

AIRHEATER FOR INDUSTRIAL BOILERS

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Airheater is a heat recovery equipment, which improves the efficiency of the boiler. The fuel consumption is reduced to an extent of 5 %, depending on the duty.

In Airheater the combustion air is preheated before admitting the air to combustion zone. The air preheating can be heated up to 200 deg C max, depending on the type of Combustion equipment. In FBC boilers preheating up to 150 deg C is normal. With use of SS air nozzles, air can be preheated up to 200 deg C. With grate bars as in stationary or traveling grate, the temperature is limited to 150 deg C.

CONSTRUCTION DETAILS OF AIRHEATER

The air can be made to pass either through the tubes or outside the tubes. Each arrangement has its merit and demerit.

With gas flowing over the tubes steam soot blowers can be arranged for on line cleaning of Airheater. The tubes would be in line in this case. The Airheater calls for more space as compared to gas inside tubes. Usually the tubes have to be held horizontally as shown in figure. This leads to sagging of the tubes, in case they are longer.

With gas flowing through the tubes, the plugging of the tubes with ash is very common. Only if the gas is clean smaller tubes can be used. Generally the tubes are positioned vertically. This avoids the tube sagging. Acoustic soot blowers can be used in this case.

The Airheater is made as multipass design in order to recover the heat with less heating surface. Several arrangements are possible as shown in figures.

- *Tube Size*

The tube size is usually 63.5 mm OD x 2.01 mm thk and of non IBR quality. Tube material specification can be IS 3601 or BS 1774. Corten steel tubes are used for improving the tube life against cold end corrosion. Tube size smaller than 63.5 mm can pose problems such as choking with fuel ash. Smaller tubes also increase the pressure drop across the Airheater on the tube side.

- *Tube Length*

The tube length is usually limited depending on the access available below or above the Airheater for tube replacement. Long tubes are certainly vulnerable for vibration. Also the longer tube lengths need expansion joint at Airheater casing to account for differential expansion between the casing and the tubes.

- *Tube Pitch*

Tube pitch is so selected to have a minimum ligament of 15 mm. This is necessary for expansion of tubes to the tube sheet.

- *Tube Length*

The tube length per pass is usually limited to 3-m. Proper deflectors or guide vanes have to be provided to ensure the flow across the Airheater is properly distributed.

- *Tube Arrangement*

Tube can be arranged in line or staggered. However when the gas is dust laden and when the passes outside the tubes, the tubes have to be in line.

- *Tube Fit Up*

The tubes are expanded in to the tube sheet. Some tubes are welded in addition to expansion for structural stability of the Airheater. The expansion of the tubes also facilitates easy removal of tubes by collapsing of tube ends.

- *Air Side Velocity.*

The air side velocity is usually around 5 to 6 m/s in order the have an optimum draft loss. Airheaters are usually designed for an air side pressure drop of 50 to 100 mmWC.

- *Gas Side Velocity*

The gas side velocity is limited to 18 m/sec. Higher gas side velocities could lead to erosion of tubes. Further the draft loss is usually limited to 75 to 100 mmWC.

AIR HEATER CORROSION

There are two modes by which the corrosion failures are initiated. The flue gas contains water vapor, which is due to moisture and hydrogen in fuel and moisture in air. This water vapor condenses on the cool surfaces of Airheater. The temperature of the Airheater tubes will be closer to ambient temperature at air inlet section. This is where the water droplets form. The sweating of the tubes here promotes corrosion spots. The ash in flue gas also deposit at this point and leads to choking of the tubes.

With fuels containing sulfur, the acid formation takes place and the corrosion is accelerated. The Airheater failure in oil fired boilers would be faster as compared to coal fired boilers. With high moisture fuels such as lignite, wood, bagasse the tube failures are common.

It is better to design the Airheater with multiple blocks so that the cold end block can be replaced when necessary. If the Airheater is of a single block, the replacement cost and down time cost for replacement of tubes will be high.

CONTROL OF COLD END CORROSION

The following methods are used in controlling the cold end corrosion.

- Bypassing a portion or all of the cold air to increase the metal temperature. This is used when the boiler operates at low loads, when the condensation of the gases is unavoidable.
- Increase the spacing of the first few rows of the tubes at the air inlet side to decrease the cooling effect. The heat exchange will be less in this section, thus preventing the condensation.

- Recirculate a portion of the hot air back to the cold end, so that the air inlet temperature is more. This improves the metal temperature thus avoiding condensation.
- Use parallel flow Airheater to improve the metal temperature.
- Use steam coil air preheater to preheat the air before admitting into the Airheater.
- Use tubes made of corten steel to extend the life of the tubes.

AIRHEATER EROSION

The Airheater tubes are subject to vortex erosion when flue gas passes through the tubes. This happens only in ash containing fuels such as coal & rice husk, and with flue gas flowing through the tubes.

