Research Paper Engineering

RDF (Refuse Derived fuel): An Alternate Energy Resource

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ABSTRACT

The conventional source of energy, coal, continues to be the most important source of electricity generation in India. Being a non renewable resource of energy its existence directly effects the production of electricity. These fossil fuels are at the verge of their extinction some replacement to these traditional sources needs to be made. RDF or REFUSE DERIVED FUEL can be a substitute to the coal. Along with good calorific value it also has least polluting bi-products and its usage leads to a proper waste management as well. This paper aims at reviewing the characteristics of a good RDF and its application as a raw material for electricity generation.

KEYWORDS

Refuse Derived Fuel, Waste to Electric Energy, Solid Waste Management, Energy crisis, Coal Substitute.

INTRODUCTION:

What is RDF?

A method of the recourse recovery is the combustion of the processed solid waste. The solid wastes are subjects to various processes to improve their physical & chemical properties. These processes include drying, comminuting, densification, physical separation and chemical modification. At the end of these processes we get REFUSE DERIVED FUEL (RDF).

As its name (Refuse Derived Fuel) suggests it is a type of fuel derived by the processed waste. India is presently dealing with the problem of waste management the waste is either composed, land filled, recycled or converted to some form of energy but we have another option called as Resource Recovery the waste has a potential to generate power. RDF consists largely of combustible components of municipal waste such as plastics and biodegradable waste. RDF is burnt in specially design furnaces like Traveling grate furnace, Spreader stoker fired boiler, and Suspension fired boiler and Fluidized bed combustor for production of steam. This steam can be used to run Turbine which is mechanically coupled with Generator which produces Electrical power.The Municipal Solid Waste (MSW) is processed to remove non-combustible materials such as glass and metals. It is further crushed into small particles. The product of processing is further processed and fine clay and sand particles are segregated from it. And eventually on drying a combustible fuel, RDF, is obtained.

WHY RDF?

In the present scenario developing countries like India most of the electricity demands are met by conventional sources such as fossil fuels, hydal, nuclear power etc. The use of these sources has not only resulted in their depletion but also increased the pollution. Hence there is a great need for improving technology in the use of non-conventional sources of energy which could greatly decrease the environmental needs and which would assure the future need of rural people fulfilled at affordable rates. RDF can be an alternative to the depleting fossil fuel for energy generation. RDF's use not only solves our energy crisis problem but also gives an efficient method to manage the Solid Waste.Solid waste is being dumped at the waste material dumping sites. There is an immediate need to create methods for proper management of the waste material. Converting the MSW to RDF is an efficient way to manage waste as well.

The MSW has to be treated before converting it to the RDF.

TREATMENT OF SOLID WASTE:

Five major processes are available to improve the physical and chemical properties of agricultural and other solid waste.

DRYING

In this process removal of water takes place either thermally or mechanically in Centrifuges.

COMMINUTION

It is reducing the size of the material particles by operations like grinding or pulverization.

DENSIFICATION

Increasing of bulk density of waste through palletizing, cutting, Briquette, extrusion, and rolling compression to get a denser form of product is done.

PHYSICAL SEPARATION

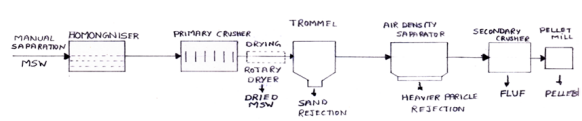
Removal of unwanted components from solid waste like glass, metals etc.

CHEMICAL MODIFICATION

Some changes are made to the MSW by using chemical methods.

The conversion process of garbage into fuel fluff / pellets involves the following processes

- Pre-sizing
- Drying
- Screening / Sieving
- Separation of Combustibles
- Size Reduction and production of Fuel Fluff.
- Densification (with Binder and Additives)



RDF PREPRATION:

Step 1

The picked MSW is then allowed into the premises of the plant over a sorting conveyor to allow manual separation of unwanted material like stones, rubber glass etc and also a magnetic separator for elimination of Iron objects.

Step 2

The manually sorted out MSW is then passed to a homonegeniser for segregating the MSW over a screen, which will pass material to the Primary crusher.

