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# Utilization of Refuse – Derived Fuel (RDF) As an Alternative Energy Resource in India

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**ABSTRACT:** India is one of the rapidly developing country. The increase in socio-economic condition has also significantly increased the amount of municipal solid waste generated. The proper disposal of MSW become a big challenge for local authorities. The traditional landfill method requires large amounts of land and contaminate air, water and soil. The environmental benefits of refuse-derived fuel, as an alternative technology for disposing of huge amount of solid waste. MSW has a very good calorific value which makes it a good source of energy. RDF can be used as a fuel and raw material substitute in various energy intensive plants like industries, power plants etc. Refuse derived fuel from municipal solid waste can be an alternative form of energy to replace fossil fuels. It is increasingly perceived as a suitable option for municipal solid waste management in India as it is if correctly applied- environment friendly and resource efficient.

**KEYWORDS:** Refuse-derived fuel, MSW, Calorific value, Landfill, Environment friendly.

## I. INTRODUCTION

The global demand for energy is rapidly increasing with increasing human population, industrialization, urbanization and modernization. In modern time developing countries like India most of the electricity requirements are met by conventional sources. The non-renewable source of energy, coal continues to be the most important source of electricity generation in India (Mandloi, 2015; Surroop and Mohee, 2011).

Municipal solid waste generation increasing with the increase in economic prosperity and urban population. MSW, commonly known as refuse, trash or garbage, is a waste consisting of everyday items that are discarded by the public. The composition of municipal waste varies greatly from country to country and region to region and changes significantly with time. Solid waste generation in India is about 115,000 tons per day with a yearly increase of about 5% (according CPCB, India). Research studies reveal that the per capita generation rate increases with the size of the city and varies between 0.3 to 0.6 kg/day in the metropolitan areas. The estimated annual increase in per capita waste quantity is about 1.33% per year (Jain et al. 2014). Typical municipal solid waste composition received by municipal corporation in India is shown in the table-1. This table shows the high potential of Indian MSW for re-utilization either as compost or as refuse derived fuel pellets (Sheth, 2016).

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**Table 1 : Typical composition of MSW**

| S. No. | General waste component | Mass content |
|---|---|---|
| 01 | Easily degradable | 35-40 % |
| 02 | Combustible/ long term degradable | 15-20 % |
| 03 | Recyclables/Combustibles | 15-20 % |
| 04 | Other materials | 20-25 % |

**Source:-** CPCB Report 2012 .

The main advantages of using RDF as a fuel are an important reduction in the volume of solid waste and the possibility of energy recovery. Nowadays a number of industries are interested in this type of fuel (Gallardo et al, 2015). Refuse derived fuel has good calorific value, it also has least polluting bi-products and its usage leads to a proper solid waste management as well. The refuse derived fuel technology (RDF) developed in 1970, offers a alternative technique to mass burning of municipal solid waste and low cost of solid waste disposal. The term refuse derived fuel (RDF) is used for the segregated high calorific value fractions of processed municipal solid waste (Johari et al. 2014). RDF are increasingly used as a low-cost and regionally available energy source for cement works all over the world. In many European countries already more than 70% of the overall energy consumptions of cement manufactures is covered by RDFs (Schwarzbock et al. 2016 ; Chatziaras et al. 2016; Hajinezhad et al. 2016). Study shows that RDF has considerable potential for removal of colouring agent from waste water over a wide range of concentrations (Vanjara, 1998).

Information on the chemical composition of MSW is essential in evaluating alternative processing and recovery technologies. If solid wastes are to be used as fuel for energy production, the four most important properties to be known are proximate analysis (Moisture, volatile matter, ash & fixed carbon), ultimate analysis (% of C, H, O, S,N), densified refuse derived fuel composition (percentage of plastic, textile, paper etc.) (Kothari and Thorat, 2014; Pohl et al. 2008). RDF has better emission characteristics in comparison to coal. There is no sulphur in RDF. It won't emit any harmful gases like Carbon di oxide, methane etc. This table shows comparison of calorific values and characteristics of RDF available in India and Bituminous coal (Mandloi, 2015).

