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A Three-Dimensional Investigation of Stabilized Turbulent Diffusion Flames Using Different Type of Fuel

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Abstract : In the present study, a numerical simulation study is used to 3-D model the steady-state combustion of a staged natural gas flame in a 300 kW swirl-stabilized burner, using ANSYS solver to find the highest combustion efficiency by changing the inlet air swirl number and burner quarl angle in a furnace and showing the effect of flue gas recirculation, type of fuel and staging. The combustion chamber of the gas turbine is a cylinder of diameter 1006.8 mm, and a height of 1651mm ending with a hood until the exhaust cylinder has been reached, where the exit of combustion products which have a diameter of 300 mm, with a height of 751mm. The model was studied by 15 degree of the circumference due to axisymmetric of the geometry and divided into a mesh of about 1.1 million cells. The numerical simulations were performed by solving the governing equations in a three-dimensional model using realizable K-epsilon equations to express the turbulence and non-premixed flamelet combustion model taking into consideration radiation effect. The validation of the results was done by comparing it with other experimental data to ensure the agreement of the results. The study showed two zones of recirculation. The primary one is at the center of the furnace, and the location of the secondary one varies by changing the quarl angle of the burner. It is found that the increase in temperature in the external recirculation zone is a result of increasing the swirl number of the inlet air stream. Also it was found that recirculating part of the combustion products back to the combustion zone decreases pollutants formation especially nitrogen monoxide.

Keywords : burner selection, natural gas, analysis, recirculation
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