IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, May 2022
Impact Factor: 6.252

Stubble Burning Industry Contribution to Clean Environment by used of Stubble as a Flame

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Abstract: *Stubble burning has been reckoned among the major contributors of air pollution especially in South Asia. It is a significant source of gaseous pollutants such as, carbon dioxide (CO2), carbon monoxide (CO), nitrogen oxides (NOx), sulfur oxides (SOx), and methane (CH4) as well as particulate matters (PM10 and PM2.5) causing serious damage to human health and the environment. It was reported that the burning of 63 Mt of crop stubble releases 3.4 Mt of CO, 0.1 Mt of NOx , 91 Mt of CO2 , 0.6 Mt of CH4 and 1.2 Mt of PM into the atmosphere. The situation is more austere in India due to the intensive rice-wheat rotation system which generates large amount of stubble. It was estimated that about 352 Mt of stubble is generated each year in India out of which 22% and 34% are contributed by wheat and rice stubble respectively. About 84 Mt (23.86%) of the stubble is burnt on-field each year immediately after harvest. The disastrous haze observed over India during the winter season has been linked to stubble burning as it coincides with the burning periods (OctoberNovember). During this time, most Indian cities, especially within the National Capital Region (NCR) experience harsh pollution often reaching the severe levels of the air quality index (AQI). In November 2019, Delhi recorded a peak AQI of 487, Ghaziabad reported an AQI as high as 493, and Greater Noida recorded 480. The health effects of air pollution ranges from skin and eyes irritation to severe neurological, cardiovascular and respiratory diseases, asthma, chronic obstructive pulmonary disease (COPD), bronchitis, lung capacity loss, emphysema, cancer, etc. It also leads to an increase in mortality rates due to the prolonged exposure to high pollution. The Energy and Resources Institute (2019) reported that in 2012, air pollution had led to about 5 million deaths in South Asia which is around 22% of the total deaths in the region. In addition to its effects on air quality, stubble burning also affects soil fertility (through the destruction of its nutrients), economic development and climate. The crop stubbles (if managed properly) could provide immense economic benefits to the farmers and protect the environment from the severe pollution. Some of the alternative management practices include the incorporation of the stubble into the soil, use of stubble as fuel in power plants, use as raw material for pulp and paper industries, or as biomass for biofuel production. It can also be used to generate compost and biochar, or as blend for the production of cement and bricks. Most of the farmers in North Stubble burning industry contribution to clean environment by used of stubble as a flame India are not aware of the prolific alternatives for managing stubble and, therefore, consider burning as the best option. This necessitates the need for immense awareness programs to enlighten the farmers about the availability of economically feasible options and the composite effects of stubble burning.*

Keywords: Stubble, Burning, Pollution, Straw.

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I. INTRODUCTION

Straw is the left out material in the form of stem in the field. Total production of straw in India is around 100-150 million tons per year. Out of this, around 32 Million tons (say 32%) straw production is only from the States of Punjab (20 Mn tons) and Haryana (12 Mn Tons). straw is burnt by farmers in the field itself in the month of October and November as they want to clear the area for wheat sowing. The pollution caused by burning of fields in winter season particularly in Punjab and Haryana is very harmful for the entire cities of Northern India.

Straw burning are commonly in countries like Cambodia, Egypt, Malaysia. As per FAO in year 2014, the production of straw for in India was 150 Mn metric tons and in China 250 million tons. Some Farmers believe that straw open burning can remove weeds, control diseases and release Nutrients for the next crop. straw is an uncontrolled combustion process in which the products of burning are emitted to the atmosphere, such as CO2, CH4, PM, CO, NOX and SO2, influencing both the local air quality and Global climate

