Centro de Tecnologia da Informação Renato Archer

COMSOL CONFERENCE 2014 CURITIBA

Passive Indirect Evaporative Cooler

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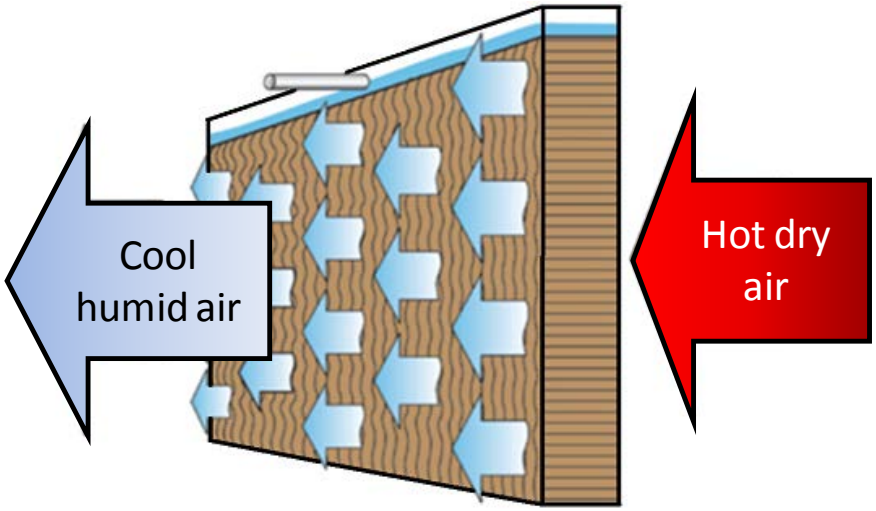
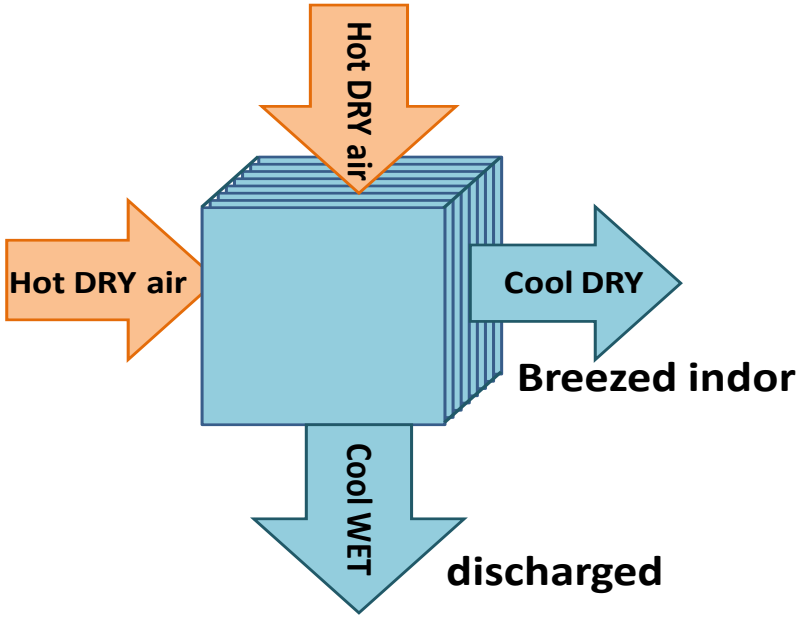
Indirect cycle



