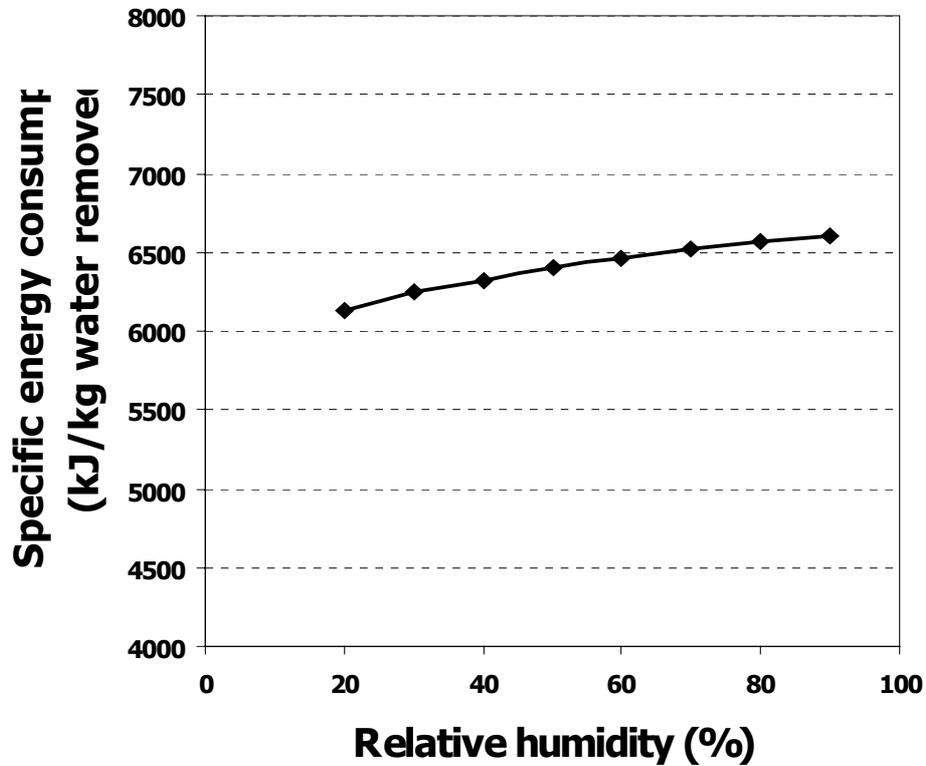


### 3.3.2.3 Effect of the relative humidity on the specific energy consumption

Figure 3.8 shows specific energy consumption versus the relative humidity. The other parameters are ambient temperature of 30 °C, 120-kg whole longan, recirculation air ratio of 40%, bypass air ratio of 10% and the air flow rate of 650 m<sup>3</sup>/hr. When the relative humidity increase from 20 to 90 %, the specific energy consumption slightly increases from 6150 to 6600 kJ/kg water removed. This is because when the relative humidity increases, the moisture ratio of the working air increase. The moist air can not absorb moisture from the product and the drying time will be longer. Therefore, the higher the relative humidity, the higher is the moisture ratio of working air, the higher moisture ratio of the drying air contributes to the longer time of drying leading to the higher specific energy consumption of heat pump system.

From this study, It can be seen that the relative humidity slightly affects the specific energy consumption of the heat pump system. This result is similar to the result of Achariyaviriya *et al.* (2000). But during the season of drying longan (rainy season) the average relative humidity will be around 70%.



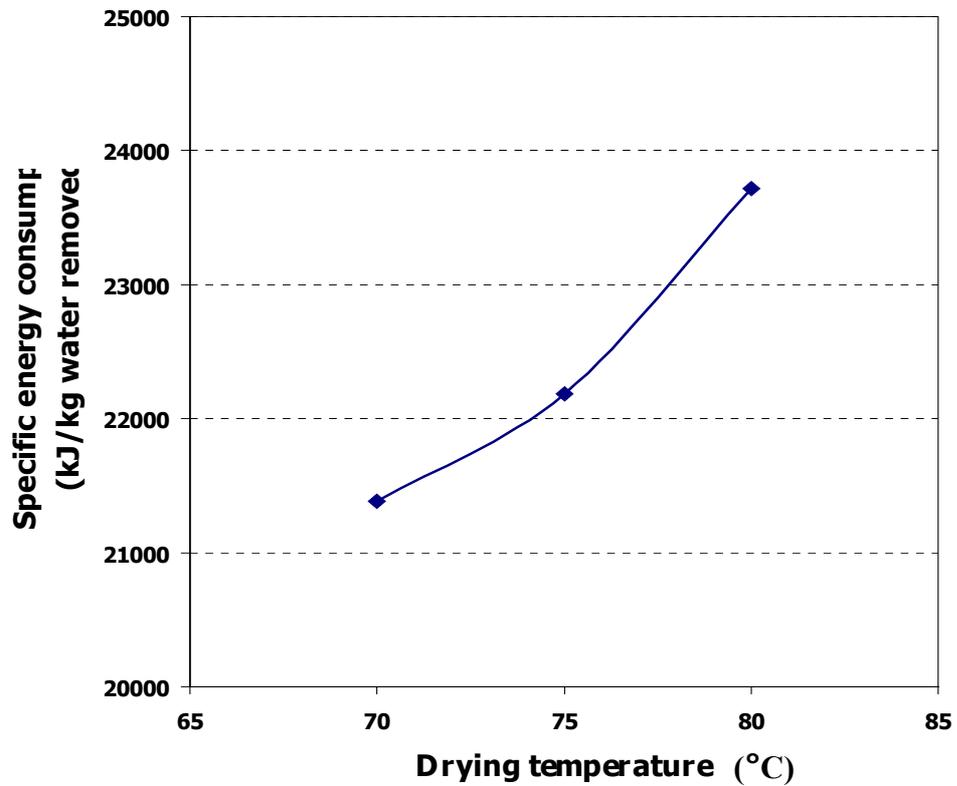
**Figure 3.8** Effect of relative humidity on the specific energy consumption of the heat pump dryer. (Simulation condition:  $M_d=650 \text{ m}^3/\text{hr}$ ,  $T_{di}=75^\circ\text{C}$ ,  $\text{RAR} = 40\%$  and  $\text{BAR}= 10\%$  The initial and final moisture content were 300 and 25 % dry-basis)

