Confederation of Indian Industry

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SUSTAINABLE ENERGY FOUNDATION

Promoting Alternate Fuel & Raw Material Usage in Indian Cement Industry

Approach Paper for Achieving

25% Thermal Substitution Rate

in Indian Cement industry by 2025

May 2016

Disclaimer

This report is a part of CII - Godrej GBC effort to promote alternate fuel and raw material utilisation in Indian Cement Industry, supported by Shakti Sustainable Energy Foundation (SSEF). This Document is an attempt to estimate the quantity and energy that could be available from different waste streams by 2025.

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Co-Processing in Indian Cement Industry

Co-Processing in cement kiln is a scientific, proven & established technology for disposing hazardous & other non-recyclable waste in an environmentally sustainable way. Due to its advantages in terms of combustion of waste & no residual left over, cement kiln stands apart among the different methods of waste disposal like incineration, waste to energy and land filling.

The Basel convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal highlighted the suitability of cement kiln for co-processing of hazardous and other wastes and also brought out technical guidance for the same and India is also a signatory to this convention.

Indian Cement Industry

The Indian cement industry is the most energy efficient in the world, emitted about 137 million $MtCO_2$ in 2010, equivalent to 7% share of India's total man-made CO_2 emissions[1]. Increased use of alternate fuel identified as one of the key levers to reduce emissions in the Indian cement industry. India's cement demand is expected to reach 550-600 million tonnes per annum (MTPA) by 2025[2].

Projected Growth of Cement industry and fuel requirement by 2025

S. No	Parameters	Existing[3] 2010	Anticipated[4] 2025	Units
1	Cement production	217	600	Million TPA
2	Cement to clinker ratio	1.35	1.49	
3	Clinker production	161	402	Million TPA
4	Specific energy consumption	725	703	Kcal/ kg of clinker
5	Total Thermal Energy Required	11.64	28.26	Million TOE
6	Average Energy from imported Coal	5500	5500	Kcal/kg of coal
7	Quantity of coal required	21.17	51.38	Million TPA
8	AF usage in TSR %	<1	25	
10	Energy From Alternate fuel estimated @ 25% of total energy		7.07	Million TOE

Waste Availability Scenario

This paper is an attempt to investigate and discuss on availability of potential waste streams for Co-processing in cement industry, which will support the industry & country in moving towards low carbon economy. Aim of this paper is to estimate the quantity of waste & energy that could be available from the different waste streams by 2025.

Municipal Solid waste (MSW)

Municipal Solid waste (MSW) is a heterogeneous mixture, includes all types biodegradable, inert, recyclable, Electrical & electronic, pesticides and hazardous wastes.

Currently, of the estimated 62 million tonnes of MSW generated annually by 377 million people in urban areas, more than 80% is disposed at dump yards in an unhygienic manner leading to problems of health and environmental degradation[5]

References

1,3,4 Low carbon technology for Indian Cement Industry
2 Department of Commerce, Ministry of Commerce and Industry, Government of India
5, 6, 7 & 8 Task Force on Waste to Energy Projects http://planningcommission.nic.in/reports/genrep/rep_wte1205.pdf
9 INDIA 2025 - Environment http://planningcommission.nic.in/reports/genrep/rep_wte1205.pdf
10 Pasig City, Philippines RDF facility

Further, if the current 62 million tonnes annual generation of MSW continues to be dumped without treatment; it will need 3,40,000 cubic meter of landfill space everyday (1240 hectare per year). Considering the projected waste generation of 140 million tonnes by 2025, the requirement of land for setting up landfill for 15 years (considering 10 meter high waste pile) could be as high as approx. 50 thousand hectares of precious land, which is equivalent to size of Chennai city[6].

68% of the MSW generated is collected of which, 28% is treated by the municipal authorities, and therefore 19% of the total waste generated is currently treated[7]. World Health Organization (WHO) has observed that 22 types of diseases can be prevented/ controlled in India by improving Municipal Solid Waste Management (MSWM) system[8].

Refused Derived Fuel (RDF) which is generated from MSW can be utilized as an effective alternate fuel in Cement plants, which can result in reduction of waste going to land fill and ensures sustainable way of waste management in the country.

S.No	Year	Existing 2012	Anticipated 2025	Units
1	MSW Generation	62	140	Million TPA
2	Collection efficiency of MSW	68	80	%
3	MSW Collected	42.16	112	Million TPA
4	Treatment efficiency	28	75	%
5	MSW for Treatment	11.80	84	Million TPA
6	MSW for treated in Pre-Processing platforms	-	80	%
7	MSW for pre-processing platforms	-	67.20	Million TPA
8	Recoverable Refuse derived fuel from MSW[10]	-	20	%
9	Generation of Refuse derived fuel	-	13.44	Million TPA
10	MSW going for RDF generation		48	%
11	Calorific value	-	3000	Kcal/ kg of RDF
12	Energy from RDF	-	4.03	Million TPA
13	% Energy from MSW on AF	-	57.06	%
14	% Energy from MSW on Total thermal energy for cement plant	-	14.26	%

Spent Pot Liner Waste

Spent Pot lining (SPL) is a waste generated in the aluminium smelting industry. SPL is having a heat content in the range of 4000 - 5000 kCal/kg, which can be used in cement plant as an alternative fuel[11].

SPL is subjected to close regulatory control including the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal[12] . Hazardous properties of SPL are :

➢ Toxic fluoride and cyanide compounds that are leachable in water.

➢ Corrosive - exhibiting high pH due to alkali metals and oxides.

➢ Reactive with water - producing inflammable, toxic and explosive gases.

Currently SPL is managed in secured storage Land filling (SLF) sites, hence this waste is stored on site for years together, posing huge environmentl risk, in particular to the ground water and health of people[13].

Cement plants can support SPL disposal in an environmentally sustainable manner through co-processing in Cement kiln. The availability of the SPL is high particularly in the states of Chhattisgarh and Orissa.

References

11 CPCB report on Co-incineration of Hazardous waste
12 http://knowledgeplatform.in/wp-content/uploads/2015/09/1.-Regulation-and-management-of-spent-pot-lining-Dr-B-Sengupta.pdf
13 Geocycle India
14 Nalco, