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SWIMMING POOL DEHUMIDIFICATION AHU'S WITH HEAT PUMP







Every swimming pool should offer optimal micro climate conditions to its visitors. The high relative humidity and condensation in this environment (especially within covered swimming pools) significantly reduces comfort and also leads to damage of the building structure and the equipment within. Using Damuent's concept solution which offers precise control of the micro climate found in covered swimming pools, minimizes these negative processes and provides optimal comfort to visitors.

ENERGY EFFICIENCY

Using conventional methods to achieve optimal micro climate conditions and reduce the negative effects of high humidity is an expensive process which uses a lot of energy. Swimming pools disproportionately consume larger amounts of energy compared to dry buildings. This energy, contained in the water vapour, is lost from the building through ventilation. Unlike dry buildings, swimming pools behave more like boilers due to the evaporation of drives out the energy which has been water which occurs naturally during the use of energy. Water evaporation requires the supply of Latent Heat of heated to maintain an air tempera-Vaporisation (the energy required to ture near to the water temperature. evaporate water). This use of energy Clearly, less ventilation means less

is about 540 times more than what is needed to raise the temperature of "Sensible Heat"), and much more than what is required to heat the air.

The problem with indoor pools is that they need to be heated to about 30°C The level of needed ventilation varies to provide a comfortable bathing environment. Even small deviations from this temperature lead to discomfort and complaints. Unfortunately, the level of evaporation at this temperature is quite high. Most of the heat used to warm the water ends up in the hot, wet, energy-rich air above the pool. In the absence of ventilation, this air will become saturated with water and condensation appears on all surfaces which are at a lower temperature than the air. Therefore, ventilation systems are installed in order to dilute the concentration of water vapour in the air and minimize conden-

The net effect is that the ventilation used to maintain the water at 30°C. In addition, the cold inlet air has to be

sation on exposed surfaces.

energy loss but creates a higher risk of condensation and damage to the buildwater by one degree Celsius (the ing. The level of activity in swimming pools affects the rate of evaporation since the surface area exposed to the air increases due to splashing, etc.

> significantly as activities vary widely during the day and cease altogether overnight.

> A variety of measures can be taken to reduce energy consumption. Such as the use of: pool covers which can be rolled out overnight; variable speed fan motors; dehumidification systems; heat recovery units; improved insulation; etc.





efficiency!

• 2nd – "active heat recovery" - evaporator of the air-to-air heat pump, recovering from 65% to 100% the extract heat from the room





CONCEPT

MAXE is a concept solution designed to maintain the indoor climate parameters (Temperature and Relative Humidity) within covered swimming pool environments, according to the latest requirements for energy

MAX®³-00L is "e-conomizer" with 2 stage thermodynamic heat recovery technology - recovering up to 100% of the extract heat, achieved in two consecutive stages:

• 1st – "passive recovery" – air-to-air plate exchanger, 65% to 70% from the room

CONSTRUCTION

www.e----- is a single "1 piece" (standalone) unit. The construction is manufactured from high quality profiles made of extruded aluminum characterized by high strength and resistance to adverse weather conditions. Size MAX@=---- 13.0 consists of two blocks. The connection between the two blocks is carried out by aluminum connection plates.

> Unit enclosure panels are double skinned and shall comprise of a 1mm inner skin manufactured from galvanized sheet steel, 50mm mineral wool insulation having a density of 75kg/m3 and a 1mm outer skin manufactured from galvanized sheet steel. Both the inner and outer skins have a powder polymer coating color RAL9006. The insulation material is thermal and sound absorbing, fire and high temperature resistant mineral wool having CE certificate in accordance with EN14303.

Gaskets - Closed cell structure gaskets, made of Ethylene Propylene Diene Monomer (EPDM) are used for internal insulation and separation between the air flow sides- supply and exhaust, as well as on all doors and panels to protect the unit from internal and external leakages.

The components wherein condensation may occur (such as, direct expansion coils and plate heat exchanger) are equipped with a condensate drain pan. The condensate is removed via drain outlets connected to siphons (detailed schematics are provided with the documentation of the unit). The condensate drain pans are a welded steel structure made from 1.2mm thick galvanized steel sheets with a powder coating.

REFRIGERANT CIRCUIT

The Refrigerant circuit is 1 or 2 circuits, depending on the type of the unit. Refrigerant - R407C.

[M∧×@³→□□L] 03, 06, 09,13.0 use 3 phase es the system service life "Scroll" Compressors - 1, 2 or 4 pcs. depending of the type of the unit.

compressor. The main components of the refrigerant circuit are: electronic expansion valves; filter dryer; receiver; suction line accumulator; thermostats (high/low pressure); and differential pressure transmitter (high/low pressure).

