Guidelines for Co-processing of Plastic Waste in Cement Kilns

(As per Rule '5(b)' of Plastic Waste Management Rules, 2016)

CENTRAL POLLUTION CONTROL BOARD

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Contents

1.0 Background:

Plastics are made from long chains of hydrocarbons derived from petroleum products. Broad range of application of plastics are in packaging films, wrapping materials, shopping and garbage bags, fluid containers, clothing, toys, household & industrial products, medicinal applications, packaging and storage of food and other perishable items, electronic and electrical applications and building materials etc. Many petro-based plastics are non-biodegradable and remain a cause of concern in the environment for several years, thus becoming an eyesore. However, its uses are increasing day by day due to low cost and convenience.

As per BIS, there are '7' different types of plastics. Symbol, short name, chemical name and general uses of different types of plastics are shown in **Table 1**.

Table 1. Different types of plastics & its uses

S. No.	Symbol	Short Name	Scientific Name	Uses
1		PET	Polyethylene terephthalate	Soft drink bottles, furniture, carpet, panelling etc.
2		HDPE	High-density polyethylene	Bottles, carry bags, milk pouches, recycling bins, agricultural pipe, base cups, playground equipment etc.
3		PVC	Polyvinyl chloride	Pipe, Window profile, fencing, flooring, shower curtains, lawn chairs, non-food bottles and children's toys etc.
4		LDPE	Low-density polyethylene	Plastic bags, various containers, dispensing bottles, wash bottles, tubing etc.
5		PP	Polypropylene	Auto parts, industrial fibers, food containers, dishware etc.
6		PS	Polystyrene	Cafeteria trays, plastic utensils, toys, video cassettes and cases, clamshell containers, insulation board etc.
7		O	Other	Thermoset Plastics, Multilayer Packaging and Laminates, Bakelite, Polycarbonate, Nylon SMC, FRP etc.

Plastics are generally categorized into two types:

- Thermoplastics: Thermoplastics or Thermo-softening plastics are the plastics which soften on heating and can be moulded into desired shape. The examples of Thermoplastics are PET, HDPE, LDPE, PP, PVC, PS, etc.

- Thermosets: Thermoset or thermo-setting plastics get moulded on heating, but cannot be remolded or recycled subsequently. The examples of Thermoset plastics are Sheet Moulding Compounds (SMC), Fiber Reinforced Plastic (FRP), and Bakelite etc. are the examples of the same.

Generally, the thermoplastics are recyclable plastics and thermosets are non- recyclable plastics. However, due to the contamination, technical or economic considerations a large quantity of thermoplastic waste remains non-recyclable and littered in the environment. Some of the typical examples of multilayered and non-recyclable plastics materials- that include both thermoplastics and thermosets are shown in **Table 2.**

Table 2. Sources and Uses of Non-recyclable Plastic Waste

S. No.	Sources	Uses
1	Food packaging	Multilayered films are used for packing of biscuits, namkeen, chips, edible oil, juices etc.
2	Pharmacuetical& cosmetics products	Multilayered packing for packing of medicines, tablets and cosmetics etc.
3	Electrical and electronic goods	Multilayered films such as bubble raps, laminates are used for packing of electrical and electronic items, housing, fuses, switchgear, MCB boxes etc..
4	Item used for food storage & serving	Thermocol products such as plates, cups etc. are used for serving food, tea, coffee etc. Also used as fillers in packing of goods/items etc.
5	Automotive industry and mass transportation	Cars, trucks and other commercial and agricultural vehicles, trains, trams, light railways and monorail (body parts, structure and engine parts)
6	Building & construction	Civil engineering and household fixtures etc.
7	Domestic appliances	Coffee machines, toasters, irons etc.
8	Sanitary	Bathroom suites and hygienic surfaces etc.

2.0 Quantification and characterization of plastic waste generation in India:

As per the study conducted by Central Pollution Control Board (CPCB) in 60 major cities of India (2012), it has been reported that 4059 T/day of plastic waste is generated from these

cities. The fraction of plastic waste in total Municipal Solid Waste (MSW) ranges from 3.10% (Chandigarh) to 12.47% (Surat). Average plastic waste generation is around 6.92% of MSW. With extrapolation of per capita plastic waste generation, it is estimated that 9.46 million tons per annum of plastic waste is generated in India, which is approximately 25,940 T/day. Study revealed that, out of total plastic waste, around 94% waste comprises of thermoplastic content, which is recyclable such as PET, LDPE, HDPE, PVC etc. and remaining 6% belongs to the family of thermoset and other categories of plastics such as SMC, FRP, multi-layered, thermocol etc., which are non-recyclable.

3.0 Plastic Waste Management (PWM) Rules, 2016:

The Government of India notified Plastic Waste Management (PWM) Rules, 2016 on 18th March, 2016.As per the Rule '5(b)' of PWM Rules, 2016,'local bodies shall encourage the use of plastic waste for road construction as per Indian Road Congress guidelines or **energy recovery** or waste to oil etc. The standards and pollution control norms specified by the concerned prescribed authority for these technologies shall be complied with.'

3.1 Responsibility of Local Body and Gram Panchayat:

(A) As per Rule '6' of PWM Rules, 2016 followings are the responsibilities of Local Bodies for plastic waste management:

(1) Every local body shall be responsible for development and setting up of infrastructure for segregation, collection, storage, transportation, processing and disposal of the plastic waste either on its own or by engaging agencies or producers.

(2) The local body shall be responsible for setting up, operationalization and co-ordination of the waste management system and for performing the associated functions, namely:-

a) Ensuring segregation, collection, storage, transportation, processing and disposal of plastic waste; ensuring that no damage is caused to the environment during this process;
b) ensuring channelization of recyclable plastic waste fraction to recyclers;
c) ensuring processing and disposal on non-recyclable fraction of plastic waste in accordance with the guidelines issued by the Central Pollution Control Board;

d) creating awareness among all stakeholders about their responsibilities;
e) engaging civil societies or groups working with waste pickers; and
f) ensuring that open burning of plastic waste does not take place.

(3) The local body for setting up of system for plastic waste management shall seek assistance of producers and such system shall be set up within one year from the date of final publication of these rules in the Official Gazette of India.

(4) The local body to frame bye-laws incorporating the provisions of these rules.

(B) As per Rule '7' of PWM Rules, 2016 followings are the responsibilities of Gram Panchayat for plastic waste management:

(1) Every gram panchayat either on its own or by engaging an agency shall set up, operationalize and co-ordinate for waste management in the rural area under their control and for performing the associated functions, namely,-

a) ensuring segregation, collection, storage, transportation, plastic waste and channelization of recyclable plastic waste fraction to recyclers having valid registration; ensuring that no damage is caused to the environment during this process;
b) creating awareness among all stakeholders about their responsibilities; and
c) ensuring that open burning of plastic waste does not take place.

