Bulletin

PREPROCESSING MSW

CII-Sohrabji Godrej Green Business Centre, Hyderabad

ABSTRACT

The management of Municipal Solid Waste is one of the major environmental challenge for developing countries like India. The purpose of this paper is to discuss the usage of Municipal Solid Waste as alternate fuel in cement industry, there by addressing dual challenge of waste management and fossil fuel consumption in cement industry.

Municipal solid waste is a heterogeneous mixture of day to day items which people use and throw away. It includes all type biodegradable, inert, recyclable and hazardous wastes.

In India, the quantity of municipal solid waste generated is estimated to be 1,27,000 MT/day[1]. The amount of waste generated is increasing every year due to urbanization, population and changes in lifestyle.

As per sustainable solid waste management report, estimates[2] reveal that by the year 2021, 590 square km of land will be required for waste disposal, which is equal to 90% of Hyderabad. By 2047 more than 1400 square km of land[3] would be required for solid waste disposal if MSW disposed continuously as it is today.

Characteristics of Indian MSW

1. Heterogeneous
2. Varying moisture content
3. Low calorific value
4. Wide range of particle sizes
5. Odour

Major concerns of MSW with conventional disposal methods

- Community health effects

Methane (CH_4) and carbon-dioxide (CO_2) gas emissions

Breeding of domestic flies and their maggots

Leachate generation

- Vegetation damage
- Fire hazards in waste dump

Typical Indian Solid Waste Composition

Municipal solid waste comprises organic and inorganic wastes including recyclables.

Bio-degradable (organic matter)	-	30 -55%
Inert matter	-	40 -55%
Recyclable matter	-	5 -15%

Disposing of MSW

Out of 127000 MT/day of MSW generated only 89,334 TPD (70%) is collected and 15,881 TPD (12.45%) is processed or treated[1].

Per capita waste generation in major cities ranges from 0.20 Kg to 0.06 Kg[4]. Generally the collection efficiency ranges between 70 to 90% in major metro cities whereas in several smaller cities the collection efficiency is below 50%. It is also estimated that the Urban Local Bodies spend about Rs.500 to Rs.1500 per tonne on solid waste for collection, transportation, treatment and disposal.[4]

In Indian towns, individuals dispose their waste in bins located at street corners at specific intervals. This posses a huge threat to public and environment. The local admin, civic bodies and policy makers are posed with a serious concern of its effective and safe disposal.

All developed nations globally have utilized cement kilns as an effective option for MSW management, as it creates a WIN-WIN situation for both local administration and cement plants.

Due to its varying characteristics in nature, raw MSW without processing is unattractive for co processing in cement kiln. MSW has to be pre processed to utilize it as a fuel.

Type of waste generated and the approximate time it takes to disintegrate

Type of Waste	Time to disintegrate
Organic waste such as vegetable & fruit peels, leftover foodstuff, etc.	A week or two.
Paper	10-30 days
Cotton cloth	2-5 months
Woolen items	1 year
Wood	10-15 years
Tin, aluminium and cans	100–500 years
Plastic bags	One million years?
Glass bottles	Undetermined

Preprocessing is recovering quality fuel fractions from the waste, particularly removal of recyclable particles like metal, glass and converting the raw waste in to more usable form of fuel for co processing.

The resultant product from the preprocessing facility is termed as RDF (Refused Derived Fuels), which has uniform particle size and high calorific value when compare to the raw mass of MSW before preprocessing. The RDF can be used along with traditional sources of fuel in coal fired power plant & cement kilns.

RDF production line consists of several unit operations in series in order to separate unwanted components and condition the combustible matter to obtain the required characteristics. Noncombustible materials such as glass and metals are removed during the process. These unit operations can be arranged in different sequences depending on raw MSW composition and the required RDF quality[7]. The main functions are

A. Separation of waste **B.** Size reduction

Refuse Derived Fuel (RDF)

RDF is a product of pre processing, a way by which waste can be converted in to usable form of fuel. It consists of organic components of municipal solid waste which are more homogeneous in physical and chemical properties.

A. Separation of waste

Separation of the waste is done to diversify the material for the end use. The end use includes separation of recyclables, inert material and other combustible materials for RDF.

