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SUSTAINABLE UTILIZATION OF CROP RESIDUE AS BRIQUETTES

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ABSTRACT

Reducing anthropogenic emission of CO_2 and other greenhouse gases are important strategies for mitigating the greenhouse effect. Sustainable use of crop residue as a possible source of feedstock should be adequately assessed because of its potential impacts on soil carbon sequestration and good soil quality maintenance. Crop residue plays an important role in climate change mitigation without harming the food security. In the present work, an attempt to evaluate the CO_2 emission released from the biomass briquettes compared to that from the coal and their cost benefit analysis has been carried out. The suitability of using biomass briquettes to substitute coal is debatable, as coal gives more production in the industry in less time than briquettes.

Keywords: *Briquettes, Crop Residue, Sustainable utilization*

INTRODUCTION

Humans are increasingly influencing the climate and the earth's temperature by burning fossil fuels, cutting down of rainforests and farming livestock. "Climate change" means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UNFCCC).

Climate change is anticipated to have far reaching effects on the sustainable development of developing countries including their ability to attain the United Nations Millennium Development Goals by 2015 (UN 2007). While discussing about the emission scenarios, the Intergovernmental Panel on Climate change (IPCC) have developed long term emission scenarios in 1990 and 1992; which is widely used to evaluate the possible impacts of climate change and its mitigation option. The major emission is released from the industries due to combustion of fossil fuel for the manufacturing of industrial goods. Industry sector emissions have been estimated from manufacturing of minerals, metals, chemicals, other specific industries, and from non-energy product use. The e0pmissions covered in the industry sector include fossil fuel combustion related emissions as well as the process based emission. Energy consumption in India has been increasing rapidly due to increasing population and its being a developing country. Coal continued to supply most which is 45% of India's total energy consumption in 2018, followed by petroleum and other liquids contributes 26%, and 20% is contributed by traditional biomass and waste.

Crop residue can be defined as the plant material remaining after harvesting, including leaves, stalks, roots. (OECD, 2001) For thousands of years, biomass was almost the only constant available and controllable energy source. The use of agricultural and agro-industrial wastes as biomass fuel for power generation is being increasingly studied and could be an alternative solution for the replacement of fuel in the industry while shutting the carbon cycle loop and can be sustainably used as renewable energy by people living in developing countries. These wastes can also be used as briquettes and pellets in the combustion and gasification processes in power generation. The moisture content in the wastes for briquetting must be between 8 and 15 % and when it is in combustion process, the wastes showed maximum release of energy at approximately 580°C and briquettes at 300°C. The thermal properties and physicochemical characteristics of these wastes show that they are potential aspirants to produce briquettes as fuel in several applications.

Biomass based energy generation is one of the major focus areas of renewable energy programs in India. The strength of India's biomass resources mostly lies in the agricultural sector. Overall, India produces 686 MT gross crop residue biomass on annual basis, of which

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234 MT (34% of gross) are estimated as surplus for bioenergy generation. Amongst all the crops, sugarcane produces the highest amount of surplus residue followed by rice. The estimated annual bioenergy potential from the surplus crop residue biomass is 4.15 EJ, equivalent to 17% of India's total primary energy consumption. As briquettes is made up of agro waste, it has low calorific value but at the same time it is cost effective and environmental friendly. The research is carried to evaluate the reduction of CO_2 emission of briquettes and coal and compare them to have a brief idea about it; also the cost benefit analysis is done.
The study aims to assess the potential of replacement of coal by briquettes in Industries– its Environmental effectiveness and its cost benefit analysis**.**

Methodology
First of all the area is identified to carry out the research. The second step is to identify the industry where coal and briquettes were used. Primary survey is done at the industries through personal interview and questionnaire with the stakeholders. All the required data and information regarding the usage of fuel, production ratio, cost of fuel etc was collected. After data, a brief Secondary data collection is done through referring various national and international research papers, books, etc. Data Assessment was done for both the industries. The calculation for the CO2 emission and cost benefit is carried out with the help of Microsoft excel. Major section of this study is based on ground reality by collecting data through primary survey.