Step 3
The screened MSW is fed to an impact or for disintegration of the MSW in to small pieces .There is no limit on the input size. The moisture will be high. It may contain some sand and silt, which may have some abrasion affect and corrosion affect.

Step 4
A conveyor to the rotary then transports the discharge of Impact or to dryer for moisture removal.

Step 5
The rotary dryer comprises of rotary dryer, feeding, hot air circulation in co current fashion with a cyclone separator and blower and chimney for removal of fines.

Step 6
The discharge of Rotary dryer will be dried MSW. This is fed to a screen to remove fines of less than 5-mm size, which is primarily sand. This can be used as manure. Over 5 mm will be fed to the air classification system.

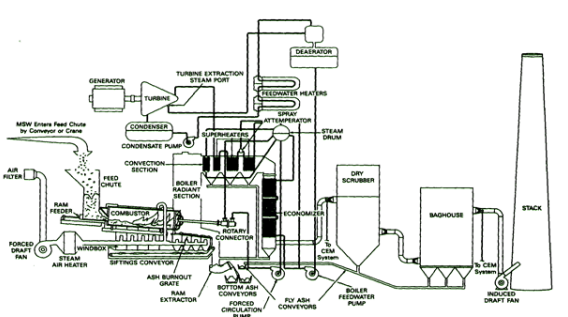
Step 7
The discharge from the secondary screen will be fed to AIR DENSITY SEPERATOR (ADS) system in which the material is fed through a rotary air lock. The discharge from the rotary lock is subjected to airflow in a zigzag construction, which is controllable, by dampeners. Hot air from Hot air generator is also introduced here in addition to the rotary drier for achieving higher dryness.

In this system the light combustible system (organic and combustibles) is segregated and the heavier material (inert) falls by gravity. The key factor for the separation is dryness of the feed. Highly wet input material will not separate and loss of combustible fraction may occur. The rejects at the ADS will be non-combustible fraction. This fraction is conveyed and manual sorting is resorted to pick up heavier fraction of combustibles like woody biomass, coconut shell, etc to return the same to feed.

Step 8
The discharge from ADS (Combustible fraction) is further subjected to a secondary shredding for finer disintegration of the refined, combustible fraction of the Processed MSW. The unit also comprises a cyclone separator and a bag filter unit and a suction blower in closed circuit.

Step 9
The discharge of the Secondary Crusher cyclone is palletized through a pellet mill.

POWER GENERATION USING RDF
The specific processed fuel (RDF) which produced from above process burnt in specially designed machines like Travelling grate furnace, Spreader stoker fired boiler, and Suspension fired boiler and Fluidized bed combustor for production of steam. This steam can be used to run Turbine which is mechanically coupled with Generator which produces Electrical power.



RDF - CHARACTERSTICS:
Refused derived fuel has better emission and burning characteristics and it is a low cost substitute for other fossil fuels like coal, gas. High sulphur content of oil and coal when burnt pollute the environment. There is no sulphur in RDF. RDF has a consistent quality and high burning efficiency and is ideally sized for complete combustion. Combustion is more uniform compared to coal and boiler response to changes in stream requirements is faster to higher quality of volatile material.

RDF Characteristics

Ash Content	- 2-10%	
Moisture Content	-	8%
Volatile Material	-	75-80%
Sulphur Content	-	Nil

RDF eco-friendly fuel:
RDF has better emission characteristics than coal. In the process due to reduction of sand and reduced moisture content it has improved calorific value. It won't emit any harmful gases, which cure global warming like CO_2, CO and methane (CH_4). Due to less carbon content this avoids methane gas, which is produced due to decomposition of waste

WTEE IN INDIA:
Waste to electrical energy is the best alternative comparing to other conventional and non-conventional sources. This is mass reliable and cheap source. WTEE won't give any harmful pollutants and it decreases the problem of waste disposal and decomposition of waste. This WTEE system can aid in saving a lot of urban land, which is wasted. And this is the system among the other non–conventional sources, which is more reliable.

This WTEE is the only solution to meet our future needs. According to Central Pollutions Control Board (CPCB) the per capita generation of MSW per head is 350 Gms. From this statistics being second largest population country our India won't get any power scarcity if we use this WTEE technology.

