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قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
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A NUMERICAL STUDY OF OPTIMUM NORMALIZED PREMIXING LENGTH FOR TURBULENT PARTIALLY PREMIXED FLAME IN A CONCENTRIC FLOW CONICAL NOZZLE BURNER

By

Eng. **Ahmed Said Hanafy Mhmoud**

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Mechanical Power Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

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Title of Thesis:

A numerical study of optimum normalized premixing length for the turbulent partially premixed flame in a concentric flow conical nozzle burner

Key Words:
Partially premixed; Conical nozzle burner; Mixing field; Stability; Turbulent flame

Summary:

The current work involves a numerical study to validate the numerical models to investigate the effects of the normalized premixing length (L/D) at a certain overall jet equivalence ratio (Φ) and a certain Reynolds number (Re) on the mixing field structure in a concentric flow burner. Also, involves finding the best normalized premixing length, L/D, in a concentric flow burner using validated numerical models.

Finally, a numerical study of the partially premixed flame structure in a Concentric Flow Conical Nozzle (CFCN) burner by using numerical models, which included calculating the flame curvature and discussing the influence of equivalence ratio on the structure of the flame and finding the lowest value of the equivalence ratio at which the flame be sustainable.

All numerical studies were carried out for air-natural gas mixture using ANSYS 2020 R2 Package.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Ahmed Said Hanafy Mhmoud Date: ../../2021

Signature:

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Table of Contents

List of Tables

List of Figures

Nomenclature

(A/F)	Actual air-to-fuel ratio
$(A/F)_{st}$	Stoichiometric air-to-fuel ratio
D	The inner diameter of the outer tube of the burner nozzle, mm
L/D	The normalized premixing length
pdf	Probability density function
R_e	Reynolds number
R_Δ	The normalized ratio of the mixture fraction
R_Z	The normalized ratio of the mean mixture fraction
Z	Mixture fraction
Z_L	Lean flammability limit mixture fraction
Z_R	Rich flammability limit mixture fraction
Z_{min}	The minimum value of the mixture fraction
Z_{max}	The maximum value of mixture fraction
Z_{mm}	Mean of Z_{min} and Z_{max}
Z_{LR}	Mean of Z_L and Z_R
ΔZ	Range of mixture fraction within the mixing field, = Z_{max} – Zmin
v_a	Airstream velocity, m/sec
v_f	Fuel stream velocity, m/sec
Φ	Equivalence ratio

Acronyms

CFCN	Concentric Flow Conical Nozzle
CFD	Computational Fluid Dynamics
DO	Discrete Ordinates
FGM	Flamelet-Generated Manifold
LES	Large Eddy Simulation
PIV	Particle image velocimetry
PLIF	Laser-Induced Fluorescence
POD	Proper Orthogonal Decomposition
RMS	Reynolds Stress Model