3.2 Protocol to be followed by different stakeholders in co-processing of plastic waste in cement kilns:

The concerned Local Bodies and Gram Panchayats are responsible for collection, storage, segregation, transportation and disposal of waste in their jurisdiction. Protocol for co-processing of plastic waste and responsibilities of stakeholders are given in **Table 3.**

Table 3. Roles and responsibilities of different stakeholders for use of plastic waste in co-processing in cement kilns

S. No.	ACTIVITY	RESPONSIBLE STAKEHOLDER
1.	Door to door collection and segregation of all category of **used plastic waste** by Municipal Staff or Authorised NGO or person.	Safai Karamchari (Municipal Staff)or Authorized Private Person
2.	Collection of **littered/dumped plastic waste** in public places like market areas, bus stands, railway stations, cinema halls, parks, community centres, road side etc. by Municipal Staff or Authorised NGO.	Safai Karamchari (Municipal Staff)or Authorized Private Person
3.	Storage of collected **plastic waste** from households and other places in a covered yard authorised by Municipal Authority.	Municipal Staff or Authorized Private Agency
4.	Shredding of plastic waste to desired size, if required, using shredder and storing in bags.	Municipal Staff or Authorized Private Agency
5.	Signing the MoU with cement kilns for management of plastic waste by co-processing.	Municipal Authority or Urban Development Department
6.	Transporting plastic waste to cement kilns and maintaining the record of the same.	Municipal Authority or Authorized Private Agency
7.	Receiving the shredded plastic waste from Municipal Authority and maintaining the record of its receipt, storage and co-processing.	Staff of Cement Plant
8.	Collection of the plastic waste under EPR and transporting it to the cement plant for co-processing	Producer, Brand Owner or Importer
9.	Monitoring of the efficient implementation of plastic waste management Rules 2016 by assigning the responsibility to a nodal officer.	Concerned SPCB / PCC
10.	Co-processing of Plastic Waste as Alternative Fuel & Raw Material (AFR) in cement kilns and monitoring/controlling emissions as per set standards.	Cement Plant
11.	Monitoring of emissions and sharing the data with concerned SPCB/PCC and CPCB.	Cement Plant

3.3 Method of Collection, segregation and storage of plastic waste:

Municipal Solid Waste (MSW) shall be delivered, segregated, recovered processed and stored for use in material segregation & recovery (MSRF) facility. The main function of the MSRF is recovery of recyclables into compstand efficient segregation/processing of mixed solid waste into a feedstock for bio-logical conversion or into a fuel source for the

production of energy. Mixed Municipal Solid Waste should collected in trucks/compactors and delivered for the processing of recyclable and non-recyclable waste in the covered shed. The shed should have adequate height with proper arrangement for lightening and ventilation. The processing floor area shall be provided with an Odour Control System comprising Centrifugal Fans, Air Ducting and Bio-filter to ensure that odorous gases are effectively sucked and absorbed in the Bio-filter. Advatage of having MSRF facility is to achieve segregation and recovery of maximum possible recyclables from the mixed waste such that they can be directly reused for beneficial purposes. The segregated compostable fraction (SCF) such as plastic, paper, leather etc. The SCF can be compacted and handover to the cement kilns which can be used as Refused Derived Fuel (RDF) and residue material which cannot be converted into RDF will be taken to the sanitary landfill cells.

Other plastic waste segregated from electrical and electronic equipments can also be transported to nearest cement plant for co-processing. Thus all segregated combustible fraction can be transported to nearest cement plant as alternative fuels or raw material (AFR). The process for collection, segregation and use of plastic waste as AFR is explained in **Figure 1.**

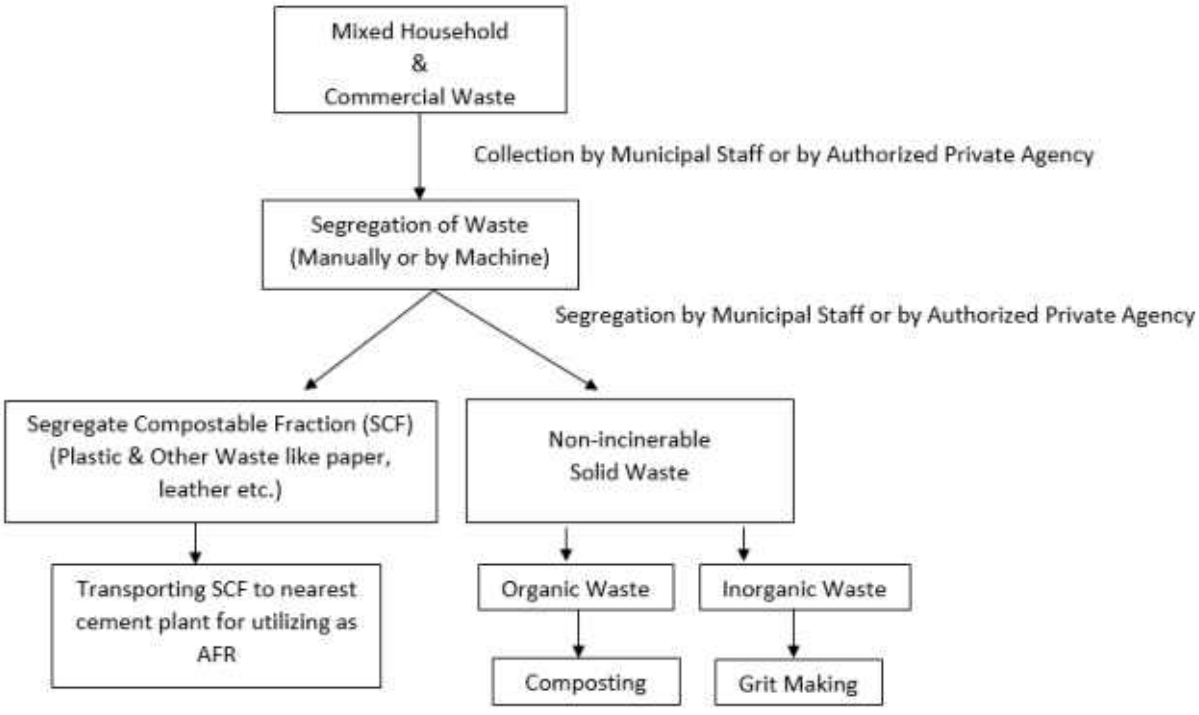


Figure 1. Flow Diagram for Plastic Waste Management

4.0 Description for co-processing of Plastic Waste in Cement Kilns:

Co-processing is a more environmentally friendly and sustainable method of waste disposal as compared to land filling and incineration because of reduced emissions and no residue after the treatment. Co-processing refers to the use of waste materials in industrial processes as alternative fuels or raw material (AFR) to recover energy and material from them. Due to the high temperature in cement kiln, different types of wastes can be effectively disposed without harmful emissions. As per the Basal Convention, variety of wastes including hazardous wastes, get disposed in an environmentally safe and sound manner through the technology of co-processing in cement kiln. Disposal of different categories of plastic wastes through co-processing is practiced in many countries as a regular method for their environmentally sound disposal. A schematic representation of cement production process is shown at **Figure 2**.