Area Identification
As Gujarat is the leading State in India, the Industrialization rate has been increased. The engine of growth for the Gujarat economy has been the industrial sector, whose share in the state domestic product has increased from 15 per cent in 1981 to 29 per cent in 2001 and is still increasing. Gujarat maintains a variety of industries, electrical engineering and the manufacture of textiles, vegetable oils, chemicals, soda ash, and cement. In Gujarat, there is an electronics estate at Gandhinagar, ceramics estates near Bhavnagar, chemical estates at Vapi, Ankleshwar, Panoli, Nandesari, Naroda. New industries include the production of fertilizers and petrochemicals. If we talk in terms of agricultural production, Gujarat have large amount of Rice and Sugarcane production. The total crop area in Gujarat amounts to more than one-half of the total land area.
Among all the districts in Gujarat, the selected site for my project is Vadodara as it is one of the cosmopolitan cities in India and this district is comparatively more industrially developed than other districts. The Vadodara district is located in central Gujarat. The district has total area of 7555.55 sq kms with 12 talukas, 1548 villages and 16 urban areas. The main industries in Vadodara are chemical, petrochemical, textile, paper mill and engineering industries. The district even today depends heavily on agriculture, with total geographical area of the district 57,603 hectors. The main crops of the Vadodara districts are Paddy, Bajra, Jowar, Maize, Pulses, Castor, Cotton, Wheat, Sugarcane, and Ground nuts. Further district has a good agricultural productivity in Cotton, Maize, Pulses and Paddy.

Data collection & Data Assessment
In the further proceeding of the project, the Data collection and assessment was carried out. The Data collection was done through an extensive secondary data study from various research papers, journals, desk reviews etc and primary data is collected through the questionnaire survey with the stakeholders.
After the data collection, assessment is carried out in two steps. The first step will be assessing the CO_2 emission from the industry by using the materials such as coal and briquettes. In the second step the cost benefit analysis is carried out. The assessment is based on the primary data and secondary data. The primary data contained the information of the content of fuel, per tonne usage of fuel in industry, the type of boiler, per hour production rate. The comparison of material is between the coal and the briquettes. The secondary data contained the emission ratio of CO_2 through different usage of fuel.

RESULTS AND DISCUSSION

Types of Industries:

1) Case study 1: The industry is taken from savli GIDC located near village Mota Motipura, Vadodara. It is a small scale industry and is into the production of various types

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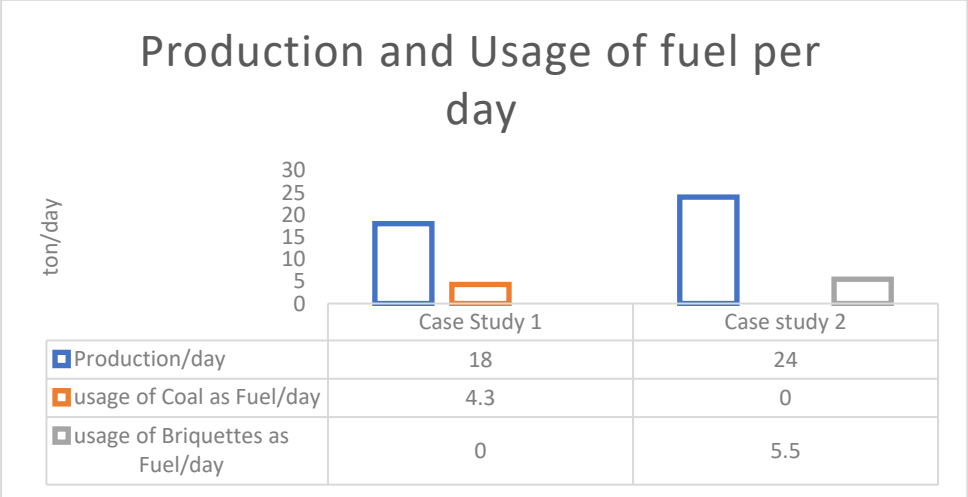
of tissue paper. It is classified as Non-govt Company and is registered at Registrar of Companies. The types of product they produce are Airlaid paper napkin, Magic tissue, Nonwoven wipes, Food wrapping paper, Color tissue paper, Jumbo rolls. It is basically a paper mill.

2) Case Study 2: This industry is based in Nandesari GIDC and is a chemical industry, bringing up catalyst for sustainability. It is a large industry with 133 different chemical products. They give innovative solutions and improved efficiency and quality of end products through the production of catalyst which is environmentally sustainable and results in resource conservation. They manufacture 133 chemical products.



The above graph depicts the production and fuel consumption per day by both the industry. The industries with briquettes require more amounts of tonnes then coal as it is made from biomass waste and have low calorific value. It takes more time to burn compared to coal.

