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# Evaluating of Refuse Derived Fuel (RDF) Production from Municipal Solid Waste

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**ABSTRACT:** In recent decades, expanding population has been a cause of concern, as has increased resource demand and waste generation. Recycling waste has become increasingly important in recent years in order to reduce both its volume and its environmental impact. One such approach for reducing waste and producing briquettes from home and commercial waste is well-refused derived fuel (RDF). The purpose of this study is to assess the Refuse Derived Fuel (RDF) produced from municipal solid trash (Biodegradable waste as well as Plastic). Non-combustible elements like glass and metals are separated from garbage, and the remainder is shredded. RDF briquettes are used in boilers or to generate power using steam.

**KEYWORDS:** Refuse Derived Fuel, Biodegradable Waste, Briquettes.

## I. INTRODUCTION

Combustible components form industry calls Municipal Solid Waste (MSW). MSW is used to make fuels such as refuse-derived fuel. Green garbage, plastic, and other biodegradable materials are commonly utilised in this waste, which is mainly acquired from industrial or commercial waste. Electronic garbage, biological waste, explosives, and other non-biodegradable waste are not utilised in RDF synthesis. After the waste is shred, dried, screened, and bladed, RDF is created. Refuse Derived Fuel is a sustainable energy source that guarantees garbage is not thrown away but rather put to good use.

"By-product of chosen waste, i.e. RDF with recoverable calorific value utilised as fuel in a cement kiln, boilers, substituting traditional fossil fuels like coal, if they fulfil strict standards," the World Business Council for Sustainable Development states. Tyre Derived Fuels (TDF), Solid Derived Fuels (SDF), and Alternative Fuels are the three types of RDF (AF).

### 1.1 General Process of RDF Production:

Non-combustible materials such as glass and metals are removed throughout the process. The next step is to smash it into little pieces. The treated product is further processed, with fine clay and sand particles separated. Finally, after drying a combustible fuel, refuse-derived fuel is obtained in pellet form for power generation.

### 1.2 Objectives:

- To suggest regulatory and economic incentives for the use of RDF in various sectors in order to accomplish the Swachh Bharat Mission's objectives.



- To minimise the amount of municipal solid waste produced.
- Adding monetary value to organic waste.
- Creation of new energy sources.
- Maintaining a healthy environment and lowering public health risks.
- Leachate may be reduced, and hence soil and ground water contamination can be avoided.

### 1.3 Future Scope:

- Makes stinky waste safe for handling
- Avoids ground water contamination from leachates.
- The processing technology of producing RDF itself is non-pollutant.
- RDF can be used as alternate fuel in Boiler, Steam turbines and cement industry.
- Ensures substantial relief on landfill burden and future complications of landfill bioreactor.

## II. LITERATURE SURVEY

The report suggests guidelines for using RDF in various businesses in order to satisfy the Swachh Bharat Mission's goals. The committee also identified elements that might affect the long-term viability of waste co-processing in cement plants [1]. The goal of the study is to define the operating parameters for a 30 kg/h scale pyrolysis melting incinerator by investigating the pyrolysis properties of RDF in a pilot-scale unit. The gaseous volatile and tar components in the pyrolysis products were analysed using Gas Chromatography (GC). The shape of char formed by RDF pyrolysis was examined using scanning electron microscopy (SEM). The findings of kinetic study show that the first-order reaction model was accurate in predicting RDF pyrolysis conversion [2]. In this case, waste refers to any flammable, non-hazardous material produced by domestic and industrial activities. This includes a diverse spectrum of feedstock, from building waste to sewage bio-solids. MSW contains chemicals and substances that span much of the periodic table, and various methods may be more or less suitable for effective conversion. The research provides information on the properties of municipal solid waste utilised for RDF, as well as the various types of waste accessible [3]. The goal of the research is to determine the amount of energy available from MSW and to design a new site for MSW management that is both self-sustaining and environmentally friendly. The project also included the collection and separation of all accessible energy in the communities and the Municipal Corporation. According to the findings of the article, both green villages and municipal corporations have significant energy potential. The magnitude of energy density will aid in the construction of self-sufficient power generation villages [4]. The review article discusses probable waste resource recovery in the Indian Himalayan Region (IRH), government-led collective initiatives particular to the IRH, and the path forward for enhanced SWM in the IRH to achieve sustainable development [5]. Plastics, textiles, cardboards, paper, wood, and other organic waste can be turned into Refuse Derived Fuel (RDF) and utilised as a substitute for fossil fuels. A RDF facility could be built in Aqaba as part of an integrated management system. The report presents research on the MSW waste stream in Aqaba and outlines RDF standards and associated specifications. Also suggests that RDF could be used as a fuel in the cement industry [6]. The purpose of this article is to examine the key factors of municipal solid waste management, as well as a review of MSW generation, characterisation, and collection and treatment alternatives in India. It finds that in developing nations like India, installing decentralised solid waste processing plants in major cities and establishing the official recycling industrial sector are critical [7].