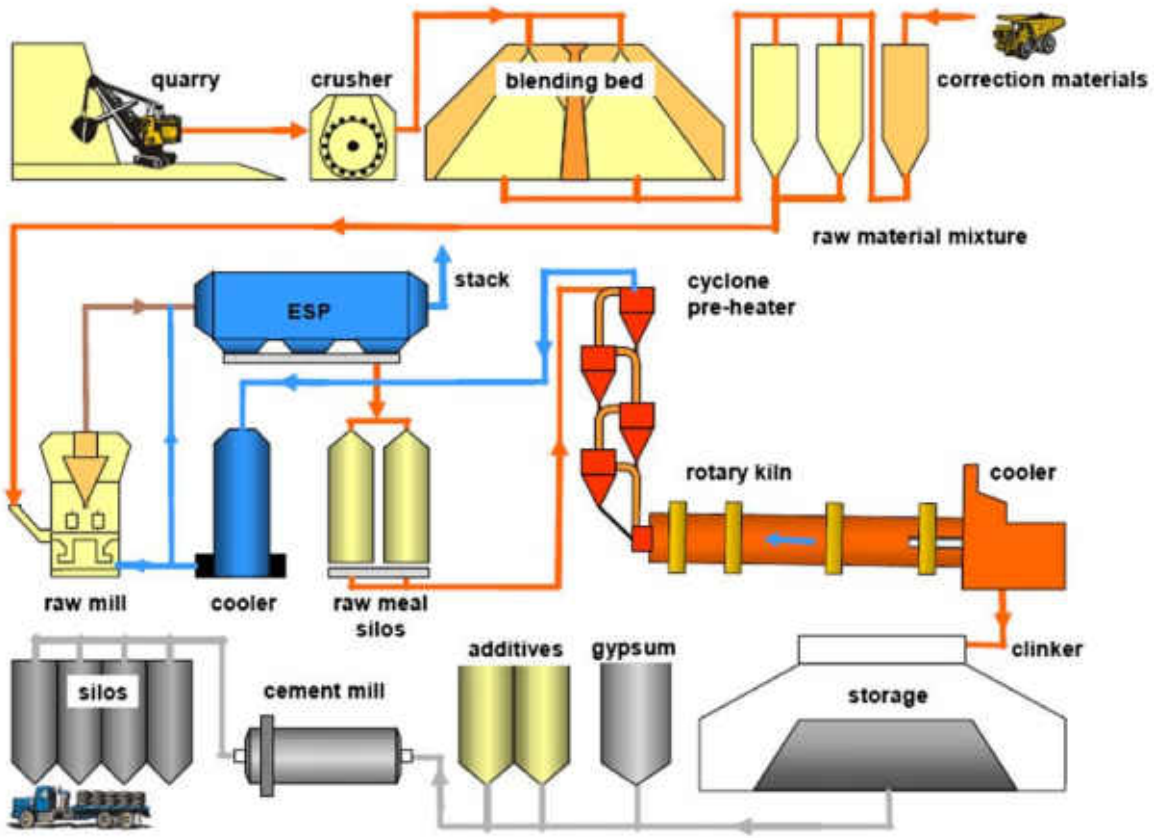


Figure 2. Schematic representation of cement production process(Source: Lamas et. al. 2013)

4.1 Evaluation of Co-processing in cement kilns as an option for management of Plastic Wastes

Co-processing of plastic wastes in cement kiln is practiced substantially in different countries as an environmentally sound option for management of plastic wastes. In cement kiln, different kinds of hazardous and non-hazardous wastes including plastic wastes get utilized as Alternative Fuel and Raw materials (AFRs). During the usage of plastic wastes in cement kiln as AFRs, the material and energy value present in them gets fully utilized in the cement kiln as replacement to the fossil raw materials and fossil fuels that are conventionally utilized in the kiln.

The performance evaluation of co-processing of plastic waste was carried out in ACC Limited, Kymore, Madhya Pradesh, in collaboration with Indian Centre for Plastic in Environment (ICPE) and Madhya Pradesh Pollution Control Board (MPPCB). The various trial parameters such as raw material & product testing and emission monitoring was carried out by SGS Limited, which is a CPCB approved testing laboratory.

Based on the results of trials - that included chemical & thermal parameters of raw materials, clinker product, plastic wastes & coal and the emission monitoring during and after feeding of plastics waste in the cement kiln as AFR. Based on their evaluation, MPPCB forwarded the same to CPCB along with their recommendations. CPCB after reviewing the trial report approved the results of the trial and declared co-processing of plastic waste in cement kiln as a successful method for its environmentally sound management.

Based on this suggestion, several SPCBs have provided consent to various cement plants and plastic waste generators to implement co-processing of plastic wastes. Various cement plants are currently managing plastic wastes as AFRs in their kilns. A list of cement plants having co-processing facility as shown at **Annexure-I.**

4.2 Infrastructural Requirement for Plastics Co-processing:

Every cement plant will have to have a separate feeding arrangement for undertaking co-processing of AFRs. In case it already has one on the calciner or kiln inlet, then the same can be utised for plastics as well. However, if it does not have any on the calciner or kin inlet, then the same needs to be set up. This feeding facility will consists of proper covered

storage along with conveying mechanism to move plastic waste from storage area to kiln. This can be manual or can be automatic. The manual one consists of winch and hopper arrangement and conveyor belts arrangements. At the feed point, it is desired that equipment such double flap valves, shut off gates etc. are implemented to ensure uniform feed and safety in operation. The feeding facility shall also be equipped with a lab to carry out the calorific value, ash content, moisture content and chloride content.

4.3 Feeding of plastic waste material for co-processing:

Different feed points that can be used to feed the plastic waste materials into the cement production process are given below.

- The main burner at the rotary kiln outlet end
- The rotary kiln inlet end
- The pre-calciner
- The mid kiln (for long dry and wet kilns)

Appropriate feed points amongst the above will have to be selected for the environmentally sound co-processing of the plastic waste. Usually, plastic wastes, that are contaminated with toxic components such as pesticides etc, should be fed to the main burner to ensure its complete combustion in the high temperature and long retention time. For this, the plastics may need to be shredded to less than **20 mm size**. The non-recyclable plastic wastes, that is not contaminated with toxic components, can be fed at the other feed points such as calciner, kiln inlet or mid kiln depending upon its size. Process flow diagram for co-processing of plastic waste in cement kilns along with the points of feeding of plastic waste is shown in **Figure 3.**

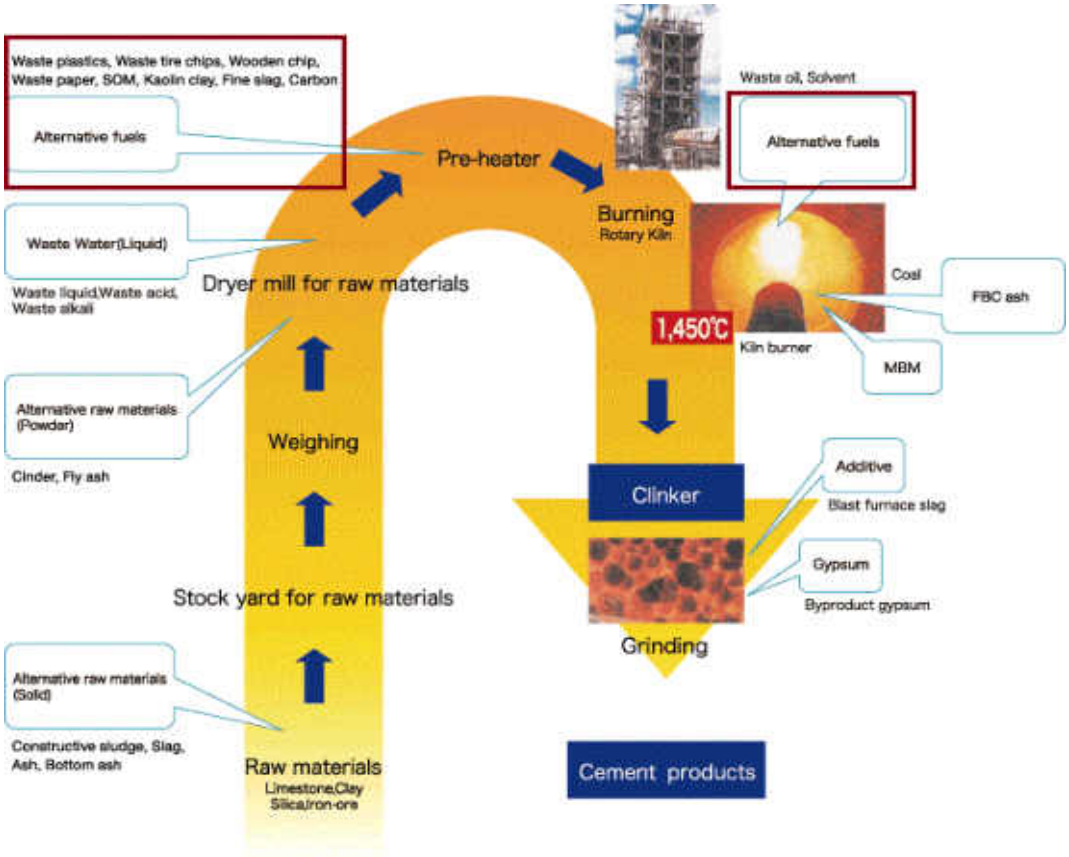


Figure 3.Process flow diagram for co-processing of plastic waste in cement kilns

4.4 Operating Conditions:

- Feeding of plastic waste is not to be carried out during kiln start up and kiln shut down conditions.
- Feeding of plastic waste needs to be initiated only after the kiln attains its stable operating conditions.
- The Feeding of plastic waste should not be continued in case the continuous emission monitoring system (CEMS) is not connected with CPCB and SPCB servers. Feeding of plastic waste should be discontinued in case the emission values are not complying with the prescribed emission standards for co-processing of incinerable waste **(Annexure-II)**. It is necessary to depute trained person in the cement plant to handle whole operation of co-processing of incinerable waste including plastic waste.
- The cement plants shall ensure that the emission parameters are monitored as per the prescribed monitoring protocol provided by regulatory bodies like CPCB, SPCB/PCC andMoEFCC.
- Cement plants shall maintain proper records with regard to the amount of plastic waste received, stored and co-processed.

