CHAPTER V

CONCLUSION

5.1 GENERAL

The following conclusions are derived from this research work:

- The utilization of solar energy in purifying water offers a good recommendation not only to the environmental aspect but to sanitation also.

- The distillate yield of solar still increases with the increase in the intensity of solar radiation and ambient temperature.

- The distillate yield of the solar still also increases with the increase in wind velocity.

- Thermal conductivity of the basin material, water glass temperature difference, basin area, insulation thickness, glass angle, thermal heat storage, evaporation techniques and depth of water are the various operational parameters, affecting the productivity of the solar still.

- Higher value of evaporative surface temperature and lower value of condensing surface temperature lead to the rise in distillation output.

- The parameters are changed by modifying the solar still to enhance the performance of the solar still.

- Copper has thermal conductivity and increases the heat transfer rate. Thus the water temperature increases in turn increasing the yield.

- The black coating over the basin absorbs the entire incident solar radiation increases the productivity of the still.
• The productivity of a passive solar still with black coated copper sheet increases because copper conducts more heat when compared to the still with galvanised iron sheet.

• The passive solar still with black coated copper sheet (PSS - Cu, B) has a higher yield of 1.21 kg/day resulting in the increase in productivity by 64% when compared to the yield of the passive solar still with galvanised iron sheet (PSS - GI) 0.74 kg/day.

• The efficiency is also higher for a solar still with black coated copper sheet and it can be increased further by modifications.

• The solar still black coated copper sheet with gravels (PSS - Cu, B, S) has a higher yield of 1.48 kg/day and in turn increases the productivity of the still by 22%.

• The passive solar still made up of black coated copper sheet with pebbles is more efficient than the others.

• The productivity of the passive solar still with black coated copper sheet with pebbles increases with the inclusion of stainless steel fins.

• Fins are used to increase the area of the absorber plate.

• The productivity of the still passive solar still with black coated copper sheet with pebbles and fins (PSS - Cu, B, S, F) is increased to 1.91 kg/day and in turn increases the productivity of the still by 29%.

• The passive solar still with black coated copper sheet with pebbles, fins and vacuum pump (PSS – Cu, B, S, F, V) has the yield of 2.56 kg/day which is 3.5 times higher when compared to the conventional passive solar still working at atmospheric conditions.

• The temperature outside glass was higher than the inner glass temperature during morning hours and the reverse was true during the afternoon hours because the rate of condensation is lower in the morning and higher in the afternoon.
- The solar still with pebbles is more efficient than the other because it helps to store thermal energy.

- By incorporating fins inside the solar still, the productivity of the still is increased.

- In the case of passive solar still with black coated copper sheet using pebbles, fins and vacuum pump, the vacuum inside the solar still helps to reduce the boiling point of water in the basin leading to an increase in the evaporation rate.

- In the case of vacuum the water temperature is slightly lower than the water temperature without vacuum, there is more evaporation, hence the water temperature is reduced.

- In the case of passive solar still with black coated copper sheet using pebbles, fins and vacuum pump, the lower temperature of water causes less heat loss due to radiation from the water surface, increasing the water temperature.

- The yield obtained from the passive solar still with black coated copper sheet using pebbles, fins and vacuum pump is two times higher than that of the passive solar still.

- The optimum water depth is 0.01 m for all the stills and further reduction has been created for operational difficulties.

- The outside glass temperature was higher than the inner glass temperature during morning hours and the reverse was true during the afternoon hours because the rate of condensation is lower in the morning and higher in the afternoon.

- During low sunshine hours (afternoon), the theoretical values of water temperature were slightly higher than the experimental values because of the assumption of negligible thermal losses through the collector area.

- The highest distilled water yield is obtained in summer seasons for all the modes of operation of the solar still.
- The thermal efficiency of the passive solar still with black coated copper sheet using pebbles, fins and vacuum pump (PSS - Cu, B, S, F, V) is more efficient than that of the passive solar still with GI sheet and the passive solar still with black paint coated copper sheet throughout the year.

