The governing equations that describe the change in air humidity and air temperature, air flow rate a cross segment are given below. A detail derivation of there equations is given by Treybal.
Substitution equation 3 to 2 found

$$\frac{dY}{dZ} = -\frac{M_v F_v a}{G} \ln\left[\frac{1-{P_{vs}}/{P_t}}{1-{P_{va}}/{P_t}}\right] \text{..............} \quad 4$$

Or

$$\frac{dY}{dZ} = -\frac{M_v F_v a}{G} \ln\left[\frac{1-Y_i}{1-Y}\right] \text{...................} \quad 5$$

A schematic of liquid-desiccant packed layer is shown in Figure.2 along with the nomenclature for differential element. Water balance on differential element can be written:

$$d\, m_L = m_a\, dY_a \text{..............................} \quad 6$$

Integrating Equation 2 from the bottom of element to the top the packed layer result in

$$m_s = m_{s,in} - m_a\left(Y_{a,out} - Y_a\right) \text{...................} \quad 7$$

or moisture removal rate

$$m_v = Ga\left(Y_{a,in} - Y_{a,out}\right) \text{.........................} \quad 8$$

Sensible heating leaving volume control I (equivalent to that enter control volume II) is

$$q_a a dZ = h_a^{'} a\left(T_a - T_s\right) dZ \text{.....................} \quad 9$$

Applying the Ackermann correction for simultaneous heat and mass transfer

$$h_a^{'} a = \frac{-GC_v\left({dY}/{dZ}\right)}{1-\exp\left(GC_v\left[{dY}/{dZ}\right]/h_a a\right)} \text{............} \quad 10$$

Energy balance on air side – volume I,

$$GH - \left\{G(H + dH) - GdY\left[C_v(T_a - T_0) - \lambda_0\right]\right\} = q_a a dZ \text{........} \quad 11$$

Moist air specific enthalpy (J/kg dry air) is defined,

$$H = C_p\left(T_a - T_0\right) + Y\lambda_0 \text{.........................} \quad 12$$

$$dH = C_p dT_a + dY\left[C_v\left(T_a - T_o\right) + \lambda_0\right] \text{........} \quad 13$$

Where

$$C_p = C_a + YC_v \text{................................} \quad 14$$

Substituting equation 11 to 9

$$\frac{dT_a}{dZ} = -\frac{h_a^{'} a\left(T_a - T_L\right)}{GC_p} \text{.........................} \quad 15$$

4. Result and discussion.

In order to carry out above calculation, the effect of different varying air flow rate and temperature have been brought to depict for evaluate moisture removal in regenerating and dehumidifying process.

Vapor transfer can take place at bottom to the top of packed layer, where air and liquid desiccant have vapor pressure gradient. If dry areas are present in packing due to poor liquid distribution or low liquid flow rate, these areas are available for heat transfer not for mass transfer.

The driving force for regeneration and dehumidification are the difference in water vapor pressure in air and at desiccant surface. In addition to improve moisture removal and mass transfer in packed layer which one is by designing a more efficient liquid distribution, increase air flow rate, temperature at regenerator and increase air flow rate and decrease temperature at dehumidifier. The moisture removal was calculated along the experiment setup's packed layer. Based on calculation result, the analysis was continued to obtain moisture removal. The effect of air flow rate on moisture removal rate at regenerator and dehumidifier are shown in Fig. 3 and Fig. 4.

With air capacity increasing, the volumetric mass transfer rate through the regenerator packed layer decreased and also increasing temperature air flow rate, volumetric mass transfer rate become increased as shown in Figure. 3 until maximum volumetric mass transfer rate at tower height around 2m. Increasing the air inlet temperature may increase the desiccant temperature via sensible heat transfer from the air to desiccant by with it may affect the moisture removal rate.

The rate of absorption water from air flow, as function of capacity air as obtained is shown in Fig. 4 for the same ambient conditions increasing air capacity, the volumetric mass transfer rate through the dehumidifier packed layer decreased and decrease temperature air flow rate volumetric mass transfer rate also decrease. The experiment results are general agreement with result of the test performed by other investigator (X.H. Liu et al, 2005; Alizadeh,S and Saman, W.Y., 2002; Elsarrag.E, 2006)

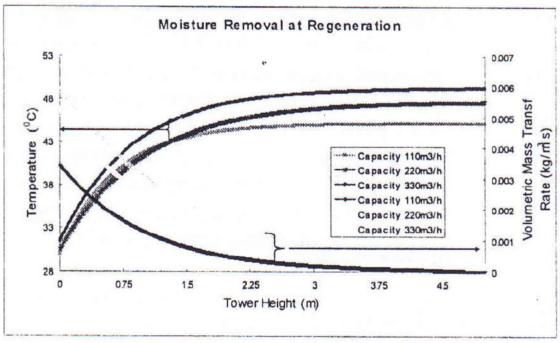

Figure.3 Volumetric Mass Transfer rate at Regenerator packed layer.

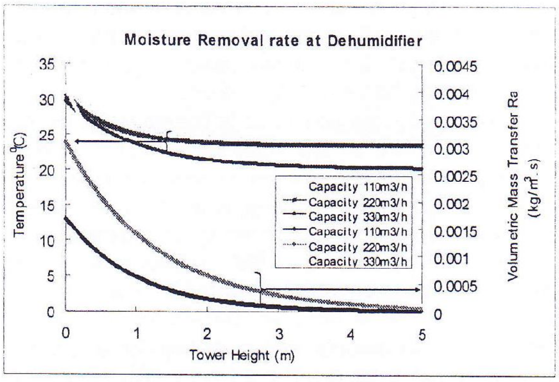

Figure.4 Volumetric Mass Transfer rate at dehumidifier packed layer

5. Conclusion

In this study, the effect of difference capacity of air flow on the volumetric mass transfer rate of a Random packed layer using Lithium Chloride was investigated experimentally. In this analysis lithium chloride solution was used in counter flow arrangement with the air flow for cooling and dehumidification and regeneration process. It is shown that the effect of increasing capacity air flow rate on the volumetric mass transfer rate increase and decrease at throughout height packed tower. Increasing Temperature air flow rate give occasion to increased the volumetric mass transfer rate and on the contrary also.

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Nomenclature

a	Specific internal surface for contact of gas with liquid, (m^2/m^3)
C_a, C_p, C_v	Specific heat (J/kg.K)
F_v	Vapor molar mass transfer coefficient ,(kmol/m^2.s)
G	Air Mass flux or air flow rate per unit cross-section area, (kg/m^{2}s)
H	Specific enthalpy of air-water mixture (J/kg dry air)
M_v	Mol air side, (kg/mole)
m	Mass flow rate, kg/s
N_v	Mass transfer flux, mole/m^2.s
h'_a	Heat transfer coefficient corrected for simultaneous mass and heat transfer, (W/m^2 K)
L'	Superficial liquid mass velocity, (kg/m^2.s)
P_t	Vapor pressure, (kg/m^2)
$P_{v,a}$, $P_{v,s}$	Partial vapor pressure in air over liquid , (kg/m^2)
q_a	Sensible heat transfer flux, W/m^2
T	Air Temperature, ^{0}C
Y	Specific Humidity or Humidity ratio, kg H$_2$0/kg dry air
Z	Tower height, m

Greek symbols

λ_o	Latent heat of vaporization, (J/kg)

Subscript

a	Air side
i	Interface
s	Liquid desiccant side
o	Reference
v	vapor