5.0 Business Model for Success of Co-processing:

Following are the major income and expenditure items involved in the business model of the cement kiln co-processing solution. The viability of the co-processing of RDF in the cement plant would depend upon following:

1. For Municipality

Income Items	Expenditure Items
1. Sale price of RDF from cement plant 2.Additional revenue from community towards waste disposal	1. Marketing expenses 2. Laboratory assessment cost 3. Handling and storage 4. Pre-processing cost to convert Segregated Combustible Waste into RDF 5. Interest and Depreciation cost

2. For PPP Operators

Income Items	Expenditure Items
1. Sale price of RDF from cement plant 2. Additional tipping fee from municipality towards RDF conversion process.	1. Marketing expenses 2. Laboratory assessment cost 3. Handling and storage 4. Pre-processing cost to convert Segregated Combustible Waste into RDF 5. Interest and Depreciation cost

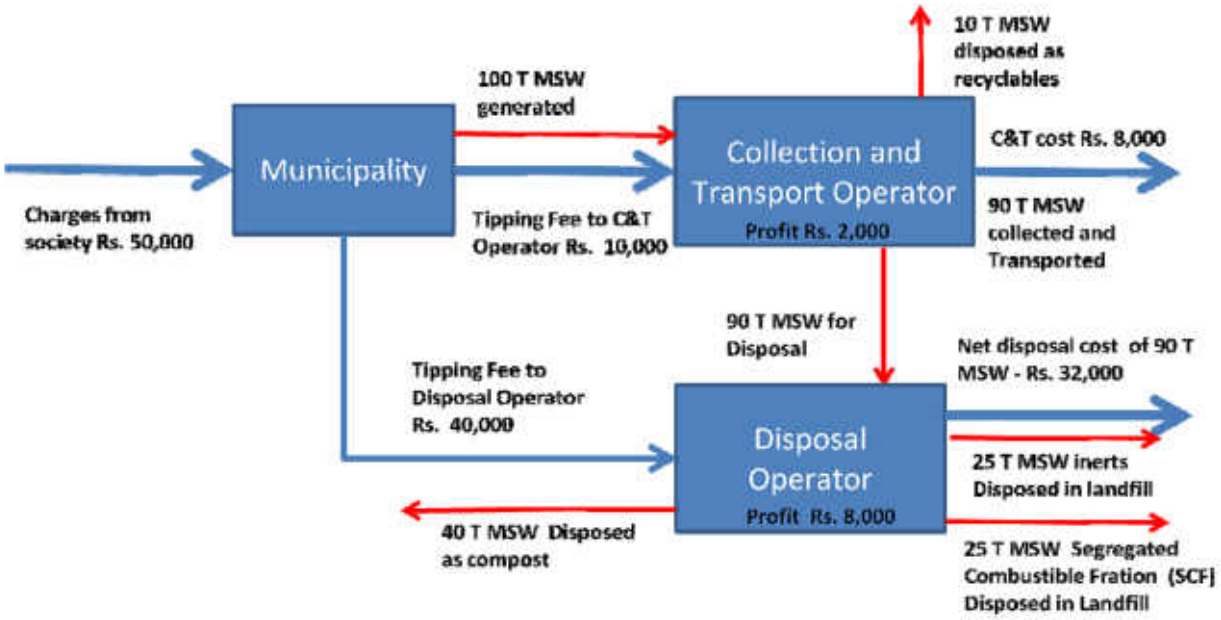
3. For Cement Plants

Income Items	Expenditure Items
1. Tipping Fees to cement plant by Municipality / PPP Operator 2. Substitution benefit derived by cement plant due to the replacement of traditional raw materials and fuels by RDF.	1. Market coordination 2. Purchase price of RDF 3. Laboratory assessment 4. Handling and storage 5. Pre-processing 6. Co-processing 7. Production impact due to moisture, ash, chlorine etc. 8. Traditional fuel consumption increase 9. Interest and Depreciation etc.

A viable business model for demands that income should be higher than expenditure incurred by the respective entity. Typical case situations are presented below

