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Agro Waste: A New Eco- Friendly Energy Resource

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Abstract

Global warming is a global issue. Intergovernmental Panel on Climate change and the International Energy Agency have suggested that, in order to achieve the international goal of limiting global warming to 2˚C. Sustainable use of the resources is the best way to reduce the global environmental issues. Use of agro waste for the power generation is the new eco friendly resource for the sustainability. Power generation from the agro waste is less polluting resource in comparison to conventional energy resources (coal). It helps to fulfill the world energy demand and natural resource conservation in a sustainable way. The world will need to live within a set carbon budget that can be achieved by the sustainable agro-waste management The highlight of the study is comparative analysis of lignite based coal fired power plant and agro waste (mustard crop residue) fired power plant, which is being used at "Kalptaru Power Plant, Uniyara" (Tonk District, Rajasthan).

Keywords: Sustainable use, global warming, mustard crop residue (MCR), coal, KPCL.

Introduction

A huge amount of agricultural waste is produced during the cultivation of crops; this waste can be used for energy production and can cater the energy demands in rural areas of the surrounding region. After the processing of one ton of the main product, 1.5 tons of crop residues are generated. According to a survey by Govt. of India it is estimated that every year about 500 Metric ton of crop residue is generated. These available crop residues are either burnt in open or are used inefficiently so as to clear the fields for cultivation of crops. As a result of which environmental problems like the production of green house gases causing global warming and various human health issues and also results in loss of plant nutrients like Nitrogen, Phosphorus, Potassium and Sulphur.

Judicial use of these crop residues is very important[1], so management of these crop wastes in a well-planned manner is essential[2] It is evident that the power plants using agricultural residues are very cost-effective in energy generation. As the power plants using biomass are usually smaller, so biomass combustion is nowadays the most common energy conversion method. Biomass combustion occurs at medium-pressure steam boiler (modified Rankine cycle with regenerative feed water heating and water cooling condensation). For power generation agricultural residues like Maize Cobs, Wheat Straw and Rice Husks are collected at a place, from where they can easily be used for energy generation. Agro waste feed stock contains energy in the chemical bonds of its constituent varieties of hydrocarbon (such as cellulose hemi-cellulose lignin and proteins).

Study Area: The Project is located in Rajasthan, India. Kalptaru power Transmission Ltd. (KPTL) is a plant that works for power generation by biomass particularly mustard crop leftovers[3]. For power generation, it uses direct combustion boiler technology. Agro waste power generation plant is located at Uniara, Tonk 25055'N7600, elevation 266meters (MSL). 8 MW is the installed capacity of the plant. Due to the large amount of mustard leftover in this area which has no further utilization; this is used as fuel by this power plant. After the power generation, electricity will be supplied firstly to the State grid and then to the local consumers[4].

Various agricultural biomass residues are being operated in this plant for power generation but mustard crop residue is principle feedstock and in case of shortage, Juliflora is also being used. Mustard crop residue (mix of husk and stock stem) is used as a fuel because of reasons: Mustard is the second largest oil seed in India. Average yield is 10-15 quintal /hectare over 40% of Indian mustard produced in Rajasthan. It is generally not used as fodder. It contains higher calorific value and low ash content[5].

Methodology

Discharged water quality, fuel properties, stack emissions and ash content has been analyzed by the Standard methods.

Results and Discussion

Emissions into air: Less amount of NO_x , SO_x and CO_2 emit into air through biomass as compared to coal (table-2). It results in a clean reduction of emissions[6].

Ash characteristics: Agro waste power plant generates less amount of ash content in comparison to coal-based power plant which is approximately three times lesser than coal.