The failure takes place at the inlet end of the tubes within a distance of 125 mm. To prevent tube failures, concreting is done at gas inlet end to a height of 125 mm. Alternately, ferrules are used, which can be replaced on failure.

EFFECTS OF AIRHEATER FAILURE

In the event of tube failure, the heat gain from Airheater will not be available for furnace heat transfer. In order to compensate for this heat loss the fuel consumption would go up. As the failures increase, beyond a limit the combustion airflow to the furnace would start coming down, as the combustion airflow goes to chimney directly. This leads to poor combustion of fuel. The unburnt in ash and flue gas will go up. The furnace draft can not be maintained. Further the steam generation would come down. Generally at this stage only, the failure is realized by many.

HOW TO DETECT THE FAILURE

Draft loss and temperature drop can be checked with performance parameters of the installation when it was new. In the absence of proper instrumentation / log procedures, only physical checking can help.

Inspection doors are required at inlet and outlet of Airheater both on air side and gas side. Without which one can not confirm the failure. With boilers operating on low load, the failure happens but does not surface up with problems. Hence periodical check up alone can be the solution.

AIRHEATER TUBE / CASING VIBRATION

Vibration could be experienced due to air column inside the Airheater. For this, it is necessary to adjust the width / height of airflow passage. This can be done by introducing baffles / tube sheet.

In some cases, the tubes may vibrate due to air flowing air around tubes. Bypassing some airflow would solve the problem. Sometimes the tube thickness may have to be changed.

The above solutions can be best given by the designers only.

CONCLUSION

It has been seen that many boiler users are unaware of the mechanism of Airheater failures. For the general knowledge of the boiler users, the above information is shared. Feedback is welcome.