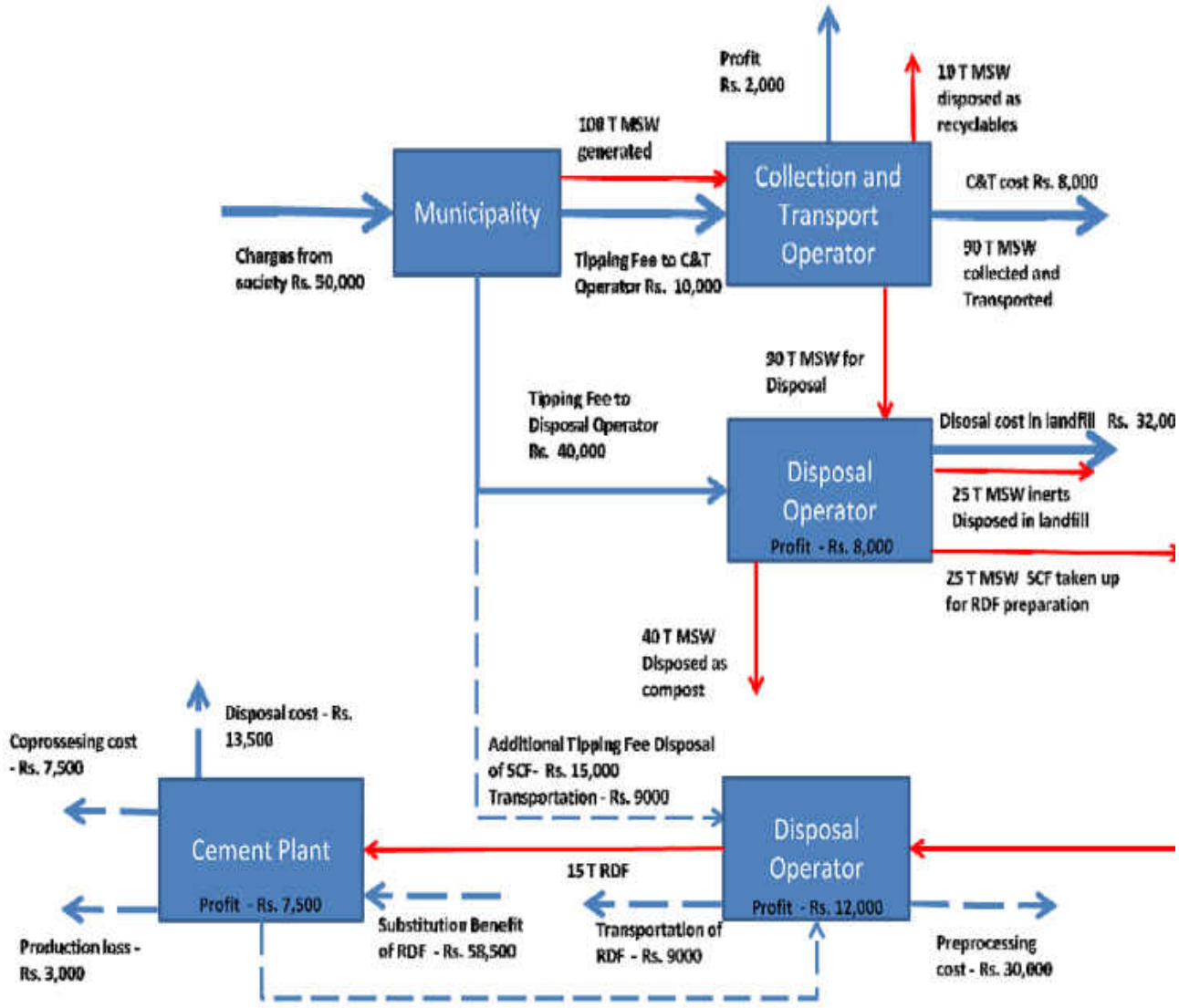
Case 1: Base Case

In this situation, the Municipality collects the charges and pays as tipping fee to the C&T Operator and MSW Disposal Operator. It is assumed that the Tipping fee is Rs. 100 / T for C&T and Rs. 400 for disposal. It is further assumed that both of them receive a profit of 20% on their tipping fee. The revenue from compost and recyclable is considered as zero.



Case 2 : RDF generation by Disposal Operator

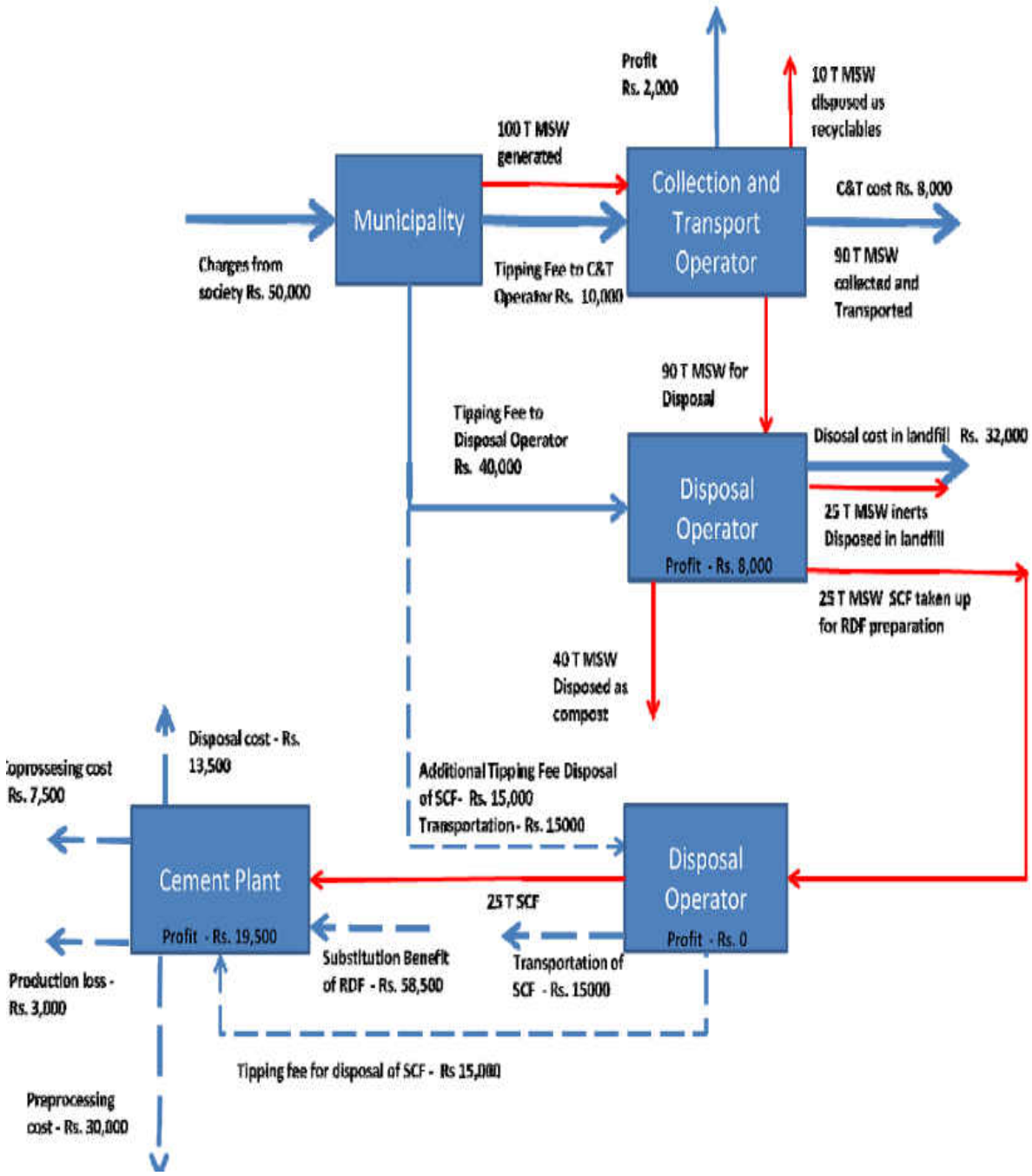
In this case the conversion of Segregated Combustible fraction (SCF) into Refused Derived Fuel (RDF) is carried out by the waste management operator within the existing waste management site. This involves setting up of the pre-processing facility having storage, shredding and blending operation. The project operator needs to get reasonable profit to pay off the investments made. The cement plant has to set up the co-processing facility in the plant and therefore cement plant also must make a reasonable profit to pay off this investments. At the disposal operator level, the income streams are tipping fee & the proceeds from the sale of RDF to cement plant and the expenditure streams are pre-processing cost and the transportation cost of RDF to cement plant. At cement plant, the income stream is the saving due to reduction in use of coal, cost of RDF handling & management, cost of co-processing, and cost due to production loss. Transportation cost is considered at Rs. 3 / T with full charge for return empty load and distance between processing plant and cement plant is 100 Km.



Sale amount for cement plant for RDF Rs. 27,000/-

Case 3: RDF generated by Cement plant

In this case, the conversion of Segregated Combustible fraction (SCF) into Refused Derived Fuel (RDF) is carried out by the cement plant at the cement plant site. This involves setting up of the pre-processing facility having storage, shredding and blending operation and also the co-processing facility. Therefore, cement plant must make a reasonable profit to pay off this investments. At the cement plant level, the income streams are tipping fee & the savings due to reduction in use of coal and the expenditures are cost of RDF handling & management, cost of co-processing, cost due to production loss and pre-processing cost. Transportation cost is considered at Rs. 3 / T with full charge for return empty load and distance between processing plant and cement plant is 100 Km.



Salient features of the Business model:

1. Commodity materials such as RDF help improve the Thermal Substitution Rate (TSR%) but they contribute substantially less in the investment payback.
2. If RDF is a non-processed non-uniform mix of combustible materials, then the same is feasible to be co-processed only when it arrives with tipping fee.
3. If RDF is a pre-processed combustible material with uniform quality as per the cement kiln specifications, the same would be feasible to be purchased by the cement plants.

4. The per capita burden on account of the additional Tipping fee towards SCF disposal as RDF in cement kiln along with its transportation over a distance of 100 Km works out to about Rs. 2 / capita / Month and would increase to about Rs. 8 / capita / Month for a distance of 600 Km.

