

Using RDF [Refused Derived Fuel] as an Alternate Fuel in Boiler

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Abstract

Waste to Energy is project for making energy from Municipal waste. Day by day increasing problems of municipal waste needs to be solved as it has harmful effect on environment. In today's world the problem of municipal waste is increased. All the waste generated goes to landfill and its decomposition process is very slow. In Pune itself the waste generation per day is more than 1600-1700 tons whose decomposition and handling are a huge problem.

This Waste need to be used in other manner as to avoid problems related to it. The fuel used in industry (Oil, Coal etc.) also needs to be replaced as it has many side effects and the resources used in industries are non-renewable. However, we can say that these sources of energy will deplete within the next 40–50 years. We need to find new sources of energy. Moreover, the expected environmental damages such as the global warming, acid rain and urban smog due to emissions from Municipal waste sources is a huge problem so using municipal solid waste to prepare briquettes and to use them as fuel in boiler in the main aim of this paper as the alternate fuel instead of biomass.

Keywords: Municipal solid waste (MSW), Refused derived fuel (RDF), Biomass briquettes, RDF briquettes, Boiler fuel

I. INTRODUCTION

The municipal waste available in India is not segregated. There are huge problems relate to waste management and its disposal. There is huge problem of this waste handling as waste collected is not properly segregated by people due to which it cannot be properly recycled and most of it goes for landfilling and caused environmental, economic and financial loss. The research in this topic is carried out from last many years in India but has various problems.

During last few decades' population of India has increased and thus the management of municipal solid waste has emerged as a big challenge not only because of health and environmental concerns but also due to quantity of waste generated [1]. So it can be utilized to produce beneficial things such as solid fuel briquettes for boiler [2]. Much attention has been recently paid to Refuse Derived Fuels (RDF) due to its benefits in aspects of municipal solid waste management and waste to energy technology [6]. This has solved transportation, storage and handling problems by converting the waste into briquette leading to increase in net calorific value per unit volume [7]. Briquettes are essentially a compressed block of organic waste materials of different shapes and sizes [3]. Different binding materials are also added in these briquettes for proper densification and compaction [4]. An appropriate initial preparation, mainly proper size, moisture content is important [5]. It was observed that density, ignition and burning time increased with moisture content at all sizes of briquettes and size had no significant effect on calorific value [3]. Hollow core briquettes form a recent special category due to their distinctive properties. They can be carbonized from both inside and outside. After ignition in combustion chamber the flame enters their inner part as a result of air which gets into hollow part of briquette leading to increased burning temperature and combustion speed [8]

II. RELATED WORK

Waste problem has increased a lot in last few decades but converting it into the energy offers great potential in terms of supplying the worlds energy needs. Manufacturing briquettes from this waste will act as a solution to current waste problem. Biomass briquette is block of compressed garden waste and saw dust and we are working on making these briquettes using municipal solid waste, and in this presentation, we have explained the process of selecting and segregating this waste for manufacturing of the briquettes.

This paper [7] tells that Renewable energy source for power generation has become very promising. As we know that energies through conventional or non-renewable source are very limited and are depleting very rapidly. As the population is continuously growing there is a power demand gap and it needs alternate sources of energy. Biomass is one of the renewable sources of energy. This paper discusses the technologies of power generation through biomass. This paper [4] discuss the biomass as the energy source it discusses the various processes of densification of the biomass Densification of three different materials with saw dust was tested, these materials were cow dung paper pulp and wheat flour. Result showed that Dry cow dung, wheat flour and paper pulp are possible binders and dry cow dung was not suitable for it.

This paper [1] shows that Municipal solid waste and its management has emerged as a big challenge not only because of the health and environmental concerns but also due to huge quantities of waste generated. Segregation of waste, door to door collection of waste, technologies for the treatment of waste, land resources and disposal through scientific methods are some of the challenges faced. This paper [2] showed the research conducted to produce solid fuel briquettes using the MSW. Experiments were performed on briquettes made from various ratios of municipal solid waste and different material to 100:0, 80:20, 60:40, 50:50, 40:60 and 20:80 by weight. Slop waste was used as a binder. The solid fuel briquettes were made of cylindrical shapes 3.8 cm in external diameter, 1.3 cm in internal diameter and 15 cm in length.

III. METHODOLOGY

The municipal waste available in India is not segregated. There are huge problems relate to waste management and its disposal. This project involves making fuel from Municipal waste and using it as alternate fuel in boiler. The basic steps involved is to segregate the waste for large metallic particles, glass and other elements like plastic causing excessive emissions. This segregated MSW is called RDF which is further dried and briquettes are made out of it for using it as fuel in boiler. The role of engineering in this waste management is to design the fuel compatible with the boiler. This involves manufacturing, testing, analyzing, developing fuel for boiler. Various additives and binders are to be added for making the fuel compatible. The problem related to this can be solved by using various emission control devices but their operation cost is too high as compared to energy produced by it.