Direct Cycle

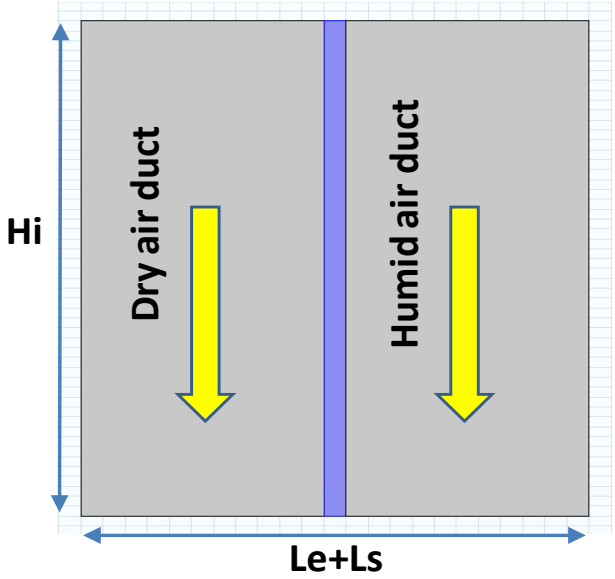


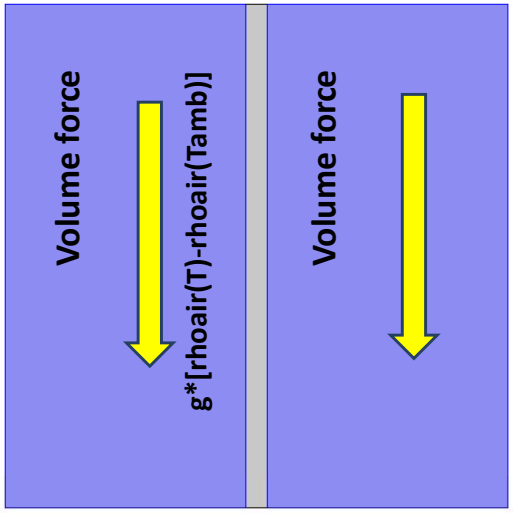
Indirect Cycle concept

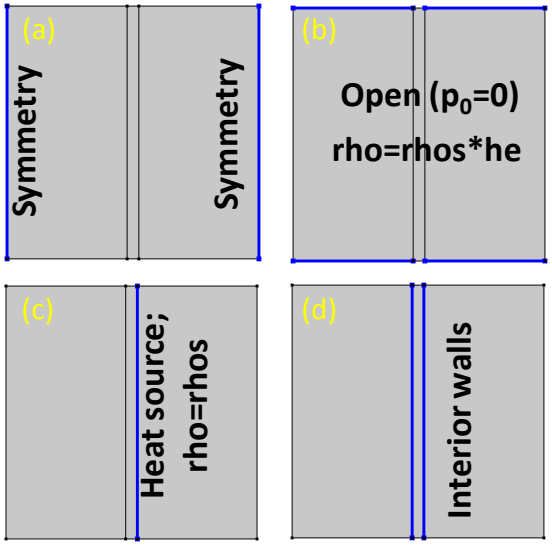
Advantage: Dry air is more confortable

Disadvantage: Lower efficiency per unit volume

Simulation approach







