Effect of Blending Ratio of Coal and Biomass on NOx Emission Regarding Co-Firing

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Abstract

Greenhouse gas emission had a huge effect on global warming as well as cause of acid rain. Regarding this study was made to investigate the effect of blending ratio on coal and biomass on NOx emission through co-firing. Different biomass was used to measure the considerable value of biomass with coal on NOx emission. Fluidized bed combustor was used at 300^{0}C optimum temperature for co firing of coal and biomass. The maximum emission of NOx measured at tree leaves 40% and lignite coal 60% and minimum range of NOx at 80/20 ratio for coal and banana tree waste. This could be healthfully beneficial when utilizing biomass with coal.

Key words: Blending ratio; Coal; Biomass; NOx emission; Co-firing

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INTRODUCTION

World is facing problem of energy crises and global warming, there are also new technologies available in the world to overcome the problem of energy demand and global warming. Co-combustion of coal and biomass getting attention now a days, because co-combustion has many advantages regarding emissions coming from stacks or chimney and for power generation. The major world energy source is the fossil fuel. It is predicated that these resources will be depleted in 40-50 years to come. In addition, it is anticipated that it will damage the environment and cause catastrophic on global environment. These emissions from fossil fuel had alarmed the world community. Co-combustion is probably the less complicated and one of the most advantages ways of utilizing coal and biomass for replacement of fossil fuels for stationary energy conversion. There was different biomass were used to carry out the combustion for giving energy. Co-combustion has many advantages regarding environmental pollution and also suitable for power generation. Pakistan has advantages regarding biomass available in large amount also coal is present. Different researcher also work on different biomass and coal, their blends to decreases the amount of pollution and also decrease the energy crises. When we utilize the biomass with coal give good option for decreasing the amount of CO_2 and also different types of emissions. biomass when we use with. Coal have many advantages such are calorific value and emissions reduction. In Pakistan there are many reservoirs of coal which can be utilized with the help of available technologies. In Sindh province Thar coal, Lakhra coal, Sonda and many reservoir's present in these reservoirs type of coal present is lignite coal. In Pakistan agriculture and other waste is increasing so there is need to be utilize in proper way. Co-combustion gives the opportunity to utilize biomass waste with coal for power generation and to reduce the emissions. With the development of human civilization, the solutions to waste disposal and energy crisis are emerging to be the most important tasks to be focused on (Boxiong et al., 2004; Liang et al., 2011b). Biomass energy is one of the renewable energy sources. When the huge biomass potential of the world is considered, biomass is a candidate fuel to play a supplementary but active role for meeting part of the world's energy demand. Particularly, within the European Union (EU) biomass is the most relevant renewable energy source besides hydropower. Thus, it is expected to contribute substantially to the CO_2 emission reduction targets defined in the Kyoto protocol (Obernberger, 2005). Biomass utilization in energy production is very important to decrease the fossil fuel usage in energy

sector. It is also seen a very effective way of removal of bio waste materials which occupy great volumes when they are disposed to a landfill Co-combustion of biomass with coal in fluidized bed combustors to get cleaner energy is a promising application. However, there can be some operational problems because of the alkali and chlorine content of the biomass fuel. Agglomeration of bed material, fouling, and corrosion of super heater tubes are commonly seen when biomass containing high alkali and chlorine content is burned in fluidized bed combustors (Hupa, 2005). Pisa et al., 2013 discussed emission gases such as NO_x generation. He also discussed its separation during the process co-combustion of biomass in power plant. He worked on the effect of excess air coefficient on particles and gravimetric involvement of the sawdust in the blend. Re-circulation of gas at the combustor inlet in addition to combustion gases in the heater excess air and initial time of secondary air was kept constant during the combustion. Different biomasses such are sawdust, sewage sludge, straw, woodchips and refuse, derived fuels. Biomass has positive impact over environment regarding burning with primary fuel regarding environmental problem. There is decrease in CO_2 because burning of biomass. Co-firing takes importance for greenhouse gas reduction excluding CH_4 emission. The nitrogen content present in biomass converted into ammonia as rear cases in coal during combustion. Hence, co-firing can also result in lower NO_x levels. Blending had importance over utilization low value fuel biomass with coal. There are several works dealing with the effect of biomass addition on the gas emissions discussed by Leckner et al., 1993; Nordin, 1995; Gulyurtu et al., 1997, Armesto, 1997; Desroches-Ducarne et al., 1998, Hein KRG and Bemtgen, 1998; Dayton et al., 1999; Werther et al., 2000; Amand, 2001; Laursen et al., 2002; Skodras, et al., 2002; Ross et al., 2002; Armesto et al., 2003. Study was made to investigate the optimize blending ratio for coal and biomass for reduction NOX emission.

Co-combustion

Co-combustion is technique which meant that combustion of more than one fuel or we can say that combustion occur simultaneously without change the conditions. As we know that combustion not use nowadays but that were applied many years but as for development in new technology combustion has getting advancement regarding coal and biomass. Because when we utilize biomass with coal give the opportunity to decrease the emissions and also increase the amount of power. As co-combustion of coal and biomass concerned new advancement also increase regarding fluidized bed, co-gasification and also different techniques that have many advantages regarding environmental and energy requirement. Co-combustion can be carried out in various ways for various purposes. A coarse classification could be as follows, covering new plants as well as existing ones converted for the purposes:

- A small amount (a few percent of total fuel power) of bio-fuel or waste is fired together with coal in a boiler, originally designed for coal. The purpose is to get rid of waste or to replace coal by biomass utilization.

