Indoor Pool Ventilation

Achieving high IAQ for indoor pools while
minimising energy consumption

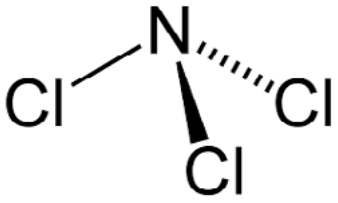
AIR CHANGE
DOAS & DEHUMIDIFICATION

Chloramines in indoor pools

Chloramines are contaminates present in indoor pools and cause eye, skin and respiratory irritation if air concentration levels are high. Chloramines form when bodily proteins combine with chlorine in pool water.

The WHO recommends that chloramine concentrations in the air be kept below 0.5mg/m^3 to ensure the health and wellbeing of occupants. Other guidelines like France's AFSSET suggests even lower limits of 0.3mg/m^3.

Chloramines are also highly corrosive and contribute to the degradation of a building and its contents when condensation occurs.



Trichloramine molecule

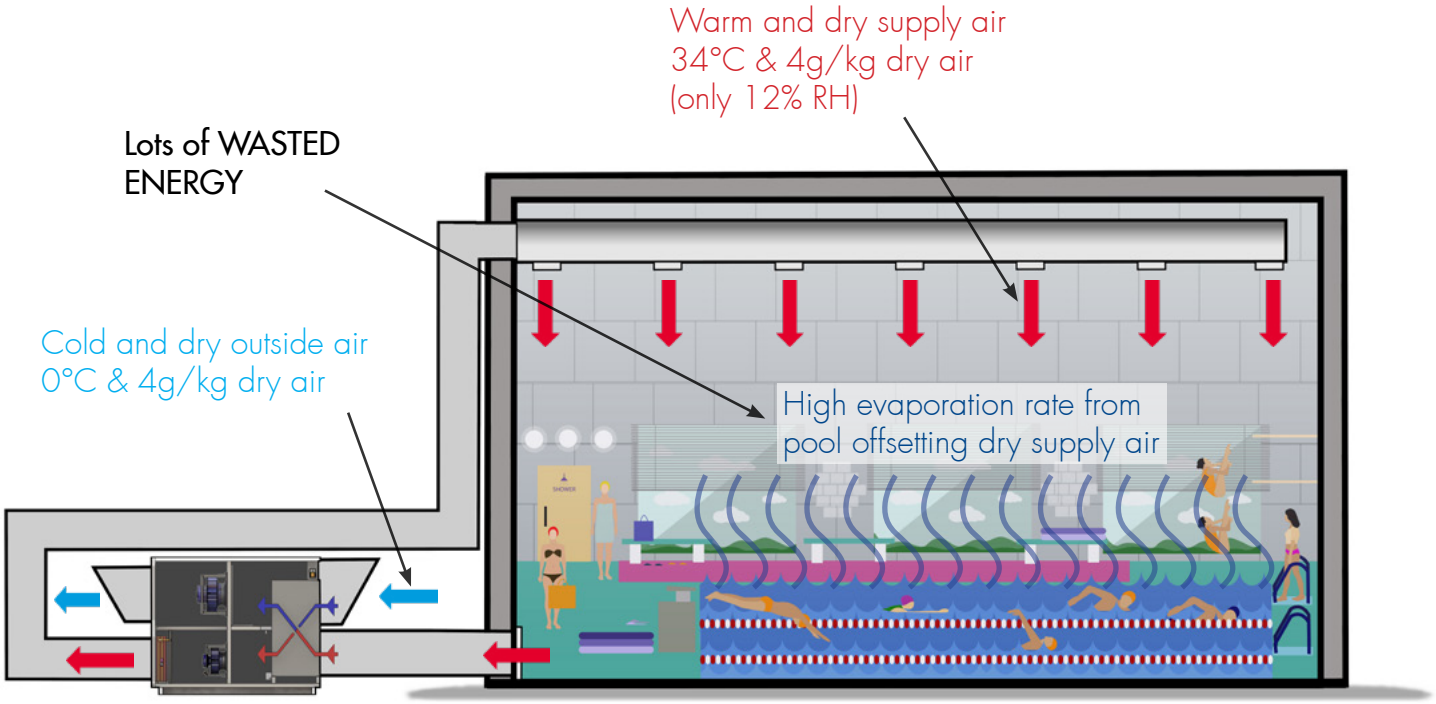
Too much fresh air?