CO_2 Assessment

The below given table illustrates the data of fuel, the consumption of fuel by industry per day, production per day and its cost. From that data, the consumption of fuel required for per tonne of production, the cost of fuel per tonne production, the cost of fuel per day is calculated. On the basis of data such as consumption of fuel and the production ratio the CO_2 emission/tonne of production is calculated.

Types of Fuel	Consumption/day (Tonnes)	Production/day (Tonnes)	Consumption of fuel/tonne of production	Fuel cost (Rupees)	Fuel cost/Tonne of production (Rupees)	CO_2 Emission %ppm	CO_2 emission %ppm	CO_2 emission /Tone of production %ppm
Coal	4.3	18	0.238888889	6000	1433.333333	0.39	1.677	0.093166667
Briquettes	5.5	24	0.229166667	5000	1145.833333	0.035	0.1925	0.008020833

Table 1: CO_2 assessment of Industries with actual Production data

The above table given illustrates the consumption of coal is 4.3 tonnes and of briquettes is 5.5 and the production per day of industry with coal is 18 tonne and that of industry with briquette is 24 tonne of production per day. The consumption of fuel per tonne of production of coal is 0.238 tonne and briquettes counts for 0.229 tonnes.

Industries are one of the major contributor to Greenhouse Gas emission as they require fossil fuels for energy generation and it is necessary to produce goods from raw material. So,

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considering the climate change impacts, carbon dioxide emission is calculated to know the emission scenario, the CO_2 emission by the coal industry is 1.677%ppm and CO_2 emission/tonne of production is 0.093%ppm. Similarly, the CO_2 emission done by the briquette industry is 0.192%ppm and CO_2 emission/tonne of production is 0.008%ppm.
But in terms of environmental issues the coal is non – renewable fossil fuel. It emits large amount of CO_2, SOx and CO. The smoke released from the industry directly contributes to the gases present in the atmosphere. Comparatively, the briquettes have very low content of ash, the thermal calorific value is high, it is non - volatile fuel hence very easy and safe to store and is renewable source of fuel.

Types of Fuel	**Consumption/day (Tonnes)**	**Production/day (Tonnes)**	**Consumption of fuel/tonne of production (Tonnes)**	**Fuel cost (Rupees)**	**Fuel cost /Day (Rupees)**	**Fuel cost/ Tonne of production (Rupees)**	**CO_2 Emission %ppm**	**CO_2 emission %ppm**	**CO_2 emission/Tone of production %ppm**
Coal	4.3	10	0.43	6800	29240	2924	0.37	1.591	0.1591
Briquettes	5.5	10	0.55	5000	27500	2750	0.035	0.1925	0.01925

Table 2: CO_2 assessment of Industries with minimum Production of 10 tonnes by Industries

If the minimum production of industry is 10 tonnes per day, the emission of CO_2 of coal industry would be 1.591%ppm and that of briquettes is 0.192%ppm. The CO_2 emission/tonne of production of coal industry is 0.159%ppm and briquette industry is 0.019%ppm. The difference in the CO_2 emission by both industry is clearly seen. While talking in the economic way, the rate of coal is 6800 rs/tonne and that of briquettes is 5000 rs/tonne, and so the fuel cost/tonne of production of coal is Rs. 2924 and cost of briquettes is Rs. 2750. Henceforth briquettes are also economically viable. The ash content of coal is 30 - 40% and the ash content of briquette is 10 – 20 %. Thus considering all the points' briquette is more viable than coal both environmentally and economically.

CONCLUSION

- Briquettes are cost effective tool as well as environment beneficial since CO_2 emission would be reduced up to 75%. Also it is easy to produce and has very low ash content. A briquette is 100% natural as it does not call for any chemicals for its binding and processing. But however, considering the limitation of briquettes such as raw material availability & maintain moisture will become barrier in case of large scale production industries.
- To start with the potential of replacing coal with the briquettes in small scale industries should be assessed. Awareness among small scale industries about cost benefits of briquette replacement should increase through promotional programs.
- The feedstock from farms will be wet and the moisture content of the newly formed biomass briquettes will be higher than normal. Therefore, the biomass briquettes will need to be subjected to a drying process. A drying process which employs another heat source other than the sun may be necessary.
- Availability of raw material should be ensured to increase the use of briquettes.
- Biomass briquettes production also has limitations as during the process, there is a high energy requirement and need for a constant supply of feedstock in order to meet demand.

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