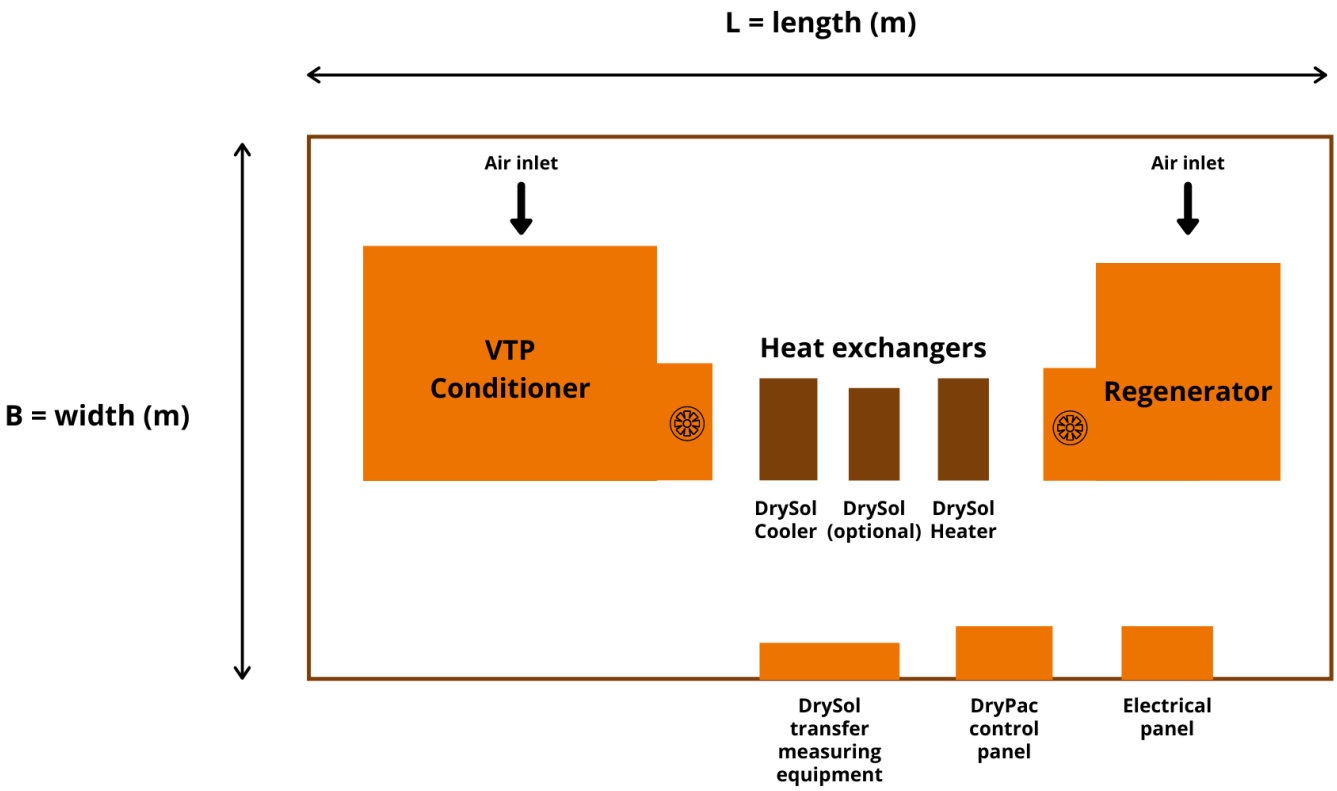

Figure 6: standard layout of a DryPac system

	Regenerator type									
Conditioner type	**10 P**	**15 P**	**20 P**	**24 P**	**30 P**	**36 P**	**48 P**	**60 P**	**72 P**	**96 P**
VPT 1000	8.5 x 4.5 m	9 x 4.5 m	9 x 4.5 m	9 x 4.5 m	-	-	-	-	-	-
VPT 1500	9 x 4.5 m	10 x 4.5 m	9.5 x 4.5 m	9.5 x 4.5 m	10 x 4.5 m	10 x 4.5 m	-	-	-	-
VPT 2000	10 x 4.5 m	10.5 x 4.5 m	10 x 4.5 m	10.5 x 4.5 m	10.5 x 4.5 m	11 x 4.5 m	-	-	-	-
VPT 2500	-	11.5 x 4.5 m	11 x 4.5 m	11 x 4.5 m	11.5 x 4.5 m	11.5 x 4.5 m	13 x 4.5 m	-	-	-
VPT 3000	-	12 x 5	12 x 5 m	12 x 5 m	12.5 x 5 m	12.5 x 5 m	13.5 x 5 m	14.5 x 5 m	-	-
VPT 4000	-	-	13.5 x 5 m	13.5 x 5 m	13.5 x 5 m	14 x 5 m	15 x 5 m	16 x 5 m	17 x 5 m	-
VPT 5000	-	-	-	15 x 5.5 m	15 x 5.5 m	15.5 x 5.5 m	16.5 x 5.5 m	17.5 x 5.5 m	18.5 x 5.5 m	19.5 x 5.5 m
VPT 6000	-	-	-	16 x 5.5 m	16.5 x 5.5 m	17 x 5.5 m	18 x 5.5 m	19 x 5.5 m	19.5 x 5.5 m	21 x 5.5 m
VPT 7000	-	-	-	-	18 x 5.5 m	18 x 5.5 m	19.5 x 5.5 m	20.5 x 5.5 m	21 x 5.5 m	22.5 x 5.5 m