### III. METHODOLOGY

Process of RDF is a combination of following steps

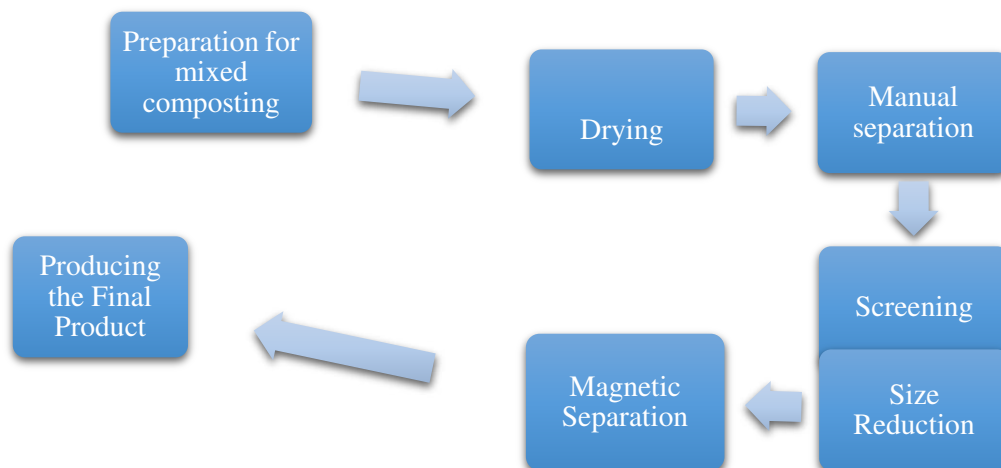


Fig. 01- Drying Drum

1. **Preparation for mixed composting:** RDF plant collect solid waste from MSW and stored it for a week after that scented chemicals are sprayed out on waste to overcome odour.
2. **Drying:** Decayed waste is dried by drying drum or under the sun. Drying Drum consist of hot blast heater, revolving drying cylinder, lifting board, support sealing device, draught fan and cyclone separator. By feeding raw material in drying drum by conveying system and then passed through rotating drum with hot air flow. Material passes through spiral plates in the drum under the rotational force and suction of the draught fan. Under the transmission and dispersion of hot air flow, moisture in wet materials vaporises. In the drying drum, up to 35-50 percent moisture is removed.



Fig. 02-Manual Separation

3. **Manual separation:** Before mechanical process bulky items such as wood, rocks, long pieces of clothes are removed by hand. Sorting belt and tables are usually included in manual separation.





Fig. 03- Trommel Screen

4. **Screening:** Size separation of waste is done by screening in which waste is passed through Trommel Screens of varying size mesh to fine refinement of compost. Trommel Screen is also Rotary Screen in which separation of material is done by Mechanical Screening Machine. Physical separation occurs as material in the drum spirals down the revolving drum, with smaller material passing through the screen and larger material exiting at the other end.
5. **Size Reduction:** Hammer mills are typically used for size reduction process. Hammer mill consist of grinding chamber in which coarse raw product is fed using rotary feeder by inlet at top of the unit. High speed hammer impact coarse material against stationary cutting plates decrease the velocity of the material and guides it into the hammer path by reducing the size of materials.



