Bulletin 3

TECHNICAL BULLETIN

INNOVATIVE POOL VENTILATION TECHNOLOGY FROM Recotherm

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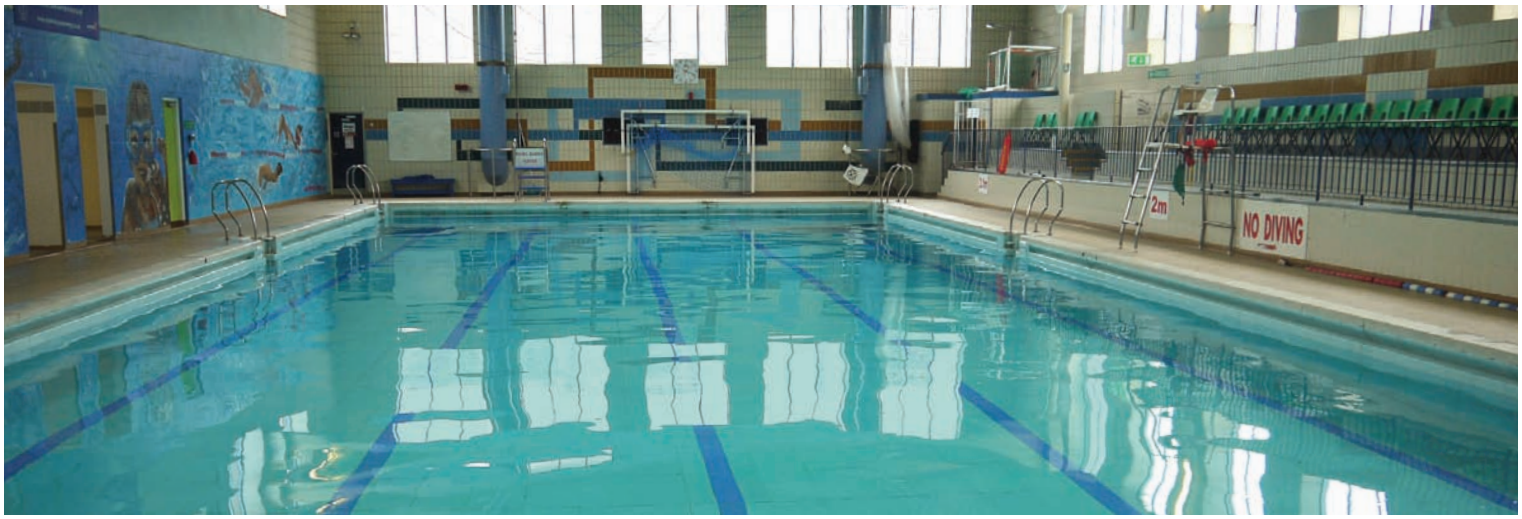
Indoor pool myths - the 1°C rule

Condensation not caused by evaporation

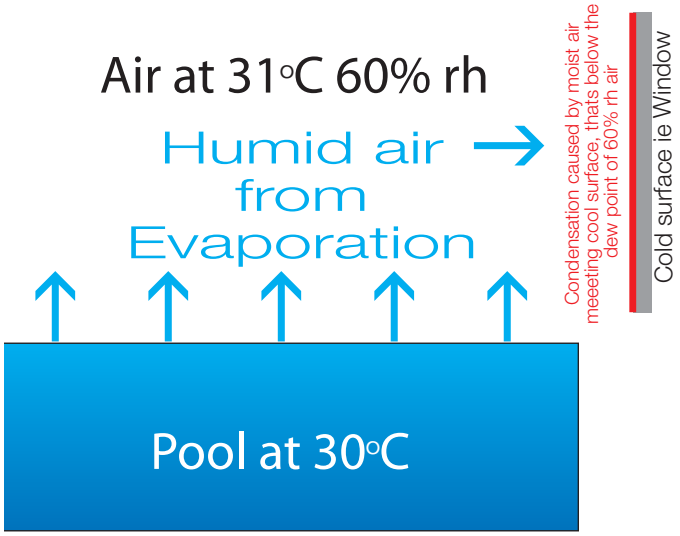


The above statement may come as something of a surprise to some, who for years have been told that the pool hall air temperature must be maintained 1°C higher than the pool water temperature or you will suffer from condensation.

In order to explain why the above statement is incorrect we first need to know why moisture condenses on windows.

