Air quality of indoor swimming pools is important for the health and comfort of staff and guests.

Recent Dutch regulations define air quality as a new control parameter.

Conventional installation techniques are not up to the task.

“Best practice” solution.
Indoor Pool Air Quality

1. Reduce the source of most air pollutants:
   Good pool water treatment

2. Dilute the remaining volatile pollutants:
   Adequate fresh air ventilation
Two design goals:

1) Thermal comfort of staff and guests
   PMV model of Prof. Fanger, ISO 7730, EN 15251

2) Protection of the building
   No condensation, VDI 2089
Ventilation designs based on VDI 2089

Verein Deutscher Ingenieure

Technische Gebäudeausrüstung von Schwimmbädern

Building Services in Swimming Pools

Technical guidelines
VDI 2089: evaporated water flow

Swimming hall air: $T, p_{dl}$

Fresh air mass flow $M_a$

$M_w = \left( \frac{\beta}{R_d \cdot T_m} \right) \cdot (p_{dw} - p_{dl}) \cdot A_b$

Evaporating water mass flow $M_w$

Water: $T, A_b, p_{dw}$
VDI 2089: evaporated water flow

\[ M_w = \left( \frac{\beta}{R_d \cdot T_m} \right) \cdot (p_{dw} - p_{dl}) \cdot A_b \]

- \( M_w \): evaporating water flow, in kg/h
- \( \beta \): water transfer coefficient, in m/h, accuracy limitations
- \( R_d \): specific gas constant for water vapour, in J/kgK
- \( T_m \): arithmetic mean water and air temp., in K
- \( p_{dw} \): saturation pressure water vapour at water temp., in Pa
- \( p_{dl} \): water vapour pressure of the swimming hall air, in Pa
- \( A_b \): reference water area of the pool, in m\(^2\)
VDI 2089: maximum fresh air flow

\[ M_a = \frac{M_w}{\Delta x} \]

- \( M_a \): maximum fresh air flow, in kg/h
- \( M_w \): evaporating water flow, in kg/h
- \( \Delta x \): difference in humidity of the inside/outside air, in kg/kg

VDI 2089 section 6.2.1:
\( \Delta x = 5.3 \text{ g/kg, most humid summer month} \)
Conventional installations
# Fresh air component Theory & Practice

<table>
<thead>
<tr>
<th>Outdoor Temperature</th>
<th>Theory VDI 2089</th>
<th>Conventional Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter – 10°C</td>
<td>30%</td>
<td>20%</td>
</tr>
<tr>
<td>Mid-season 5°C</td>
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</tbody>
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How to prevent low Air Quality?
Modern Design: third design goal

1) Thermal comfort of staff and guests

2) Protection of the building

3) High air quality
Solution:

High indoor air quality can be achieved by selecting heat recovery systems with latent recovery during the winter and no latent recovery during the summer.

This is the case when the latent recovery is based on the principle of condensation.
Heat recovery + condensation

Special Rotary Heat Exchanger

Kantherm Heat Exchanger
Heat recovery + condensation
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High Air Quality
Conclusion

A healthy and comfortable indoor climate can be achieved in practice without any compromise by selecting heat recovery systems with latent recovery during the winter and no latent recovery during the summer.

The fresh air component will be up to three times as high. This is a huge improvement of the pool air quality and a good way to meet the new Dutch regulations.
Not according to Dutch regulations
Any Questions?

Improving Air Quality of Indoor Swimming Pools

Ir. J.G. Middendorf

20-03-2015