PERFORMANCE OF A LIQUID-FUEL-FIRED POROUS BURNER FOR THERMOELECTRIC POWER GENERATION

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ABSTRACT

Utilization of heat generated from a burner for thermoelectric power application is increasingly investigated and the concept has been expounded in voluminous literatures. Significant research effort has also been expended in devising various types of burners specifically for thermoelectric power generation. In spite of this considerable body of work, the thermal aspects of the burners are not thoroughly investigated and there is insufficient information disseminated related to this particular area. In other words, the combustion characteristics are generally lacking and pertinent parameters of the burners have yet to be clearly elucidated. We have therefore attempted to elicit the effects of essential combustion features of a porous and non-porous burner operating on liquid fuels specifically for thermoelectric application. Comprehensive results from a study of this burner operating on kerosene and 75/25 mixture of kerosene and vegetable cooking oil (VCO) are presented. The design of the burner hinges on the concept of eliminating the requirement of compressed air for fuel atomization, instead utilizing the wick and perforated thin cylinders for flame enhancement. The fuels were fed to the base of the fiberglass wick via gravity action and allowed to adequately soak before the starts of the experiment. The flame was initiated on the exposed layer on top of the wick and it was further augmented in a concentric perforated cylinders. Electric power was generated by means of six bismuth telluride (BiTe) thermoelectric (TE) cells. Comparisons are made between the porous and non-porous burner and the experimental results are alternated for both kerosene and 75/25 mixture of kerosene and VCO at various fuel-air equivalence ratio. Flame temperature, surface temperature of the alumina (Al_2O_3) porous media and wick temperature were measured as well as the emission and power output of the TE cells. Considerable temperature increase is observed at rich equivalence ratio for both types of fuel blends even though it appears not to affect substantially the power output generated from the TE cells. Subsequent analysis from the observations also inferred that the products of emission show diminishing trend at lean equivalence ratio. In addition, it is also intuitively obvious that the incorporation of alumina as a porous medium resulted in favorable surface temperature distribution for the burner.