$$-Dif\ \nabla^2 rho + \beta.\nabla rho = 0$$

$$F_y = g\left[rhoair(T) - rhoair(Tamb)\right]$$

$$rho_{boundary} = rhos(Tamb) * he$$

$$rhos = rhoair(T)\frac{Ps(T)}{Patm}$$

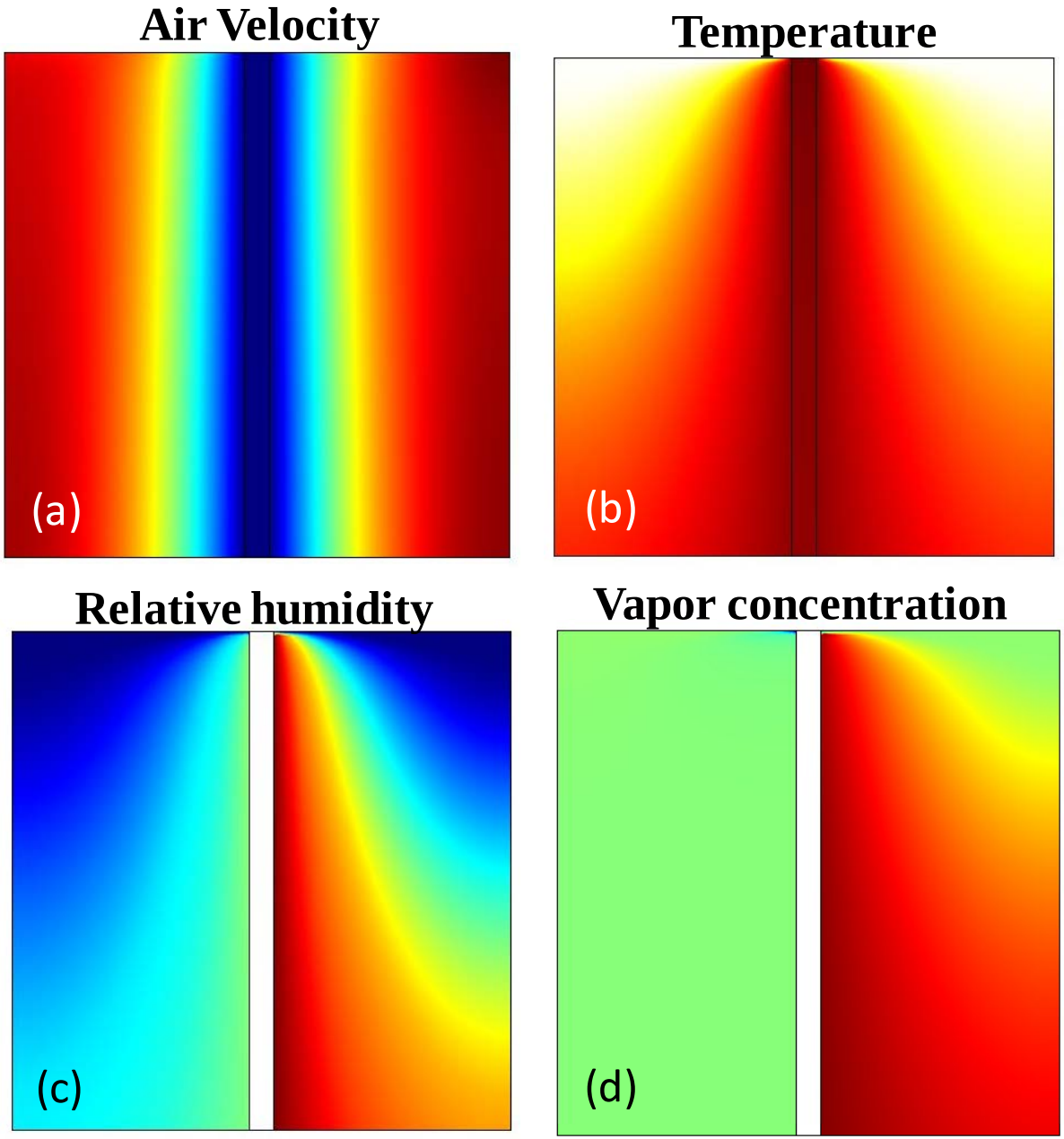
$$Q = \frac{\partial rho}{\partial x} Dif(T) * Ql(T)$$

Approximations:

