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Condition Based Monitoring of boiler parameters in a thermal power station (Case of anonymous company)

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Abstract

In large scale industrial applications, the controlling and optimization of the parameters must be done efficiently and effectively so as to attain smooth operation of the plant. In this paper the main control parameters in the boiler are coal flows, temperatures in the combustion zone, air to fuel ratio, ash content that is the percentage of ash in raw coal, and mineral content. These parameters are to be monitored so as to avoid clinker formation on the platen super heater tubes in the boiler. Condition Based Maintenance (CBM) was used as the main maintenance method to monitor the boiler parameters and a branch known as fuzzy logic for the monitoring of the boiler parameters. The results show that the boiler should stop or continue to run depending on the Furnace Draught Pressure (FDP). When the FDP is within the range -7.5 – 5kPa the fuzzy controller send a message to continue run the boiler, fro -10kpa to -7.5kPa the fuzzy controller send a message to stop the boiler, also from 6kPa to 10kPa the fuzzy will send a message to stop the boiler. The boiler will only run when the logic is 1 and when the logic is zero the boiler should stop but in the case that the logic is 0 but there is no clinker that is forming the run command will be executed that is the fuzzy read the environment and act according to the environment. On the ID fans when the electrical consumption is within the range 0.9225-0.9375kPa the fuzzy controller send a message to run the boiler because there will be no clinker formation and this is shown by the accepted range of electrical consumption, any value outside this range the fuzzy controller will send a message to stop the boiler. The fuzzy logic controller is used in the sense that it is adaptive and can control itself when necessary.

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Keywords: Online (Intelligent) Condition Based Maintenance, Fuzzy Logic, Platen superheaters, platen super heaters, thermal power station

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1.0 Introduction

Clinker formation is a serious problem in the boilers of thermal power stations which may result in forced outages for very long duration and generation loss if not attended to [1]. Coal fired Boilers which contain platen super heater elements experience high rate of platen super heater tube leaks [2]. This contributes to reduced boiler efficiency and increased in down time on the boiler which has impacted on the total output of the station.

1.1. Clinker Formation

Clinkering is the formation of non-combustible residue that is fused into an irregular lump that remains after combustion of coal [3]. Clinkers are mainly a mass formed on the furnace walls due to low fusion temperature of ash present in coal these clinkers are rough and strong bonded with surface in appearance [3]. The Presence of silica, calcium oxide, magnesium oxides and other mineral matter in ash lead to low fusion temperature [4]. These minerals in ash differ as feed coal changes to other fused. Clinker on the furnace walls has tendency to grow and generally sticks to the hot surfaces rather than cold surfaces. Hence clinker formation and accumulation in furnace depends on quality of coal, ash fusion temperature according to the boiler operating parameter and conditions [5]. Ash melting behaviour is a dominant parameter in generating clinkers as it follows mineral distribution of coal and existing temperature conditions in the boiler [5]. Hence analysing temperature distribution of par bide streams in the boiler can prove to be valuable for power utilities to adopt corrective measures for clinker formation on the furnace walls [11]. The purpose of the paper is to identify ways of removing the clinker intelligently.

1.2. Condition-Based Maintenance (CBM)

Condition-Based Maintenance (CBM) is a philosophy used by industry to actively manage the health condition of assets (plant) in order to perform maintenance only when it is needed and at the most opportune times. CBM can drastically reduce operating costs and increase safety of assets requiring maintenance. Corrective/Reactive maintenance can have severe performance costs, and preventive/scheduled maintenance replaces parts before the end of their useful life. CBM optimizes the trade-off between maintenance costs by increasing availability and reliability while eliminating unnecessary maintenance activities [6]. CBM components are an optimized mix of maintenance technologies (diagnostics, prognostics), Reliability-Centered Maintenance (RCM)-based processes and enablers (total asset visibility) [9]. It also has some features which are data acquisition and it involves various types of information: Vibration, Temperature, Pressure, Speed, Voltage/current, Stress/strain/shock, Position and Particulate count/composition. The applications of CBM involves jet engines, wind turbine generators, natural gas compression and thermal power plants. It is a useful tool in that there is: increased system availability, increased system reliability, reduced maintenance cost and reduced inventories.

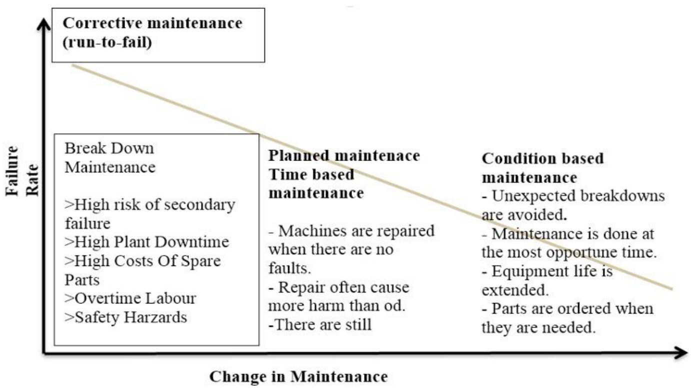

Fig 1: Change in Maintenance against Failure Rate [6]