Conclusions:

1. The above illustrations and discussions demonstrate that there is a feasible business model on which the cement kilns can come forward to manage RDF from MSW on a large scale. To achieve this large scale management of RDF from MSW, following are the specific requirements.
2. The economic viability of the pre and co-processing of RDF in cement kilns depends substantially on the quality of the same on as received basis at the cement plant gate.
3. Most of the countries including BASEL CONVENTION have provided the BAT status to the cement kiln co-processing technology for effective and environmentally sound management of wastes.
4. Co-processing provides the waste management solution without any waste to worry about in future.
5. It has been demonstrated globally and also in India (through >75 successful co-processing trials) that co-processing provides environmentally sound and ecologically sustaining disposal of a variety of wastes starting from simple ETP sludge to most complex POPs including the hazardous ones.
6. If the cement plants have to undertake large scale co-processing activity to solve the MSW problem faced in the country, then they have to make investments of more than Rs. 25 Cr to 30 Cr per million TPA clinker manufacturing capacity while operating at a TSR level of about 15%.
7. To encourage this kind of investment, cement kilns be provided the same grants and subsidies that are extended to the waste management project operators.
8. Use of RDF by cement plants will not only help reduce the waste management problem but also it will help reduce GHG emissions, reduce foreign exchange outgo on account of reduced coal imports and conserve the coal reserves of the country.
9. Where facilities are available, this model can be initiated to work as a demonstration project for the stake holders including cement plants and waste management companies.
10. At other locations, a pilot scheme can be worked out with the involvement of an existing MSW project operator of a town and nearby cement plant. The map of the location of cement plants in the country is attached.
11. Capacity building of the MSW project operators on proper segregation of the combustible fraction and also on producing right quality RDF is essential.
12. Cement plants need to analyse and define the quantum of RDF that they can co-process in their cement kiln with minimum changes in their process & infrastructure.

6.0 Case Study-1

Case Study on Clean & Green Madukarai Town

Madukkarai is a town in near Coimbatore in Tamil Nadu and is having population of about 40,000. ACC Limited - the oldest cement company in the country - has a clinker and Cement manufacturing facility near this town.

Five years back the panchayat of the Madukkarai town considered it relevant improve waste management in their town and move towards zero landfill concept. ACC having experience in managing wastes proposed to collaborate with them. This collaborative initiative was started in 2012. Initially, as a part of this collaborative initiative, the waste collectors, the households & the other waste generating establishments were given awareness on proper management of the wastes for putting it to good use.

As a system design, the door to door collection waste collection drive was started after training the waste collection team in segregating it properly in different fractions. The waste collecting team initiated the collection and segregation process in which the household waste was segregated into bio-degradable, recyclable and non-recyclable wastes. The street sweeping and drains cleaning job which included sweeping, cleaning, collection and transportation was assigned to a totally separate team so that the door to door collected material does not get contaminated with the inert materials by design.

The door to door collected waste in a segregated manner is them transported to a Material Recovery Centre (MRC) where in the biodegradable waste is converted into bio compost and vermi compost and sold to the farmers. The recyclable materials such as plastics, paper, cloth, metals, batteries etc are sold to the recyclers. The balance material contained different fractions such as non-recyclable plastics, leather, rubber, soiled clothes, soiled paper and other similar materials. Usually, this material tends to get dumped or land filled in normal course of operations.

The plastic material out of this non-recyclable material, that can be utilized in the road construction activity, is shredded and sold for that purpose. The remaining non-recyclable plastics and other material which can be called as non-recyclable Segregated Combustible Fraction (SCF) is sent across to the cement plant of ACC after bailing it. This kind of approach has provided an opportunity to Madukkarai Town to achieve a clean and green status.

In the cement kiln of ACC Cement plant, this SCF gets co-processed as Alternative Fuels and Raw material (AFR) in the cement making process. The use of this kind of waste as AFR helps ACC cement plant to reduce its coal consumption and also reduces the amount of greenhouse gas emissions from the operations.

The above initiative is being implemented by the Madukkarai Town Panchayat successfully and sustainably for the past six years without any interruption and has achieved the status of zero landfill town.

Swatch Bharat team has shot a video film on this initiative of Madukkarai town which is available to see on **https://www.youtube.com/watch?v=A8qldAu9BQ4**

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7.0 Case Study-2

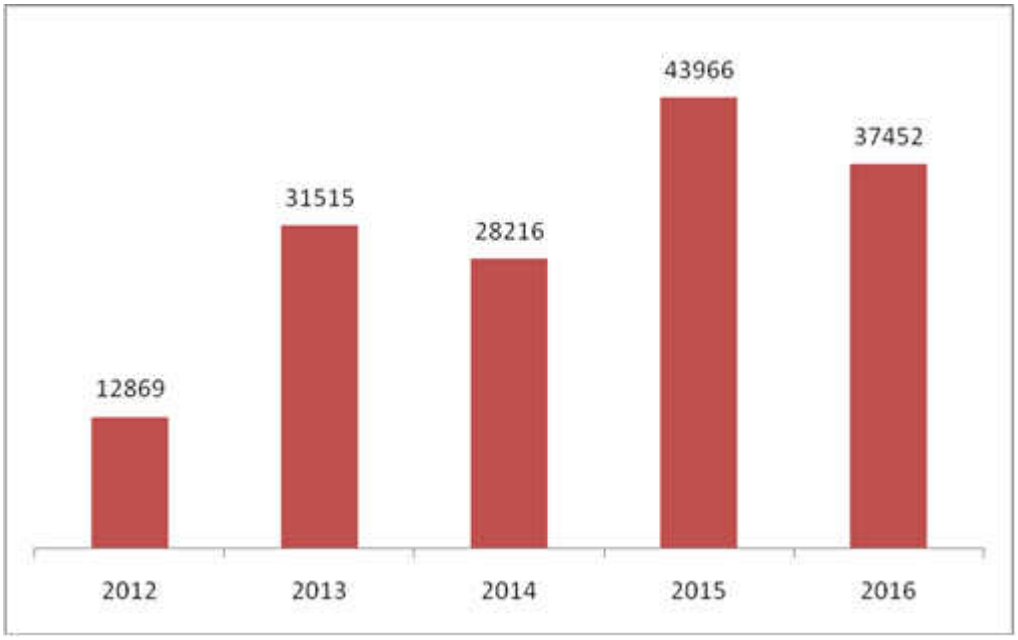
Case Study on Vapi Plastic Waste Co-processing

Vapi in the state of Gujarat where there are many Small scale and Large scale Paper mills and these Paper Mills generate non-recyclable Plastic waste which were earlier sent for landfill or it was stored in the premises of the paper mill in large quantum. Because of the non-biodegradable and impervious nature of plastic, landfill was not a suitable solution for the disposal of the plastic waste.

Later after the release of CPCB Guidelines on co-processing in Cement/Power/Steel Industry in 2010, Gujarat Pollution Control Board issued a note wherein it was instructed to all paper industries to explore possibilities of co-processing plastic waste in industries at high temperature.

Ambuja initially signed an MOU with Paper Mills. The summary of the MoU was long term understanding between the 2 parties that the total quantity of plastic waste generated by the Paper Mills will be consumed by Ambuja as a co-processing (AFR) in their cement kilns. Accordingly, plastic waste is being regularly sent by Paper Mills for co-processing to the Kodinar unit of Ambuja Cements Ltd from all paper mills in Vapi. From year 2012 to year 2016 **1,54,018 MT** of plastic waste is being Co-processed from paper mills of Vapi.

A bar chart (Shown in Figure 1) showing the year wise data from 2012 to 2016 of plastic waste co-processed at Ambuja Cements Ltd, Kodinar.



