ABSTRACT

The combination of burner and combustion chamber is one of important factors controlling flame characteristics. This work investigates experimentally the combustion characteristic of cyclone jet hybrid combustion. This is achieved by using combination of swirling premixed and coaxial jet diffusion flame to perform high stability and low pollutant emissions by using (LPG) (40%propan, 60%butan) as a fuel in experimental tests. The experimental apparatus consists of cyclone which investigates the premixed mode and annular air-fuel nozzle with different design of fuel nozzle. Studying stable flame regions and measuring amount of emissions at stable flame regions and measuring flame temperate at lean, stoichiometric and rich limit and evaluate swirl number. All experimental tests depend on the equivalence ratio and heat input rate.

Two kinds of combustion modes were examined to measurement of stability and emissions : the diffusion combustion (DC) mode , and the hybrid combustion (HC) mode which consists of swirling premixed and jet diffusion flames.

In the (HC) mode, the effects of fuel nozzle design on the fuel–air mixing were investigated in terms of flame stability and pollutant emissions where two designs of fuel nozzles were used in tests: the first is a multi hole at position of 45° angle (nozzle1) and the second is a single hole (nozzle 2). In this combustor, an extremely stable flame can be obtained in the swirl flow, formed along the inner wall of the combustor, which utilized this combustor as a flame holder.

The results showed that the (HC) mode can significantly reduce *CO* and NOx emissions in a stable flame region compared to the (DC) mode. In addition, a multi-hole fuel nozzle shows a NOx reduction of 53% compared to that of the (DC) mode. However, *CO* emission in the HC mode increases drastically when the overall equivalence ratios drop below 0.75. By modifying the fuel nozzle for the jet diffusion flame, it was found that the increases in fuel–air mixing provide a stable flame region approximately twice as wide as that of the fuel nozzle using a single hole, the range of heat input for nozzle 1 at a constant overall equivalence ratio reaches to 1.6 kW but at nozzle 2 is 1kW.

The results showed that the burner design investigate high swirling flow by evaluate swirl number by special equation for premixed cyclone with diffusion jet burner type in term of heat input and overall equivalence ratio.

The results of flame temperature for three types of combustion mode (PC, DC , HC) and three cases of equivalence ratio are measured. The values of flame temperature at each case reached to 1300°C at hybrid mode (HC) and 1100°C at diffusion mode (DC).