**Table 2 :- Comparison of RDF and Coal calorific values and characteristics**

| S. No. | Calorific values and characteristics | RDF (Refuse Derived Fuel) | Coal (Bituminous) |
|---|---|---|---|
| 01 | Calorific value | 3,500-4,000 K.cal/Kg (Depends on the volatile waste material in the MSW) | |
| 02 | Pollutants | Nil | Sulphar dioxide, Nitrogen oxides, Particulate matter, Mercury |
| 03 | Boiler efficiency | 53% | 48% |
| 04 | Cost | 15910.29 INR/Tonne i.e. 15.9 INR/Kg | 1,700 INR/Tonne i.e. 1.7 INR/Kg |

Refuse derived fuel (RDF) from municipal solid waste can be an alternative form of energy to replace non- renewable fuels or fossil fules.

## II. WASTE TO ENERGY POTENTIAL IN INDIA

According to the Ministry of New and Renewable Energy (MNRE), there exists a potential of about 1700 Mega Watt from urban waste (1500 Mega Watt from MSW and 225 Mega Watt from sewage) and about 1300 Mega Watt from

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industrial waste (Chouhan et al. 2015; Sriram, 2015). State wise potential of energy recovery from urban and industrial waste in India is given in table 3.

**Table 3:- Potential of Energy Recovery from Urban and Industrial Wastes in India.**

| States | From Liquid Wastes (Mega Watts) | From Solid Wastes (Mega Watts) | Total (Mega Watts) |
|---|---|---|---|
| Andhra Pradesh | 16.0 | 107.0 | 123.0 |
| Assam | 2.0 | 6.0 | 8.0 |
| Bihar | 6.0 | 67.0 | 73.0 |
| Chandigarh | 1.0 | 5.0 | 6.0 |
| Chhattisgarh | 2.0 | 22.0 | 24.0 |
| Delhi | 20.0 | 111.0 | 131.0 |
| Gujarat | 14.0 | 98.0 | 112.0 |
| Haryana | 6.0 | 18.0 | 24.0 |
| Himachal Pradesh | 0.5 | 1.0 | 1.5 |
| Jharkhand | 2.0 | 8.0 | 10.0 |
| Karnataka | 26.0 | 125.0 | 151.0 |
| Kerala | 4.0 | 32.0 | 36.0 |
| Madhya Pradesh | 10.0 | 68.0 | 78.0 |
| Maharashtra | 37.0 | 250.0 | 287.0 |
| Manipur | 0.5 | 1.5 | 2.0 |
| Meghalaya | 0.5 | 1.5 | 2.0 |
| Mizoram | 0.5 | 1.0 | 1.5 |
| Orissa | 3.0 | 19.0 | 22.0 |
| Pondicherry | 0.5 | 2.0 | 2.5 |
| Punjab | 6.0 | 39.0 | 45.0 |
| Rajasthan | 9.0 | 53.0 | 62.0 |
| Tamil Nadu | 14.0 | 137.0 | 151.0 |
| Tripura | 0.5 | 1.0 | 1.5 |
| Uttar Pradesh | 22.0 | 154.0 | 176.0 |
| Uttaranchal | 1.0 | 4.0 | 5.0 |
| West Bengal | 22.0 | 126.0 | 148.0 |
| **Total** | **226.0** | **1457.0** | **1683.0** |

**Source:** MNRE, 2011

## III. STATUS OF RDF PLANTS USED FOR POWER GENERATION IN INDIA

In India, with RDF alone generates up to 7.5 MW of electricity. RDF is mostly utilized for pulp, paper industry and the wood industry waste, followed by the saw-mill industry (Ouda and Raja, 2014). The total waste quantity in India is about 600,000 tons per day (6.0 lakhs MT/d). Assuming that 20% can be utilized as RDF, this translates to 120,000 tons per day (1.2 Lakh MTD) of RDF fuel. This can theoretically effect a substitution of 240,000 tons (2.4 lakh MT) of coal every day, assuming a 50% lower GCV of coal compared to RDF. A power potential of 15,000 MW exists if all the RDF can be utilized in India but this will account for approximately 2-4 % of the total energy demand of the country. Overview of RDF plants in India are shown in table 4 (Dube et al. 2013).

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**Table 4 :- Status of RDF Plants in India**

| No. | Operator | Location | State | Processing capacity (TPD) | | Status of power Generation | | |
|---|---|---|---|---|---|---|---|---|
| | | | | MSW plant | RDF plant | Implementation | Operation | Since |
| 1 | SELCO | Hyderabad | Andhra Pradesh | No processing only RDF | 500 | 5 MW power plant commissioned but now closed as it was not viable | Not in operation | 2003, closed in 2005 |
| 2 | Foundation for Greentech Environmental systems | Vijayawada | Andhra Pradesh | No processing only RDF | 300 | 5 MW power plant commissioned but now closed as it was not viable | Not in operation | 2003, closed in 2005 |
| 3 | Shriram power | Guntur | Andhra Pradesh | No processing only RDF | 250 | RDF only | RDF was supplied to Vijayawada plant | 2003, closed in 2007 |
| 4 | Kochi Municipal corporation | Kochi | Kerala | 400 | 100 | | Operational | 2007 |
| 5 | Hanjer Biotech energies Pvt. Ltd. (HBEPL) | Rajkot | Gujarat | 300 | 75 | | Operational | Jan-05 |
| 6 | HBEPL | Surat | Gujarat | 500 | 125 | | Operational | Aug-08 |
| 7 | HBEPL | Junagarh | Gujarat | 150 | 30 | | Operational | Jan-09 |
| 8 | HBEPL | Vadodara | Gujarat | 300 | 75 | | Operational | Mar-10 |
| 9 | HBEPL | Bhavnagar | Gujarat | 150 | 75 | | Operational | Apr-10 |
| 10 | HBEPL | Surat Expansion | Gujarat | 500 | 120 | | Operational | Aug-10 |
| 11 | HBEPL | Ahmedabad | Gujarat | 500 | 120 | | Operational | |
| 12 | Nashik municipal corporation | Nashik | Maharashtra | 400 | 100 | | Operational | |
| 13 | HBEPL | Jalgoan | Maharashtra | 150 | 30 | | Operational | Feb-08 |
| 14 | HBEPL | Pune | Maharashtra | 200 | 50 | | Operational | Jul-08 |
| 15 | HBEPL | Vasai | Maharashtra | 300 | 75 | | Operational | Nov-09 |
| 16 | HBEPL | Pune Expansion I | Maharashtra | 500 | 120 | | Operational | May-10 |
| 17 | HBEPL | Nagpur | Maharashtra | 800 | 200 | | Operational | Jun-10 |
| 18 | HBEPL | Pune Expansion II | Maharashtra | 500 | 120 | | Operational | Jul-10 |
| 19 | HBEPL | Mira-Bhayandar | Maharashtra | 350 | 80 | | Operational | Dec-07 |
| 20 | HBEPL | Shankarpur | West Bengal | 500 | 120 | | Operational | Jul-10 |
| 21 | HBEPL | Mangalpur | West Bengal | 300 | 75 | | Operational | Jul-10 |
| 22 | HBEPL | Burdwan | West Bengal | | | | Operational | |
| 23 | HBEPL | Gwalior | Madhya Pradesh | 300 | 75 | | Operational | Dec-09 |
| 24 | HBEPL | Faridabad | Haryana | 1000 | 250 | | Operational | Aug-10 |
| 25 | HBEPL | Shimla | Himachal Pradesh | 120 | 30 | | Under commissioning | |
| 26 | HBEPL | Agra | Uttar Pradesh | | | | Operational | |
| 27 | A2Z | Kanpur | Uttar Pradesh | 1500 | 300 | Planned 15 MW power plant | Operational | |

