TECHNICAL BULLETIN

INNOVATIVE POOL VENTILATION TECHNOLOGY FROM Recotherm

01527 894533 www.recotherm.co.uk

To control the swimming pool environment, which is best?

Heat pump or Fresh air

Which one reduces running costs & improves reliability

Swimming pool hall ventilation requirements and solutions

The swimming pool environment is one of the most challenging environments for a ventilation engineer to design. Fundamentally the system needs to balance the comfort of the bathers with the protection of the building structure.

It needs to be capable of:

1. **Compensating for the heat loss from the hall to maintain the correct temperature.**
2. **Providing enough fresh air for the occupants.**
3. **Maintain an appropriate internal humidity. This is important to protect the building structure from condensation and mould but also to protect the occupants from bacteria, viruses, fungi and mites that can occur if the humidity is not correctly controlled.**
4. **Maintaining a slight negative pressure in the pool hall to prevent egress into adjacent rooms.**
5. **Most importantly the plant should be capable of doing all of the above whilst using the least amount of energy.**

To achieve this there are 2 main options available to the pool owner

A) Heat pump refrigerant based systems or

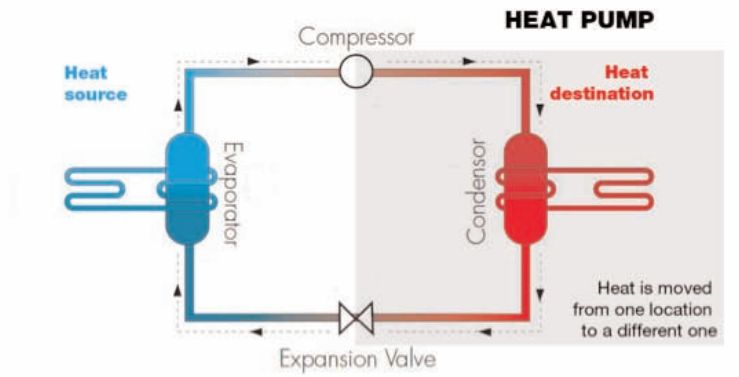
B) Fresh air systems

The Heat pump dehumidification option

How does the 'heat pump' dehumidifier work

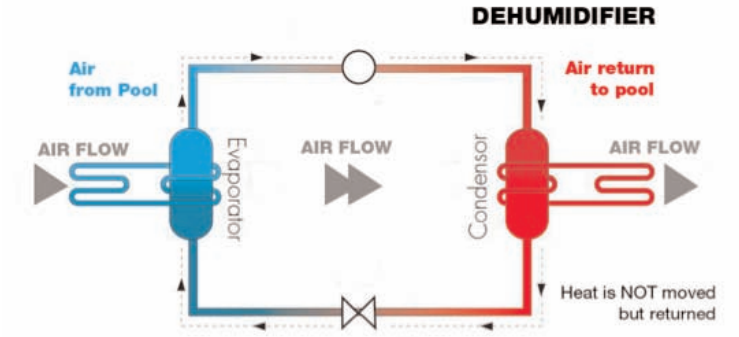
The term Heat pump in connection with dehumidification is somewhat misleading. A heat pump is not a dehumidifier and a dehumidifier is not a heat pump.

A heat pump is a device that moves heat energy from a source of heat, to a required destination. Heat normally flows from hot to cold areas by dispersion. Heat pumps are designed to move thermal energy in the opposite direction to that of normal heat flow by absorbing heat from a cooler space and releasing it to a warmer one.



Now the important point of note here is that the heat 'source' and the heat 'destination' are separate, for instance in an air source heat pump you are removing heat from the external air to heat an internal space, in a bore hole you are removing heat from the ground water to heat the internal space. The important thing is that the source and the destination are not in the same space and the overall function is to move heat.

A heat pump dehumidifier draws moist air over a cold surface with a fan. The cold evaporator coil of the refrigeration device cools the air and condensation is formed on the surface, which is removed thus dehumidifying the air, and then a condenser coil reheats the air. The now dehumidified warm air is released into the room.



