Improving Indoor Air Quality in Indoor Pools

Exploring Legislation and Best Practices Regarding Natatorium Design and Operation

Michael Atrach
Supervised by Dr. Chun-Yip Hon

Email: Michael.atrach@torontomu.ca

Toronto Metropolitan University

School of Occupational and Public Health

01. Background

Indoor Air quality (IAQ) is a set of parameters that are widely researched and enforced in a variety of applications. When is comes to indoor pools and natatoriums, the legislation aspect is vague and does not present concrete guidelines.

When scanning through provincial legislation and building codes all across the country, and even internationally, there are no hard set parameters to be found. Instead, it is quite common for legislation to recommend that national standards published by corporations such as ASHRAE and CSA are followed to the operator's best ability.

So what is ASHRAE and why is it so relevant?

ASHRAE is the American Society of Heating, Refrigerating and Air-Conditioning Engineers. ASHRAE establishes and is constantly refreshing many guidelines regarding ventilation in enclosed spaces. In regards to indoor pools, there are two documents that are relevant and constantly explored, namely: ASHRAE Standard 62.1(Ventilation and Acceptable Indoor Air Quality) and ASHRAE Journal Article: Ventilation Requirements for Natatoriums.

02. Objectives

1. Scan all relevant legislation and recommendations regarding IAQ in indoor pools with a North American/Canadian focus.
2. Compile a reliable set of design methods and operating procedures that operators can follow to maintain an IAQ that is acceptable for all occupants.
3. Provide recommendations and methods to help achieve these desired parameters.

03. Methodology

Federal legislation was first explored before examining the legislative requirements of each province individually.

Best practices and recommendation guidelines by both government and private institutions were explored.

Private institutions were examined for previous relevant publications and vetted to ensure the data and opinions were both valuable and reliable.

Publications were scanned for both numerical guidelines as well as methods for exposure reduction and promotion of air quality.

04. Results/Findings

04.1 Ventilation Rate (cfm)

Along with the table shown in *Figure 1*, there is a formula that outlines the required amount of outdoor air exchange recommended based on the factors outlined above. Outdoor air exchange is one of the key components of maintaining suitable IAQ and ensuring proper ventilation within the facility. This value is represented in (cfm).

The formula is as follows: The minimum ventilation rate (outdoor air required) for indoor aquatic facility pool and deck areas = 0.48 cfm/ft2 of pool and deck × Minimum outdoor air multiplier [2].

The commonly referenced ASHRAE 62.1 Standard does not go into much depth regarding pool spaces. It classifies natatoriums as class two air spaces which results in recirculation limitations. It also recommends that an outdoor air rate of 0.48 cfm/ft2 is provided; this number is less comprehensive than the formula presented in the journal article [1].

VENTILATION RATE (cfm)

TABLE 3 Minimum ventilation rate (outdoor air) multipliers to adjust for activity factor and air distribution complexity.

		POOL TYPE					
		THERAPY/ CONDO	HOTEL	PUBLIC/ SCHOOL	COMMUNITY RECREATION	RECREATION PLUS	SMALL HOTEL WATER PARK
		ACTIVITY FACTOR					
		0.65	0.80	1.00	1.25	1.5	2.0
		MINIMUM OUTDOOR AIR MULTIPLIERS					
POOL SPACE HEIGHT	15 ft	1.00	1.19	1.39	1.59	1.75	2.06
	20 ft	1.04	1.24	1.45	1.65	1.82	2.14
	25 ft	1.08	1.29	1.50	1.71	1.89	2.23
	30 ft	1.12	1.34	1.56	1.78	1.96	2.31
	35 ft	1.16	1.38	1.62	1.84	2.03	2.39
	40 ft	1.20	1.43	1.67	1.90	2.10	2.47
	45 ft	1.24	1.48	1.73	1.96	2.17	2.55
	50 ft	1.28	1.52	1.78	2.03	2.24	2.63

Figure 1 above is a table produced in the ASHRAE journal article outlining ventilation requirements in natatoriums.

04.2 Air Changes

Air changes per hour or (ACH) is a measurement of how many times the air within an enclosed space is exchanged through the HVAC system within the hour. According to ASHRAE the recommended rate is **4-6** air changes per hour for **recreational pools** and **6-8** for competition pools including spectator decks [2].