Ventilating indoor pool halls with large amounts of outside air is an effective way to control humidity in the space and minimise airborne chloramine levels. However, supplying large fresh air volumes when it is cold and dry presents a new problem – high energy consumption.

In cold conditions, pool HVAC systems consume large amounts of energy, even when air-to-air heat recovery is used. Cold outside air holds very little moisture, so after warming, it drastically reduces the relative humidity in the space.

As a result of the lower room relative humidity, water evaporation from the pool surface increases, which increases energy consumption.

Too much fresh air increases both pool water and air heating energy requirements.

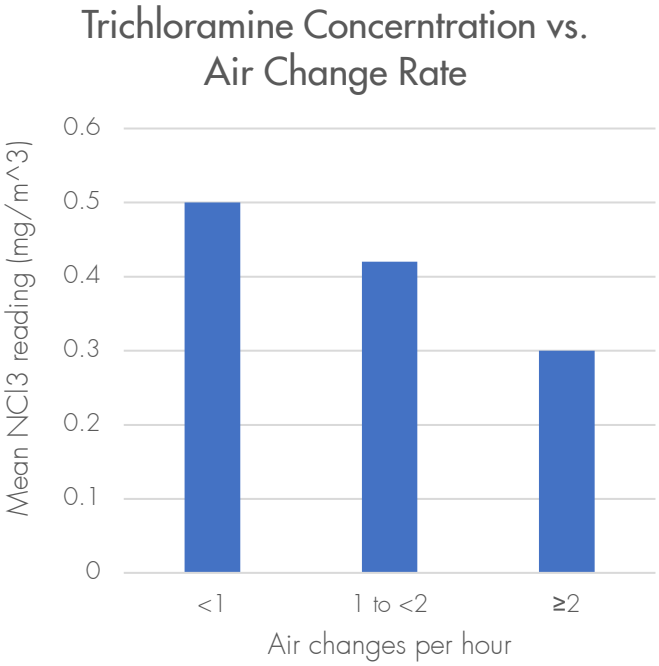


Indoor pool study

Studies have been conducted on the relationship between ventilation rates and airborne chloramine levels in indoor pools.

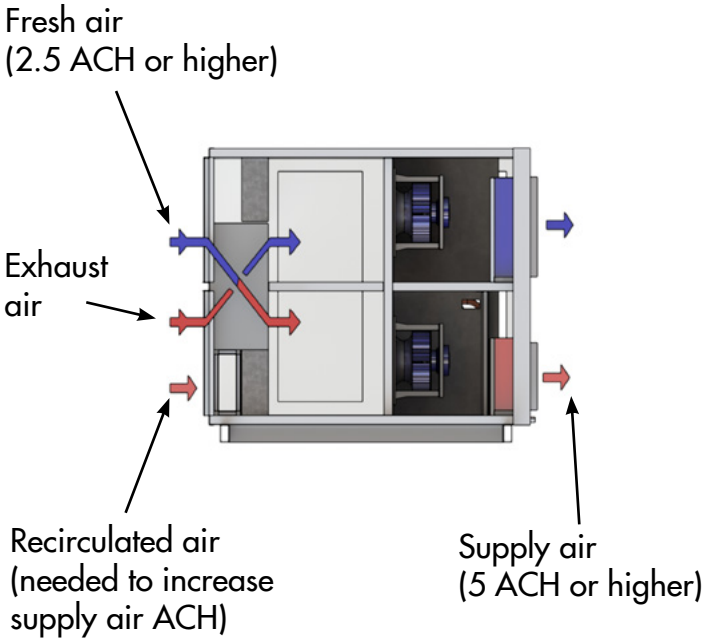
One by Lévesque et al., discovered that air change rates greater than two were sufficient in keeping trichloramine levels below the recommended level of 0.3mg/m^3. This concurs with AHRAE's recommended air change rate of 2.5 in indoor pools to control trichloramine.

It was also found that closing ventilation at night when the pool was unoccupied had no significant effect on airborne chloramine levels during the day.



