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REFUSE DERIVED FUEL

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Abstract — *Since last decade it has been characterized by a drastic increase in the demand for fossil fuels, which has caused a steep rise in oil price. At the same time, several environmental catastrophe have increased the sensitivity of world-wide public opinion towards the effect that environmental pollution has on human health and climate change. These conditions have increased a renewed interest in renewable energy like solar energy, wind energy, biomass and solid wastes. However, the disposal of municipal solid waste (MSW) has become a critical and costly problem. The traditional landfill method requires large land and contaminates air, water and soil.*
The study was, therefore, started to assess the potential of power generation from refused derived fuels (RDF) from Municipal Solid Waste in order to reduce the dependency on fossil fuels. There are 337 tons which is equivalent to 12 tons/h of RDF that can be generated daily from the MSW and this would generate 19.2 MW power.

Refuse derived fuel (RDF) generally refers to the product of "CHEMICAL" plus "MECHANICAL" processing of Municipal Solid Waste (MSW) produce as per specific output. The current research work is the assessment of the energy available from the municipal solid waste (MSW) and from the rural Village for the Self-Sustainable development of new (RDF), as a green fuel and development of the new site for MSW management. The study also contained the Collection and Segregation of all the energy available in the villages as well as Municipal corporations. From the study it is found that the green village as well as Municipal Corporation has considerable energy potential.. The energy & green fuel density will also help for the development of the green fuel at one particular village as well as at Municiple Corporation locations.

Keywords- *paper, waste wood, used oil, cardboards, municipal waste, impregnated sawdust and spent solvents.*

INTRODUCTION

As per CPCB, the Municipal Solid Waste generation in India is 200-800 kg/day depending upon the region. With increase in population and industrialization, it is estimated to increase by 1.3% every year.

Municipal Solid Waste incorporates the garbage, rubbish, ashes, dead animals, sewage- treatment solids etc. The primary problems due to the dumped MSW are odour problems, methane generation and leachate generation. It also poses serious threat to ground water resources and soil. The contamination of soil can cause adverse effects on human health, animals and soil productivity. These wastes could be converted to fuel that can be used in boilers.

Conventional fuel emits the harmful air pollutants like SOx, NOx, CO2, CO Etc. These air pollutants can cause the respiratory problems, affects the visibility and other carcinogenic diseases to the human being. Apart from this, it also poses threat to plants, animals and other attributes of environment.

There are many processes available for the conversion of MSW to fuel such as gasification, incineration, anaerobic decomposition, Pyrolysis etc. The most eco-friendly and economically feasible technique is RDF- Refused Derived Fuel. By this method, the MSW can be converted into pellets which can be used as a fuel.

IMPORTANT PROPERTIES OF RDF

Important Properties of RDF is Producing energy from trash is known as a "waste-to-energy" option. Several such options have existed for many years and are in extensive use One of the more exciting options that has been proposed within the last decade is to convert waste into solid recovered fuel (SRF) refuse derived fuel (RDF or process engineered fuel (PEF). The most common forms of this kind of fuel are pellets and briquettes.

PROCESSES OF RDF

Production processes :- Refuse derived fuel (RDF) can be produced from municipal solid waste (MSW) through a number of different processes consisting in general of:

- Separation at source
- Sorting or manually or mechanical separation
- Size reduction (shredding, chipping and milling)

- Separation and screening
- Blending
- Drying and pelletizing
- Packaging
- Storage.

Waste collection:- Fresh solid waste has been collected from the dumping site for further process.

Drying:- Fresh waste collected from the dumping site is dried for 48 to 72 hours with the help of solar drying. During the drying stage, majority of moisture content is removed from the waste.

Segregation:- In this step, the plastic, rags and metals are segregated from the MSW. Little amount of plastic have to be left in the waste which can act as a binder for the pellets.

Shredding:- In this step, the segregated waste material is shredded with the industrial grade hammer mill and the waste is converted into smaller size for the further pelletisation process.

