A PROJECT REPORT MAJOR -II

ON

COMPUTATIONAL ANALYSIS OF EFFECT OF PARTICLE INJECTION IN A RECTILINEAR TURBINE CASCADE

Submitted in partial fulfillment for the award of the Degree of

MASTER OF TECHNOLOGY

IN

THERMAL ENGINEERING

By

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(2K12/THR/16)

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STUDENT'S DECLARATION

I **Neelam Baghel**, hereby certify that the work which is being presented in the major project-II entitled **"Computational analysis of effect of particle injection in a rectilinear turbine cascade"** is submitted in the partial fulfillment of the requirements for degree of **M.Tech** at **Delhi Technological University** is an authentic record of my own work carried under the supervision of **Prof. Samsher & Dr. K. Manjunath**. I have not submitted the matter embodied in this major project-II for the award of any other degree. Also it has not been directly copied from any source without giving its proper reference.

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CERTIFICATE

This is to certify that the project entitled, **"Computational Analysis of Effect of Particle Injection in a Rectilinear Turbine Cascade"** is submitted by **Neelam Baghel (Roll no. 2K12/THR/16)** to Delhi Technological University, Delhi for the evaluation of M.Tech Major Project-II as per academic curriculum. It is a record of bonafide research work carried out by student under our supervision and guidance, towards partial fulfillment of the requirement for the award of Master of Technology degree in thermal engineering.

The work is original as it has not been submitted earlier in part or full for any purpose before.

30th June, 2014

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ABSTRACT

Blade is the most important part of turbine. During the flow of working fluid various types of contaminants come in contact of turbine blades which give rise to the trilogy of "CDE" names corrosion, deposition and erosion. This decreases the strength and overall efficiency of blade as well as turbine. In this report the attention is focused on the variation of inlet velocity in the rectilinear turbine cascade with the injection of particles using FLUENT®.

This report gives a detailed explanation about the effect of particle injection on blade length and profile loss coefficient with variation of inlet velocity. Two Dimensional geometry of rectilinear cascade with six blades is created in Gambit® 2.4.6 software and flow behaviour is analyzed using fluent 6.3.26. Air at inlet velocity 50m/s, 100m/s and 150m/s with injection of ash, steel and water particles of 50µm, 100µm, 200µm and 300µm is passed through the cascade. The profile loss is decreased by increasing the velocity for a blade span. In case of ash particles of 50µm, profile loss is 17.92% by increasing velocity from 50m/s to 150m/s, 17.89% in case of steel particles,17.15% in case of water particles. We analyze that the effected length on the suction and pressure side of the blade will increases by increasing the velocity and diameter of injected particles.

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NOMENCLATURE USED

ρ	Density
u_i	Velocity vector
S_m	Momentum Source Term
P	Static Pressure
ρg_i	Gravitational Body Force
F_i	External Body Force
τ_{ij}	Stress Tensor
δ_{ij}	Kronecker's delta
μ	molecular viscosity
K_{eff}	Effective Thermal Conductivity
$J_{j'}$	Diffusion Flux
S_h	Source term includes heat of chemical reaction
T	Temperature
E	Energy term
h	Enthalpy
$m_{j'}$	mass fraction
u_i	instantaneous velocity
κ	turbulent kinetic energy
ε	energy dissipation rate
M	Mach Number
P_{2s}	Static pressure at outlet
P_{o1}	Total pressure at inlet
ξ_y	Profile loss coefficient
P_{o2}	Total pressure at outlet
T_0	temperature at inlet
T_2	actual temperature at exit
T_{2s}	temperature at exit when expansion in the cascade is isentropic.

γ	Ratio of specific heats for air
S	span
z	blade height
y	distance along pitch
C_v	sand volume fraction