A review article published by a private company, Innovent, suggests starting at 6 air changes per hour then adjusting depending on condensation and relative comfort. The number should never fall below 4 air changes per hour [3].

04.3 Relative Humidity

Opinions regarding humidity vary across industry standards. ASHRAE 62.1 outlines that relative humidity should not exceed 65%, but does not provide a clear suggestion [1].

Operating costs and outdoor air conditions are typically dictating factors in the humidity range an operator may select.

A comprehensive summary of benefits and downfalls associated with high and low humidity can be seen in *Figure 2.* This chart places the ideal range between 40-60% which aligns with nearly all industry standards [4].

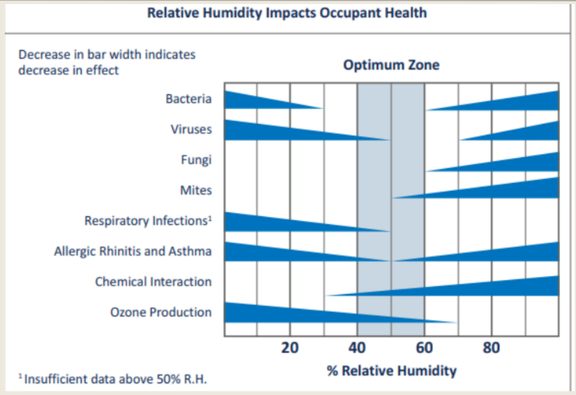


Figure 2. A chart produced by PoolPak to outline the ideal humidity range for natatoriums.

04.4 Pressure

It is recommended that a negative pressure of 0.05-0.15 Inch of water column is maintained within the natatorium relative to exterior spaces. This helps keep the moisture and various airborne contaminants confined within the pool space [3].

04.5 Chloramines

Chloramines most commonly NCL3 (trichloramine) are a byproduct of hypochlorites used for disinfection of pool water. When the hypochlorite interacts with nitrogen, typically through sweat, urine, cosmetic products, etc., these trichloramines are released into the air.

Chloramines typically float along the surface of the water and can be propelled throughout the enclosure through physical activity and water features.

This compound is responsible for the strong chlorine odour within pools and can cause skin, eye, and respiratory irritation.

An article published by WorkSafe BC found that facilities with less than 0.35 milligrams per cubic metre of chloramines present were able to mitigate the irritating effects [5].

04.6 Mold/Microbial Growth

Similar to most occupational regulations there are no specific parameters regarding microbial growth and exposure.

ASHRAE 62 suggests that building components are comprised of moisture resistant materials that can withstand microbial growth and continuous exposure to high levels of moisture [1].

05. Recommendations

Increasing Circulation and Ventilation

Although the increase of these factors may be beneficial to the air quality, they come with a high operating cost that most operators are not willing to invest in [4].

Placement of Circulatory and HVAC Components

The placement of capture hoods and vents can greatly improve indoor air quality, which in turn, improves the comfort of occupants and the building longevity. Here are some examples of how placement can make an impact:

1. Directing airflow to the surface of the pool to sweep chloramines away from the swimmers breathing zone protects the occupant from irritation. It is required that the air flow across the water's surface does not exceed 30fpm as a higher rate would cause discomfort for the swimmer [2].
2. Blanketing surfaces with exterior contact such as windows with supplied air can help mitigate indoor condensation. It is recommended that 3-5 cfm per square foot of supplied air is curtained across these surfaces [4].
3. High volume low speed fans (HVLS) can be used to promote circulation in structures with large ceiling heights. This prevents corrosive damage to the ceiling, while also aiding in the circulation of the newly exchanged air [3].
4. By placing the exhaust air directly above fixtures, such as, spa jets and whirlpools, chloramines can be captured directly from the water's surface. This helps reduce the unpleasant odour, while increasing occupant comfort.

06. Conclusion & Forward Direction

In short, no two pools are the same. Factors such as purpose, material, size, traffic, and outdoor conditions, all play a part in design and operation factors. This level of variety is what prevents the establishment of legal design parameters enforced by government bodies.

Moving forward monitoring of present IAQ variables and likely contaminants such as, trichloramines, could be a more effective way to ensure occupants are provided with acceptable indoor air quality.

References

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