All of the <code>[MAXE@B-OOL</code>] units contain high efficiency direct expansion coils which are made from copper tubes and aluminum fins that are "epoxy" coated, and condensate drain pans.

The refrigerant circuit is intended for use only in "Heating" mode and is nonreversible. If the situation calls for "Cooling" mode, this is an optional feature that must be coordinated in advance with the manufacturer.

FANS

02, 03, 06, 09 use "EC MAX @ POOL (Electronically Commutated) Blue Plug Fans" - with a Cpro frequency inverter manufactured by Ziehl-Abegg. The fan wheel is statically and dynamically balanced on the axis of the direct-driven motor. Both the fan wheel and the motor are mounted on a common base frame with vibration dampers.

Using EC Blue fans [MAX@³-00L] ensures the highest IE4 Premium Efficiency and ErP conformity- 2015/EC controller integrated. The high-performance composite material Cpro ZAmid[®], developed using the latest insights, makes the impeller significantly lighter than those made of steel and offers superior mechanical properties. Cpro ZAmid[®] provides new opportunities for system runtimes, enables lower power consumption and leads to a drastic reduction in noise. Cpro ZAmid[®] is manufactured using a one-shot injection-moulding process in a highly complex injectionmoulding machine, resulting in no welded

joints. This highly technical process ensures the highest system reliability. Innovation at a glance:

• Significant weight reduction, which reduces motor bearing loads and increas-

• Drastic reduction in noise generation leads to tonal noise reduction up to 5 dB

• Significant increase of the impeller efficiency, which reduces the absorbed power • Reduced power consumption - up to

15% energy savings during operation

• Significant CO₂ reduction - improved mechanical properties, comparable with steel

• No weld seams - high peripheral velocities up to 70 m/s

• Suitable for operational temperatures from -20°C to +80°C, comparable with steel impellers

- Corrosion-free
- No toxic gas emissions
- Colour-stable

MAX®³-00L 13.0 uses Plug Fans complete with an IE2 efficiency motor and a separate frequency inverter mounted within the unit.

The fan wheel is statically and dynamically balanced on the axis of the direct-driven motor.



Both the fan wheel and the motor are mounted on a common base frame with vibration dampers.











PLATE HEAT **EXCHANGER**

All of the 🕬 🕬 🖉 🗛 All of the 🕬 to-air plate heat exchangers made from aluminum fins that are "epoxy" coated; condensate drain pans; and mounted motorized dampers (bypass and "freecooling").

Efficiency (Sensible) – $E \le 65\%$ ÷70%. The of differential pressure, and work perfectly special cover of the plate heat exchanger extends its useful life and prolongs the best levels of performance.

CONTROLLER AND

executive mechanisms. eventual cut-offs.

FILTERS

Filters are installed at the entrance of the steel sheets.





The Classes of filtration are F6 (standard), F7. F8 and F9 (optional). One of the benefits of using this type of filter is that despite the turbulence, variable air volume, and vibration found in the system, it performs perfectly. Since the air passes equally through Microcell filters, a maximum service life is achieved.

Microcell filters are unaffected by fan shut down or start up, can resist up to 1000 Pa. in humid conditions.

AUTOMATION SYSTEM

Is fully equipped with all necessary automation as well as with all

The "Brain" of MAX @ ---- is a CAREL controller, which controls and manages all processes and protects the unit from

The software is developed with a high level of know-how and it automates all processes. Only the parameters (temperature and relative humidity) of the room need to be input. The controller automatically chooses in which of the 4 processes to work depending on variables input for the outside temperature, the set point temperature, and the supply and room temperatures. The controller even measures the necessary relative humidity within the

unit to ensure normal operation of the airhandling unit and to prevent contamination of the components. Microcell filters are used in the $(M \times B^3 \rightarrow OOL)$ units 06, 09 and 13.0. These filters are made of plated micro glass paper and spaced with hotmelt adhesive beads which are uniformly positioned to deliver optimum air-flow. The frame is constructed with composite material (plastic) and 130mm Galvanized



1. OPERATION IN STANDSTILL MODE (WITHOUT SWIMMERS)

The exhaust air from the pool is pre-cooled in the plate heat exchanger, then sub-cooled in the evaporator below the dew point temperature. The moisture in the form of condense is taken out. The dehumidified air is partially mixed with recirculation air. The so mixed air is heated within the condenser and then supplied to the pool. The plate heat exchanger is used as an economizer, reducing significantly the energy costs.