Size screening:- Segregated waste is screened from the 2 mm sieve and the grinded MSW is used for the further process. The materials which have been left over can be used in the large scale (Industrial purpose) pelletisation machine. For the industrial purpose, the mixture contains 70-80% of screened material and 20-30% of remainder material which act as a binder

Homogenization:- For better pelletisation process, Binders are added in the mixture. Approximately 10% powder of Bentonite clay along with 1-2% of oil and 4-5% of water is added with the raw material. After adding all the material and binders, the raw material is thoroughly mixed.

PRODUCTION OF RDF

A wide range of industrial wastes are used as substitute or secondary fuels in INDIA.

These wastes include plastics and paper/card from commercial and industrial activities (i.e. packaging waste or rejects from manufacturing), waste tyres, biomass waste (i.e. straw, untreated waste wood, dried sewage sludge), waste textiles, residues from car dismantling operations (automotive, shredder residues - ASR) and hazardous industrial wastes with high calorific value, for example, waste oils, industrial sludge, impregnated sawdust and spent solvents.

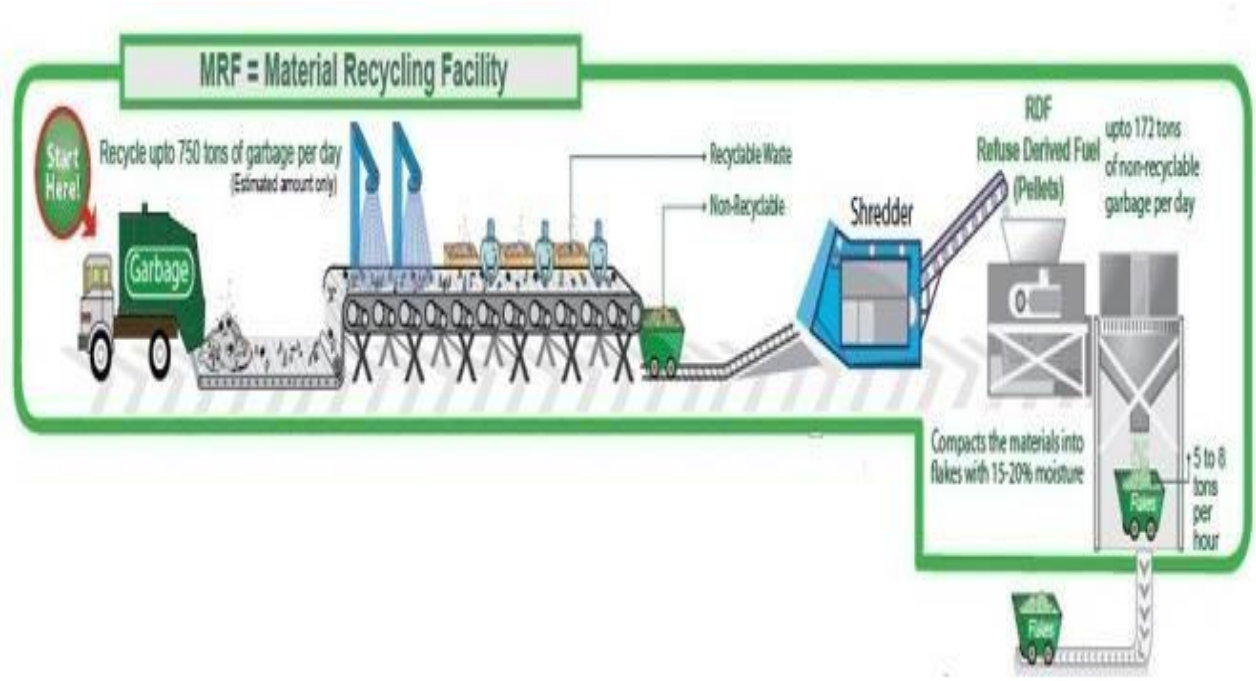
Industrial wastes used as secondary fuels have to be processed to meet industry specifications e.g. homogenization to provide a consistent calorific value and the limiting of compounds such as chlorine or phosphorous for clinker production. For example, industrial sludge, spent solvent or waste oil are mixed with sawdust before being injected in cement kilns, old tyres are shredded, sewage sludge is dried to 90% . RDF generated from certain commercial and industrial wastes (e.g. reject paper from composite paper manufacturing, packaging waste, wood waste) may require size reduction or simple screening, but usually do not require the advanced physical processing necessary to reduce contaminant levels in MSW and in some cases alter its physical form.