- A small amount of fuel with a high heating value is fired together with a fuel having a low heating value (such as sludge) that needs thermal support to attain a desired combustion temperature.

Spontaneous use of co-combustion with fuels in any ratio, depending on price, availability and local supply conditions.

MATERIALS AND METHODS

Lignite coal collected from lahara coal field and biomass were collected from district Hyderabad.

Coal

The material that has property to combusted and contains carbonized matter said to be coal. Coal have many advantages to fulfill the requirement of energy, because due to its calorific value there are different types of coal present in overall the world. because it is originally generated from debris of animal and trees decay from many years, as Pakistan is concerned millions of tons are present in different areas of the world due to from previous century there were different types of trees available due to that Pakistan has huge reservoirs of coal. Coal can be utilized with biomass give less amount of emissions, because when we talk about coal it contain nitrogenous compound which will give NO_2 and NOx after combustion.

Biomass

Biomass has getting interested nowadays due to its availability and environmental friendly approach. Biomass is mainly consisting of organic matter that will produce by naturally photosynthesis and also artificial photosynthesis. Different sources of biomass are described in given Figure 1.

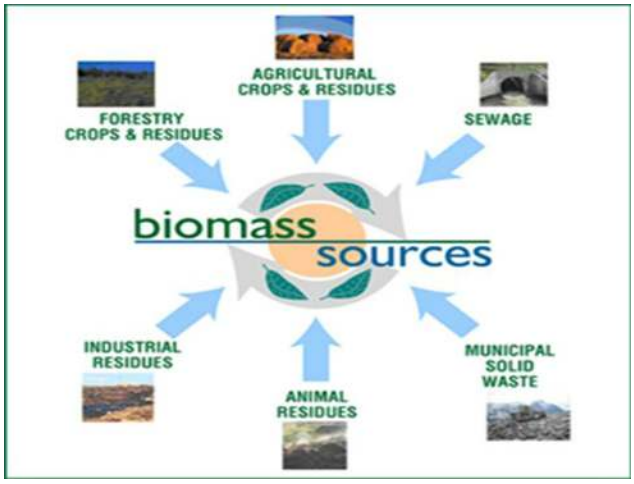

Figure 1: Biomass Resources

Tree leaves

The tree leaves has many advantages regarding environmental pollution. The tree leaves used for many different prospective regarding for co-combustion and combustion also. As we know that every part of the world consists of mainly tree leaves due to this researcher developed the techniques.

Banana tree waste

In many areas of the world banana is also grown and after the growth period some part of banana tree waste also generated. So, there is need to utilize in manner to decrease the basic need of the environment. As for Pakistan is concerned it has many areas covered by banana tree waste so there need to utilize in good manner to decrease the amount of the waste from environment and also suitable for environment. For banana tree waste, it can be utilizing with coal for co-combustion give opportunity to decrease the emissions and also increase the amount of energy.

Cow dung manure

Cow dung manure is present in huge amount in world, because it has advantages regarding for burning propose. as in different areas of world cow dung manure is directly used for burning purpose. But as for world is growing towards the new technology co-combustion implemented due to its potential. Cow dung manure has also advantages for biogas generation

Methodology

Sample of coal and biomass were collected and crushed in laboratory scale jaw crusher. Sieve analysis was used to take a homogeneous particle size of sample for co-combustion. Coal and banana tree waste were blended using laboratory scale blender.

Figure 2: Experimental setup for co-combustion of coal and biomass

RESULTS AND DISCUSSUION

The presence of biomass in combustion was found to lead to a reduction of NOx and N_2O in flue gas. The fuel-nitrogen content was observed to be a major factor for determining both NOx and N_2O emission (Saikaewa et al., 2012). In this regard this study focus on the different blends of biomass with coal to reduce the emission of coal. Different blends include 90:10, 80:20, 70:30 and 60:40 for carry out co-combustion of coal and biomass.

Effect of Tree Leaves and Lignite Coal Blending Ratio on nox Emission

Tree leaves with coal for co-combustion to investigate the emission of NOx generated. it is clear from fig when tree leaves add with coal had not much impact. on emission of NOx. When tree leaves added with coal emission of NOx increases. But at use of 20% tree leaves give a view on decreasing percentage of Nox.

