CFD Analysis Of Bed Coil Tube Using Advance CAE Tools & it's Optimization Of Erosion And Corrosion

[1]ANKUR B VAIDHYA, [2]ASHWIN BHABHOR

[1,] P.G STUDENT, [2,] ASSISTANCE PROFESSOR
L.D.R.P I.T.R GANDHINAGAR

ABSTRACT: In the Present paper a Review the aim of the present investigation is to reduce the erosion-corrosion behaviour of Bed coil in Fluidized Bed combustion system. After lots of search I knew that there are many possibilities of tube failure. In this investigation, Ansys CFX module has been used to analyze the different parameters which affect on the erosion-corrosion of bed coil like coal properties, air flow velocity, tube material, nozzle diameter, thickness and pitch of bed coil or tube, elevation of the boiler tubes to a higher position in the unit and etc. I have validated data with experimental readings than after I will do experimental evolution with the help of software.

Keywords: Erosion, Corrosion, CFD Analysis

INTRODUCTION

Atmospheric fluidized bed combustor (AFBC) boilers for steam or electricity generation is gaining popularity because of its ability to burn wide variety of fuels with low atmospheric emissions. Compared to pulverized coal fired boilers, the AFBC boilers are more susceptible to erosion along the fireside path. The erosion is caused by the direct impingement of in-bed particles on the tube surfaces. Super heater coils of an AFBC boiler are found to be affected extensively by solid particle erosion. Erosion and corrosion of bed coil is a major problem faced by the power plant industry today. The damage caused to the exposed surface of the tubular, due to these phenomena can be enormous. The failure of equipment during treatment can be very expensive both from the point of view of economic losses as well as personnel safety.

Hence, the determination of material loss is very important to predict the life of these equipment under different operating conditions. A clear understanding of the effect of particle impact, while varying various parameters is needed to be able to quantify the erosion phenomenon.

II REVIEW

To enhance the bed coil tube is analyzed and experimental results are compared with the Ansys CFX analysis results to optimize the design specification and parameter. Therefore this paper concentrates on the review of modeled and analyzed Erosion and Corrosion of bed coil tube component.

Manish Agrawal [1] In this work, different wear resistant coatings named Alpha 1800, Armacor M and Ducor were deposited using TAFA 9000 wire arc spray equipment for their application in atmospheric fluidized bed combustion boilers. The erosion behaviour of these coatings was evaluated in a test rig and compared with that of carbon steel. Evaluation of coatings up to 600^{o}C indicated that

the lowest erosion rates were observed for Alpha 1800 coating, the erosion rate of this coating being 5–10 times lesser than steel base depending upon the test temperature and erodent impact angle. Therefore, Alpha 1800 coating was sprayed on the super heater coils of an AFBC power plant.

S. Bahadur b [2] A number of parameters for characterizing the angularity of particles had been proposed in the literature. These parameters serve as good indicators of irregularity as opposed to roundness, but fail to provide a good measure of angularity. The relevant parameter in erosion was angularity and not irregularity. In that work, a new parameter for characterizing the angularity of particles was proposed. It took into account the sharpness of particle comets and the probability of these comers contacting the target surface. The particles of SiO2, garnet, Al_2O_3 and SIC are characterized for angularity in terms of this parameter and compared with other measures, P^2/A and W/L, where P, A, W and L denote the perimeter, area. width and length of the particle, respectively. It was found that the new parameter provides the characterization for even where the other measures fail. In addition to the above, the effect of particle angularity and size on the erosion of 1020 HR steel in a fluidized bed atmosphere at 500^{o}C and 5 m/s impingement velocity was studied. It was found that the erosion rate increases with increases in both particle angularity and size.

Fig:- Bed Coil Tube

Buta Singh Sidhue [3] Hot corrosion and erosion are recognized as serious problems in coal based power generation plants in India. The coal used in Indian power stations had large amounts of ash (about 50%) which contain abrasive mineral species such as hard quartz (up to 15%) which increase the erosion propensity of coal. Hot corrosion and erosion in boilers and related components are responsible for huge losses both direct and indirect in power generation. An understanding of these problems and thus to develop suitable protective system was essential for maximizing the utilization of such components. These problems could be prevented by either changing the material or altering the environment or by separating the component surface from the environment. Corrosion prevention by the use of coatings for separating material from the environment was gaining importance in surface engineering.

Ramesh Bhagat [4] The super-heater and re-heater tubes of the boilers used in thermal power plants were subjected to unacceptable levels of surface degradation by the combined effect of erosion–corrosion mechanism, resulting in the tube wall thinning and premature failure. The nickel-based super alloys could be used as boiler tube materials to increase the service life of the boilers, especially for the new generation ultra-supercritical boilers. The aim of this investigation was to evaluate the erosion-corrosion behaviour of Ni-based super alloy Superni-75 in the real service environment of the coal-fired boiler of a thermal power plant. The cyclic experimental study was performed for 1000 h in the platen super heater zone of the coal-fired boiler where the temperature was around 900◦C. The corrosion products had been characterized with respect to surface morphology, phase composition and element concentration using the combined techniques of X-ray diffractometry (XRD), scanning electron microscopy/energy-dispersive analysis (SEM/EDAX) and electron probe micro analyser (EPMA). The Superni-75 performed well in the coal-fired boiler environment, which had been attributed mainly to the formation of a thick band of chromium in scale due to selective oxidation of the chromium.

