CHAPTER 6

CONCLUSIONS

The following conclusions were obtained from the theoretical and experimental studies. Three configurations of falling film absorbers with R134a-DMAC as working fluid was designed and built to suit 1kW cooling capacity evaporator and their heat transfer characteristics and mass absorption rate were investigated and the results compared.

6.1 THEORETICAL STUDIES

- In view of the impending phase out of HCFC-22, R-134a is a promising refrigerant for VARS. The single, double and half effect system with R-134a-DMAC as working fluid can efficiently be applied, where the heat source is available at 80°C, 130°C and 55°C respectively.

- At constant generator, condenser, absorber and evaporator temperatures if the absorber mass transfer effectiveness is increased from 0.5 to 0.9, double effect system yielded a maximum improvement in COP of 54.76 %, single effect system 29.9 % and half effect system gave only 6.29 %. This shows that double effect system is more sensitive to absorber mass transfer effectiveness than single effect system followed by half effect system.

- Further, in half effect system HP absorber is more sensitive to mass transfer effectiveness than LP absorber. The thermo
dynamic penalty of half-effect system is its higher heat rejection at the absorbers.

- Solution heat exchanger effectiveness plays a dominant role on absorber and generator heat load and COP. The increase in solution heat exchanger effectiveness from 0.5 to 0.8 resulted in decrease in absorber heat load by 23%, thereby minimizing the cooling water flow through the absorber and thus heat transfer surface area. The COP is increased by 14.8%.

- For all the three configurations, the increase in falling film flow rate when the other parameters are kept constant improved the heat and mass transfer characteristics.

- The theoretical values of overall heat transfer co-efficient for coil, vertical and horizontal tube absorber are 841, 410 and 280 W/m$^2$ K.

- The heat and mass transfer performance found to improve when the cooling water temperature is reduced from 30°C to 20°C, keeping all the other parameters constant.

6.2 EXPERIMENTAL STUDIES

- In the experimental range, the heat transfer co-efficient and heat transfer rate was found to increase almost linearly as the solution flow rate per unit length of the heat transfer surface.

- The experimental values of overall heat transfer coefficient are found to be 745, 320 and 230 W/m$^2$ K for coil, vertical and horizontal tubes respectively. For the same heat transfer surface area, among the configurations tested, the shell and coiled tube absorber was found to yield higher heat transfer coefficient and is also more compact.
The effect of inlet cooling water temperature is significant in design of absorbers. In case of coil tube absorbers, when all the other parameters are kept constant, if the cooling water temperature is reduced from 30ºC to 25ºC, the absorber heat load and refrigerant mass absorption rate is increased by 16.3% and 15 % respectively.

The solution and cooling water temperature profiles along the height of the coil absorber plotted from experimental observations indicated that the maximum absorption rate is 30 mm from the bottom of the coiled tube.

In counter current flow of refrigerant vapour, the falling film heat transfer deteriorated, if the vapour velocity becomes higher. At a constant solution flow rate, solution and cooling water temperatures, if the refrigerant flow is reduced from 0.0032 to 0.004 kg/s, the percentage reduction in overall heat transfer coefficient for coil, vertical and horizontal tube absorbers are found to be 5.6%, 14.2% and 13.2% respectively.

The percentage deviation of experimental values of overall heat transfer co-efficient from the predicted values for coil, vertical and horizontal tube absorbers are found to be in the range of 10 to 21%.

These results can be used to provide fundamental and practical information needed for the design of different geometric configurations of falling film absorbers for actual absorption chiller, heat pump and heat transformers, operating with R134a-DMAC as working fluids.
6.3 FURTHER STUDIES

The present studies revealed that among the falling film absorbers investigated the shell and coil tube type was found to be superior in terms of heat and mass transfer characteristics and also more compact.

The future scope of this work is to design and fabricate a bubble absorber to work with R-134a DMAC for the same heat transfer surface area and investigate its heat and mass transfer characteristics and the results may be compared with present results for the shell and coil absorbers.