For More information call. Martin Killen
Tel 01527 894533
Email sales@recotherm.co.uk www.recotherm.co.uk

Recotherm. Unit A, Astwood Business Park
Astwood Lane, Astwood Bank, Redditch,
Worcestershire, B96 6HH

In this function there is no separation between the 'source' of heat and the 'destination'. In this application you cool the pool hall air down and then heat the same air back up again. This is why the swimming pool refrigerant-based air recirculation systems are dehumidifiers and not heat pumps.

Heat pumps have become synonymous with energy efficiency, which most people associate with reduced running cost (this is not always the case as a heat pump is just an efficient way of using electricity for heating, the fact is electricity is 4-5 time more expensive than gas).

So companies that use the term 'heat pump' in their pool dehumidifier product description, are trying to borrow the credentials of the heat pump and mislead the buyer into thinking their unit is more efficient than it actually is. A more accurate description would be refrigeration dehumidifier.

What are the shortcomings of a refrigerant based dehumidifying system/heat pump?

EFFICENCY

A lot is made of how efficient heat pumps are. They will tell you that you get 4.5 kW of heat out of the condenser for every 1 kW of electricity consumed by the compressor. That is when used for heating not dehumidifying.

A typical refrigerant base dehumidifier takes the air at 30°c cools it to 22°c and heats it to 34°c. You started with air at 30°c and you finished with air at 34°c so your actual gain is only 4°c, this translates to 1.5 kW for every 1 kW input not 4.5.

For the average domestic user the price of a kW of electricity is 5 times more expensive than the cost of a kW of gas. So you can see you would be losing money if you relied on this "heat pump" for heating purposes.

Manufacturers promoting heat pumps will tell you that the heat you get is waste heat from the dehumidification process but that assumes that we need a heat pump to control the humidity, which as you will see later we don't.

CORROSION

When you dehumidify the air, the condensation that is produced will contain small amounts of chlorine. This chlorine has a corroding effect on the evaporator coil. Unfortunately there are no totally corrosion resistant coils on the market so if it is condensing out moisture then it will still corrode, which means replacing components.

MAINTENANCE

Mechanically a heat pump is a complicated unit. It isn't something that could be maintained by the on-site handy man. When things go wrong you need a qualified refrigeration engineer. These engineers do not come cheap because they have to be F gas approved in order to be able to work on refrigerant based systems.

STALE ATMOSPHERE

For the heat pump system to work you need to be re-circulating most of the existing air. This means the same air with the same odours and no freshness; in the end it will give you a stale atmosphere in the pool hall. We all need a breath of fresh air from time to time

What is the alternative to a Heat pump?

Fresh air

Sounds a bit too simple but it really is the answer to the question!!! However you can't just open a window and bob's your uncle, to do the job economically you need 'controlled fresh air', heat recovery systems and variable speed fans.

How does Fresh air dehumidify my pool hall?

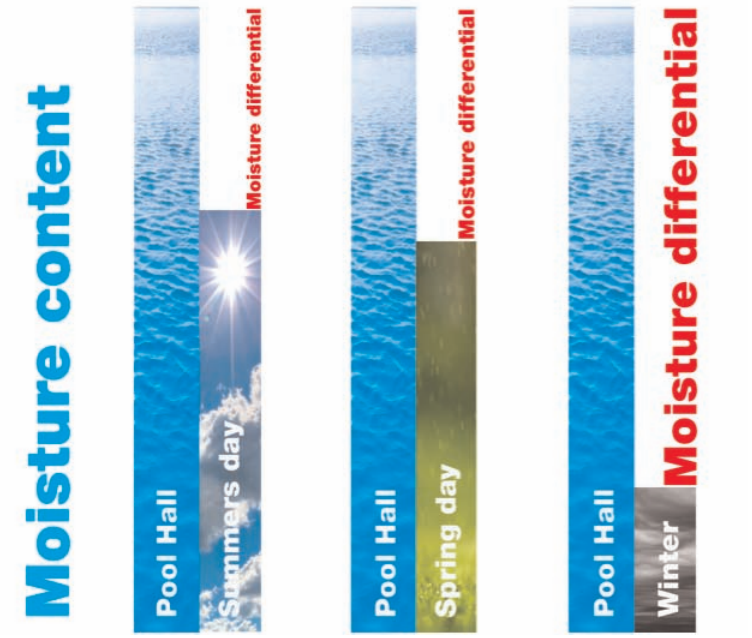
To understand how fresh air ventilation can work it may be useful to look at the properties of air.