John Stringer[d] [5] Heat-exchanger tubes in fluidized bed combustors (FBCs) often suffer material loss due to combined corrosion and erosion. Most severe damage is believed to be caused by the impact of dense packets of bed material on the lower parts of the tubes. In order to understand this phenomenon, a unique laboratory test rig at Berkeley was designed to simulate the particle hammering interactions between in-bed particles and tubes in bubbling fluidized bed combustors. This paper described the characteristics of this test rig, reviews results at elevated temperatures and compares them to field experience. At higher temperatures, deposits of the bed material on tube surfaces could act as a protective layer. The deposition depended strongly on the type of bed material, the degree of tube surface oxidation and the tube and bed temperatures. With HCl present in the bed, wastage was increased due to enhanced oxidation and reduced oxide scale adherence.

Xuan Shi[a], Yaowu Shi[b] [6] Tube coils made of 25Cr-20Ni austenitic stainless steel were horizontally installed in the fluidized bed of an actifier column of a catalytic cracker installation in an oil refinery unit. Catalyst particles and flue gases were moved in the fluidized bed. When the catalyst lost activity, carbon in the catalyst was burned out in the fluidized bed to recover the activity of the catalyst. Meanwhile, a steam–water mixture was formed with a pressure of 4 MPa and saturation temperature of 250^{o}C in the tube coils by the heating of the flue gases. Thus, the heat in the fluidized bed was utilized to generate steam. However, after the installation had been in service for about 40 days, leakage occurred in the tube coils. In general the positions of leaks were in the upper part of the tubes within about 6 m of the inlet. Microscopic analyses indicated that cracks initiated at local corrosion pits where chloride ions present in the feed water enriched and accumulated. The crack propagated in an inter granular or trans granular manner. Obvious striations were found on the crack surfaces at some positions. Based on the failure analysis and heat transfer calculation, failure of the tube coils was mainly caused by the effects of corrosion fatigue. The lifetime of the tube coils could be prolonged by changing the steam–water flow conditions.

william yang [7] A CFD model of a 375 MW tangentially-fired furnace located in Australia's Latrobe Valley has been developed. Coal feed rates, air flow rates, coal particle size distribution and coal properties, obtained from plant data, are taken as input conditions in the CFD simulation. A level of confidence in the current CFD model has been established by carrying out a mesh independence test and comparing simulated results against power plant measurements. Performance of two turbulence models ,standard k-ε model and SST model, are compared. The effect of particle

dispersion on predicted results is foundto be insignificant. The validated CFD model is then used to simulate several brown coal combustion cases at full load with different out-of-service firing groups.

III. CONCLUSION

The boiler tubes are located in the bed area and the wastage is caused by both corrosion and erosion. Erosion rate increases with increases in both particle angularity and size. If the studded tube is used in place of plain plane, erosion-corrosion rate will be reduce and if the coating cover is placed on tube or bed coil, sulphur, chlorine alloy do not affect on the tube so life of the bed coil will be increased and over all plant efficiency increased.

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REFERENCES

1 Evaluation of arc sprayed coatings for erosion protection of tubes in atmospheric fluidised bed combustion (AFBC) boiler was presented by Krishnarao Venugopal, Manish Agrawal.

2 Hot Corrosion & Erosion Problems in Coal Based Power Plants in India and Possible Solutions-A Review were presented by Vikas Chawlaa, Amita Chawlab, D. Puric, S. Prakashc, Prema G. Gurbuxanid and Buta Singh Sidhue

3 Particle characterization for angularity and the effects of particle size and angularity on erosion in a fluidized bed environment was presented by S.L. Palasamudram a, S. Bahadur b

4Erosion-Corrosion behavior of Ni-based super alloy Superni-75 in the real service environment of the boiler was presented by T S Sidhu[1], S Prakash[2], R D Agrawal[2] and Ramesh Bhagat.

5 High Temperature Degradation by Erosion-Corrosion in Bubbling Fluidized Bed Combustors was published by Peggy Hou[a], Stuart Macadam, Yan Niu[c], John Stringer[d].

6 Corrosion fatigue cracking of tube coils in an actifier column catalytic cracker was published by Xuan Shi[a], Yaowu Shi[b].

7 Numerical modeling of brown coal combustion in a tangentially-fired furnace. Zhao feng tian, peter j. Witt, m. Phillip schwarz and william yang.