Table 6: Measurements of the installation

- Standard selection/all components are located on same floor within the above mentioned dimensions. Optional: components can be located remote from each other.
- Height of room (for VPT) 6 m. HPT height 3.5 m (for information contact Ventilex engineers).
- Standard layout, optional: other version. Exact dimensions of the DryGenic system depend on detail engineering of the project.

9 INSTALLATION NOTES

Pre-installation storage/transport

Equipment should be protected from outside weather conditions prior to installation. Indoor storage is preferred (frost-free and UV light protected).

Rigging and handling

Ventilex DryGenic equipment should be lifted only from the base of the unit.

Equipment location

The systems are designed for indoor installation. The engineering data tables should be used to determine the operating weight of the conditioner and regenerator units. If the equipment is installed outside, weather protective covering should be provided. The units may be installed outside if air temperature will not be lower than 5°C and the units are protected against ultraviolet light. Conditioner and regenerator units should be set on a level concrete floor. Adequate space should be provided around the conditioner, regenerator, and heat exchangers for maintenance operations.

Filters

Before entering the conditioner, the air must be filtered with a G4 (pre-filter) and at least a F6 bag filter. The regenerator also needs this filter section at the entrance of the unit.

Insulation

To prevent surface condensation (sweating) and to minimize coolant use, the piping, ducts, etc. can be insulated. Steam or hot water piping/equipment must also be insulated to prevent burning through touching the piping and/or equipment.

DrySol piping

DrySol piping should be made of PP or, in special cases, HDPE.

Fans

The total pressure drop of the conditioner is ± 900 Pa, while the total pressure drop of the regenerator is ± 600 Pa. The conditioner fan has a total pressure drop of ± 1500 Pa. The regenerator fan has a total pressure drop of ± 1200 Pa. The dry air fan should be installed in the outlet duct of the conditioner (under-pressure). The regenerator exhaust fan should preferably be installed in the supply duct (over-pressure).

Plenums and ductwork

Ventilex DryGenic® units are fitted with flanges on the air openings for duct connection. Inlet ductwork must be designed to allow uniform distribution of air across the entire opening. Outlet plenums and ductwork must be designed to allow adequate space for servicing the droplet eliminators and to provide proper airflow through the equipment. Access doors, for servicing the filters, diffusers and droplet eliminators, must be provided in the inlet and outlet plenums/ductwork.

Regenerator exhaust ductwork

Because exhaust air from the regenerator is hot and humid, the regenerator exhaust ductwork should be made of plastic. The material should be rated for continuous duty at 90 °C. Other insulated metal ductwork will have a shorter lifespan when exposed to the hot humid regenerator exhaust air.

10 REFERENCES

We proudly present

Ventilex has acquired a wealth of experience when it comes to delivering air dehumidification solutions to industries worldwide. In this document we have included some of our proud clients, currently thriving with their Ventilex installations.

VENTILEX DRYGENIC®
AIR DEHUMIDIFIERS

Many companies already chose to partner up with Ventilex for their drying needs. Our equipment is space saving, energy-saving and there is no product loss. Customers also discover that their installation and maintenance costs are significantly lower.

The DryGenic® systems come in a variety of configurations depending upon air volumes, temperature range, available energy and any need for additional biocidal capacity. The systems keep the air at a constant, precise humidity regardless of weather conditions or load variations.

Your benefits?

- Microbiological decontamination of the air
- Elimination of 'wet' coils and potential breeding sites for micro-organisms including bacteria, molds and viruses
- Highest energy efficiency of any desiccant dehumidifier
- Uses relatively cheap coolants, like well water, river and cooling tower water
- Dew-point humidity as low as -7 °C with 7 °C chilled water coolant
- Easily accessible, non-toxic desiccant has low replacement costs, is not poisoned by hydrocarbons and is not affected by normal plant environments
- Reduction of operation costs through lower cooling and lower regeneration heat requirements
- Temperature and humidity are automatically controlled throughout the year
- Multiple conditioners can be coupled with a single regenerator for system design flexibility, reduction of investment and installation costs
- Remote regenerator can save duct work space and installation costs
- Factory field service support for installation, start-up and training
- Also used in drying plants for sausage casings and applications in the meat industry

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