II. OBJECTIVES OF THE STUDY

1. To analyze supply chain management for effective & efficient collection and storage of straw for round the year fuel availability.
2. To study the challenges involved in the usage of straw as fuel for boiler i.e. chopping requirements, feeding system requirements and effects of straw on the performance of boiler, used in power generation projects.
3. To study the economics of straw based energy plant and analyze for private sector investment through financial modeling
4. The ethanol can be produced from straw. There is no Bio refinery i.e. biomass to Ethanol plant in India however there are few plants worldwide. The brief analysis of the same for techno-commercial viability.
5. To analyze pollution reduction through straw utilization in Punjab
6. To analyze social aspects attached to straw biomass projects in Punjab
    a. Direct and indirect employment
    b. Additional income for farmers

III. METHODOLOGY

The data collected by literature review and study focus on World energy sources, Renewable energy sources, About biomass & biomass power plant ,About straw, Environmental aspects of straw burning, Regulatory aspects of biomass energy project, Economics of Biomass power project, Briquette manufacturing from biomass, Ethanol production from straw, Social benefits from utilization of straw, Study of India‟s only 100% straw power project

IV. RESULTS AND DISCUSSION

The season of production starts from monsoons and its cutting starts by end September or early October. Once the fields are clear from, the residue material i.e. straw of is left behind in the fields. The agri-waste need to be removed from fields by end November or by mid-December because wheat sowing starts from thereafter. The window period is of 55-70 days only. Punjab State government has started encouraging the farmers through advertisements in newspapers, through hoardings and FM radio etc. mentioning that all farmers are requested to supply their residue waste to biomass power plant, operating in their vicinity area i.e. District Patiala. collection centers are radially located in the radius of 40-50 km from power plant for the ease of farmer's so that they can transport and sell their agri- waste to M/s PBPL conveniently. Every season M/s PBPL provides a set consisting of one baler, trolley and cutter to every group of framers. There are around 100 such groups in the vicinity area. These groups hire their own tractor, driver and arrange diesel for vehicle

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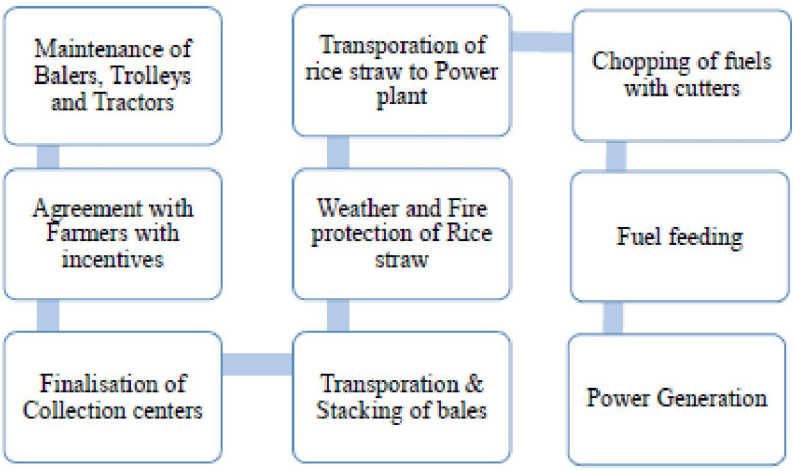

Figure 1: Flow diagram of straw supply chain management

State Government of Punjab provides few collection centers to M/s PBPL at a subsidized rates as a promotional activity for more collection and storage of straw with an ultimate aim of reduction in field burning. The methodology adopted and explained above for protection of fuel, at one of the collection center of the power plant is as shown in Picture 4.1. The straw collection and degradation loss due is presented in Table 4.1 below.

Year	Fuel Collection MT/year	Degradation or fire Losses in %age
2010-11	2459	25%
2011-12	33170	30%
2012-13	70240	35%
2013-14	46525	5 %
2014-15	92165	6%
2015-16	62280	6%

Table 1: Fuel Losses due to Degradation and/or Fire

For 12 MW plant to operate on full load basis approximately 350-400 MT of straw as a fuel is required on daily basis. The main belt conveyor has a capacity of 14 T/hr and direct bale feeding conveyor has a capacity of 3 T/hr .Bale feeding system need to be reviewed critically for success as there is a back fire from furnace and adequate negative pressure from ID fan is required. So if both systems work properly, plant easily be operated on its full load. Presently bale feeding system of the power plant is a failure and non-operational. The equipment's used in fuel feeding are mentioned here below in Table 2

