CFD Analysis and Flow Optimization Within Flue Gas Duct for Enhanced Air Pre Heater (APH) Performance

Introduction

Flow optimization within ducts to enhance the perfromance of components like Economizer, APH and Electro Static Precipitator (ESP) used in power plants, is of paramount importance to increase the operating efficieny of plants and reduce emissions. Use of Computational Fluid Dynamics (CFD) is being increasingly used to accomplish such tasks. The case study considered here for description demostrates the use of CFD analysis to achieve uniform flow distribution of flue gas across an APH system to improve its thermal efficiency.

Content

Flue gas ducts that act as a passage for the supply of flue gas from boiler to APH suffers from high level of flow non uniformity and accumulates energy losses , leading to poor performance of APHs. This is mainly attributed to the design of ducts. In this case a flue gas duct leading to APH of a coal fired power plant was considered for improvements. Applying CFD techniques the duct was modeled and analysed to the existing design conditions. The results obtained from the analysis showed a high level of non uniformity in the flow pattern and velocity distribution across the duct, mainly at the inlet section of APH (flue gas duct outlet), as shown in **Figure:1 & Figure:2 existing design condition**. This in turn was presumed to have an overall effect on the heat transfer rate of APHs. Various possible design changes were considered and through the application of CFD an optimized design modification was identified. The resultant design had a better flow distribution and a reduced standard deviation in the velocity values at the flue gas outlet was achieved, as shown in **Figure:1 optimized design condition**. The resultant uniform flow distribution as observed in **Figure:2 optimized design**, within APH would lead to an increased thermal efficiency of APHs.

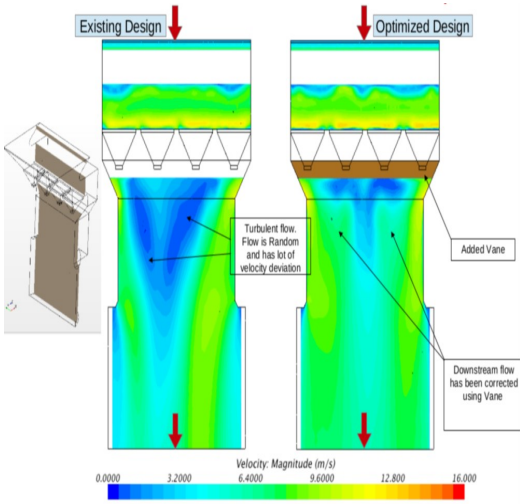

Fig.1: Velocity magnitude (YZ plane)

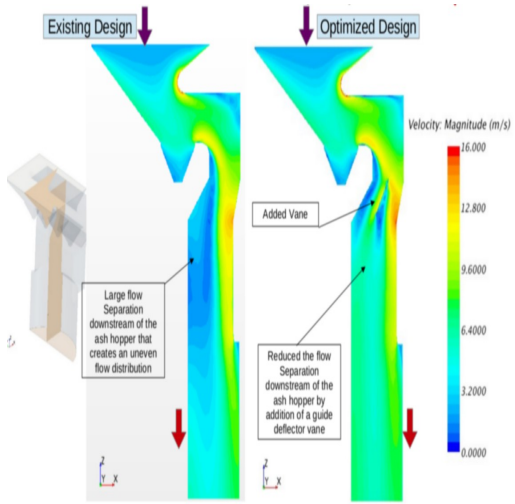

Fig.2: Velocity magnitude (XZ plane)

Key Benefits

- Better flow distribution within ducts and reduced pressure drops
- Better flow distribution at APH inlet and within APH elements
- Enhanced APH performance
- Reduction in auxilary power consumptions and cost incurred
- Reduction in erosion

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