CHAPTER 6 CONCLUSIONS AND RECOMMENDATION FOR FUTURE WORKS

6.1 Conclusions

A new design of self-aspirating gas burner concept based on heat recirculation combustion using the porous medium technology has been developed in this research. The burner geometry , burner performance and combustion characteristics of the SPMB and SPMB with PRRB were clarified though measured thermal structures in terms of temperature profiles along the axis of the packed bed, thermal efficiency of the impingement flame and emissions of CO and NO_x at the burner exit and compared with those of the CB. The following conclusions can be drawn from the experimental results.

1. Design and development of the SPMB with a submerged flame are successfully performed. The SPMB geometry, i.e. packed bed shape, packed bed length, combustion chamber diameter, particle diameter and mixing chamber obtained from the calculation are valid for operating the SPMB burner within range of *CL* from 23 to 61 kW or a turn-down ratio about of 2.65.

2. The thermal efficiency of the CB can been improved by changing the open combustion flame with ring burner head to the submerged combustion flame with porous burner head. The SPMB has a thermal efficiency higher than the CB because heat transfer to vessel loading is improved by radiative heat transfer. An average thermal efficiency of the SPMB in all conditions is increased to about 4.38% higher than the CB. The SPMB provides an average energy saving about of 12.84%.

3. More enhancement of thermal efficiency of the SPMB is obtained by using the heat recirculation technique with porous radiant recirculated burner (PRRB). For all conditions, an average thermal efficiency of the SPMB with PRRB is higher than the SPMB and the CB about of 5.02% and 9.40%, respectively. Then the average energy saving of the SPMB with PRRB is 20.06% and 33.21% as compared with the SPMB and the CB, respectively.

4. The distance between the burner top and the bottom of the loading vessel, *H*, has more effect on thermal efficiency than the firing rate, *CL*. At small *H*, the thermal efficiencies of the SPMB and SPMB with PRRB are relatively high when compared with the CB but it is scarified by a increasing of CO emission.

5. Comparison in CO and NO_x emissions among the CB, SPMB and SPMB with PRRB with impinging flame combustion at the same conditions, the CB yields a more complete combustion with relatively low CO emission of less than 1,148 ppm and acceptably high NO_x emission of less than 115 ppm throughout the experimental range of *CL* studies as compared with the SPMB and SPMB with PRRB. A lack of secondary air causes a high level of CO emissions in the SPMB and SPMB with PRRB. But NO_x emissions of them are relatively low due to an advantage of combustion with the matrix stabilized flame.

6.2 Recommendation for Future Works

A study of possibility for thermal efficiency enhancement of the self-aspirating gas burner that is true in this research. Submerged combustion flame and heat recirculation technique are adopt into the CB to improve the thermal efficiency by porous medium technology. The SPMB with PRRB provides a maximum thermal efficiency when compare with the CB and SPMB, of about 52.86%. Result shows that the main objective of this work is achieved. Unfortunately the SPMB and SPMB with PRRB have a high thermal efficiency but it is scarified by high level of CO emission with a long flame length because of a lack of secondary air at center of flame [52-53]. It is recommended that future development of the SPMB and PRRB is extremely required more complete combustion with secondary air. This is an important step toward for thermal efficiency and emission characteristics improvement. Thus an optimization design of the new SPMB and PRRB with more secondary air is necessary to change the old one for saving the earth.