Effective Use of Tree Leaves with Pakistani Coal Through Co-Firing

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Abstract

Biomass utilization with coal had many advantages over pollution control regarding burning of fossil fuel. Co-firing can give opportunity to utilize coal with biomass to make environment eco-friendly. Utilization of tree leaves with coal to make valuable use of biomass material is studied in this work. Different ratios of biomass were blended with coal to investigate the proper blending ratio where minimum emission measured. Such ratio is 90:10,80:20,70:30 and 60:40, the minimum emission of CO at 100% Lakhra coal and tree leaves (60:40), for as CO_2 emission measured minimum lignite coal burning separately. As coal combustion is a serious environmental problem without biomass addition and can emit many harmful gases that may disturb environment. Utilization of biomass with coal could make remedial action against environment pollution. Biomass addition could make allure towards gaseous emission.

Keywords: *Tree Leaves; Coal ;Co-Firing; Blending Ratio*

1. Introduction

Biomass co-firing with coal has been known to have positive impact on environment. Biomass co-firing with coal addresses direct combustion fermentation and pyrolysis. Apart from this few studies had done over co-firing biomass/coal for energy generation [1]. Typical biomass includes sawdust, sewage sludge, straw, wood chips and refuse derived fuels. Biomass is considered to have positive impact over environment conditions. There is decrease in CO_2 concentration because burning of biomass. Coal burning with biomass fuel reduces CO_2 emission. Co-firing brings importance over greenhouse gas reduction by excluding CH_4 emission from the otherwise landfilled biomass residues (sewage sludge, manure, etc.). The ash which is alkaline in nature from biomass captures SO_2 during co-firing. The nitrogen content present in biomass converted into ammonia as rare cases in coal during combustion. Hence, co-firing can also result in lower NOx 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 [2–14]. Co-firing application regarding coal and biomass has seen continuous utilization for electricity generation in coal fired boilers in recent years [15]. Researchers have used different methods for investigation to decrease amount of emission after burning of fossil fuel [15-16]. Some of the techniques employed are expensive, co-firing and co-combustion play an important role for utilizing low value fuel biomass with coal to take part against air pollution and is comparatively inexpensive technique. Co-firing is defined as firing of biomass with primary fuel. Current studies in Europe and the United States [16–19] have recognized that burning biomass with fossil fuels has a positive effect both on the environment and the economics of power generation. The reduction in emission can be

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attained with efficient utilizing of different biomass with coal and efficiency is further depend upon the nature of biomass and fuel. Total fuel cost can be reduced if it is coupled with biomass efficient utilization including processing cost, transport and grinding cost. Waste product typically used are saw dust, wood chips, waste e.g. corn husks, wheat chaff, etc., municipal waste , animal manure and industrial wastes e.g. sewage sludge etc. Dedicated energy crops, including short-rotation woody crops like hard wood trees and herbaceous crops like switchgrass, are agricultural crops that are entirely adult for use as biomass fuels. These fast growing crops have tremendous application in fuel supplement. Biomass fuels are considered environmentally friendly for several reasons. Firstly there is no net increase in CO_2 as a result of burning a biomass fuel (i.e. fossil generated CO_2). During biomass growth CO_2 consumes at same rate as biomass generate heat energy. For that reasons CO_2 emission reduces with biomass utilization [16, 18]. Co-firing of biomass residues crops demand for energy, brings additional greenhouse gas mitigation by avoiding CH_4 release from the otherwise landfilled biomass. It is believed that CH_4 is 21 times more potent than CO_2 in terms of global warming impact. Most biomass fuels have very little or no sulphur content and therefore net SO_2 emissions can also be reduced by co-firing of coal and biomass. This attribute is particularly desired when Co-firing with high sulphur coals. The alkaline ash from biomass also captures some of the SO_2 produced during combustion [16, 20]. Present work is related with Co-firing of coal and tree leaves, their emissions and energy generation near different mergers of lignite coal and tree leaves.

2. MATERIALS AND METHODS

The present study was carried out at the department of Chemical and Mining Engineering MUET Jamshoro.
Materials used in the study were lignite coal and tree leaves & their combinations.

2.1. Lignite coal

In Pakistan it is naturally gifted with huge reservoir of coal which mainly contains lignite coal. This study was carried out to investigate importance of coal when added with biomass. As coal contain significant amount of moisture that will cause corrosion in boilers for power generation.

2.2. Tree leaves

Tree leaves available everywhere at cheap source. These cheap sources of tree leaves play an important role in power generation. In this study different blends of tree leaves were added with coal to take part in energy generation as well as for emission reduction.

2.3. Methodology

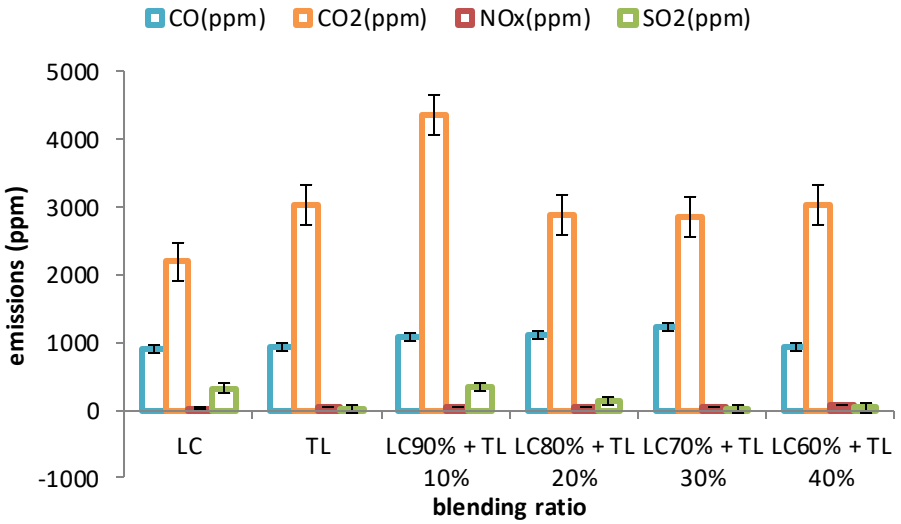
Finer particles were created by crushing and grinding of coal and tree leaves. Sieve analysis was carried out on the basis of the size up to 300µm for Co-firing. Co-firing was accomplished with utilization of different blends of coal and cow dung manure. Excess air was used in fluidized bed combustor in different ratios for Co-firing at temperature of 300^0C. Results were analysed during