The major techniques for separation include:

Separation	Technique	Materials separated
Trommels and Screens	Size	paper, plastic, organics, glass, fines
Manual Separation	Visual examination	Plastics, contaminants, oversize
Magnetic Separation	Magnetic Properties	Ferrous metals
Eddy Current Separation	Electrical Conductivity	Non-ferrous metals
Wet Separation Technology	Differential Densities	Plastics, organics will float Stones, glass will sink
Air Classification	Weight	plastics, paper, stones, glass
Ballistic Separation	Density and Elasticity	plastics, paper, stones, glass
Optical Separation	Diffraction	Specific plastic polymers

B. Size reduction

Waste size reduction is one of the processes in mechanical treatment of waste. This is carried out to convert the waste in to a uniform size for usage as RDF in coprocessing

The major techniques for size reduction include

Equipment	Principle	Key Concerns
Hammer Mill	Material significantly reduced in size by swinging steel hammers.	Wear on Hammers.
Shredder	Rotating knives or hooks rotate at a slow speed with high torque. The shearing action tears or cuts most materials.	Large, strong objects can physically damage the shredder. Exclusion of pressurized containers.
Rotating Drum	Material is lifted up the sides of a rotating drum and then dropped back into the centre. Uses gravity to tumble, mix, and homogenize the wastes.	Gentle action - high moisture of feedstock can be a problem.
Ball Mill	Rotating system using heavy balls to break up or pulverize the waste.	Wear on balls. Pulverizing and 'loss' of glass / aggregates.
Wet Rotating Drum	Waste is wetted, forming heavy lumps which break against the knives when tumbled in the drum.	Relatively low size reduction. Potential for damage from large contraries.
Bag Splitter	A relatively gentle shredder used to split plastic bags whilst leaving the majority of the waste intact.	May be damaged by large strong objects.

INTERNATIONAL CASE STUDY - NEUE PLASTREC AG, (HOLCIM GROUP), SIGGENTHAL STATION, SWITZERLAND

The company aims at the acquisition, processing, and disposal of solid waste combustible materials (Particularly Plastics). The plant is processing plastic waste of 35,000 tonnes per year.

The company procured machinery from Lindner-Recycling tech GmbH, Austria.

There are two lines installed for AFR preprocessing. Quantity of AFR preprocessed in each line is about 35000 t/year. Current total production is about 50,000 t/y from two lines together. Installed system can handle approximately 8 to 30 tonnes / hour depending on chosen shredded size.

The company installed processing plant in 2011 and it is operating without any problems with the optimum output.

System consists of the following equipment for preprocessing of Plastic Waste

1. Primary shredding of non treated waste
2. FE-Separator
3. Heavy Fraction separator
4. Secondary shredding Machine
5. Conveyors

Types of waste used :

1. Commercial and industrial waste, Municipal solid waste
2. Plastics and textile from automotive industry
3. Packing material made of wood
4. Waste products and lumps from plastic industry

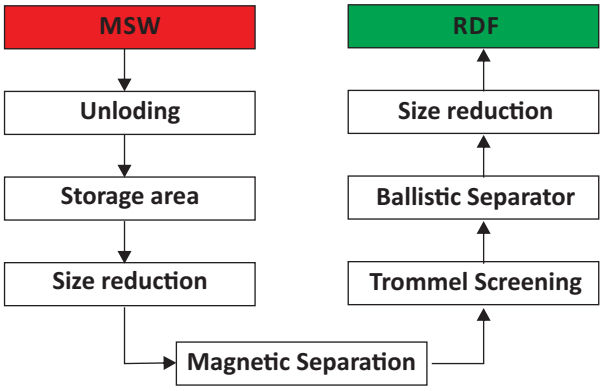
NATIONAL CASE STUDY - ULTRATECH CEMENT, JAIPUR, MSW PRE PROCESSING FACILITY

UltraTech cement in association with Rajasthan Pollution Control Board & Jaipur Municipal Corporation has set up a MSW preprocessing plant at Langriyawas village 26km from Jaipur in January,2007 .