Used oils :-Untreated waste oils are commonly used as secondary fuels. In addition, a proportion of collected waste oils receives limited treatment (separation of water and sediment) and is also re-used as fuel in cement kilns.

Plastics:-Examples of plastic waste processed into secondary fuels include non-recyclable plastics such as plastic bags from retail outlets or rejects from industrial processes. Some plastics are derived from source-separated MSW as discussed in Section above. Plastics usually have a high calorific value (6926.53 to 9553.83 kcl/kg) It is usually shredded and mixed with other waste before injection. The principal limiting factor in plastics is chlorine content, mainly in PVC.

Waste wood:-Waste wood has a calorific value ranging between 3582.69 and 4060.38 kcl/kg at 10 to 15% residual water. If the wood has been treated or painted concentrations of heavy metal (As, Cr, Cu) chlorine compounds and other toxic substances may be high.

Paper and paper sludge:- Waste paper is used as alternative fuel usually together with plastic and other waste. Paper has a typical calorific value of 2985.56 to 5254.61 kcl/kg. Sludge or residues from the production of paper are also used secondary fuels mainly by paper industry itself.. Paper sludge has a lower CV of about 02030.19 kcl/kg.



TYPICAL COMPOSITION OF MSW IN MUNICIPAL CORPORATIONS IN INDIA

Surveys performed during the last years for preparation of DPRs (Detailed project reports) in Municipal Corporations in India and the information of input material from various private plant operators showed the following general composition of MSW from Indian cities:

Table-1: Composition of MSW

General waste components	**Mass**	**%**
Content		
A.	Easily degradable	35-40
B.	Combustibles/long term degradable	15-20
C.	Recyclables/Combustible	15-20
D.	Other materials	20-25
Grand Total		**100.00**

Table shows the large potential of Indian MSW for reutilization, either as compost or as a potential RDF material. In the end only around 20 % remains to be safely disposed on landfills.

REPORT ANALYSIS

The proximate and ultimate analysis of the shredded MSW and MSW pallets in LILABA ANALYTICAL LABORATORY. It is depicted from the result that the fixed carbon content of shredded MSW is almost three times that of the MSW pallets. The volatile matter in both the sample is being almost equal that is 32.6% and 35.88% in shredded MSW and MSW pallets respectively. The moisture content in the shredded MSW is 4.08% whereas in MSW pallets being 1.11% because of the further pressure and heat generation of shredded MSW in the peletalizing machine. Also ash content is lower in the shredded MSW than that of the MSW pallets. While comparing proximate analysis of our MSW pallets with the coal, the volatile matter in three of the fuel are being approximately same.

The calorific value of the shredded MSW is 3580 kcal/kg which is almost equal to the calorific value of the coal that is3500 kcal/kg. The CV of the MSW pallets is 2750 kcal/kg because of the short period of drying of sample. Taking a glance at the result of Ultimate Analysis, hydrogen content is being highest with the 5.70%. The oxygen content is 25.8% and the nitrogen content is 1.19%. The percentage of main component of air pollutant in the fuel SOX is 0.04%which gives the green signal on usage of the MSW pallets as a fuel.

