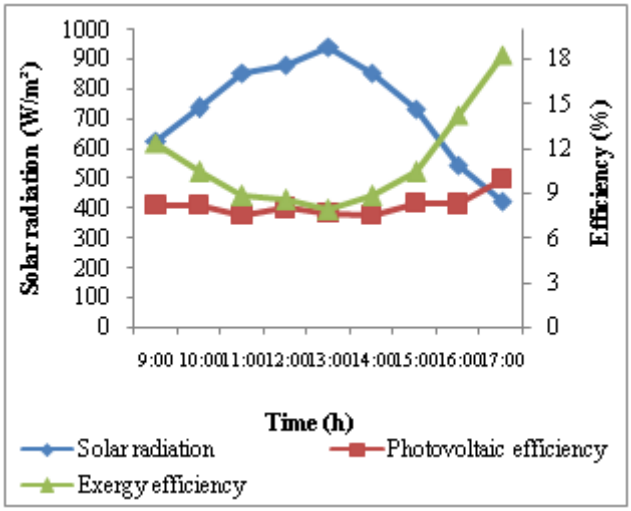

Figure 6: Variation of photovoltaic efficiency, exergy efficiency and solar radiation with time (May)

Multiple regression equations were obtained and used to predict the module efficiency, exergy efficiency and power output with load for May month. The regression equation for photovoltaic efficiency is as follows:

η_{pv}= 4.8542 – 0.0057SR + 0.1772T_0 R^2 = 0.87

Where, SR – Solar radiation T_0 – ambient temperature

Photovoltaic efficiency was found significant at 5 % level of significance. Thus combined linear effect of solar radiation and ambient temperature contribute significantly to variation in efficiency. The correlation between exergy efficiency of photovoltaic system and ambient conditions in case of full load condition can be expressed as follows:

ψ_{PV} = 24.7071 – 0.0193SR + 0.0151T_0R^2 = 0.95

Above equation revealed that 95 % variation in efficiency and significant at 1 % level of significance and solar radiation affected the exergy efficiency. The multiple regression equation for power output of photovoltaic system is as given below:

P_{output} = 36.2403 + 0.0930SR – 0.4488T_0 R^2 = 0.96

Analysis of data indicated that power output was significant at 1% level of significance and solar intensity and ambient temperature was highly significant and affected the SPV power output. Following are the multiple regression equations used to predict photovoltaic efficiency,exergy efficiency and power output for March month at full load condition.

η_{pv} = 14.76 – 0.004SR – 0.064T_0 R^2 = 0.96

ψ_{PV} = 25.06 – 0.026SR + 0.13 T_0 R^2 = 0.94 P_{output} = 45.42 + 0.105SR -0.7438T_0R^2 =0.99

From this it was concluded that solar radiation and ambient temperature significantly affect and used to predict photovoltaic efficiency, exergy efficiency and power output.

Several multiple regression equations were obtained for April month also which are as follows:

η_{pv} = 2.7984 -0.0063 SR +0.4102T_0R^2 = 0.84 R^2 = 0.84

ψ_{PV} = 8.81- 0.0265SR +05799T_0R^2 =0.97 R^2 = 0.97

P_{output}= 77.62 -0.070SR +2.937T_0R^2 =0.93 R^2 = 0.93

5. Conclusions

Performance of photovoltaic system at no load and full load condition were carried out to assess its technical viability. This study indicated the necessity and usefulness of energetic and exergetic techniques to evaluate the performance of the SPV refrigerator. The average photovoltaic conversion efficiency and exergy efficiency found nearer to 8.5% and 11% respectively in both no load and full load condition for May month. This indicates that the full load condition does not affect the PV system. The photovoltaic and exergy efficiency was found less due to the module temperature hence exergy were destroyed highly in PV

6. Future Scope

In the vapor compression cycle the compressor is the major power consuming device. The compressor of the vapor compression cycle requires large quantities of power for its operation and it increases as the size of the refrigeration system increases. In case of the vapor compression refrigeration system, the compressor can be run by electric power supply only; no other types of energy can be utilized in these systems. These days the electric power has become very expensive, hence the running cost of the vapor compression refrigeration system is very high. The Sun's Heat and Light energy can be effectively utilized to convert incident solar radiation into electric current hence solar energy systems are becoming more and more popular by the day. Majority of people believe that solar energy systems such as "solar panels" are going to be the source for future energy requirements. It is thus a renewable energy source and does not cause any kind of pollution to the ground or air or water bodies. Hence, Solar Energy Is both CLEAN and GREEN Energy!

References

[1] Jung Hun So, Young Seok Jung, Gwon Jong Yu, JuYeop Choi and Jae Ho Choi (2007).'Performance results and analysis of 3 kW grid-connected PV systems'. Renewable Energy 32, 1858–1872

[2] Kattakayam, T.A., Srinivasan K. 1996. 'Thermal performance characterization of a photovoltaic driven domestic refrigerator'. Int. J. Refrig. 2000,23: 190–196.

[3] Pandey A. K., Tyagi V. V. and Tyagi S. K. (2013).'Exergetic analysis and parametric study of multi-crystalline solar photovoltaic system at a typical climatic zone'.Clean Technologies and Environmental Policyvol. 15, Issue 2, pp 333-343

[4] Saidur R., H.H. Masjuki, M. Hasanuzzaman, T.M.I. Mahlia, C.Y. Tan, J.K. Ooi and P.H. Yoon 2008.'Performance investigation of a solar powered thermoelectric refrigerator'.International Journal of Mechanical and Materials Engineering (IJMME), 3(1) : 7-16.

[5] Srinivas M., S. Jayaraj2013**.** 'Energy and exergy analysis of a two pass photovoltaic – thermal (PV/T) air heater'**.**International Journal of Energy and EnvironmentVolume 4, Issue 3, pp.467-480

[6] Steffen Robert E., Sung Joon Suk, Yong Han Ahn and George Ford. 2013. 'Modeling energy generation by

grid connected photovoltaic systems in the united states'. Journal of Building Construction and Planning Research, 1, 39-44.

[7] Sudhakar K. and Tulika Srivastava (2013). 'Energy and exergy analysis of 36 W solar photovoltaic module'. International journal of ambient energy.

[8] Yilanci A., E. Cetin and H. K. Ozturk 2011. 'Experimental Performance Evaluation of a PV-Powered Refrigeration System'.Electronics and Electrical Engineering. – Kaunas: Technologija, 8(114): 7–10.

[9] Yilanci A., E. Cetin and H. K. Ozturk. 2011. 'Experimental Performance Evaluation of a PV-Powered Refrigeration System'. Electronics and Electricl Engineering ISSN 1392 – 1215 8(114).