Air can hold different quantities of water in the form of vapour at different temperatures. In simple terms, the higher the air temperature, the greater the amount of water it can hold. So in a pool hall with an air temperature of 30°C and a relative humidity of 60% all is fine. But picture in your mind the thin strip of air in contact with the window. This air is being cooled by the window pane; cooling until it starts approaching the temperature of the window itself. If this temperature is below the dew point of the air (i.e. the temperature at which water vapour turns back to liquid water), moisture will condense out of the air and show as condensation on the window pane.

Notice that at no point did we once mention the pool water temperature in explaining how condensation occurs.



Why? Because it's irrelevant. That is because there are only two things that affect the appearance of condensation:-

a) the moisture content of the air and thus its dew point, and

b) the surface temperature of the glass.

As a double pane window has a greater resistance to heat transfer, the surface temperature of the internal pane of glass will be higher meaning it is possible to operate at a higher internal humidity with double glazing than we can with single glazing.

Where the temperature of the water is significant is in the evaporation from the pool but again it is portrayed - wrongly - that if you have the air temperature 1°C above the pool water temperature, you will eliminate evaporation. This is not true. The driving force behind evaporation is the difference between the saturated vapour pressure at the pool temperature, and the partial vapour pressure of the air. This difference is still there when the air is warmer; in fact the difference can be higher if the humidity drops.

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To illustrate this, the tables below show the evaporation rates for different air conditions.

In the first (Fig.1), the air temperature is 1ºC above the pool water temperature, and in the second (Fig. 2) the air is 1ºC below the pool water temperature. The humidity for both varies from 40% to 70%. (Evaporation rates have been calculated using the Biasin and Krumme formula)

Fig.1 air temperature is 1ºC above the pool water temperature

Water temp	Air temp	Humidity	Vapour pressure	Evaporation rate	Evaporation 100 m^2 pool
30	31	70	3.187	0.142	14.17
30	**31**	**60**	**2.744**	**0.152**	**15.16**
30	31	50	2.298	0.162	16.16
30	31	40	1.846	0.172	17.18

Fig. 2 air temperature is 1ºC below the pool water temperature

Water temp	Air temp	Humidity	Vapour pressure	Evaporation rate	Evaporation 100 m^2 pool
30	29	70	2.837	0.150	14.95
30	**29**	**60**	**2.442**	**0.158**	**15.84**
30	29	50	2.043	0.167	16.74
30	29	40	1.641	0.176	17.64

From these tables you can see that a pool with a surface area of 100 m^2 operated at 30ºC with the air temperature one degree above at 31ºC and a humidity of 60% has an evaporation rate of 15.16 kilogrammes per hour (kg/h). If the air was one degree below the pool at 60% humidity the evaporation rate would be 15.84kg/h which is only 0.68 kg/hr more. In fact running the air temperature at 31ºC 50% RH gives a greater evaporation rate than having the air two degrees cooler and 60% RH.

The reason we highlight these facts is that the attendants, staff, lifeguards and teachers on the poolside have to work in these conditions, not to mention members of the public in viewing areas within the pool hall. As swimming pool temperatures have risen over the years in order to attract more customers, the industry has slavishly followed with the (as we've shown above) misconception that the air temperature must be maintained at 1ºC above water temperature. In the past with a pool at 27ºC and the air at 28ºC the attendants had a relatively comfortable working environment.


Higher temperatures not comfortable for all

However, with most commercial and leisure pools now averaging temperatures of 30ºC, maintaining the air at 31ºC 60% RH is not very comfortable at all for those not in the water. This is also true for domestic pools where the majority of the home owners who we work with would like the rooms kept at an average of 28ºC, but want their pool water at 30ºC.


Humidity causes condensation

So in conclusion you CAN run below the1^{0}C rule, despite the industry myth. It is possible to maintain the air temperature comfortably below the pool water temperature and still not get condensation on the windows. You will get a slight increase in evaporation from the pool, but your system should be designed to easily cope with this.

The problems occur when you have a heat-pump based dehumidification system, as these systems are already more expensive to operate than a controlled fresh air system with passive heat recovery.

However - and this where you can start to see where the industry 'rule' about maintaining the air 1ºC higher than the water temperature came from - if you lower the pool hall temperature they become even more inefficient because they are designed to take air at certain conditions in order to operate efficiently. Under these circumstances you will not be able to lower the air temperature without detrimentally affecting the performance of the unit.

This is not the case with controlled ‘fresh air’ ventilation systems which can cope with lower air temperatures providing they have been sized correctly for the project.

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