The air around us always has moisture content. That is, it contains so many grams of moisture for every kilogram of air. The amount of water the air can hold is dependent on the temperature of that air.

Air at 0°c has maximum moisture content of 3.8 g/kg. If it contained that amount of water it would be said to be saturated i.e. 100% relative humidity. It is important to appreciate that the term to use is relative humidity, and that it is relative to temperature. If the air was heated from 0°c to 15°c the relative humidity for the same moisture content would be 35% RH.

Air at 0°c 100% RH would actually contain less moisture than air at 15°c 50% RH.

The moisture content inside a pool hall in the UK is always higher than the external air. To give you an example, a typical pool with an air temperature of 30°c and relative humidity of 60% has a moisture content of 16.3 g/kg. The external ambient air on a cold day in the middle of the winter holds 3.8 g/kg of moisture, on a wet day in April the moisture content would be 10.2 g/kg and on a summers day the moisture content would be 11g/kg. In almost all circumstances ambient air humidity in the UK is less than the pool hall humidity.



Throughout the year the fresh air has lower moisture content than the air inside the pool hall. By introducing fresh air in any of these conditions it will lower the moisture content of the pool hall and thus the relative humidity within the pool hall.

For More information call. Martin Killen
Tel 01527 894533
Email sales@recotherm.co.uk www.recotherm.co.uk
Recotherm. Unit A, Astwood Business Park
Astwood Lane, Astwood Bank, Redditch,
Worcestershire, B96 6HH

How do we make it work? It's all about control.

If you were to introduce the fresh air without any sort of control then the running cost for the system would be extremely high, so what you need to do is to introduce the precise amount of fresh air that is required and no more.

A fresh air unit should combine a number of energy saving techniques to reduce the overall energy bill.

HEAT RECUPERATOR

This recovers the heat in the outgoing exhausts air.

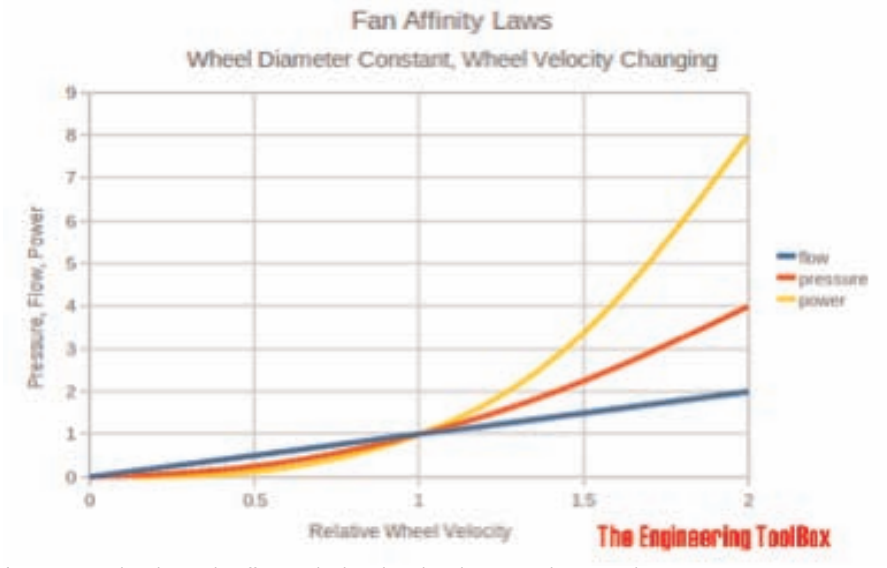
It also needs to be a passive heat exchanger; where there is no energy input to the unit. It absorbs the heat in the exhaust air stream and transfers this into the fresh air stream over a series of aluminium plates. Typical efficiencies for these exchangers are 60% - 90%.