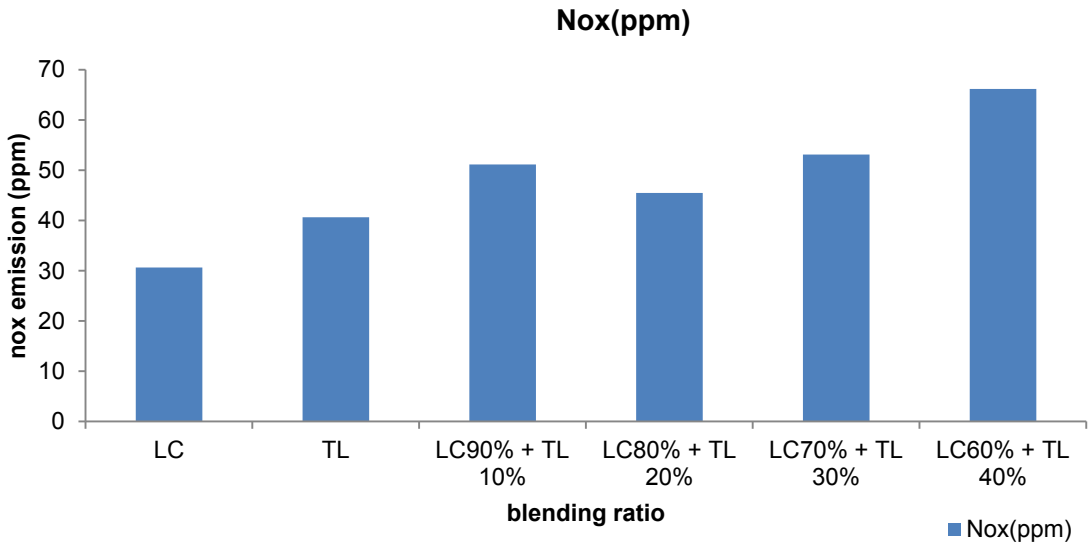

Figure 3: Effect of blending ratio of coal and tree leaves on emission of tree leaves

Effect of Banana Tree Waste and Lignite Coal Blending Ration on nox Emission

Co-combustion of lignite coal with banana tree waste had present many advantages regarding environmental pollution and energy production. different blending ratio for lignite coal and banana tree waste to identify the suitability against environmental and energy production. NOx emission was analyzed by changing the percentage of banana tree waste with coal. In figure 3 it was observed that lignite coal separate combustion give minimum amount but for simultaneously we deal with energy production 80/20 ratio for coal and banana tree waste give about same amount of emission and also beneficial for energy production. Same time we also concerned with energy production.

Effect of Cow Dung Manure and Lignite Coal Blending Ratio on NOx Emission

Emission of NO_X though co-combustion were under study to investigate the effect type of optimized blending ratio.co-combustion of coal and cow dung manure used at different blending ratio maximum emission of NO_X observed at 80%LC+20%cdm. Combustion between coal and cow dung manure.

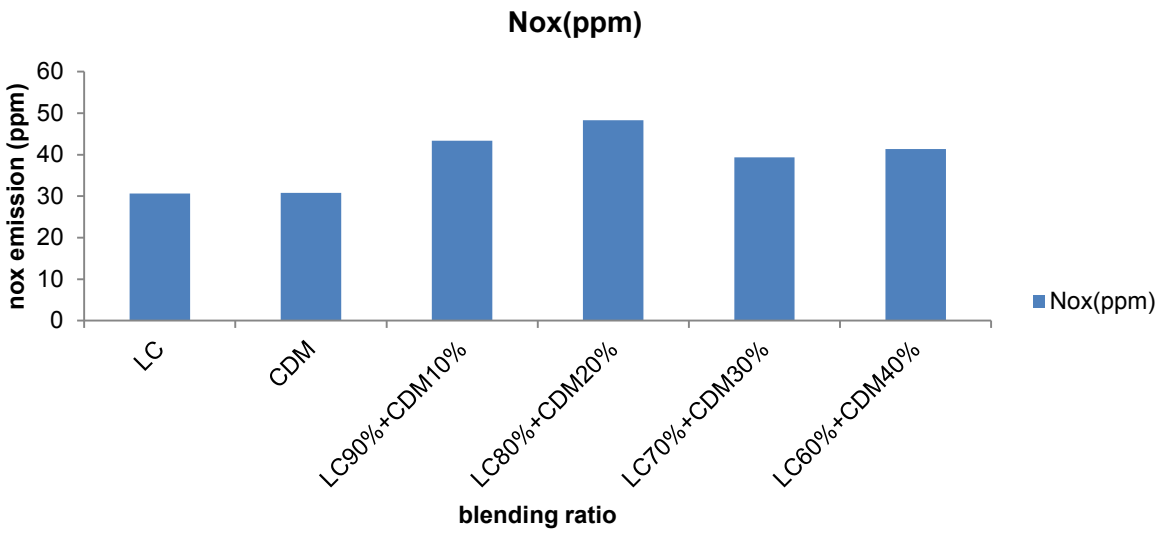

Figure 4: Effect of blending ratio of coal and cow dung manure on emission of NOx

CONCLUSION

Co-firing of coal and biomass presents many environmental benefits regarding emission of greenhouse gases. Different biomass including cow dung manure, banana tree waste and tree leaves were blended with coal. From observed result it concluded banana tree waste presents minimum emission of NOx when blended 20% of it with 80% coal and maximum emission at 60/40 ratio of coal & tree leaves. As for considering the cow dung manure it had significant effect on emission of NOx. Co-firing of coal and biomass could be tremendous technique against environmental pollution.

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