Co-processing refers to the use of waste materials in industrial processes as alternative fuels or raw material (AFR) to recover energy and material from them. Co-processing is a more environmentally friendly and sustainable method of waste disposal as compared to land filling and incineration because of reduced emissions and no residue after the treatment.

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Annexure-I

List of Cement Plants Having Co-processing Facility

S. No.	Cement Plant	S. No.	Cement Plant
1.	M/s Ambuja Cements Ltd., Bhatapara, PO – Rawan, Tehsil Baloda Bazar, Distt. Raipur, Chhattisgarh	**2.**	M/s Shree Cement Ltd., AndheriDeori, Post Box No. 33, Bangur Nagar, Beawar, District – Ajmer, Rajasthan – 305901
3.	M/s ACC Ltd., Lakheri Cement Works, P.O. Lakheri, Distt. Bundi (Rajasthan), 323 603	**4.**	M/s ACC Ltd., Kymore Cement Works, P.O. Kymore, Distt. Katni (MP), 483 880
5.	M/s ACC Ltd., Madukkarai Cement Works, P.O. Madukkarai Distt. Coimbatore Tamil Nadu-641 105	**6.**	M/s Vasavadatta Cement, Post &Tq- Sedam, Distt. Gulbarga Karnataka, 585 222
7.	M/s ACC Ltd., Gagal Cement Works, P.O. Barmana, Distt. Bilaspur (HP), 174 013	**8.**	M/s ACC Ltd., Bargarh Cement Ltd., Cement Nagar, PO Bardol, Distt. Bargarh (Orissa), 768 038
9.	M/s Lafarge India (P). Ltd., Arasmeta Cement plant, PO Gopal Nagar, Janjgir, Champa, Chhittisgarh	**10.**	M/s Ambuja Cements Ltd., Suli, P.O. Darlaghat, Distt. Solan (HP)
11.	M/s Lafarge India Ltd., Sonadih Cement Plant , PO Reseda, Via Baloda Bazar, Distt. Raipur (Chhattisgarh)	**12.**	M/s ACC Ltd., Jamul Cement Works, Distt. Durg Chhattisgarh 490 024
13.	M/s Ambuja Cement Ltd., P.O. Ambujanagar, Tal.-Kodinar, Distt. Junagadh, Gujarat – 362715	**14.**	M/s GajAmbuja Cements Ltd., Tal.-Kodinar, Distt. Junagadh, Gujarat – 362715
15.	M/s Ambuja Cements Ltd., P.O. Rabriyawas, Teh. Jaitaran, Distt. Pali Rajasthan	**16.**	M/s Trinetra Cement Ltd., Mahi Cement Works, P.O. Walwana, Banswara – 327 025, Rajasthan
17.	M/s ACC Ltd., Chanda Cement Works, P.O. Cement Nagar , Distt. Chandrapur Maharashtra 442 502	**18.**	M/s Shree Cement Ltd., Village-RAS, Tehsil-Jaitaran, Distt.-Pali, Rajasthan.
19.	M/s ACC Ltd., Chaibasa Cement Works, P.O. Jhinkpani, Distt. West Singhbhum Jharkhand 833 215	**20.**	M/s ACC Ltd., Wadi Cement Works, P.O. Wadi, Distt. Gulbarga Karnataka 585 225
21.	M/s Bharathi Cement Corporation Pvt. Ltd. Nallalingayapalli village, KamalapuramMandal, KadapaDistt. – 516 289, Andhra Pradesh	**22.**	M/s My Home Industries Limited Mellacheruvu (Post &Mandal) NalgondaDist - 508246 Telangana State

23.	M/s Anjani Portland Cement Ltd, MellacheruvuMandal, NalgondaDistt., Telangana State 508246	**24.**	M/s Kesoram Cement Ltd., Post-Basantnagar, Karimnagar Dist.- 505 187 (AP)
25.	M/s Sagar Cement Ltd., Nalgonda, Telangana	**26.**	M/s Lafarge India Pvt. Ltd. Chittor Cement Plant Chittorgarh, Rajasthan
27.	M/s Kalburgi Cement (formerly VicatSagar Cement), Chhatrasala, Gulbarga Karnataka	**28.**	M/s Dalmia Bharat Cement, Ariyalur, Tamilnadu
29.	M/s J.K.Cement Works, Muddapur, BagalKot, Karnataka	**30.**	M/s Sanghi Cement Ltd., Kutch, Gujarat
31.	M/s Chettinad Cement Corporation Ltd., Kallur Works, Sangem K, Garagappalli Post, Chandapur (SO), Chincholi (TK), Gulbarga (DT), Karnataka-585 305	**32.**	M/s Chettinad Cement Corporation Ltd., AriyalurTrichy Road, Keelapur post, Ariyalur dist-621707, Tamilnadu
33.	M/s Dalmia Cement (Bharat) Ltd., Dalmiapuram, Dist. Tiruchirapalli, Tamil Nadu 621651	**34.**	M/s J. K. Cement Works, Mangrol, C/o J.K. Cement Works, Kailash Nagar, Nimbahera, Distt. Chittorgarh 312617
35.	M/s J. K. Cement Works, Kailash Nagar, Nimbahera, Distt. Chittorgarh 312617	**36.**	M/s Zuari Cement Ltd., Krishna Nagar, Yerraguntla, KadapaDistt., AP 516 311
37.	M/s Zuari Cement Ltd., Sitapuram, Dondapadu, Distt.- Nalgonda, Telangana	**38.**	M/s Dalla Cement Factory, Village – Dalla, Distt. – Sonebhadra, UP 231207
39.	M/s Dalmia Cement (Bharat) Ltd., V&P- Chinnakomerla, Mandal-Mylavaram, Jammalandhu, Distt. Kadapa, AP	**40.**	M/s Chettinad Cement Corporation Ltd., Rani Meyyammai Nagar, Karikklai PO, Guziliamparai (via), DindigulDistt., Tamilnadu 624 703
41.	M/s J. K. Lakshmi Cement Ltd., Jaykaypuram, Distt. Sirohi, Rajasthan 307 01	**42.**	M/s Keerthi Industries Ltd., Mellacheruvu (V & M), NalgondaDistt., Telangana 508 246
43.	M/s India Cements Ltd., Malkapur Village, TandurMandal, Ranga Reddy Distt., Telangana 501 157	**44.**	M/s Chettinad Cement Corporation Ltd., Puliyur Cement Works, KarurDistt., Tamilnadu
45.	Ultra Tech Cement Ltd., Andhra Pradesh Cement Works, Bhogasamudram, PO: Chukkalur, Mandal:Tadipatri Distt. Anantapur (AP)	**46.**	M/s UltraTech Cement Ltd., RajashreeCemeworks, AdityanagarMalkhed Road, Dist. Gulbarga, Karnataka 585 292
47.	M/s Ultratech Cement Ltd., Narmada cement-Jafrabad Works, Babarkot, Taluka- Jafrabad, Distt. Amreli, Gujarat.	**48.**	M/s Ultra tech Cement Ltd. P.O. Mohanpura, Tehsil Kotputli, Distt. Jaipur, Rajasthan- 303108
49.	Ultra Tech Cement Ltd., Aditya Cement, Adityapuram, P.O. Sawa Distt. Chittorgarh, Rajasthan -312 612	**50.**	Ultra Tech Cement Ltd. P.O. Reddipalayam, Ariyalur, Distt. Perambalur Tamil Nadu-621 704

51.	Ultra Tech Cement Ltd. Gujarat Cement Works, P.O. Kovaya, TalukaRajula, Distt. Amreli Gujarat-365 541	**52.**	UltratechCemenLtd., V ikr Cement Works, ikram Nagar, P.O. Khor, Distt. –Neemuch, M.P. – 458 470.
53.	M/s Ultra Tech Cement Ltd., Rawan Cement Works P.O. Grasim Vihar, Distt. Baloda Bazar – Bhatapara, Chhattisgarh – 493196	**54.**	M/s Ultra Tech Cement Ltd., Hirmi Cement Works, Hirmi, Bhatapara, Distt. Baloda Bazar Chhattisgarh – 493195

