ANALYSIS OF VELOCITY OF FLUE GASES IN ECONOMIZER OF COAL POWER PLANT IN KOSOVA B

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Abstract- It is known that the velocity of flue gases in economizer is a key factor in heat transfer by convection from the gas side, with the increasing of velocity in one side it`s increased the heat transfer but in other side the pressure drop are increased. The aim of this work is to describe the velocity of flue gases in tube banks of Economizer of coal Power Plant Kosova B. The velocity analysis of Economizer it`s done by CFD codes and obtained results can be useful for the maintained engineer to make suitable prediction of the tube life.

Keywords- Economizer Model, Mesh Generation, CFD Modeling.

I. INTRODUCTION

An economizer is a heat exchanger which raises the temperature of the feed water leaving the highest pressure feed water heater to about the saturation temperature corresponding to the boiler pressure. This is done by the hot flue gases exiting the last super heater or reheater at a temperature varying from 370 ºC to 540 ºC. The economizer has an important function in providing high overall boiler thermal efficiency. Thermal coal power plant Kosova B has the type of boiler Tower boiler once through and the last heating surface at the boiler if we not consider air heater it is economizer, this economizer is made by plain tubes with inline arrangement because of fouling which impact in additional resistance to heat transfer, soot blowers are installed in middle of upper side and down side of the tube banks to clean them from accumulation deposits.

II. ANALYSIS OF VELOCITY BY ANASYS FLUENT R15.0

Computational Fluid Dynamics CFD code is a branch of fluid mechanics that uses numerical analysis and algorithms to solve and analyzes problems that involve fluid flows. CFD analysis of economizer can be useful to gain gas velocity distribution in tubes. The results by CFD will be useful to find the right velocity operating parameter and to minimize the rate of erosion.
CFD analysis divided into 3 steps.

- Pre-Processing
- Solution
- Post-processing

Equations which are applicable commonly to all fluid dynamics problems are the conversations of mass, momentum and energy equations.

Conservation of Mass (Continuity equations):

$$\frac{\partial \rho}{\partial t} + \nabla\left(\rho \vec{V}\right) = 0 \quad (1)$$

Mometum equation:

$$\rho\left[\frac{\partial \vec{V}}{\partial t} + \left(\vec{V}\cdot\nabla\right)\vec{V}\right] = -\nabla p + \nabla\cdot\bar{\bar{\tau}} + \rho\vec{f} \quad (2)$$

Conservation of Energy:

$$\rho\left[\frac{\partial h}{\partial t} + \nabla\cdot\left(h\vec{V}\right)\right] = -\frac{Dp}{Dt} + \nabla\cdot\left(k\nabla T\right) + \phi \quad (3)$$

2.1. Geometry

Geometry of economizer is built in Solid Works 2014, than it is imported in Design Modeler, ANSYS Workbench. Because the symmetrical of economizer and a constant density of flue gases we took in consider as a model only half of it which is easier for generating better results. The goal of this paper is to study the velocity distribution in tube banks of economizer. Dimensions are given in **Table 1**, and the drawing model in **Fig.1.**

Table1: Geometrical specification of Economizer

Specifications	Dimensions
Length (Shell)	7977.5 mm
Height (Shell)	4140 mm
Diameter of tubes	Ø38x4 mm
Pitch on length direction	81 mm
Pitch on height direction	76 mm
Distance from tubes to wall (left side)	222.5 mm

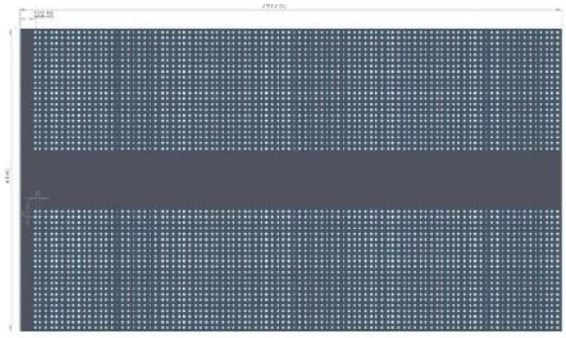


Fig.1.2D Geometry of economizer

2.2. Meshing

Before meshing we define boundary conditions (Inlet Velocity, Pressure Outlet and Tubes Wall) than we generate mesh, also in this paper it is used inflation to define edge better. Mesh contains quadrilateral elements as it seems in **Fig.2**.