So if the exhaust air is going out at 30°C and the fresh air is coming in at 0°C we will heat the air to a minimum of 18°C.

HIGH EFFICIENCY EC FANS

The fans used in the unit should be direct driven, backward curved with electronically commutated motors (EC). These fans are not only highly efficient but they also allow you to control the speed of the fans and thus the volume flow of the air

By controlling the air volume the exact amount of fresh air that is required can be introduced so minimizing the heating load. There is an even better reason for reducing the fan speed to the lower the air volume - it lowers the power consumption. You may expect a 20% reduction in air volume gives a 20% reduction in power consumption. It's better than that, a 20% reduction in air volume will give a 50% saving in power consumption. The following graph demonstrates this.



You can see the dramatic effect reducing the air volume can have on the power consumption of the motor. If we reduce the air volume down to 50%, we would reduce the power consumption to only 12.5% of the maximum. To put that into figures, a unit that takes 2.5 kW on maximum load would be reduced to 0.3 kW if the unit were running at half speed.

You can lower the air volume on a swimming pool because the air volume is calculated to cope with the maximum dehumidification load but for the majority of the time the maximum dehumidification is not required.

BUILDING MANAGEMENT CONTROL UNIT

One of the key principles to making the fresh air concept work is fine control and utilising the latest technology to achieve this.

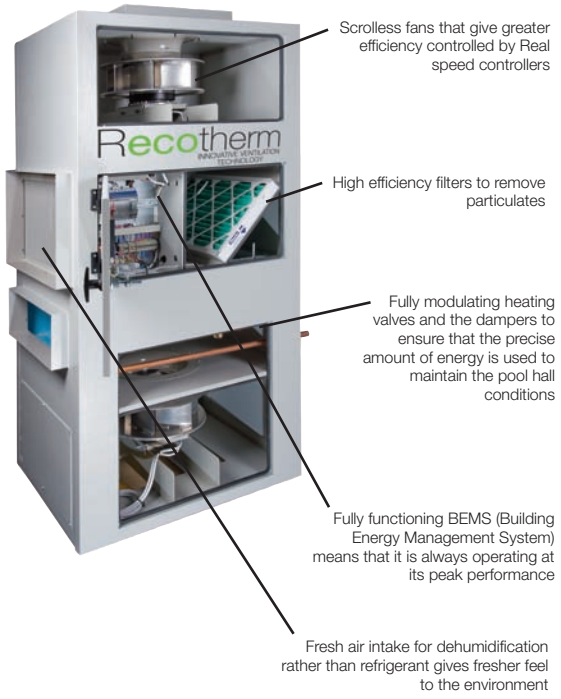
Sensors mounted in the return air chamber should send back to the controller the temperature and humidity readings every five seconds. Using this information, the controller should decide on the amount of air and heat that is required along with how much recirculation can be permitted. This gives precise control over the internal conditions within the pool hall and ensures that the unit is not working any harder than it needs to, thereby keeping running cost to a minimum.

BENEFITS AN FEATURES OF A RECOTHERM UNIT

Typically a Recotherm fresh air unit runs at 60% of the cost of a refrigerated unit, a Recotherm unit protects the building fabric better, removes stale air and odours and lasts over 20 years if maintained properly.

Recotherm's UK based manufacturing centre combined with its in-house design means virtually any solution you need be it: flat pack, variable ventilation control software for variable use buildings, scented fresh air, mobile phone control or high efficiency double recuperator options all backed by our own full service and maintenance teams we can even provide remote monitoring for peace of mind.

Our objective is to make the job of dehumidification simple, reliable and honest value for money. For further information please contact us for a technical consultation.



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