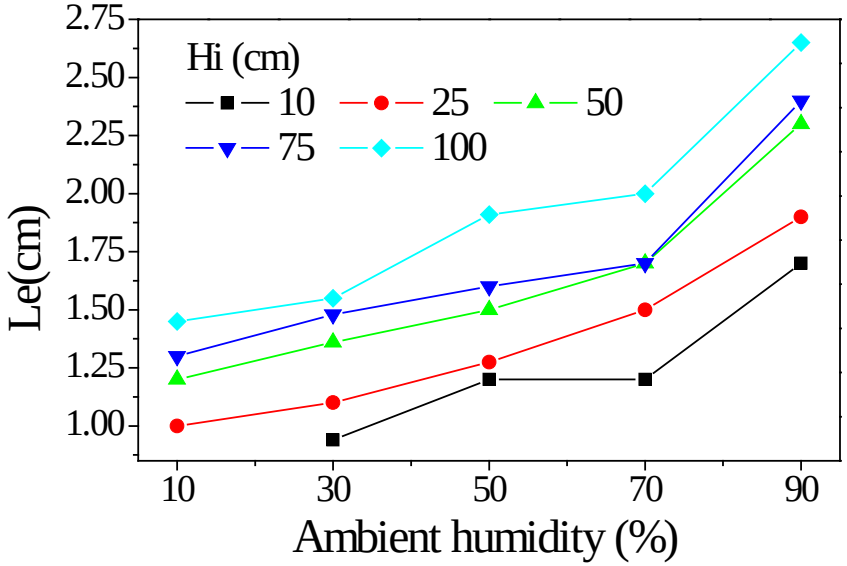
- No turbulence

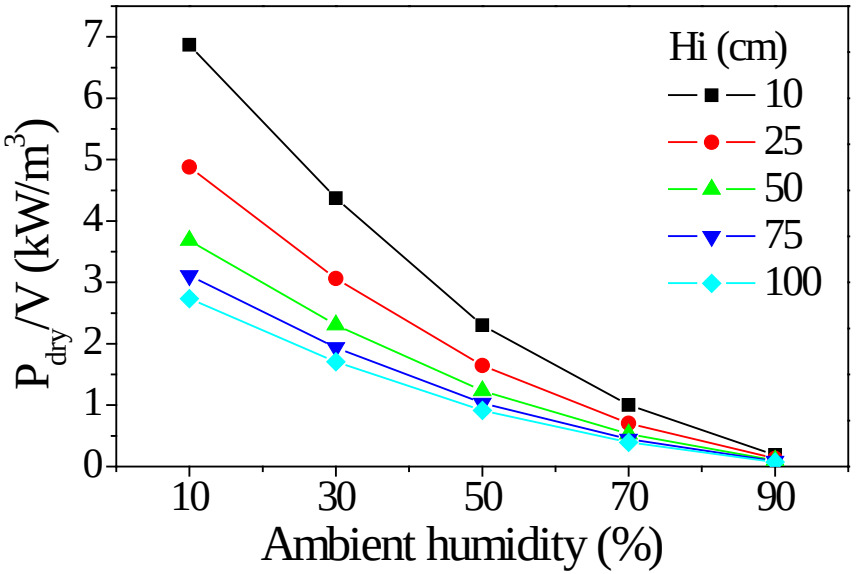
rho, Dif, rhoair, Ps and Ql are all given by interpolated tables

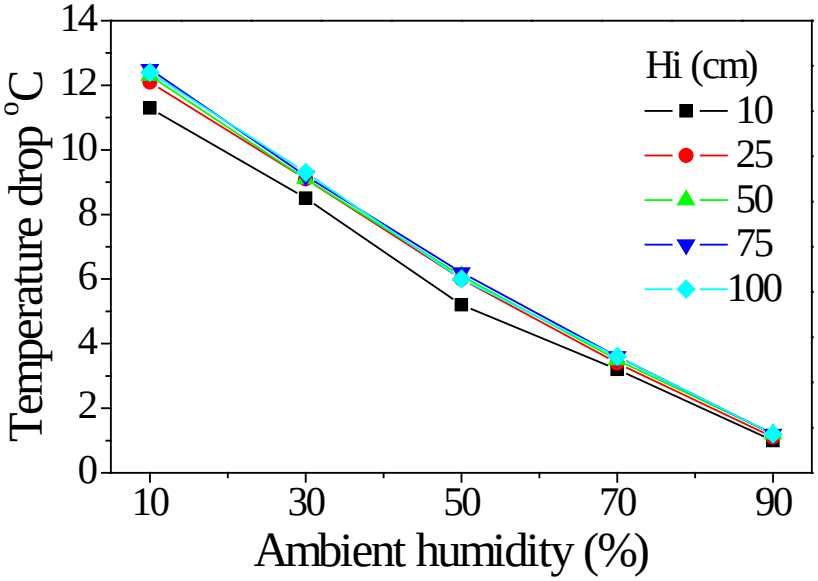
Results


Air Velocity
(a)
Temperature
(b)
Relative humidity
(c)
Vapor concentration
(d)

Operation Characteristics







Recommendation:
8kW/100m^3.

Discussions and Conclusions

- Outdoor breeze should improve the performance.
- Operation off the optimized condition can deteriorate the performance.
- Sequestrates ½ to ¼ of the heat of a direct cooler, but it consumes no energy.
- Simulation wise, the system behaves as expected (“validation”).
- Successful coupling of modules.