The preprocessing facility processes 500 TPD of MSW with output of 150 TPD of RDF. The Technology suppliers for this project are M/s Doppstadt Calbe, Germany, M/s Humboldt Wedag, India & M/s SHW, Germany.

With the permission of Madhya Pradesh Pollution Control Board vikram cement line - III kiln conducted six months of RDF trial. During the trial the environmental aspects and product quality has been given due importance. The quantity of RDF increased from 2 to 6.25 MT/hour during the trial, without affecting the product quality.

Block diagram of preprocessing facility at Jaipur



MATERIALS APPROVED BY CPCB FOR CO PROCESSING IN CEMENT KILNS:

- Paint sludge, ETP sludge, Tyre chips, TDI tar, Refinery sludge, plastic waste, pond sludge
- Waste mix solid & waste mix liquid- GEPIL- Surat, Lupin
- Spent carbon - Soft drinks industry
- Chemical sludge, oily rags,
- Phosphate sludge - Automobile industry
- Plastics and laminates - Consumer goods
- Grinding muck - Textile machine manufacturing industry
- Grinding dust - Roller bearing & sealing industry
- Vepo rub process waste, liquid organic solvents - Pharmaceutical
- Lead zinc slag - Hindustan zinc
- Waste liquid and solid blend - Colourtex industries

APPROVED CEMENT PLANTS IN INDIA FOR CO PROCESSING HAZARDOUS WASTE IN KILN

ACC - Bargarh (Odisha), Chaibasa (Jharkhand), Jamul (Chhattisgarh), Kymore (Madhya Pradesh), Lakheri (Rajasthan), Madukkarai (Tamilnadu), Wadi (Karnataka), Gagal (Himachal Pradesh).

AMBUJA CEMENT - Kodinar (Gujarat), Rabriyawas (Rajasthan), Darlaghat (HP).

LAFARGE - Sonadih (Chhattisgarh), Arasmeta (Chhattisgarh)

SHREE CEMENT - RAS (Rajasthan), Bewar (Rajasthan).

TRINETARA CEMENT works (Rajasthan).

ULTRATECH - Aditya cement (Rajasthan), Reddipalayam (TN), GCW (Gujarat), Narmada (Gujarat), Tadipatri (AP), Mohanpura (Rajasthan).

VASAVADATTA - Gulbarga (Karnataka).

ENVIRONMENTAL IMPACT AND PRODUCT QUALITY - MSW TRIAL ON ULTRATECH CEMENT[5]

Parameters		Without using RDF	With use of RDF
Particulate Matter, (mg/Nm^3)	Min.	28	26
	Max.	57	71
	Avg.	38	39
Oxides of Nitrogen (NO_x), (ppm)	Min.	517	459
	Max.	808	809
	Avg.	631	596
Carbon Monoxide (CO), (ppm)	Min.	159	163
	Max.	248	248
	Avg.	190	200
HCl, (mg/Nm^3)		Traces	Traces
Combustion Efficiency, (%)		>99%	>99%
Oxides of Sulphur (SO_2), (ppm)		Traces	Traces
PRODUCT QUALITY CLINKER			
C_3S	%	49.17	48.99
C_2S	%	22.97	22.87
C_3A	%	6.34	6.74
C_4AF	%	15.25	14.85
Liquid Content	%	29.40	29.34
Free CaO	%	0.90	0.86

Based on the successful trial run, Vikram cement obtained the permission from M.P. Pollution Control Board for the regular use of RDF and Agro Waste to the tune of 59130 MT/Year.

The above results prove that co processing provides an effective resource recovery option. The use of MSW not only utilizes the waste for energy generation, it also reduces fossil fuel consumption.

Cement industry can play a big role in alternate fuel usage especially MSW, which is gaining concern for developing countries like India. This will help the country to move towards low carbon economy.

