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Title: CFD ANALYSIS OF WASTE HEAT BOILER

Volume 07, Issue 13, Pages: 542–546.

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CFD ANALYSIS OF WASTE HEAT BOILER

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ABSTRACT: Waste Heat boilers are used to recover waste heat from high temperature exhausts in chimney stacks. Waste heat boilers are typically water tube boilers which use large volume, high temperature waste heat streams as a heat source as opposed to conventional fuel. Typical heat sources include hot exhaust gases from such equipment as gas turbines, incinerators, furnaces and reciprocating engines. Should the waste heat in exhaust gases be insufficient for generating the required amount of process steam, it is sometimes possible to add the auxiliary burners. These systems burn fuel in the waste heat boiler or an afterburner may be added to the exhaust gas duct just ahead of the boiler.In this analysis, flow simulation (CFD) of the Regenerative Air (RA) & Gas Turbine (GT) ducts along with inlet pipes and mixing chamber were carried out for various configurations to identify the real cause for the vibrations developed. An amicable solution identified was to guide the flow properly through the RA duct with guide plates to eliminate the vortex generation and circulation induced which was the primary cause for vibrations developed in the duct assembly.

Keywords: CFD (Computational Fluid Dynamics), Waste Heat Boiler, RA (Regenerative Air), GT(Gas Turbine).

I INTRODUCTION

Waste heat boilers are ordinarily water tube boilers in which the hot exhaust gases from gas turbines, incinerators, etc., pass over a number of parallel tubes containing water. The water is vaporized in the tubes and collected in a steam drum from which it is drawn out for use as heating or processing steam. Because the exhaust gases are usually in the medium temperature range and in order to conserve space, a more compact boiler can be produced if the water tubes are finned in order to increase the effective heat transfer area on the gas side The flue gas temperature, pressure and velocity field of fluid flow within an economizer tube using the actual boundary conditions have been analyzed using CFD tool.

Boilers.

Two vital types of boilers involve Firetube and Watertube boilers. In a Firetube kettle, singing gases of ignition float by means of a grouping of tubes encompassed by utilizing making utilization of water. Be that as it may, in a Watertube heater.

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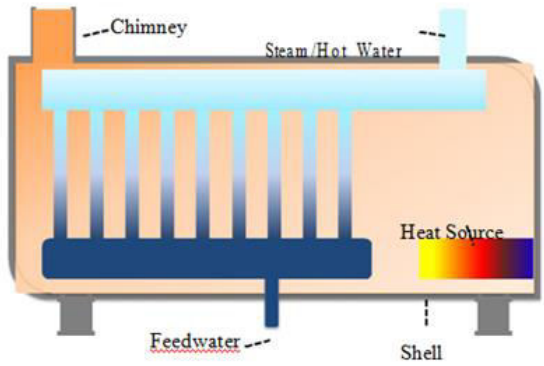


Figure 1: water tube boiler

II LITERATURE SURVEY

Krunal P. Mudafale & Hemant S. Farkade work on "CFD analysis of economizer in atengential fired boiler".

A.D.Patil, P.R.Baviskar, M.J.Sable, S.B.Barve work on "To optimize economizer design for better performance" This paper focuses on optimization of economiser design with finned & baretube economiser. The aim of this work is to develop methodology which finds optimisation of economiser design.

TSUNG-FENG WU work on "failure analysis for economizer tube of the waste heat". This paper is about failure analysis of the leakage of the economizer tube of the waste heat boiler inthe energy factory. The results show that although the material and mechanical properties of thefailed tube, were inferior to those of the new one, most of them were still satisfactory to the criterion requirement it is clear that the crack initiated in the outer surface and propagated toward the innersurface of the tube and the crack was identified to be rectangular in shape. Deendayal Yadav, Dr. G. V. Parishwad, P. R. Dhamangaonkar*, Dr. S. R. Kajale, Dr. M. R.Nandgaonkar, Dr. S. N. Sapali.

