Ventilation and air conditioning

Private indoor swimming pool halls

menerga
a systemair company
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tribute – with effectively controlled and
demand-driven outdoor air handling –
to a comfy and healthy room climate. Highly efficient heat recovery reduces en-
ergy consumption here to a minimum for
dehumidification of the swimming pool.

Good air means feeling good
The air quality in an indoor swimming pool determines how long guests remain in the
pool – they won’t stay long unless the pool air climate is comfortable and cozy. Mugg-
ny or cold air – or even drafts – quickly ruin any fun in a pool.

Reduce energy costs
Operating an indoor pool means expensive energy costs. The use of highly efficient
technology lowers these costs and, in addition, makes a major, positive difference in
assuring comfortable room climate.

Protect building substance
Poor thermal insulation, in conjunction with poorly installed moisture barriers, is the
most frequent cause of damage when conditions fall below the dew point on the
indoor side of a building shell. Over the long run, this leads to damage by condensa-
tion.

Hygienic coziness
When water evaporates from the surface of an indoor swimming pool, by products of
disinfection enter the room air. These are substances created by disinfection of the
water that can release unpleasant odors. An intelligent control system, together with
a highly efficient recuperator, dehumidifies the indoor pool with outdoor air. The
excess humidity is extracted along with the exhaust air from the pool, and with the
smelly substances.

The feel-good factor makes the difference
AND THE AIR HANDLING UNIT PLAYS A KEY ROLE

Today, owning a private pool often com-
bines the comfort of a wellness oasis and a
fitness facility. This makes an indoor pool
a pleasant place to retreat from the stress of
everyday life.

Especially in a private swimming pool, the
main focus is on the feel-good factor –
and a cozy, comfortable indoor climate at
the pool plays a key role. It is not only the
interplay between room temperature and
humidity that makes a major contribution
here – air-flow distribution is also essenti-
al and must be perfectly coordinated with
room conditions. Drafts and misted-over
windows should be avoided. Air-flow
control must ensure uniform air circulation
around the pool. Air circulation is essential
from two standpoints: first, properly circu-
lized air passes warmth over all building
components, which prevents condensa-
sion on the cooler elements. Second,
uniform air movement over the pool en-
able by products of disinfection evapo-
rated from the water to be extracted from
the pool by the room ventilation system.
Owing to uninterrupted evaporation from
the water surface, dehumidification of the
pool air must take place around the clock,
even when the pool is not in use – to pre-
vent damage to the shell and to other
components of the building.

Swimming pool equipment that dehumidi-
fies the air with outdoor air enables main-
taining a comfortable pool atmosphere. Advanced control systems, in connection
with an efficiently designed dehumidi-
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As a rule, indoor pool water temperature
lies between 28 and 32 °C. Pool air temperature is usually 2 to 4 °C
higher than pool water temperature – but
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for the pool user. The partial-pressure
difference resulting under these condi-
tions keeps the amounts of water evapo-
rated – and, in turn, the energy required for
dehumidification – at a comparatively low
level. The temperature and the relative
humidity in an indoor pool are extremely
important in determining the comfort ex-
perienced by the pool user. The absolute
water content of the air in the indoor pool
plays an essential role here: a level of 14.3 g
water/kg air should not be exceeded for
any lengthy period. This value represents
the mugginess limit for an unclothed per-
son. Three variables basically determine
the heat requirement of an indoor pool:

1. The transmission heat requirement
(QT) describes the amount of heat re-
quired to compensate for the loss of heat
through the building shell. Effect-
tive thermal insulation for the building
can keep this heat requirement at a low
level.

2. The ventilation heat requirement
(QV) describes the amount of heat
required to heat outdoor air to the
desired indoor-pool air temperature.

3. The evaporation heat requirement
(QE) describes the amount of heat
required to compensate for the heat
loss arising from evaporation of the pool
water. Approx. 90 % of the heat re-
quired for this evaporation is extracted
from the water, and approx. 10 %, from
the air. Heat must be replaced by
the customer’s heating system. The
same applies to the heat requirement
for replenishment of the evaporated
pool water and for heating it to the
desired temperature. A heat pump with
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TEMPERATURE AND ENERGY REQUIREMENTS

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Indoor pool dehumidification

The surface area of the water and the use of the pool are key factors in evaporation of the pool water. An additional, deciding influencing variable is the partial pressure difference, i.e., the difference in pressure between the saturation vapor pressure at pool-water temperature, and the partial pressure of the water vapor in the pool air. On the basis of these factors, guideline VDI 2089 sheet 1 of the Association of German Engineers describes the calculations for determining the water mass flow rate from evaporation during pool-swimming and idle modes. Water attractions – e.g., a counter-current unit – increase the amount of water evaporated. Calculation of dehumidification capacity must take into consideration the use of such attractions. Ideally, the calculated evaporative water mass flow will be extracted via the dehumidifier by outdoor air. The required amount of outdoor air is calculated with reference to a difference in absolute water content between the outdoor air (9 g/kg) and the extracted air (14.3 g/kg). This outdoor air mass flow required for dehumidification is converted, using the density of the air, into an outdoor air volume flow. This volume flow determines the capacity of the dehumidifier.