"when the pool was ventilated at 2 ACH or more, the average NCl_3 concentrations were lower (≥2 ACH: 0.30 mg/m^3), reflecting the strong influence of this variable on air contamination."

Supply air volume



Even though fresh air ventilation rates above 2.5 per hour is sufficient to control airborne chloramine levels, it is vital that supply air volumes remain above five air changes per hour. This can be achieved with different combinations of fresh air and recirculated air. This ensures:

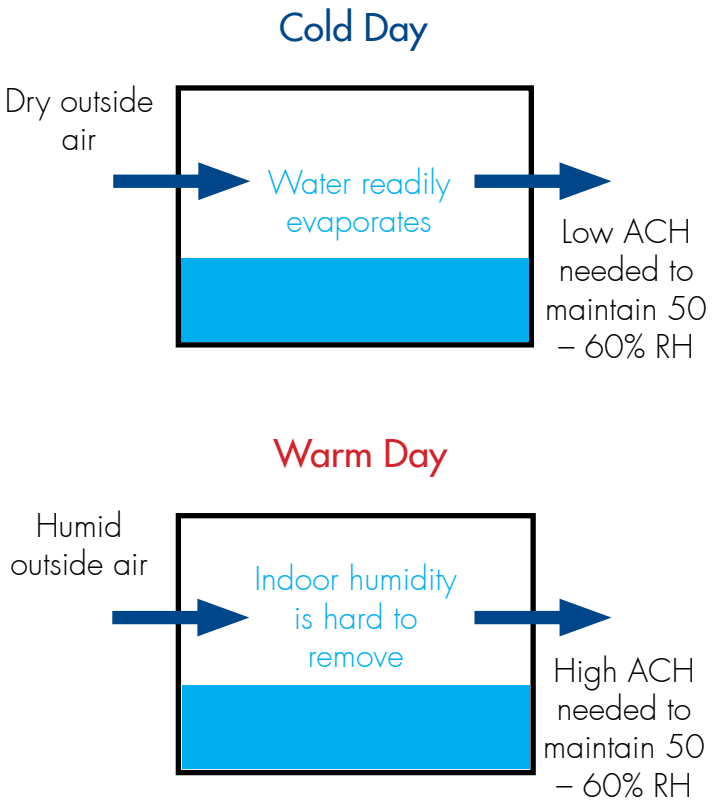
- Air handlers can provide enough heating capacity to keep the pool hall at the specified temperature;
- There is sufficient supply air available to flow over all glazed surfaces and minimise condensation;
- There isn't any airflow 'dead spots' inside the pool hall where the air can become stagnant; and
- Humidity control can be maintained when the outside humidity increases (see next section).

Humidity control

As explained, when outside air conditions are cold and dry, excessive fresh air ventilation will increase pool evaporation and thus require more air and pool water heating. When this occurs, fresh air ventilation should be kept to the minimum to provide sufficient fresh air and control chloramine concentrations.

But what about when outside air conditions are warmer and more humid? More fresh air is now needed to control the indoor humidity as less moisture is removed for the same ventilation air volume.

Therefore, indoor pool HVAC systems should ideally have a variable outside air and recirculation system. This ensures that minimum fresh air volumes can be supplied for chloramine control during cold and dry conditions, and higher volumes during more humid conditions to control indoor RH. The result – lower energy bills.



Air Change indoor pool solutions

PoolPac

Packaged DX unit with air-to-air heat recovery designed specifically for indoor pools.

ERV

Air-to-air heat recovery unit with integrated HHW coil. Constructed and treated for corrosion resistance.

PoolPac Plus

Packaged DX unit that combines pool water heating and air handling for optimal energy efficiency.

References

World Health Organization. (2006) Guidelines for safe recreational water environments. Volume 2: Swimming pools and similar environments. Geneva, Switzerland: WHO.

Agence française de sécurité sanitaire de l'environnement et du travail (AFSSET). (2010) Risques sanitaires liés aux piscines.Partie 1: piscines réglementées. Maisons-Alfort, France: Agence française de sécurité sanitaire de l'environnement et du travail.

Lévesque B, Vézina L, Gauvin D et al. (2015) Investigation of Air Quality Problems in an Indoor Swimming Pool: A Case Study. Ann Occup Hyg Vol. 59, No. 8, 1085–1089

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