SAVINGS FROM MSW SUBSTITUTION IN INDIAN CEMENT INDUSTRY[6]

MSW SUBSTITUTION	Quantity of MSW Mt/Day	Energy from MSW Million Kcals/day	Coal Savings MT of coal/Day	Carbon reduction potential Tons CO_2/day
10%	12700	25400	5080	10209
20%	25400	50800	10160	20419

NATIONAL CASE STUDY - ULTRATECH CEMENT, JAIPUR PREPROCESSING FACILITY

INTERNATIONAL CASE STUDY - NEUE PLASTREC AG, (HOLCIM GROUP), SIGGENTHAL STATION, SWITZERLAND

WAY FORWARD - MSW MANAGEMENT

- A national mission on MSW management should be developed for
  - Increasing public awareness and cooperation for source segregation
  - Technical guidance to Municipalities for handling waste
  - Sharing of best practices among Municipalities
  - Capacity building at all stake holders
  - Adaptation of new technologies in waste management
  - MOU between Municipalities and Preprocessing facilities
  - Incentives/Appreciation/award for industries solving local waste management problems
- Public private partnership models for MSW management & pre processing
- Policy to promote co processing of MSW
- Center of excellence at state level
- Concept of zero garbage on roads
- Creating a revenue model for pre processing of MSW

References

1. Status report on municipal solid waste management, CPCB
2. Sustainable Solid Waste Management in India, by Ranjith Kharvel Annepu, Columbia university
3. Position Paper on The Solid Waste Management Sector in India, published by Ministry of Finance
4 Municipal Solid Waste Management,Ministry of Urban Development
5 Workshop on waste to AFR & co-processing in cement plants: November 2011 , Jaipur
6 List of Constants and Default CO_2 emission factors
7 Technical EIA guidance manual for MSW management facilities,MOEF
8 Decentralised Carbon Footprint Analysis for Opting Climate Change Mitigation Strategies in India

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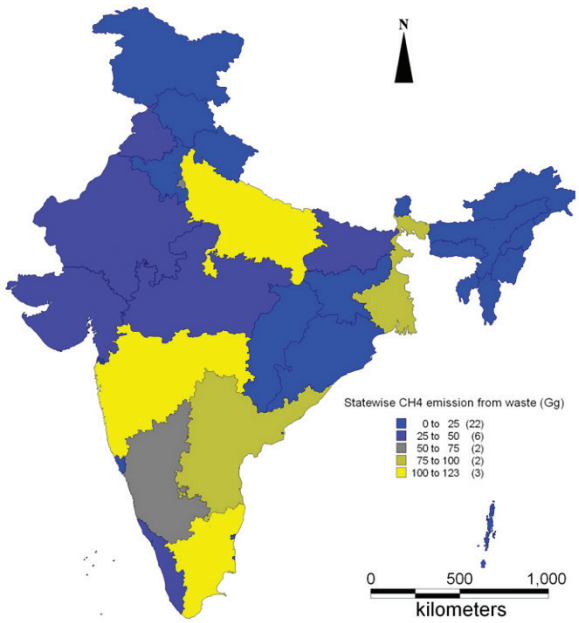

Statewise emission from municipal solid waste.

The total methane emitted from municipal solid waste accounts to 0.9 Tg/year. Uttar Pradesh is contributing the largest fraction of 0.1 Tg/year, followed by Maharashtra and Tamilnadu[8].

PROJECT BACKGROUND

Confederation of Indian Industry (CII) in association with cement Manufacturers Association (CMA) is working on an initiative to increase use of "Alternative Fuels & Raw materials (AFR)" in Indian Cement Industry. As a part of the initiative CII is working on the project "Facilitate Development of Framework to Promote Alternate Fuel Utilization in India" and is partially supported by Shakti Sustainable Energy Foundation (SSEF), a part of Climate Works Foundation.

The main objective of this project is to accelerate AFR initiatives and increasing usage of AFR in the Indian Cement Industry through capacity building, data availability and facilitating exchange of waste by working closely with Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs), thereby reducing environmental impacts of waste generation and raw material usage.

For further information, kindly contact:
Mr P V Kiran Ananth
Senior Counsellor

CII-Sohrabji Godrej Green Business Centre
Survey No 64, Kothaguda Post, Near HITEC City,
Hyderabad - 500 084, India
Tel: +91 40 4418 5152 Fax : +91 40 2311 2837
E-mail: kiran.ananth@cii.in
Web-site: www.greenbusinesscentre.com