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# Mathematical model and performance analysis of a novel outside evaporative cooling liquid desiccant dehumidifier

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## Highlights:

1. A novel outside evaporative cooling liquid desiccant dehumidifier was introduced.
2. The dehumidification rates of novel dehumidifier far outweigh adiabatic dehumidifier.
3. The mass flow rate of evaporative cooling air has an optimum value.
4. The optimum mass flow rate of LiCl solution is about 40kg/h.

**Abstract:** A numerical model of a novel outside evaporative cooling liquid desiccant dehumidifier (OECD) was developed and the effects of inlet parameters, including the inlet temperature and relative humidity of dehumidified air and evaporative cooling (EC) air as well as the inlet mass flow rate of solution and so on, on the device performances were investigated in this paper. The results show that as the inlet temperature of solution increased from 31 to 42°C, the moisture removal rates of OECD were increased by 14.0% ~ 18.0% and 31.1% ~ 101.5% compared to the non-evaporative cooling dehumidifier (NECD) and the adiabatic dehumidifier respectively. Whereas the dehumidification rate was only decreased by about 1.6% with increase in the inlet temperature of LiCl solution from 24 to 44°C. All these results can provide guidance for the structural design and performance analysis of the dehumidifier in the future.

**Key words:** outside evaporative; liquid desiccant; dehumidifier; mathematical model; dehumidification rate

## Nomenclature

- $A_i$  total tube surface area,  $m^2$
- $A_f$  fin surface area,  $m^2$
- $A_o$  total outside surface area(include fin surface area),  $m^2$
- $A_r$  fin root area,  $m^2$
- $B$  standard atmospheric pressure, Pa

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