**Source :-** As per secondary data collected (2010)

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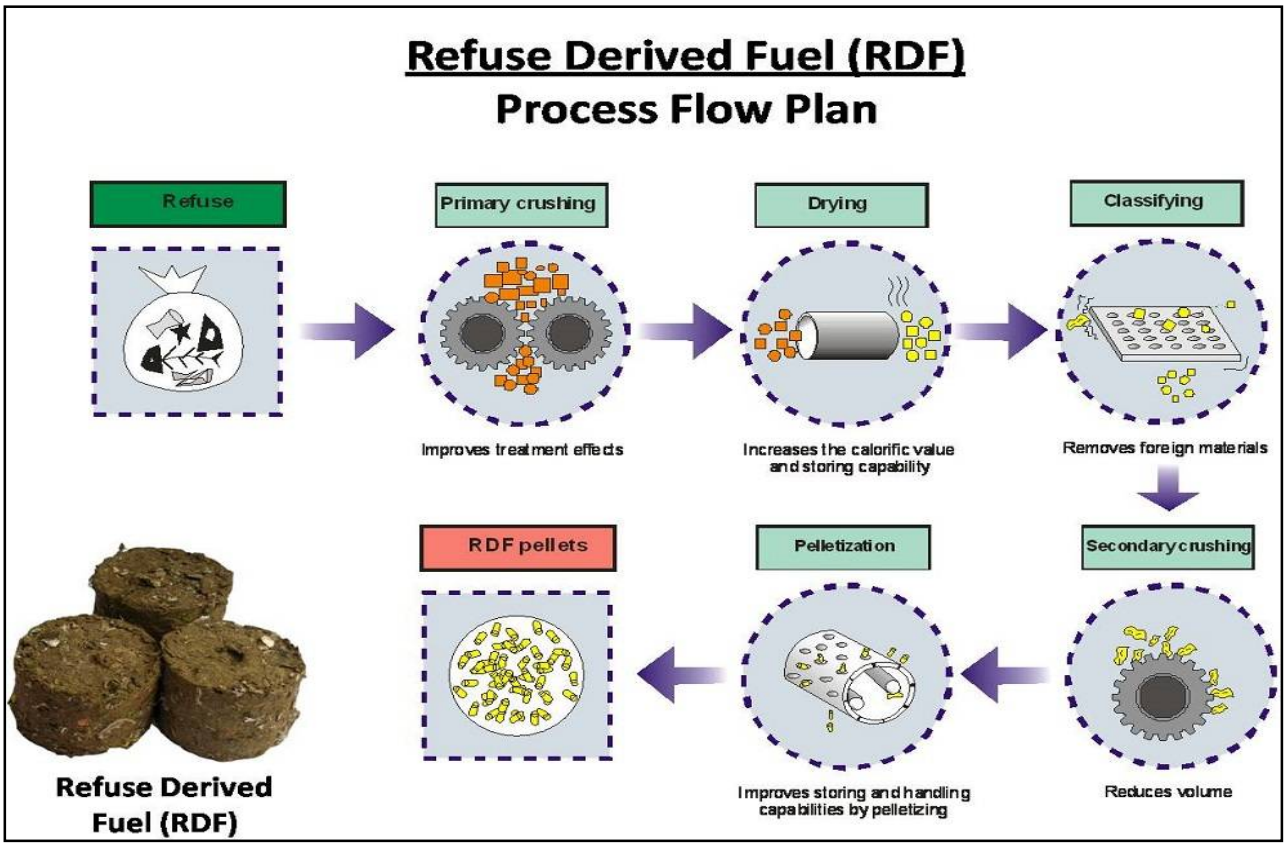
## IV. GENERAL PROCESS OF RDF PREPARATION

The municipal solid waste (MSW) is processed to improve the physical and chemical properties of solid waste. During the process non-combustible material such as glass and metals are removed. Next step it is 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, refuse derived fuel in pellets form is obtained for power generation (Mandloi, 2015).




**Source**:- http://wastebusters.com.pk/refuse-derived-fuel/

## V. CONCLUSION

Proper management of municipal solid waste is one of the major issue for local authorities. Population growth, urbanization, modernization and the increase in the standards of living are the main reasons that govern the increase of municipal solid waste generation. This amount may result harmful impact on health, environmental, aesthetic, land-use resources and economic if not managed properly. This is one of the major challenge especially in developing countries like India. Refuse derived fuel (RDF) technology provides an alternative means for safe and eco friendly disposal of municipal solid waste of the city. This technology also provides another source of energy. Many studies show that RDF can be an efficient alternative to the coal. Along with generation of electricity, solid waste management is another problem it solves. It is initiated to assess the potential of power generation from refuse derived fuel from MSW in order to reduce the dependency on fossil fuels. Using RDF technology will be helpful for achieving the aim of clean and healthy India.

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