Table-1
Comparison between coal and mustard crop residue properties

Properties	Mustard	Lignite coal
Calorific value (kcal/kg)	3800 kcal/kg	4000 kcal/kg
Ash (%)	6-7	50
Sulphur (%)	Less than 0.5	0.5-0.8
Moisture (%)	10-20	50

Table-2
Comparison Emission of pollutants between coal and mustard crop residue

S. No.	Parameters	Power Plant (using Coal)	Power Plant (using Biomass)
1	Co_2 kg/kwh	1.2-1.4	0.718
2	So_2 kg/kwh	7.02-7.34	0.099
3	No_x kg/kwh	4.2-4.4	0.122
4	Particulate matter kg/kwh	30.8	10.58

Table-3
Ash Characteristic Comparison between Coal and Mustard Crop Residue Fired Power Plant

S. No.	Characteristic	Power Plant (using Coal)	Power Plant (using Biomass)
Physical Characteristics			
1	Bulk density (gm/cm^3)	1.01-1.43	0.616
2	Specific gravity (gm/cm^3)	1.6-3.1	0..623
3	WHC (in %)	6.1-13.4	41
4	pH	10-12	10.6
5	EC(µmhos/cm)	10^4-10^6	12.4
Chemical Characteristics			
1	Silica (in %)	15-35	0.35
2	Alumina (in %)	10-20	0.18%
3	Iron Oxide (in %)	4-15	0.64%
4	Titanium dioxide (in %)	0-5	0.05%
5	Calcium Oxide (in %)	15-40	10.71%
6	Magnesium Oxide (in %)	3-10	0.57%
7	Sodium Oxide (in %)	0-6	12.66%
8	Potassium Oxide (in %)	0-4	73.82%
9	Manganese Oxide (in %)	0-5	0.10%
10	Sulphur Trioxide (in %)	6-10	0.78%
11	Phosphorous Pentaoxide (in %)	0-4	0.13

Water consumption: Coal fired power plant has a 154 m^3/day/MW water consumption rate as compared to Biomass based fired power plant which is 130.8 m^3/day/MW, which generates large amount of waste water. After the waste water treatment, the outlet can be used for the irrigation purposes as it contain less amount of pollutants and also fulfills the nutrient requirement of crops.

Table-4
Discharged water comparison between coal and mustard crop residue fired power plant

S. No.	Parameters	Power Plant (using Coal)	Power Plant (using Biomass)
1	pH	7.7	7.6
2	E.C.	45	43.6
3	Cl^-	25	15.01
4	DO	2.7	3.8
5	COD	13.6	11

Discussion: There are socio - economic and environmental benefits of using crop residues as energy resource:

Socio-economic: Crop residues of mustard are waste for farmers, only harvested grains are used by human beings. Residues are defused burnt or disposed off which results in several environmental problems. The marketability of crop residue increase the income of farmers by selling crop residue and providing employment opportunities in the vicinity that reduces the need for the farm subsidies and reliance on government support. It also leads sustainable development. For industry, four kg of crop residues could replace the one litre of furnace oil or 1 m^3 of natural gas. The crop residues supplied at Rs. 1.5/kg would offer major cost advantage over fuel oil.

Environment: Diffused burning of agricultural wastes causes air pollution, soil erosion, and decrease in soil biological activity, which eventually leads to lower yields. However, burning yields smoke and other pollutants which adversely affect air quality, visibility, and human and environmental health. The low Sulphur content of crop residues as compared to fossil fuels and their use as fuel does not add CO_2 content to the atmosphere. A tone of crop residues is used to replace 0.5 tons coal prevents addition of 1.5 tones of CO_2 to the atmosphere. Proper use of 150 Mt of anticipated biomass could reduce CO_2 emission by over 250 Mt each year.

Conclusion

With sustainable environmental advantages, power generation from biomass resources also fulfils the rural energy needs due to its potential to serve and its immense scope. For the beneficial use of biomass resources, many techniques are working both at the national and international level which use biochemical and thermo-chemical process. The need of the hour is to adopt sustainable technologies in an adequate manner and to use the available biomass energy potential. The power generation from crop residues would make the rural sector self reliant which will lead to higher production. Employment sources and income in the rural areas would also be increased by the implementation of

local resources for the power generation. According to some international research reviews, crop residues act as a sustainable renewable energy source. These research reviews along with the present biomass potential in our country should focus its attention towards clean and secure energy sources for the growth of a green nation.

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