#### 3.3.2.4 Effect of drying temperature on the specific energy consumption

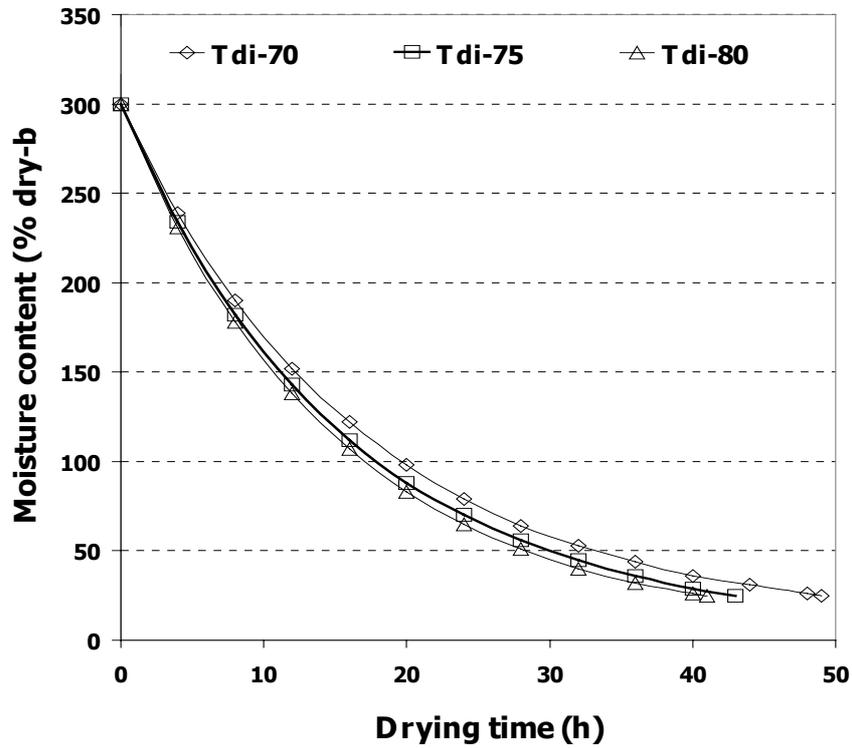
Figure 3.9 shows specific energy consumption versus the drying temperature. The other parametric values are the ambient temperature of  $30^\circ\text{C}$ , 120-kg whole longan, recirculation air ratio of 40%, by pass air ratio of 10% and the air flow rate of  $1350 \text{ m}^3/\text{hr}$ . When the drying temperature increase from  $70$  to  $80^\circ\text{C}$  the specific energy consumption increases from 21400 to 23700 kJ/kg. The reason for this is; the drying temperature increases the specific energy consumption at heater increases. Because the heat pump dryer have been operating at it peak performance

(the working fluid R-12 has a temperature of 120 °C, which is the critical temperature). Therefore, when the drying temperature increases the energy consumption at the heater increases. From this relation, it can be said that the lower temperature of drying air the lower specific energy consumption. But low temperatures affect the drying time increase. Figure 3.10 shows the relation between kinetics of drying curve virus the drying time. It can be seen that when the temperature of drying air increases from 70 to 75 and 80 °C, the drying time decreases from 49 to 44 and 41hour, respectively. The higher drying temperature may cause thermal injury leading to inferior product quality (Achariyaviriya *et al*, 2000). But the operation takes less time for completion. On the other hand the lower temperature (70 °C) the longer drying time. So, in this condition, the drying temperature of 75 °C is suitable as a compromise between quality and time.

From this study, It can be stressed that the drying temperature suitable for operation is 75 °C.



**Figure 3.9** Effect of drying temperature on the specific energy consumption of the heat pump dryer. (Simulation condition:  $M_d=1350 \text{ m}^3/\text{hr}$ ,  $T_a=30^\circ\text{C}$ ,  $\text{RH}=70\%$ ,  $\text{RAR}=40\%$  and  $\text{BAR}=10\%$  The initial and final moisture content of product were 300 and 25 % dry-basis)



**Figure 3.10** Effect of drying temperature on the moisture kinetics of whole longan. (Simulation conditions:  $M_d = 1350 \text{ m}^3/\text{hr}$ , recirculation air ratios (RAR) = 40%, by-pass air ratios (BAR) = 10%, initial and final moisture content product were of 300 and 25% dry-basis,  $T_{di}$  = drying temperature).