AHU in indoor swimming pools

The AHU used in an indoor pool combines several functions. The main function of airflow distribution consists of extracting moist air from the pool and feeding it to an air handling unit. At the same time, the drier supply air will be fed upward into the indoor pool via the duct system as a rule, through diffusers in the vicinity of the windows. Inside the AHU, the outdoor air required for dehumidification will be mixed with the supply air. The required amount of moist extracted air, with heat removed by the recuperator, will be transported outside as outgoing air. The heat obtained in this matter will be transferred in the recuperator to the supply air. So-called disinfection by products can be produced in the indoor pool during pool cleaning and disinfection of the water. When the water evaporates, these by-products enter the air of the pool. If air distribution ensures transport of these disinfection by-products in the air extracted to the outside, this enhances pool user comfort.
Ecodesign Directive

ERP DIRECTIVE APPLYING TO AIR HANDLING UNITS IN INDOOR SWIMMING POOLS

The European Ecodesign Directive (ErP Directive 2009/125/EG) creates a European Legal Framework for the stipulation of requirements placed on ecologically harmonious design of products involving energy use. It went into effect in October of 2009. The purpose of this directive is to set minimum energy-efficiency requirements on various products under the category of products for energy use - and to eliminate inefficient products from the market by 2025, compared to data in 2010.

In addition to basic requirements placed on the design of ventilation systems, requirements involving efficiency criteria were formulated to go into effect in two stages: on 1 January 2016 and, with stricter requirements, on 1 January 2018. Particular emphasis is placed here on the efficiency of the heat exchange system, as determined by the rules of EN 308. This body of regulations describes the test procedures for determining the efficiency of all recuperator systems, and thereby ensures intrasystem comparability.

Currently, indoor swimming pool dehumidification systems with a recuperator are subject to the energy requirements that are formulated by Ecodesign stipulations. An additional decisive factor for observance of the requirements of the European Ecodesign Directive is power consumption of the fans. If this consumption exceeds a reference value, the device concerned may not be marketed in the EU.

The goal of the ecological design requirements placed on ventilation systems is enhancement of primary energy savings of this product group by 60 % by the year 2025, compared to data in 2010.

In December of 2014, the stipulations for environmentally compatible design of ventilation systems were set forth in the EU Regulation 1253/2014, which went into effect in the first stage on 1 January 2016 and, with stricter requirements, on 1 January 2018.

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FROM THE ARCHITECT TO THE INDOOR POOL

The dream of owning a private indoor swimming pool often arises from the desire for a quiet retreat to relax and to feel good. A great deal of effort is expended on the design of the pool, to make these dreams come true. The selection of luxurious fittings and surfaces is matched to individual wishes. Professional pool designers go to great lengths to realize your wishes and needs in the form of a solution where you really fit in. Before these wishes can be transformed into reality, however, project planners must enter the scene. Where to put the technical equipment? The water treatment system must be installed in the machine room, as must the pool dehumidifier. This mechanical equipment cannot be integrated into the pool hall design. Where it would disturb the appearance of the luxurious design of the pool hall itself, however, is not the result of the dehumidifier unit and effective air flow control alone: an additional essential factor is the building shell. Efficient thermal insulation not only reduces energy consumption by heating, but also makes a major contribution to coziness. The human body is always engaged in radiation exchange with its surroundings: which means that we more acutely perceive this feeling of shivering when contacting cold surfaces, and that we more acutely perceive this feeling in an ambiance in which we typically wear only light clothing. In the implementation of thermal insulation, special attention must be paid to vapor impermeability. An effective moisture barrier — typically, sheeting impervious to water vapor — prevents water vapor from penetrating into walls. A moisture barrier that is not properly installed, or that does not exist at all, is frequently the cause of moist walls and even major building damage.