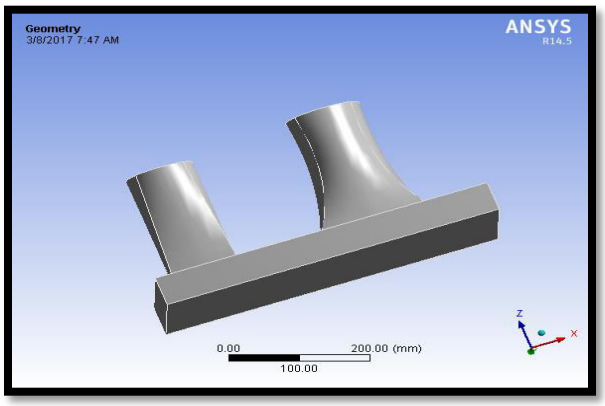
III. SYSTEM ANALYSIS

CFD ANALYSIS OF WATER HEAT BOILER

FLUID- FLUE GAS, COAL & AIR

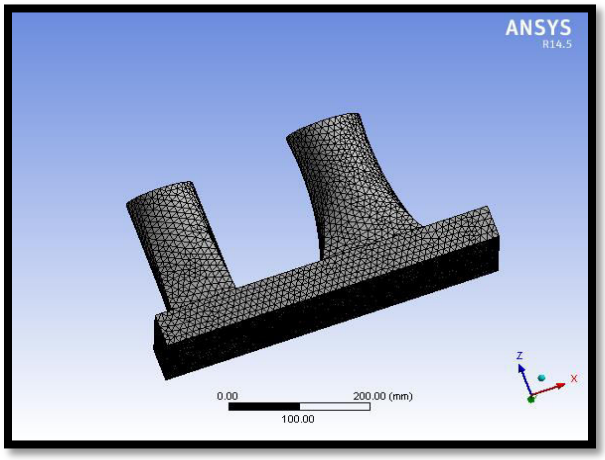
Mass flow inlet = 337kg/s, 147kg/s

→→Ansys → workbench→ select analysis system → fluid flow fluent → double click →→Select geometry → right click →new geometry



→→ Select mesh on work bench → right click →edit → select mesh on left side part tree → right click → generate mesh →

MESHED MODEL



SPECIFYING THE BOUNDARIES FOR INLET & OUTLET

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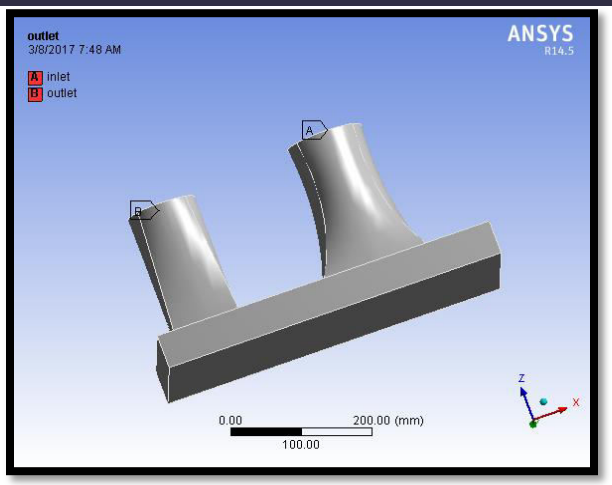


Refresh

project>setup>edit>model>select>energy condition (on)>ok

Materials> Materials > new >create or alter >specify liquid material or indicate properties > alright

Select liquid

Limit onditions>inlet>enter required channel esteems

Temperature=812K

Arrangement > Solution

Initialization > Hybrid Initialization >done

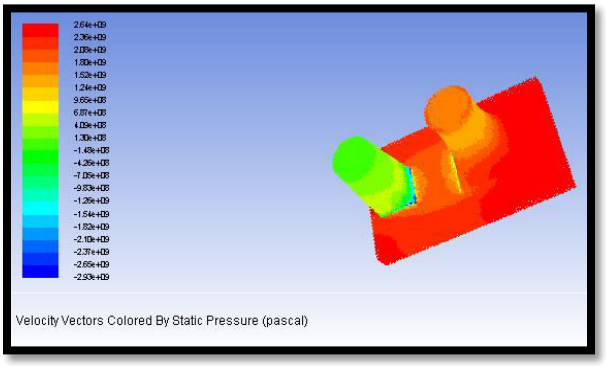
Run computations > no of cycles = 10> ascertain > figuring complete>ok