2. OPERATION IN WINTER - DEHUMIDIFICATION WITH HEAT PUMP

During the winter, water evaporation is much more intensive. Thus a dehumidification process is needed. The exhaust air from the pool is pre-cooled in the plate heat exchanger, then subcooled in the evaporator below the dew point temperature. The moisture in the form of condense is taken out. The necessary fresh air is partially mixed with dehumidified, recirculated air. The so mixed air is first pre-heated in the plate heat exchanger, then re-heated within the condenser and then supplied to the pool.

3. OPERATION IN TRANSITIONAL PERIODS -**VENTILATION AND HEAT PUMP**

The outside temperatures during the transitional periods are average and relatively high. The supplies 100% fresh air to the pool. The Heat Pump is switched on only if needed.

4. OPERATION IN SUMMER - VENTILATION WITHOUT HEAT PUMP

During the summer the heat pump is switched off and only the exhaust and supply fan are operating. The bypass of the plate heat exchanger is open and the unit supplies the maximum quantity of fresh air to the pool. Thus, optimum comfort is achieved.









Ventilation and heat pump



Ventilation without heat pump

	GENERAL TECHNICAL DATA						
АНИ Туре		MAX.@3700L 02	MAX.@3200L 03	MAX.@3=001.06	MAX.@3=00L 09	MAX.@3200L 13	
		General Technical Data					
Min/Max Airflow	m ³ /h	1000/2000	2000/3200	4000/7000	5500/10000	9000/13000	
Nominal Airflow	m ³ /h	1500	2500	6000	9000	13000	
Dehumidification capacity (VDI 2089)	ka/h	10.6	17.2	38.3	50.7	79.6	
		Pool Area Surface - m ²					
Private pool	m ²	56	93	224	336	486	
Public pool	m ²	12	70	168	252	365	
Total Heating Canacity	kW	18.7	31.4	68.0	90.5	141 5	
Total Installed Power			0.07	00.0	50.5	141.5	
(compressors + fans)	KW	7.70	9.95	16.9	18.4	33.8	
Total Power Input	1.111	2.4	5.0	11.0	11.11	24.64	
(compressors + fans)	KW	3.4	5.9	11.8	14.14	24.64	
Full Load Current	А	20.8	22.1	39.4	39.8	85.4	
Unit's Power Supply	V/ph/Hz 400 / 3 / 50						
System COP (winter mode)		5.52	5.29	5.73	6.4	5.74	
Fans	EC Plug fan						
Motor Efficiency		IE4 Premium Efficiency, ErP conformity-2015/EC controller integrated IE2					
Specific Fan Power (SFP)	W/(m ³ /s)	1848	1570	1849	1880	2104	
Supply / Exhaust static pressure Hst	Ра	250	250	250	250	250	
Installed Motor Power	kW	2 x 2.5	2 x 2.5	2 x 3.5	2 x 3.4	2 x 7.5	
Installed Current	А	2 x 4.0	2 x 4.0	2 x 5.6	2 x 5.4	2 x 14.5	
Protection Class	IP 55						
Plate Heat Exchanger	Aluminum						
Efficiency (winter mode)	%	68.0	68.0	67.0	65.0	63.0	
Recovered Heating Capacity (winter mode)	kW	7.9	13.0	29.6	41.2	59.9	
Compressors		Rotary	Scroll	Scroll	Scroll	Scroll	
Number of compressors		1	1	2	2	4	
Power Input (winter mode)	kW	1 x 2.62	1 x 4.79	2 x 4.39	2 x 4.72	4 x 4.26	
Max. Full Load Current	A	1 x 12.8	1 x 14.1	1 x 14.1	2 x 14.5	4 x 14.1	
СОР		4.13	3.78	4.37	5.22	4.79	
Filters	Cassette						
Filtration Class	F	F5	F5	F6	F6	F6	
Filtration Efficiency	%	90	90	90	90	90	
Iotal Filtration Area	m2	4.34	6.4	55.8	/4.4	99.2	
Water Heater	2.4	0.27	0.54	4.20	246	245	
Hot Water 80/60°C	m3/h	0.27	0.51	1.38	2.16	3.15	
Heating Capacity	KW	6.2	11.6	31.5	49	72	
water Pressure Drop	кРа	1	1.6	1	2.8	2.2	
Headers ain/out	mm	21.3	26.9	33.2	42.2	42.2	

(winter mode) Room Air 28°C/60%, Fresh Air -15°C/90%, Quantity of Fresh Air - 30%



MAX@***** 02 MAX@***** 03



MAXB*202 06 MAXB*202 09





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CENERAL TECHNICAL RAT

MAX@*rool 13.0

DIMENSIONS AND WEIGHTS