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شبكة المعلومات الجامعية

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التوثيق الإلكتروني والميكروفيلم

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بالرسالة صفحات
لم ترد بالأصل

CAIRO UNIVERSITY

FACULTY OF ENGINEERING

AN INVESTIGATION OF MULTI FUEL TURBULENT PREMIXED CONFINED FLAME STRUCTURE

BY

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B. Sc. , M. Sc. Mechanical Power Engineering

A Thesis Submitted to

Mechanical Power Engineering Department

in Partial Fulfillment for the Degree of

DOCTOR OF PHILOSOPHY

in Mechanical Power Engineering

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Cairo 1993

ACKNOWLEDGEMENT

I would like to express my deep gratitude to Prof. M.M.ELKOTB, Professor of combustion at Cairo university for his valuable supervision, helpful discussion, continuous and patient guidance and careful follow up.

I am very much indebted to Prof. HINDAWI SALEM Professor of combustion , Cairo university , for his encouragement and help in completion of this work .

I would like also to thank Prof. AHMED HUZAYYIN Dean of Benha Higher Institute of Technology for his help which greatly aided the finishing of this work.

Mohamed Said Attia Shehata.

ABSTRACT

Due to the great development in combustion systems and the increasing efforts to reduce the levels of gaseous emission, the combustion systems must be operated with high efficiency and low level of gaseous emission. The combustion efficiency and gaseous emission depend on the combustion rate and the mixing velocity of air and fuel. Because of a large number of combustion systems use the commercial fuel, many investigations have been carried out to study the different factors affecting the combustion efficiency. However, most of these studies have been carried out under predominantly one dimensional flow and using simple pure hydrocarbon fuels. Consequently, these studies do not simulate the conditions that exist in the practical combustors where flow and chemical kinetic effects are strongly coupled.

In the present study effect of Reynolds number, equivalence ratio, fuel type and their blends on turbulent premixed confined flames structure have been investigated. The experimental set up consists of a flat grid burner where liquid fuel is sprayed into preheated combustion air, vaporizes and strongly mixes with air prior to introduction into the combustion space through perforated plate flame holder. The combustion gases are sampled at different locations within the flame using a water cooled, stainless steel isokinetic probe and the gases samples are analyzed using gas chromatograph and infrared analyzer. Flame temperatures and gas velocities have been measured. During experiments, fuel to air ratio , air velocity and fuel type

have been varied. The effect of the fuel blending on flame structure has been investigated.

The optimum working conditions such as inlet mixture temperature, solidity ratio, optimum gas chromatograph operating conditions, check for no enterained air to flame during combustion from atmosphere and flame flatness had been carried out before any experimental results have been taken .

The experimental results show that, concentration, flame temperature and gas flow velocity in main and post flame zone have been affected by fuel to air ratio and inlet velocity. The effect in main reaction zone is greater than in post flame zone and for rich mixture than lean mixture, also, for light diesel than kerosene-air flames. Moreover, the adiabatic flame temperature can be calculated as function of mixture strength, fuel type and inlet mixture temperature. Fuel type affects flame structure through its effect on maximum flame temperature and radical concentration which consequently affect reaction rate.

Also, mathematical model for predicting concentration, flame temperature and gas velocity has been developed. In the present model under-relaxing finite-difference scheme for solving the governing conservation equations describing the motion of two dimensional, compressible turbulent and chemically reacting flow based on chemical kinetic approach have been used. The solution of finit-difference equations is accomplished by mean of tridigonal matrix algorithm. The turbulence parameters are determined by a variable density two equation k-ϵ model. At control volume near the confined tube wall node, modification for source terms and exchange coefficients have been carried out to suit the boundary conditions. The combustion model consists of eleven reactions, four steps mechanism for commercial fuel containing seventeen chemical reacting species.

The experimental results have been used to validate the theoretical results for different equivalence ratio and Reynolds number for light diesel and kerosene-air flames.

The present results are important for developments of multi fuel combustors and air pollution.

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