Fig. 04- Hammer Mill

6. **Magnetic Separation:** Electro-magnets are used for removal of collected metals. It is not possible to remove all metals by magnet as stainless steel, copper are weakly magnet or non-magnetic which cannot be removed by magnet.
7. **Producing the Final Product:** After the separation and size reduction processes are completed, the final RDF product is either shaped into bricks or left as fluff. RDF bricks are bladed together from lighter materials like plastic bags that get blown off during air separation and huge fragments in trommel screening. The trommel

reject and shredded material from the hammer mill were used to make RDF fluff. Pellets are made from residual trash and agricultural husk as a binder.



Fig. 05- RDF Fluff



Fig. 06- RDF Pellets

Percentage of different types of Waste used for production of RDF-

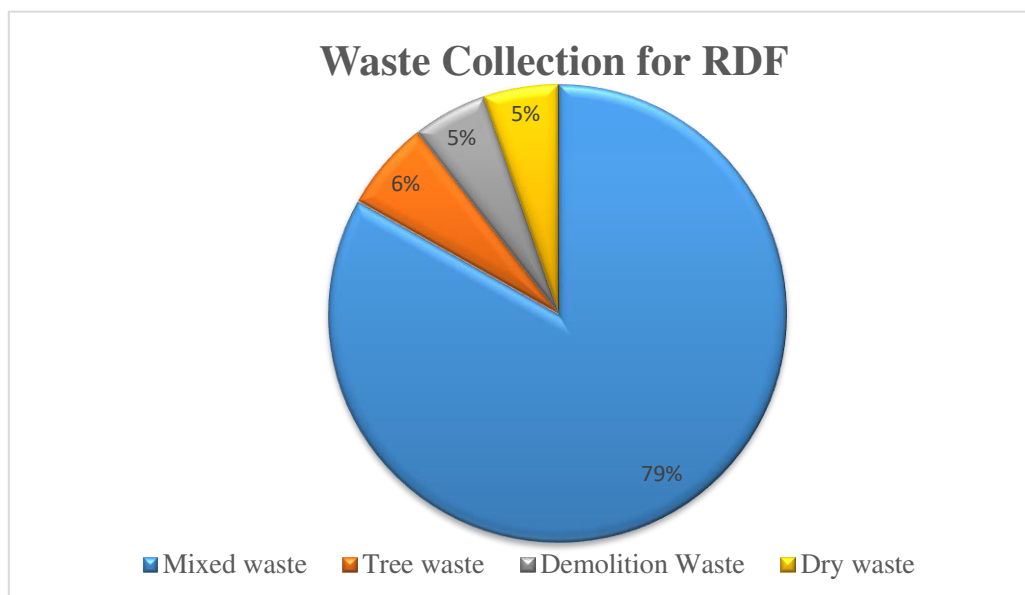


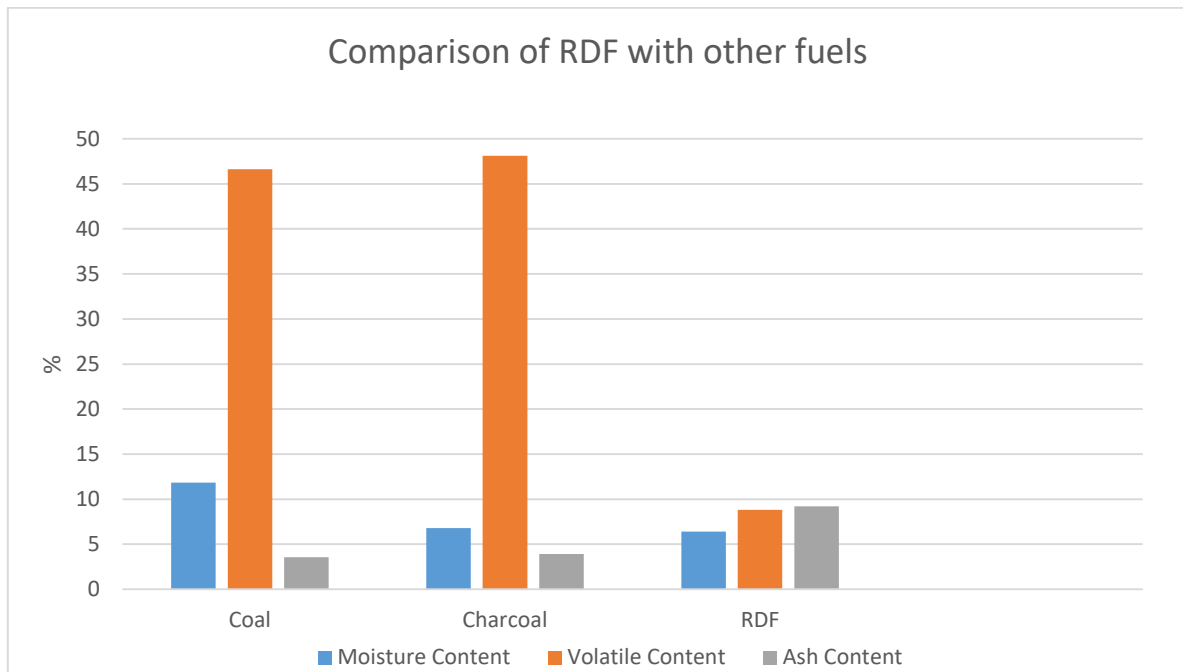
Fig. 07- percentage of different waste for RDF

**IV. RESULT AND ANALYSIS**

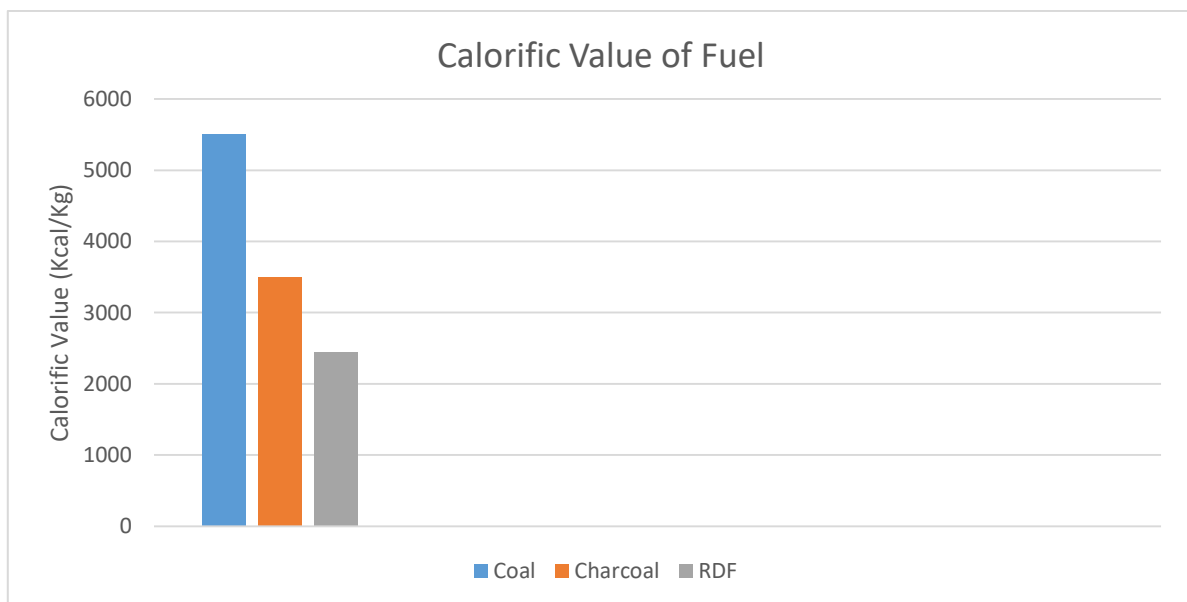
Results of various tests on RDF we obtained from Nashik Waste Management Pvt. Ltd.