Table 2: Drives_ for Fuel Feeding System in Straw Power Plant

Equipment	Specification	Drive
Underground belt conveyor	Width -1400mm Length – 36 meter	Reduction Gear Box 1:40, with 7.5 kw motor
Belt Conveyor	Width - 1300mm Length – 20 m	Geared Motor 5.5 kw
Main Belt	Width - 1400 mm Length -257 m	Reduction Gear Box- 18.5 kw
Return Belt	Width - 1400mm Length-100 m	Reduction Gear Box -9.3 kw
Rotary Chain	Roller chain 200 mm Length- 100 m	Geared Motor 7.5 kw
Bale Feeding	Width - 800mm Length - 100 m	Worm Reduction Gear Box -5.5 kw
Screw Feeder	Length 5.5 m D- 800 mm,	Geared Motor 5.5 kw
Pneumatic Spreader	4 Rotary Dampers	Chain Drive Motor 2 kw

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straw is around 1-1.5kg per kg of grains, thus total agri-waste from is around 650- 975 million tons (Mairolla, 1985). Out of this India contributes around 200 Million tons of straw.

Continent	Rice Straw in Mn MT	Ethanol Yield in Bn litres
Africa	21	8.80
Asia	668	281.70
Europe	3.90	1.65
America	37.20	15.70

Source: Binod, P (2010) and Adapted from Kim and Dale (2004)

Table 3: Worldwide Straw and Theoretical Ethanol Yield

Analysis on straw usage in developing country is scarce while there are huge social benefits if biomass power plants are setup. As per Shukla PR, IIM, and Ahmedabad "Biomass Energy in India- Policies and prospects" - Developing countries are well aware of benefits which can be obtained if biomass energy plants are installed throughout rural India. These benefits shall be in form of economics, job creations, farmer benefits and saving in foreign exchange outgo happening in form of import of oil.

V. CONCLUSION

It has been explained and mentioned that with proper supply management it is possible to collect and store straw to the tune of approx. > 120000 MT per annum. There are balers which are giving more than 1500 MT per season output. The coverage through LDPE sheets or loose straw the entire fuel i.e. baled straw can be protected from rains. This fuel is sufficient for entire year operations of power plant. Please refer supply chain management .

1. The technical aspects of fuel feeding and boiler aspects have been explained which need to be slightly modified from custom designs based on experience gained from operational straw based power plant. The jamming of fuel and corrosive action of fuel on boiler tubes can be reduced substantially.
2. The ethanol production from straw is going to be reality soon in India and all the technical and commercial aspects have been explained in detail. The net contribution from ethanol and its by product which will be produced from bio refinery are very lucrative. The first bio-refinery is being set up in Haryana by Indian Oil.
3. The scalable and huge utilization of straw can be in the form briquettes which are easy to store and transport. Recently under pressure from Govt. of India, NTPC has come out with a tender mentioning the huge requirement of agri-waste briquettes for their existing 40000 MW thermal power projects. The procurement p is very lucrative on pan India basis i.e. Rs 5500/MT and with a cost of Rs 4100/MT,
4. The profit is expected to be more than 30%. There can be tremendous reduction in particulate matter i.e. PM2.5 and PM10 if straw is utilized in totality.
5. Social benefits like income to farmers, job opportunities in rural sector have been analyzed if straw is utilized properly.

Thus it can be concluded that handling of stubble burning and its hazardous effects need proper attention and marketing to investors. The policies are also required to be change a bit.

The utilization of straw for producing either energy or ethanol is necessary not only for bridging up the energy demand but also for reducing exchequer burden which is there because of import of oils from gulf countries. Following are the different areas where in recommendation are proposed for effective and efficient utilization of straw;

A. Recommendations in supply chain management of straw
B. Recommendations in fuel feeding system of power project
C. Recommendations in boiler aspect of power plant
D. Recommendations in regulatory aspects
E. Recommendations for Integration of power plant with bio refinery

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F. Other usage of straw
G. Recommendations for government support

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