- The highest water temperature was achieved at 13.00 h for both seasons; however, the maximum solar radiation was recorded at 13.00 h during the experiments.

- Therefore, this thermal model can be used for the design of the passive solar still with black coated copper sheet using pebbles, fins and vacuum pump.

- The yield during the night for the passive solar still with black coated copper sheet using pebbles, fins and vacuum pump was higher compared to the passive solar still due to less thermal losses.

- It was found that the annual yield of the passive solar still was maximum when the condensing glass cover inclination is equal to the latitude of the place.

- The productivity also increases when the insulation thickness increases to a certain limit.

- The heat losses from the sides and base of a solar still should be minimized by adequate insulation to insure the storage of the absorbed thermal energy.

- It was found that the insulation thickness has a significant impact on the productivity of the still up to a thickness of 50 mm.

- The maximum basin water temperature was recorded as 82°C for passive solar still with black coated copper sheet using pebbles and fins (PSS - Cu, B, S, F) which is 5°C for higher than the passive solar still with black coated copper sheet, 20°C higher than the passive solar still with galvanised iron sheet (PSS - GI) and 4°C higher than the passive solar still with black coated copper sheet using pebbles, fins and vacuum pump (PSS - Cu, B, S, F, V).
- The effect of vacuum inside the passive solar still with black coated copper sheet using pebbles, fins and vacuum pump (PSS - Cu, B, S, F, V) helps to avoid any heat transfer due to convection in the still. The heat loss from the water in an insulated still is due to evaporation and radiation only.

- In the presence of vacuum, the effect of non-condensable gases (such as air) inside the still which reduces the rate of condensation is also avoided.

- There is a slight difference in the water and glass temperatures between the vacuum and without vacuum cases.

- The passive solar still made of black coated copper sheet with pebbles, fins and vacuum pump (PSS - Cu, B, S, F, V) is preferable for higher distilled water yield.

- The thermal efficiency of the passive solar still with black coated copper sheet using pebbles, fins and vacuum pump (PSS - Cu, B, S, F, V) is more efficient than that of the passive solar still with galvanised iron sheet and the passive solar still with black coated copper sheet throughout the year.

- The lower the salt concentrations the higher will be the productivity. The productivity of all the types of solar still increases when the salt concentration is lower.

- The minimum cost of water per kg is ₹ 0.50 for the passive solar still with black coated copper sheet using pebbles, fins and vacuum pump (PSS - Cu, B, S, F, V) at the interest rate of 4%.

- The passive solar still with black coated copper sheet using pebbles, fins and vacuum pump (PSS - Cu, B, S, F, V) is more economic when compared to the bottled water available in the Indian market which costs around ₹ 20/kg.

- The passive solar still with black coated copper sheet using pebbles, fins and vacuum pump (PSS - Cu, B, S, F, V) is preferable for morning and in the evening as it has higher distilled water yield even at a low ambient temperature.

- Theoretically predicted values are well agreed with the experimental data.
√ The payback period for the passive solar still with black coated copper sheet using pebbles, fins and vacuum pump (PSS - Cu, B, S, F, V) is lower when compared to the passive solar stills with galvanised iron and black coated copper sheets for different rate of interests and selling prices.

√ It has been reported that the yield of all the types of solar still is maximum for the minimum depths of water level in the basin.

√ The passive solar still with black coated copper sheet using pebbles and fins (PSS - Cu, B, S, F) is preferable for noon as it has higher distilled water yield due to the higher ambient temperature.

√ The passive solar still with black coated copper sheet using pebbles, fins and vacuum pump (PSS - Cu, B, S, F, V) is made operative during the low ambient temperature conditions and the vacuum pump is made inoperative during the high ambient temperature conditions.

√ Therefore, this cost-effective design of the passive solar still with black coated copper sheet using pebbles, fins and vacuum pump (PSS - Cu, B, S, F, V) is expected to provide the rural communities an efficient way to convert the brackish water in to potable water.