Sample id: M/08/21/05	Report no. M/08/21/05N	Report Date	21/12/2021
Name and address of customer	Nashik Waste Management Pvt. Ltd. Nashik mahanagarपालिका, khat prakalp, Gavlana phata, pathardi shivar, Mumbai- Agra road, nashik-422010		
Sample collected by	Laboratory	Sampling desc. /Type	Waste material (+100mm)
Sampling Location	Refuse Derived fuel	Date-Sampling	03/08/2021
Sample Quantity/packing	9.400 x 1 no. plastic bottle	Date- Receipt of sample	03/08/2021
Sample procedure	-	Date-Start of analysis	03/08/2021
Order Reference	As per your letter no. 068 Dated 03.08.2021	Date-Completion of Analysis	14/08/2021

Sr. No	parameter	Results	Unit	Method
1	Moisture	21.6	g/100g (%)	IS 1350 (part-1):1984 Reaffirmed 2007
2	Ash content	12.2	g/100g (%)	IS 1350 (part-1):1984 Reaffirmed 2007
3	Plastic content	64.4	g/100g (%)	IS 1350 (part-1):1984 Reaffirmed 2007
4	Volatile matter	<0.1	g/cm <sup>3</sup>	By Gravimetric
5	Bulk density	0.16	%	USEPA/SW 846/9253
6	Fixed carbon	1.8	g/cm <sup>3</sup>	IS 1350 (part-1):1984 Reaffirmed 2007
7	Gross calorific value	4093	Kcal/kg	IS 1350 (part-2):1970 Reaffirmed 2009
8	Net calorific value	2439	Kcal/kg	By calculation
9	Chloride (as Cl)	55.62	%	ASTM D 5373-08
10	Carbon (as C)	5.12	%	ASTM D 5373-08
11	Hydrogen (as H)	0.82	%	ASTM D 5373-08
12	Nitrogen (as N)	<0.1	%	ASTM D 5373-08
13	Sulphur (as S)	26.2	%	ASTM D 5373-08
14	Oxygen	36.8	%	By Gravimetric



**Fig. 08-** Comparison of RDF with Coal & Charcoal



**Fig. 09-** Calorific Value of Different fuels

For analysis data collected from D. Y. Patil College of Engineering, Akurdi

Amount of Waste produced- 100Kg/Day

Waste collected in 6 Months- 18000 Kg OR 18 Tonnes





**Sample provided to** - Municipal Corporation PCMC

**Address of Sample Collection-** D.Y.Patil College of Engineering, Akurdi, Pune 41104

By Collecting green waste as well as plastic waste from college RDF can be produced which has high calorific value. RDF is necessary to use in Cement industry, Thermal power Plant, Iron and Steel Industry and Tyre industry as per CPCB norms.

## V. CONCLUSION

In this study we investigate the quality and quantity of Municipal Solid Waste in Nashik Waste Management Pvt. Ltd. Industry reports approximate 650-700 tonnes waste per day.

1. Using MSW to manufacture RDF is a solution to both the waste management problem and the energy crisis caused by a lack of natural resources.
2. RDF can be used as replacement of coal and other natural resources which is used in industries as a fuel.
3. In the cement industry sector, RDF may be used to replace coal in both the primary burning process and calcinations.
4. RDF gives the universal solution that provides waste disposal and reduction in the volume of waste.
5. As moisture content of RDF is comparatively less than original municipal solid waste so it burns faster and process of burning itself is non-pollutant.

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