A. BIOMASS BRIQUETTES

Today fossil fuels like oil, coal and natural gas represent the important energy sources in the world. Biomass is one of the sources of energy with very special properties. In this review, different tests which are associated with biomass burning in boilers have been investigated which are composition of biomass, estimating the higher heating value of biomass, comparison between biomass and other fuels, biomass combustion, co-firing of biomass and coal, impacts of biomass, economic and social analysis of biomass, transportation of biomass, densification of biomass, problems of biomass and future of biomass. It has been found that using these biomass briquettes in boilers offers many economically, socially and environmentally benefits such as conserving fossil fuels, creation of job opportunities and Reduction of CO₂ and NO_x emissions. This biomass fuel is currently used in many boilers for generating power as it doesn't have harmful effects on environment when burned for producing power as it has Carbon balance.



Fig 1. Biomass Briquette

B. BIOMASS BRIQUETTES

1) **Composition of Municipal Solid Waste:** MSW is the solid waste which is generated in municipality by households, industries and commercial companies. The content of MSW and the amounts available changes daily. In many cases, organic matter constitutes about 47-75% of the total available MSW. Composition of MSW worldwide is in terms of organic waste, paper, plastics, metals, glass and others. In particular, organic matter which is in abundance, has been successfully utilized for the production of energy, both at commercial and household levels.

2) **Management of Municipal Solid Waste:** Management of MSW involves the proper containment, transportation, treatment and effective disposal of the treated waste) In developing countries, these processes often do not occur as they should. Waste accumulation can hinder the environment, cause air and water pollution, and promote many dangerous diseases. This could cause public health problems and lead to environmental degradation, thus resulting in underdevelopment of many developing countries 1) The waste after segregation is either recycled, composted and land filled. Processing of Municipal Solid Waste to generate energy is a developing technology which have a wide variety of systems designed both for processing of solid waste as well the combustion of the same. Traditionally two technologies have been used for the combustion, MSW mass burning and RDF firing. The technologies are distinguished by the degree of preparation the refuse fuel undergoes before it is fed into the boiler. Observation from visit The input raw material required for briquetting machine should contain moisture less than 10% but at the plant the moisture content of input raw material is more than 10% due to which the formation of briquette in first attempt is difficult and required two- or three-times processing for manufacturing complete briquettes.

C. GROUNDWORK

After studying and visiting various places. Future plan of action was prepared for making Fuel from RDF. Firstly, the biomass briquettes were studied and lab tested. By taking raw RDF Briquettes were manufactured and lab test were carried out. Test was performed on biomass briquette, RDF briquettes made of different size raw material.

1) **Biomass Briquette:** The Biomass briquettes were studied for their Chemical, Mechanical properties and its proximate analysis was carried out, this was done because on the basis of Biomass briquette the RDF briquettes are to be prepared the following table has test results.

Table 1. Biomass Briquette

Parameters	Results
Gross Calorific Value	3360Kcal/Kg
Net Calorific Value	2225Kcal/Kg
Ash Content	18.6%
Moisture Content	10.29%
Volatile Matter	56.29%

The Biomass briquette has high calorific value and is used in boiler currently. This biomass briquette has composition of wood, leaves and waste collected from garden. This briquettes when burned in boiler has less emissions and provides constant heat supply, also the emissions don't harm atmosphere as it has carbon balance. This fuel is easy to transport and use. The biomass briquette manufactured in plant are of 95mm diameter.

2) Manufacturing RDF Briquette for Lab Test: After transportation of municipal solid waste from kachra depot to briquettes manufacturers, the raw material was kept for few days for drying naturally and then the samples of 16 mm 35 mm briquettes were manufactured for lab testing. It took around 7-8 Days to Dry RDF. Approximately 500Kg of briquettes were manufactured at briquettes manufacturer. The time required for manufacturing 500kg of briquettes was 1 hour.

Challenges while manufacturing briquettes

- During production of 16 mm loose briquettes, the temperature of machine increased several times because moisture required in raw material decreased below the permissible value i.e. 8% so we added water to increase moisture percentage



Fig 2. RDF Briquette.



Fig 3. RDF Briquettes for Lab Test.

- During production of 35 mm loose briquettes, the plastic material of big size gets melt inside the machine while compression and releases some gases into the atmosphere. This need to be studied and reduced. Following are the lab test results.
- The machine could not be operated Continuously.

After testing the RDF briquettes of both 35mm and 16mm size it was observed that the 35mm size briquettes gave a better value of GCV as compared to the 16mm size. The GCV produced was fairly low as compared to the biomass briquettes and the ash produced was also high

IV. CONCLUSION

The briquettes from RDF were prepared and its strength was tested. The strength of RDF was found similar as compared to Biomass Briquette but the GCV of these briquettes were less. From the lab results which size of raw material RDF is to be selected was decided. Different sizes of RDF were used for briquetting purpose in which 35mm showed good results as raw material. These briquettes were lab tested for GCV and later they were prepared in large quantity (960kg). Briquette were tested in boiler for emissions and efficiency of boiler. This RDF showed problem in burning and the ash produced and clinker removed was also in large quantity during testing. Using RDF as a fuel in boiler solves the problem of waste to some extent. There is possibility of using it as alternate fuel in boiler.

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