Liquid FLUE GAS

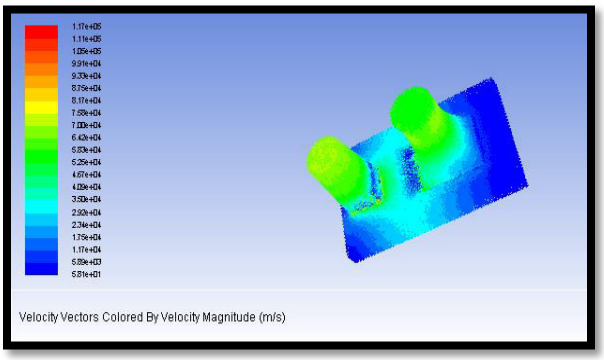
MASS FLOW INLET = 337kg/s

Weight

PRESSURE



VELOCITY



HEAT TRANSFER RATE

Total Heat Transfer Rate	(w)
inlet	2.0714104e+08
outlet	-2.08356e+08
wall-____msbr	0
Net	-1214960

MASS FLOW RATE

Mass Flow Rate	(kg/s)
inlet	336.99976
interior-____msbr	761.15674
outlet	-338.97629
wall-____msbr	0
Net	-1.976532

IV PROBLEM DISCRIPTION

At the plant location, vibration problem for the transition duct between the gas turbine and the Waste Heat Boiler (WHB) was identified and a solution was sought. For this, various data needs to be collected so that the actual cause of vibration can be pointed out and a proper solution can be framed. The input data was collected from the plant and the problem statement was identified based on discussions for detailed investigation, solution and reporting. Input study revealed variations in the operating parameters (mass flow rate) when Operational Trends was compared with PFD

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data. As per PFD data the mass flow rate need to be 337kg/s & 147kg/s in the RA > duct respectively. But the Operational Trends recorded a maximum mass flow rate of 1073kg/s & 62kg/s in the RA & GT duct respectively. Based on this observation it was proposed to study the flow physics occurring the RA & GT ducts both as per PFD data & Operational Trends. This approach will help to identify the existing operational problems of the Waste Heat Boiler (WHB) Transition Duct.

FLUID	FLUE GAS
Temperature at RA & GT inlets	857 K & 901 K
Mass Flow Rate at RA & GT inlets	337 Kg/s & 147 Kg/s
Density (ρ)	0.6214.5 kg/m^3
Viscosity (μ)	0.0284 Kg/ m-s
Conductivity (k)	0.042749 W/m–K
Specific Heat (C_p)	1099.87 J/kg–K

Table 1:input data

V RESULTS

Fluid	Mass flow inlet (kg/s)	Pressure (Pa)	Velocity (m/s)	Heat transfer rate (w)	Mass flow rate (kg/s)
Flue gas	337	2.64e+09	1.17e+05	1214960	1.976532
	147	4.41e+08	5.08e+04	500128	0.8137207
Coal	337	1.15e+06	5.41e+01	799392	1.43045
	147	2.05e+05	2.36e+01	266728	0.47743225
Air	337	1.29e+09	1.88e+05	1393312	2.4769592
	147	2.27e+08	2.48e+04	137696	0.24482727

VI CONCLUSION

Squander warmness kettle had been displayed in CREO program and examining the warmness heater warmness switch charge with decent mass drift deltas (337, 147 kg/s) with extraordinary liquids. Computational Fluid Dynamics is most every now and again utilized gadget for reproduction and assessment. 3-d numerical CFD instrument is utilized for reenactment of the float subject attributes all through the quick rigging. CFD reenactment makes it conceivable to picture the float inside warmness heater.Through taking a gander at the CFD examination the warmth swap cost, mass float charge, weight drop and % raises by means of building up the mass drift channels of the waste warmness heater and expanding the warmness change expense of the liquid air.The waste-warmness kettle is the typical option for warm recuperation. In accordance with the writing unmistakably compelling task of the heater requires adequate making sense of the procedure and its working stipulations. It used to be once conceivable to recognize and evaluate the commitment of choppiness and radiation result. Then again, a lot of the examination used to be accomplished subjectively. Set up on the discoveries got, the accompanying huge ends can likewise be made:

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