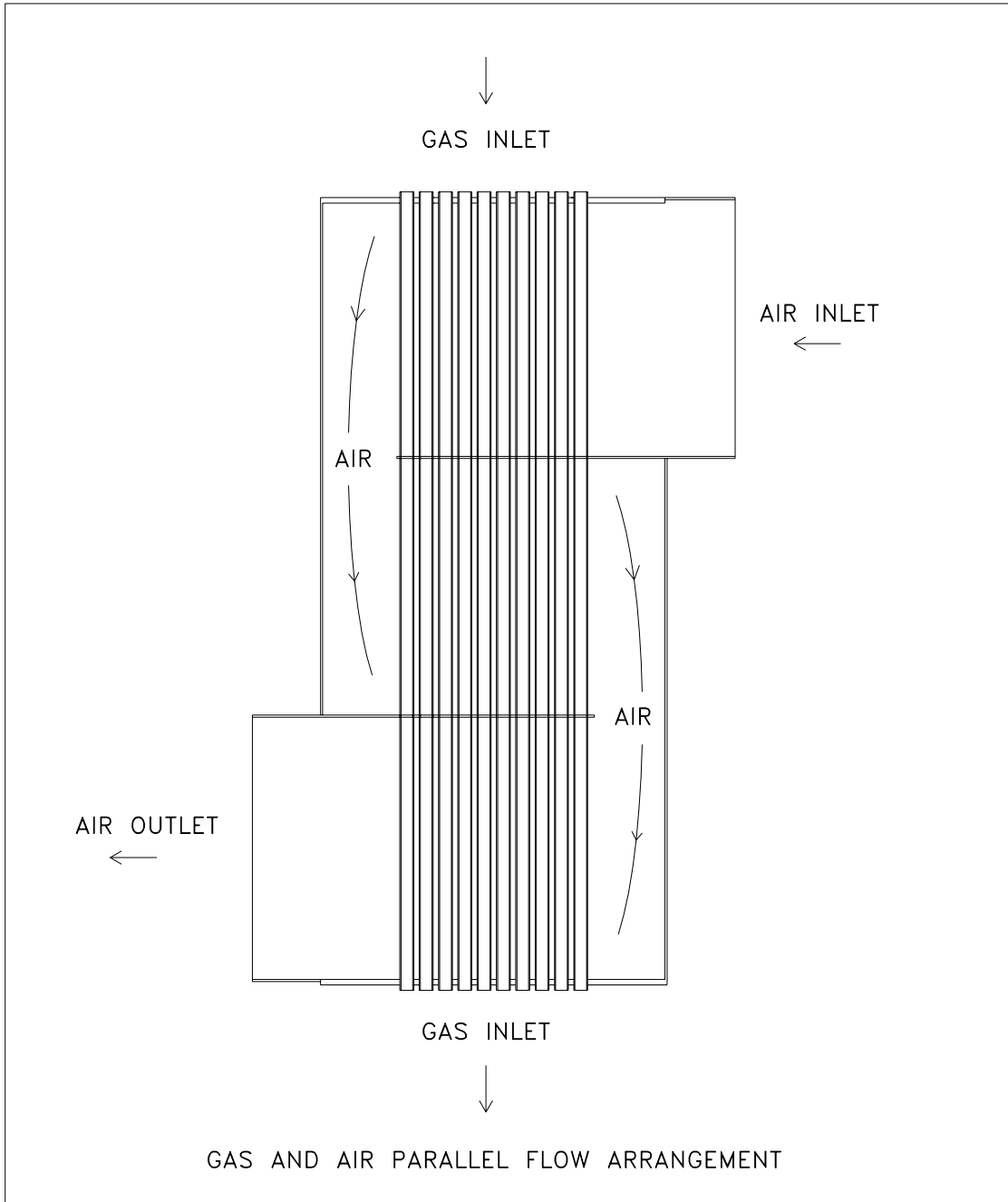


Figure 1

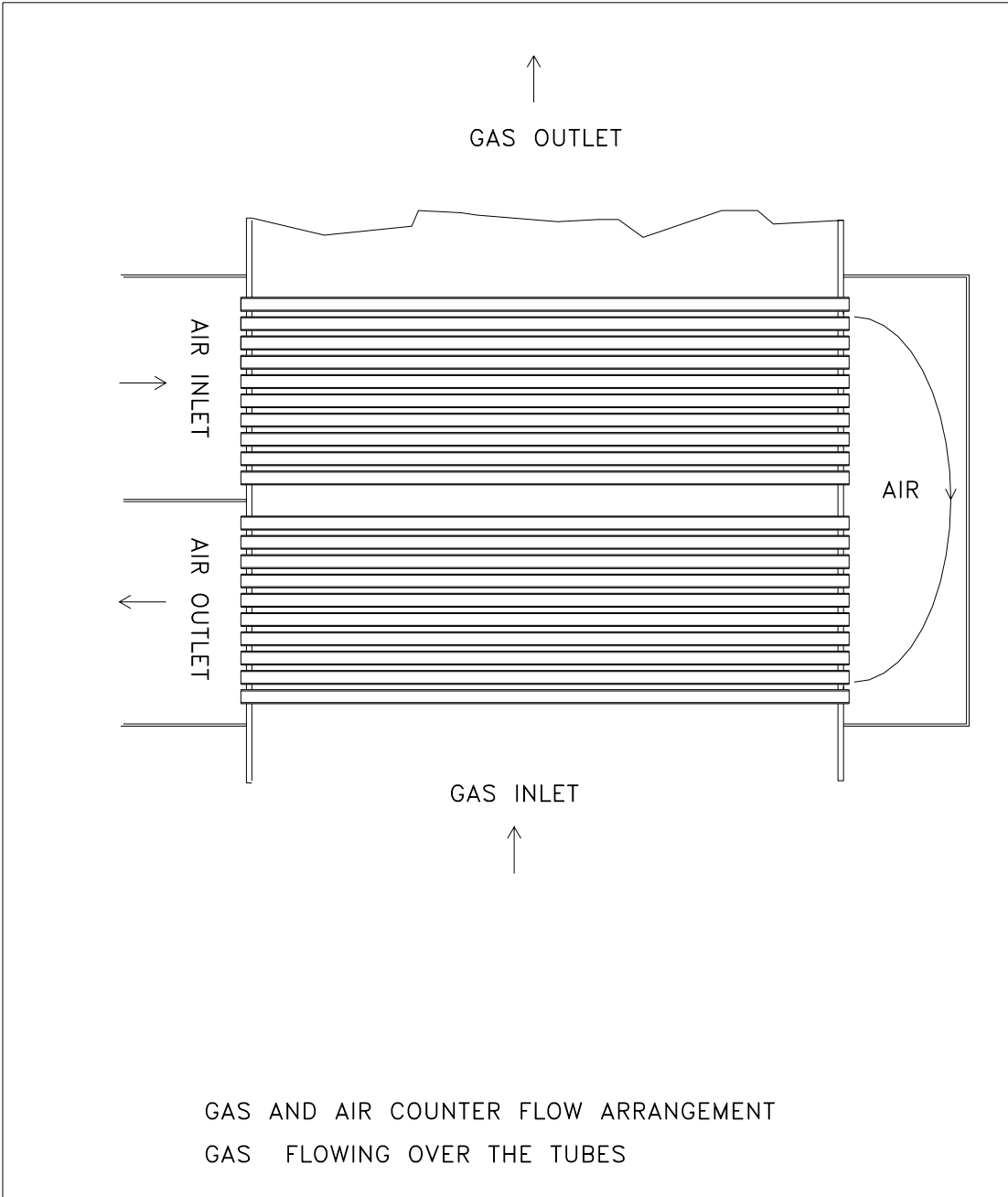


Figure 2