Annexure-II

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

NOTIFICATION

New Delhi, the 10th May, 2016

G.S.R. 497 (E). – In exercise of powers conferred by sections 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules further to amend the Environment (Protection) Rules, 1986, namely :-

1. Short title and commencement - (1) These rules may be called the Environment (Protection) Third Amendment Rules, 2016.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. In the Environment (Protection) Rules, 1986,-

(a) in schedule I, after serial number 10 and the entries relating thereto, the following serial number and entries shall be inserted, namely:-

"S. No.	Industry	Parameter	Standards		
(1)	(2)	(3)	(4)		
"10A.	Cement Plant with co-processing of wastes	**A- Emission Standards**			
		Rotary Kiln – with co-processing of Wastes			
			Date of Commissioning	**Location**	**Concentration not to exceed, in mg/Nm^3**
			(a)	**(b)**	**(c)**
		Particulate Matter (PM)*	on or after the date of notification (25.8.2014)	anywhere in the country	30
			before the date of notification (25.8.2014)	critically polluted area or urban centres with population above 1.0 lakh or within its periphery of 5.0 kilometer radius	30
				other than critically polluted area or urban centres	30
		SO_2*	irrespective of date of commissioning	anywhere in the country	100, 700 and 1000 when pyritic sulphur in the limestone is less than 0.25%, 0.25 to 0.5% and more than 0.5% respectively.
		NOx*	After the date of notification (25.8.2014)	anywhere in the country	(1) 600
			Before the date of notification	anywhere in the country	(2) 800 for rotary kiln with In Line Calciner

			(25.8.2014)		(ILC) technology. (3) 1000 for rotary kiln using mixed stream of ILC, Separate Line Calciner (SLC) and suspension pre-heater technology or SLC technology alone or without calciner.
		HCl		10 mg/Nm^3	
		HF		1 mg/Nm^3	
		TOC		10 mg/Nm^3 **	
		Hg and its compounds		0.05 mg/Nm^3	
		Cd +Tl and their compounds		0.05 mg/Nm^3	
		Sb+As+Pb+Co+Cr+Cu+Mn+Ni+V and their compounds		0.5 mg/Nm^3	
		Dioxins and Furans		0.1 ngTEQ/ Nm^3	
		Note: The abbreviations used in the Table shall mean as under: SO_2- Sulphur dioxide; NO_X - Oxides of Nitrogen; HCl – Hydrogen Chloride; HF – Hydrogen Flouride; TOC - Total Organic Carbon; Hg – Mercury; Cd – Cadmium; Tl – Thallium; Sb – Antimony; As – Arsenic; Pb – Lead; Co – Cobalt; Cr – Chromium; Cu – Copper; Mn – Manganese; Ni – Nickel; and V - Vanadium."; * The concentration values and timeline for implementation in respect of PM, SO_2 and NOx shall be governed in accordance with the provisions under notification published vide GSR No. 612 (E), dated the 25th August, 2014 and amended from time to time. **Permitting authority may prescribe separate standards on case to case basis, if Total Organic Carbon (TOC) does not result from the co-processing of waste. (a) The height of each individual stack connected to Kiln, Clinker Cooler, Cement Mill, Coal Mill, Raw Mill, Packaging section, etc. shall be of a minimum of 30 metres or, as per the formula $H = 14 (Q1)^{0.3}$ and $H = 74 (Q2)^{0.27}$ whichever is more, where "H" is the height of stack in metres and "Q1" is the maximum quantity of SO_2 expected to be emitted in kg/hr and "Q2" is the maximum quantity of PM expected to be emitted in tonnes/hr through the stack at 100 percent rated capacity of the plant; (b) The monitored values of SO_2, NO_x, HCl, HF, TOC, Metals and Dioxins and Furans at main kiln stack shall be corrected to 10% Oxygen, on dry basis and the norms for SO_2, NO_x, HCl, HF, TOC, Metals and Dioxins and Furans shall be applicable to main kiln stack and the norms for Particulate Matter (PM) shall be applicable to all the stacks in the plant. PM, SO_2, NO_x shall be monitored continuously. HCl, HF, TOC, Metals and Dioxins and Furans shall be monitored once in a year; (c) Scrubber meant for scrubbing emissions shall not be used as quencher and plants having separate stack for gaseous emission for the scrubbing unit, the height of this stack shall be at least equal to the main stack.			
		B- Service waste water (with co-processing of wastes) All efforts shall be made by the industry for 'zero discharge' of service wastewater and in case, the industry prefers to discharge service wastewater, the following norms shall be complied with:			
				Concentration not to exceed, milligram per litre (except pH and temperature)	
		pH		5.5 to 9.0	
		Suspended Solids		100	

		Oil and Grease	10
		Temperature	not more than 5°C higher than the intake water temperature
		C- Storm water (I) Storm-water shall not be allowed to mix with effluent, treated sewage, scrubber water and or or floor washings. (II) Storm-water within battery limits of industry shall be channelised through separate drain(s).".	

(b) in Schedule VI, under 'Part-D' relating to General Emission Standards, in item III relating to Load or Mass based standards, after serial number 10 and the entries relating thereto, the following serial number and entries shall be inserted, namely:-

(1)	(2)	(3)	(4)
"10A	Cement Plants (with co-processing)	Rotary kiln based plants (Particulate Matter from raw mill, kiln and pre-calciner system put together)	0.125 kg/ tonne of clinker.".

[F. No.- Q-15017/30/2007-CPW]

Dr. RASHID HASAN, Advisor

Note .- The principal rules were published in the Gazette of India, Extraordinary, Part II, Section 3,Sub-section (i), *vide* number S.O. 844 (E), dated the 19th November, 1986 and subsequently amended *vide* the following notifications, namely:-

S.O. 433 (E), dated the 18th April 1987; G.S.R. 176(E), dated the 2nd April, 1996; G.S.R. 97 (E), dated the 18th February, 2009; G.S.R. 149 (E), dated the 4th March , 2009; G.S.R. 543(E), dated the 22nd July,2009; G.S.R. 739 (E), dated the 9th September, 2010; G.S.R. 809(E), dated, the 4th October, 2010, G.S.R. 215 (E), dated the 15th March, 2011; G.S.R. 221(E), dated the 18th March, 2011; G.S.R. 354 (E), dated the 2nd May, 2011; G.S.R. 424 (E), dated the 1st June, 2011; G.S.R. 446 (E), dated the 13th June, 2011; G.S.R. 152 (E), dated the 16th March, 2012; G.S.R. 266(E), dated the 30th March, 2012; and G.S.R. 277 (E), dated the 31st March, 2012; and G.S.R. 820(E), dated the 9th November, 2012; G.S.R. 176 (E), dated the 18th March, 2013; G.S.R. 535(E), dated the 7th August, 2013; G.S.R. 771(E), dated the 11th December, 2013; G.S.R. 2(E), dated the 2nd January, 2014; G.S.R. 229 (E), dated the 28th March, 2014; G.S.R. 232(E), dated the 31st March, 2014; G.S.R. 325(E), dated the 07th May, 2014, G.S.R. 612, (E), dated the 25th August 2014; G.S.R. 789(E), dated the 11th November 2014; S.O. 3305(E), dated the 7th December, 2015; S.O.4(E), dated the 1st January 2016; G.S.R. 35(E), dated the 14th January 2016 and lastly amended vide notification G.S.R. 281 (E), dated the 7th March, 2016.