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Analysis of Gaseous and Particulate Air Pollutants Emitted From The Stack of Coal Fired Thermal Power Plant, Rihandnagar, Sonebhadra, Uttar Pradesh, India

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Abstract

The objective of present study was to study the gaseous and particulate pollutant emitted from of coal fired power plants in thr form of flue gas. Flue gas was measured qualitatively and quantitatively from the stack port using automatic stacks monitoring kit of a National Thermal Power Corporation, Rihand super thermal power plant, Rihandnagar, Sonebhadra, Uttar Pradesh, India producing 2000 MW power. The concentrations of SO2, NOx, O2, CO, CO2, CxHx and stack gas temperatures were measured with the help of automatic flu gas analyzer. The concentrations of particulate matter, SO2, NOx ranged from 72- 135, 528-556, 334-374 mg/Nm3 respectively. The stack gas temperature was ranged from 151°C - 160 °C with an average value of 155.5 °C. The hourly released volumes of CO2 from stack no. 1, 2, 3 and 4 were 253258, 277481, 207066 and 204237 Nm3/hr with an average value of 235510 Nm3/hr respectively.

Keywords: Air Pollution, Atmospheric change, Coal fired power plant, Flue gas

Introduction

Coal combustion currently produces roughly 27% of the world's energy, second only to crude oil, and is the largest single source of electricity (_41%).Coal is also a major industrial and residential fuel in some countries (Shindell and Faluvegi, 2010). Coal is the only natural resource and fossil fuel available in abundance in India. Consequently, it is used widely as a thermal energy source and also as a major fuel for thermal power plants producing electricity (Mishra, 2004). India is 6th largest energy consumer in the world, accounting for 3.4% of global energy consumption and at present, India has a total power installed capacity of 223343.60 MW and growing rapidly (Gupta, et. al. 2013). Due to rise of Indian economy, the demand for energy has grown an average of 3.6% per annum over the past 30 years. The Government of India has to increase very rapidly the installed electricity generating capacity

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at least 2 Lakh MW by 2012 to achieve the ambitious mission of "Power for all by 2012". Sufficient steady power supply is also a basic need to achieve Gross Domestic Product target growth rate of 8-10% and quality life for every individual (Madhav and Mehta, 2010)

In a fossil fuel power plant the chemical energy stored in fossil fuel (such as coal, fuel oil, natural gas or oil shale) and oxygen of the air is converted successfully into thermal energy, mechanical energy and finally electrical energy for continuous use and distribution across a wide geographic area. Most thermal power stations in the world use fossil fuel, outnumbering nuclear, geothermal biomass or solar thermal plant.

India has about 210 billion coal reserves that are being mined at the rate of about 300 million tons/year and India as the third largest coal producing nation in the world but the problems associated with the use of poor quality coal which has high ash content (40-45%) and thus low calorific value and During the combustion of pulverized coal, the oxidation of carbon, nitrogen and sulphur in the organic coal matter produces CO2, NOx and SOx together with water vapour (Kisku, et. al., 2012).

The flue gas generated from combustion of the fossil fuel is discharged into the air, it contains CO2 and water vapour, as well as other substance such as nitrogen, nitrogen oxides, sulphur oxides, and (in case of coal-fired plants) fly ash and mercury. Since Indian coal are low in sulphur content (0.3-0.4%); SO2 emission from coal based thermal power station for each MW are lower than elsewhere in the world (Lakra, 2011). Fly ash generated from the combustion of coal contain carcinogenic organic compound like chlorophenoal and chloro benzene in ppm levels and polyaromatic hydrocarbon, polychlorinated dibenzo dioxibns, polychlorinated dibenzo furans and other element like Be, C, Ca, Si, K, Li, Mn, Na, P, Pb, Co, Ni, Cd, Cr. Cu, Hg, As, Se, Bo and Mo. (Tsai, et. al., 2013). Coal is the dirtiest most carbon intensive of all fossil fuels. It is one of the leading contributors to climate change. Burning of coal releases of huge amounts of solid waste residue, massive amounts of gaseous pollutants SO2, including green house gases CO2, NOx and water vapours. Electricity generation using carbon based fuels is reasonable for a large fraction of carbon- di-oxide (CO2) emissions worldwide and for 41% of U.S. anthropogenic CO2 emission

(Ausubel, et. al., 1988). Keeping above in view the present study was conducted to analyze the gaseous and particulate pollutants emitted from the stack of coal fired Thermal power plant, Rihandnagar, Sonebhadra, Uttar Pradesh, India.

MATERIALS AND METHODS

The super thermal power plant, Rihand was selected for the present study. It had four boilers The boilers no. 1 and 2 were attached to one stack having a height of 225 m while, the Boiler no 3 and 4 was attached to other stack with 275 m height. All stack monitoring were carried out at ESP outlet ducts and at a height of 40 m form the ground floor. Stack samples were collected from the port in the respective stack using stack monitoring kit (Model APM-615, Envirotech, New Delhi). Particulate matter was collected isokinetically in pre weighed micro glass fiber thimble and quantified gravimetrically. SO2, NOx, O2, CO, CO2 CxHx, poison index, stack gas temperature were directly measured with the help of Automatic flu gas analyzer (Model KM-9106, Germany).

RESULTS AND DISCUSSION

The stack emission data and analytical results are given in table 1. The concentrations of particulate matter, SO2 and NOx were ranged 72-135, 528-556, 334-374 mg/Nm3 respectively. The stack gas temperature was ranged from 151°C - 160°C with an average value of 155.5 °C. The emitted volumes of CO2 from stack no. 1, 2, 3 and 4 were 253258, 277481, 207066 and 204237 Nm3/hr with an average value of 235510 Nm3/hr respectively. The plant was operating in full swing with greater efficiency. The plant load factor ranged from 512-520 MW with an average of 516 MW (PLF- 116%). The exit huge amount of flue gas was from the tall stack with higher temperature than enhance the ambient air temperature. The green house gases like CO2 and NOx and also steam i.e.- water vapour coming out from the leakage as well as automatic release from the plant may also be responsible for the significant cause of climatic change.

Conclusions

The present study concluded that the concentrations of particulate matter was ranged 72- 135 SO2 and NOx ranged from 528-556, 334-374 mg/Nm3 and stack gas temperature was ranged from 151°C - 160°C. The emitted volumes of CO2 from stack no. 1, 2, 3 and 4 were 253258, 277481, 207066 and 204237 Nm3/hr respectively. At present time there are

no prescribed emission standards with respect to SO2, NOx, and for stack emissions for Thermal Power Plants.

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