During the construction phase, it is essential to ensure prevention of thermal bridges: these are points in the building shell at which heat flows toward the outside faster than at the areas surrounding such points. Especially in cold months, thermal bridges have temperatures that are appreciably colder than the dewpoint temperature of the air in the pool building. This means that water from the air condenses at these cold points, and that moisture more rapidly penetrates these points. Corrosion or even failure of building components represents the worst possible resulting damage. If comfortable conditions with an air temperature of 30 °C and relative humidity of 54 % prevails in an indoor pool, the dewpoint under such air conditions is 19.4 °C. In an indoor pool hall, therefore, no surface should be colder than 19.4 °C, to prevent condensation of humidity in the colder areas.

In transition areas between living zones and the indoor pool area, mixing often takes place of pool air with living-area air which frequently results in a slightly perceptible odor from the swimming pool. Humidity from the pool can likewise penetrate into living areas — an effect that can be lessened by the use of a door or similar solution. An intelligent dehumidifier, for example, can also allow the air-extraction fan to remove somewhat more air from the swimming pool than the supply air fan feeds into the pool area. In conjunction with a door, this arrangement can create slightly lower pressure in the pool than in the home, which prevents humidity and possible odors from entering living space. A dehumidifier for the recirculation air inside the swimming pool does not provide this function.

The large-area distribution of the supply air in the window zones assures a pleasant mix of dry air throughout the pool area and, in turn, uniform distribution of temperature over the entire room. Uniform temperature and relative humidity in the areas where guests gather around the pool is the basis for a comfy, feel-good experience. Such a satisfactory climate, however, is not the result of the dehumidifier unit and effective air-flow control alone: an additional essential factor is the building shell. Efficient thermal insulation not only reduces energy consumption by heating, but also makes a major contribution to coziness. The human body is always engaged in radiation exchange with its surroundings: which means that we more acutely perceive this feeling of shivering and relative humidity of 54 % prevails in an indoor pool, the dewpoint under such air conditions is 19.4 °C. In an indoor pool hall, therefore, no surface should be colder than 19.4 °C, to prevent condensation of humidity in the colder areas.

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Make the right choice!

SELECTION OF SYSTEMS AND COMPONENTS – RELIABLE THERMOCOND SOLUTIONS

Unit with recuperator and without heat pump

A unit with a recuperator achieves a large heat-recovery coefficient, which recovers a major share of energy from the swimming pool air. As a result, this significantly lowers ventilation heat loss and the energy requirement for dehumidification.

Dehumidification of pool air takes place exclusively with outdoor air. Humidity is removed from the pool together with the extracted air, and drier, cooler outdoor air is mixed with the circulation air flow in the dehumidifier.

During high outdoor air temperatures in summer, the system maintains a pleasant temperature in the pool area by circumventing heating via an integrated bypass valve integrated in the dehumidifier. This considerably reduces the risk of overheating in the pool area. Since the valid EP directive stipulates a technical bypass in the unit, the heat recovery can be infinitely variably regulated to zero when necessary. The footprint of the unit is small, and its operating and maintenance costs are low.

Unit with recuperator and heat pump

Selection of a system with an integrated heat pump can prove effective, since the heat pump contributes to increasing the total efficiency of a swimming pool dehumidifier. Current dehumidifiers offer two operational modes.

Idle mode: When the pool is not in use, dehumidification takes place in recirculation air mode. The air in the recuperator is pre-cooled here, and a evaporator cools the air below the dewpoint limit. The already cooled and dehumidified air is preheated in the recuperator by the air extracted from the swimming pool.

ThermoCond heat recovery technology

Our ThermoCond heat recovery systems have been especially developed for energy-optimized dehumidification of private indoor swimming pools.

This mode covers a major share of the transmission/heat requirement and, in turn, relieves the load on the heating system.

Swimming mode:

During swimming mode, the control system automatically switches to dehumidification with outdoor air. This allows the heat pump to increase the heat recovery by the recuperator. Via the plates of the recuperator, this process transfers to the outdoor air the sensible energy stored in the air that is extracted from the swimming pool. This offers a major benefit, especially in swimming-pool dehumidification: substances from the extracted air can be transferred to the outdoor air. As a result, these substances cannot enter the supply air, even at low outdoor air temperatures at which water condenses from the air extracted from the swimming pool.

Unit with 100 % recirculation air mode

In selection of an effective system, it is absolutely necessary to assure that supply of outdoor air and removal of odorous air extracted from the pool are possible via the extract air. Units that dehumidify exclusively in recirculation air mode cannot satisfy essential criteria for good air hygiene: e.g., the extraction in extract air of disinfection by products, creation of sub-atmospheric pressure, or the prevention of overheating in the swimming pool.

In addition, a unit that dehumidifies the swimming pool in recirculation air mode transfers to the pool area the total energy that is extracted from the air during dehumidification, as well as from the electrical work of the compressor. This situation can lead to overheating of modern and well insulated swimming pools in transitional-season periods, and to doubtful cases in which dehumidification must take place by temperature control.

