Abstract

This Master's thesis in Mechanical Engineering, specializing in Energy (IET), titled "Numerical study of turbulent combustion of methane-hydrogen mixture in an LSB burner", is part of a context of growing energy crisis and environmental concerns. The main objective is to develop cleaner and more efficient combustion systems, particularly by focusing on turbulent combustion and the use of low swirl burners (LSB) with methane-hydrogen mixtures.

The study focuses on an industrial boiler at the Algiers refinery (RA1G), analyzing flame behavior, pollutant emissions (NOx, CO), and the impact of geometric modifications to the burner. The methodology used is based on computational fluid dynamics (CFD) using ANSYS Fluent software. The actual geometry of the combustion chamber was modeled, and several configurations (Cases A to G) were tested by varying the dilution and primary combustion zones, incorporating real boundary conditions from industrial measurements.

Simulation results showed that adding holes to the combustion chamber improves combustion efficiency in terms of flame temperature distribution and pollutant reduction. When the holes are injected into the primary zone, this prolongs the residence time of the burned gases and improves heat transfer, thereby reducing NO production. Furthermore, it multiplies the chemical reactions between CO and O2 to produce more CO2 and reduce carbon monoxide.

In summary, this project aims to optimize the performance of industrial burners by reducing their environmental impact through an in-depth numerical approach and the integration of cleaner fuels.