Fig.2. 2D Meshing model

2.3. Solution Setup

The analysis type is changed to Pressure Based Type, Velocity formulation is changed to absolute and time to steady state. In Models, Energy is set to "on", viscous model is selected as k-ε model standard. In the Materials is used coal-lv-volatiles with this properties (taken from Internet analyzed by www.firecad.net for fuel type of Kosova B)

- Density = 0.536 kg/m^3
- Cp (Specific Heat) = 1243 J/(kgK)
- Thermal Conductivity = 0.04767 W/(mK)
- Viscosity = 2.7793e-05 kg/(ms)

In the Cell zone Conditions, Zone type is Fluid. In Boundary Conditions for the Inlet is set velocity magnitude 3m/s and temperature 673 K, and for Outlet is set pressure outlet with temperature 583 K.

III. RESULTS AND DISCUSSION

In **Fig.3**, it is shown the velocity distribution of flue gases in economizer in vertical plane along its length XY plane. The flue gases moves upward through Y direction because we made analysis for one direction. Velocity is plotted by color and as it seems the higher velocity is near the wall of channel, this velocity in one side impacts in formation of erosion but in other side increase heat transfer, so the tubes near the wall are mostly endangered be erosion. In **Fig.4** and **Fig.5** it is given a closer view of **Fig.3**, it is well known for tubes arrangement inline the maximum velocity occurs at the minimum flow area between the tubes.

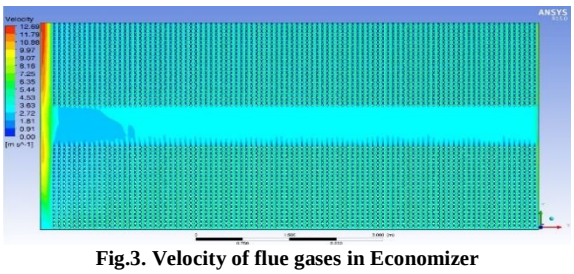


Fig.3. Velocity of flue gases in Economizer

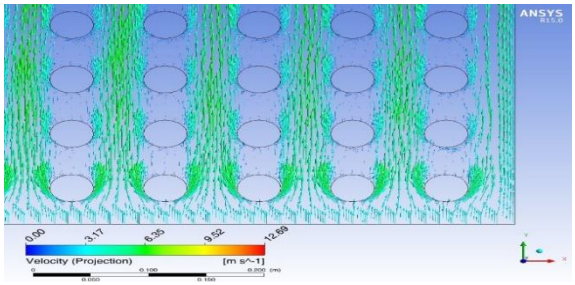


Fig.4. Velocity plotted by vector

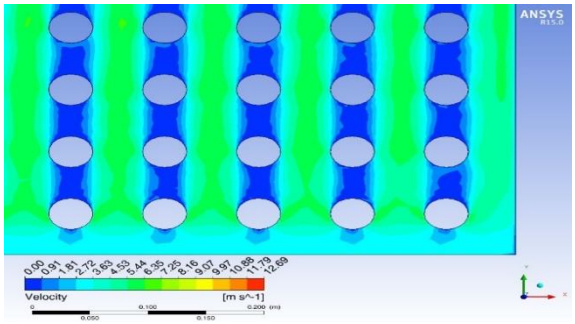


Fig.5. Velocity plotted by color contours

CONCLUSIONS

The results obtained from the modeling can be helpful for the operators in Thermal Power Plant Kosova B. As it seems velocity of flue gases in tube banks has higher value in the narrow section between 5.44-7.25 m/s and it is considered effective in heat transfer, but velocity has the highest value in space between wall side and tubes and this may affect the erosion in tubes also this velocity respectively flow gases near the wall it`s loss of energy. Therefore it remains to find the opportunity to reduce it.

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