RESULTS

SR.NO	PARAMETERS	RESULTS	TEST METHOD
1	Carbon % By Mass	34.7	IS 1350 1975 (PART-4)
2	Sulphur % By Mass	0.39	IS 1350 1975 (PART-3)
3	Moisture % By Mass	11.7	IS 1350 1975 (PART-1)
4	Ash % By Mass	12.8	IS 1350 1975 (PART-1)
5	Calorific Value kcal/kg	3580	IS 1350 1975 (PART-2)
6	NOx content % By Mass	1.19	IS 1350 1975 (PART-4)
7	Oxygen % By Mass	25.8	IS 1350 1975 (PART-2)
8	Hydrogen % By Mass	5.70	IS 1350 1975 (PART-4)

Advantages:-

- Calorific value of RDF is 3520 kcal/kg which is approximately same as the conventional fuel
- It enriches the organic content of waste by removing inorganic material and moisture.
- It can also be used in heating plant boilers and generation of electricity.
- Good substitute for coal and wood for industrial and domestic purposes.
- Less emission of pollutants like NOx, SOx, CO and CO2 as compared to that of the coal.

Disadvantages:-

- Seasonal fluctuation in the quality of the MSW.
- Higher moisture contents in the MSW due to organic matter

MARKETABILITY OF THE RDF IN INDIA

The RDF in India is usually sold by the MSWM (Municipal solid waste management) operators to industrial units as alternate fuels to coal and fire wood. The usual customers of RDF are textile units, dyeing units, industrial boilers, hot air generators etc. The consumers of RDF use them to produce thermal energy and are situated in rather close proximity to the production of RDF.

Difficulties in marketing RDF originate from bad or not stable qualities of the product (limitations are due to odour/foul smell and variation in gross calorific value {GCV} of the RDF). Since a couple of years, private MSW companies are establishing plants that follow a stringent process. These companies intend to establish RDF as an alternative fuel to coal especially and experience an emerging market due to stable quality and price advantages.

According to information from the MSW plant operators the current market prices of RDF are in the range of Rs 2700 to Rs 3000 per ton. The RDF sold in current retail market has a GCV from 3200 - 3800 kcal/kg. As the normally used coal is of rather low quality (GCV only around 50% of the RDF) the lower cost of the coal (1500 – 1800 Rs/ton) is more than compensated by the better quality of the RDF. This makes it financially attractive for the end users.

COMPARISION OF RDF VS COAL

FUEL / FACTOR	COAL	RDF
Calorific Value (Kcal/Kg)	4000	3580
Equivalent Ton In Calorific Value	1	1.14
Cost Per Ton In RS	6000	2000
Sulphur Content (Weight %)	0.4	0.39
Moisture Content (Weight %)	39	11.7
Ash Content (Weight %)	4.2	12.8
NOx Content (Weight %)	1.2	1.19
Carbon (Weight %)	31.4	34.7
Oxygen (Weight %)	7.4	25.8
Hydrogen (Weight %)	4.3	5.70

COMPARISON OF RDF vs. FIRE WOOD

Fuel/Factor	Fire wood	RDF
Calorific Value (Kcal/Kg)	4000	3500-3700
Equivalent Ton in calorific value	1	1
Cost per Ton in Rs.	16500	2000
Sulphur content (weight %)	0.01	0.2-0.5
Moisture content (weight %)	10-20	10
Ash content (weight %)	24.5-26	<15
Nox content (weight %)	0.75	1-1.5
Carbon (weight %)	3.2	35-40
Oxygen (weight %)	-	25-30
Hydrogen (weight %)	-	5-8

CONCLUSION

The RDF pallets are more efficient than the coal and wood in many ways.

RDF pallets have higher or equal calorific value as compared to coal. Cost of RDF is 1/3rd compared to coal. The concentration of pollutants in RDF pallets is much lower than the concentration of coal. One drawback of RDF pallets is that ash content is high. But the ash can be used as color adsorbing agent efficiently. Ash can also be used in brick manufacturing as well as road construction. RDF manufacturing requires smaller footprint compared to the landfill site for solid waste disposal.

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