The first power plant using waste to electrical energy technology (WTEE) was commissioned on Dec, 20th 2003 of capacity 6MW named as SELCO at Elicatta village in Shadnagar of Mahaboobnagar District. This plant using 700 tons of MSW of 2200 tons generated every day in twin cities of Hyderabad. Another plant named as Shriram Energy SystemsLtd., also producing 6 MW of power at Vijayawada using RDF as fuel processed from MSW generated in Vijayawada & Guntur cities. The technology development board and technology information forecasting and assessment council (TIFAC) are trying to assist industries on this technology. The above cited SELCO is going to establish another 20 MW power plant in Hyderabad city. And Shriram Energy got permission to install another plant in vizag. This processed to our state that the WTEE plants are only in AP and our president also appreciated.

A COMPARISON WITH COAL, THE TRADITIONAL FUEL FOR ELECTRICITY GENERATION:
Below is a comparison of calorific values and characteristics of RDF available in India and BITUMINOUS coal.

RDF	
CALORIFIC VALUE	3,500 - 4,000 K.cal/Kg (Depends on the volatile waste material in the MSW)
POLLUTANTS	NIL
BOILER EFFECIENCY	53%
COST	15910.29 INR / TONNE I.E 15.9 INR/KG

COAL (BITUMINOUS)	
CALORIFIC VALUE	
POLLUTANTS	Sulphar dioxide, Nitrogen oxides, Particulate matter, Mercury
BOILER EFFECIENCY	48%
COST	1,700 INR/ TONNE I.E RS 1.7/KG

A COMPARISON OF IDEAL RDF AND AVAILABLE RDF:

TABLE 3 HIGHER HEATING VALUE REFERENCE WASTE COMPOSITION

Constituent	% Weight (Dry) [4]		HHV (Dry) [7] Btu/lb		HHV (Dry) [7] kJ/kg		Btu	kJ
Paper	35.14	x	7600		17,677.6	=	2670.69	6212.02
Plastics	1.08	x	14,600		33,959.6	=	157.68	366.76
Leather, rubber	1.47	x	11,300		26,283.8	=	166.11	386.37
Textiles	1.80	x	8000		18,608	=	144.00	334.94
Wood	2.29	x	8300		19,305.8	=	190.07	442.10
Food waste	6.33	x	8400		19,538.4	=	531.72	1236.78
Yard waste	7.05	x	7300		16,979.8	=	511.00	1188.59
Subtotal	55.16						4371.27	10,167.56
Glass	8.62	x	65			=	5.60	13.03
Metal	8.53	x	840			=	63.12	146.82
Miscellaneous	1.76							
Moisture	25.93							
Total	100.00						4439.99	10,327.41

*the table shows characteristics of 1kg ideal RDF

S. N.O.	Components	Percentage By weight	Energy (HVV) KJ/Kg	Total Energy KJ/Kg
1	Paper	3.62	17677.6	639.9291
2	Cardboard	3.08	15025	462.77
3	Plastics	4.17	33959.6	1416.11532
4	Textiles	0.52	18608	96.7
5	Rubber	1.83	26283	480.97
6	Leather	0.37	26283	97.24
7	Wood	1.72	19305.8	332.05
8	Miscellaneous	3.5	15000	525
	Total	18.81		3953.4553

The table shows combustible components of per Kg of Indian RDF with HVV.

The above comparison clearly shows the fact that difference between ideal RDF and that manufactured in India is the quantity of combustible material present. And thatis more or less due to improper segregation of waste at the elementary stage of its treatment. And after formation of RDF it has to be made sure that RDF is kept away from dust as it directly affects its calorific value.

CHALLENGES:

The challenges faced by the RDF industry today in India are due to improper segregation of the solid waste.

An RDF plant at Dev Guradia in Indore, MP produces RDF which is not efficient to be used in electricity generation it is being used as a fuel for brick kilns.

The biggest and the only considerable challenge for the RDF production is its segregation from non volatile wastes like glass and dust which decreases its calorific value to a large extent.

CONCLUSION:

The above text and stats show that RDF can be an efficient alternative to the coal. Along with generation of electricity, waste management is another problem it solves.

And we can save a lot of money which goes on transportation of the waste material.

WTEE is an efficient way to produce electricity and in the rural areas this can be a chief way to produce electricity relieving the huge load on coal and other non renewable sources of energy.

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