Co-firing of coal and cow dung manure as different gaseous emission were emitted, these gaseous emission were also measured by use of emission analyser .

3. RESULTS AND DISCUSSION

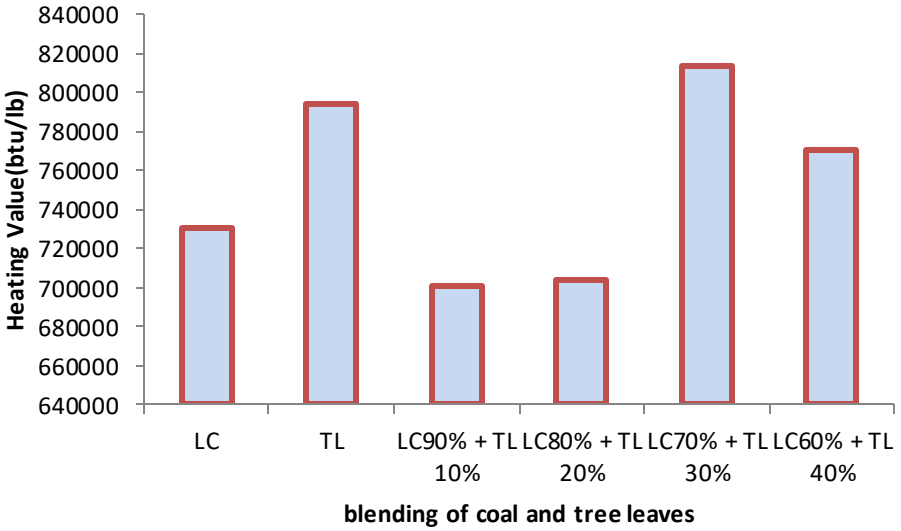
3.1. Effect of blending ratio over use of tree leaves with coal

Biomass is reaped in covenant with a persistent yield, no net carbon emissions will take place during production of energy from that biomass. Although the majority of energy produced in Co firing originates from fossil fuels, the biomass part of the total energy load is wholly renewable. Co-firing of coal and biomass is getting incredible concern these days because of low emission & energy appendage from biomass waste. Tree leaves were used with coal under different blending ratio for analyzing minimum emission ratio. In Figure 3.1 various emission are pinnacle with blending ratio, the maximum emission of SO_2 is observed at 500 ppm. Amount of biomass increase was observed which is due to appreciable amount of sulfur present in it. Further CO_2 amount increases when biomass addition increases because of moisture present in coal as well as in tree leaves. Fig 3.1 also depict trend for CO_2 emission increases when coal addition with biomass about 90%coal+10%tree leaves. Biomass can be attributed for decrease in emissions for power generation attention. Supposing a carbon-neutral biomass resource, CO_2 emissions will drop linearly in fraction to the quantity of coal balance by biomass. Most sources of biomass have slight sulfur concentrations, so sulfur dioxide (SO_2) emissions also drop linearly as the coal fraction is reduced and more biomass is added. Biomass combustion does produce nitrogen oxides (NOx), so reductions in NOx emissions during co-firing are less effortlessly enumerated. Co firing of wood at 7 percent of total heat input has shown to reduce NOx emissions by up to 15 percent compared with a conventional coal-only operation.



3.1. Effect of tree leaves addition on energy generation

Co firing is zilch but the combustion of two fuels at same time. Two fuels are related with base fuel and biomass, commonly base fuel with biomass is coal. The abundant sources of biomass are crop residue, municipal waste, and dedicated energy crops. Most types of biomass undergo substantial processing before they can be utilized for Co firing. The shape, size, and moisture-content of feedstock particles need to be adjusted to meet specifications. Co-firing is simple process, but the most important thing is preparation of the feedstocks. A mixture of coal and biomass (typically containing less than 20 percent biomass by energy content) is fed into a modified coal-burning power plant to produce energy. Co firing systems can be broadly classified as blended delivery systems, in which the two fuels are blended prior to injection, or separate feed systems, in which they are injected into the system separately[3,4]. The previous needs fewer alterations to the power plant, although alterations are usually unpretentious for both methods. Additional adjustments to the fuel-handling, processing, and storage systems may be necessary. Figure 3.2 shows the energy generation from coal and biomass co-firing. It is evident form figure that when biomass addition increase up to 30% energy production increase up to 820000 btu/lb. Trend shows that biomass addition could play important role in increase energy generation.



4. Conclusion

Biomass and coal Co-firing is emerging as efficient technique for reduction of greenhouse gases. This technique will be a resource of energy in the future as traditional fossil fuels are depleting fast. Environment effects are harmless for this technique. Different ratio of biomass was blend with coal to examine the appropriate blending ratio where minimum emission was recorded. Ratio are 90:10,80:20,70:30 and 60:40, the lowest emission of CO_2 at 100% lakhra coal and tree leaves (60:40) was observed. Efficient Exploitation of coal with biomass can mark curative feat in contradiction to environment pollution.

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