In the first part of the research, pumps running in reverse as turbines are studied. This work uses experimental data of a wide range of pumps representing the centrifugal pump configurations in terms of specific speed. Based on specific speed and specific diameter an accurate correlation is developed to predict the performances at best efficiency point of the centrifugal pump in its turbine mode operation. The proposed prediction method yields very good results to date compared to previous such attempts. The present method is compared to nine previous methods found in the literature. The comparison results show that the method proposed in this paper is the most accurate. The proposed method can be further complemented and supplemented by more future tests to increase its accuracy. The proposed method is meaningful because it is based both specific speed and specific diameter.

The second part of the research is focused on the design and analysis of the radial gas turbine. The specification of the turbine is obtained from the solar biogas hybrid system. The system is theoretically analyzed and constructed based on the purchased compressor. Theoretical analysis results in a specification of 100lb/min, 900ºC inlet total temperature and 1.575atm inlet total pressure.

1-D and 3-D geometry of the rotor are generated based on Aungier’s method. 1-D loss model analysis and 3-D CFD simulations are performed to examine the performances of the rotor. The total-to-total efficiency of the rotor is more than 90%. With the help of CFD analysis, modifications on the preliminary design obtained optimized aerodynamic performances. At last, the theoretical performance analysis on the hybrid system is performed with the designed turbine.

Persons with disabilities please contact the Mechanical Engineering office at 517-355-5131 to request accommodations.