At a glance:
- These units feature a highly efficient and hygienic recuperator made of polypropylene, which can easily be cleaned down to the core of the unit
- Highly efficient, output-controlled motors drive the fans
- The unit has a self-supporting casing 45 mm thick
- The mineral-wool insulation reduces heat transmission that prevents condensation on casing parts and also provides excellent sound insulation
- All the sheet-metal parts are corrosion-protected by powder coating
- The cabling of the unit does not contain halogen
- The integrated control principle always enables the operating point with the least possible energy requirement, with reference to dehumidification and heating performance.

All Menerga solutions feature an operator control panel and an integrated control concept.

Idle mode without dehumidification

If, during idle mode, no requirements are placed on temperature control and dehumidification, the system operates in pure recirculation air mode with reduced air volume. This assures sufficient air circulation in the pool area. With a heating requirement, the extract air is heated by the low pressure hot water heating coil up to the supply air temperature.

Idle mode with dehumidification

The air is dehumidified in the evaporator of the heat pump. This process is supported by upstream installation of the recuperator. The already cooled and dehumidified air is preheated in the recuperator by the air extracted from the swimming pool. Here, the heat transfer to the other side of the recuperator pre-cools the moist-warm extract air extracted from the swimming pool air, up to the dewpoint limit. The pre-heated, dehumidified air is next mixed with a share of untreated recirculation air, then warmed by the heat extracted from the dehumidification process, and finally returned as supply air into the swimming pool air. The heat pump is optimally designed with a dehumidification energy requirement of less than 0.25 kWh/kg. As required, the supply air is after-heated in the low pressure hot water heating coil.

Swimming mode summer

With increasing outdoor air humidity, the recirculating air damper is closed as required, up to the point of complete closure. The system then operates in 100 % outdoor air/exhaust air mode via the recuperator.

Swimming mode winter

Solution 1: The swimming pool is dehumidified by a mixture of outdoor and circulation air flow. The ratio of outdoor air is automatically and continuously adapted, depending on momentary water evaporation (i.e., current occupancy of swimming pool) and on the outdoor air humidity. If heat recovery is not sufficient to achieve the required supply air temperature, the supply air is after-heated in the water heating coil.

Solution 2: The cross-counterflow recuperator and evaporator remove from the extract air most of the sensible and latent heat, which is then transferred to the supply air. If the heat output of the heat pump is not sufficient, the supply air is after-heated in the low pressure hot water heating coil. Surplus heat can be transferred to the pool-water condenser (available as an option), which contributes to warming the pool water.

All images show ThermoCond solutions with a heat pump.
Accessories

SLOT DIFFUSERS

Slot diffusers are outlets through which supply air is blown into the indoor pool. The slot diffusers should be dimensioned such that the supply air covers the entire window surface.

As a rule, these diffusers are installed on floor level, in front of window surfaces in indoor swimming pools. They can be effectively integrated in the floor structure. In addition, they satisfy currently valid health and safety regulations with respect to structural aspects.

Lengths of 500 to 6,000 mm are available, with accuracy to 10 mm. Important: take expansion into consideration while installing.

Type A = slot width = 8 mm
Type B = slot width = 10 mm
Type C = slot width = 12 mm

Possible miter cuts

Type I
Type IV | 45° both sides
Type III | 45° right
Type II | 45° left

Air volume [m³/h]

<table>
<thead>
<tr>
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Accessories

End cover
Connection fitting
Connector

Example of installation

Application in an indoor pool hall

Type A1 = 1 × 8 | Type B1 = 1 × 10 | Type C1 = 1 × 12
Type A2 = 2 × 8 | Type B2 = 2 × 10 | Type C2 = 2 × 12
Type A3 = 3 × 8 | Type B3 = 3 × 10 | Type C3 = 3 × 12
Type A4 = 4 × 8 | Type B4 = 4 × 10 | Type C4 = 4 × 12
Type A5 = 5 × 8 | Type B5 = 5 × 10 | Type C5 = 5 × 12

Lengths and cross-sections

Type A | Type B | Type C
---|---|---
8 mm | 10 mm | 12 mm

Air volume [m³/h]

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Smart control
EVERYTHING UNDER CONTROL WITH TABLET AND SMARTPHONE

Even over long distances you have access via the Internet to the climate data of your swimming pool. This enables you not only to monitor, but also to control water and room temperatures, as well as relative humidity.

In this way, you can easily set your desired air conditions from afar, and find your own very personal feel-good climate when you arrive home.

We wish you good fun while relaxing.

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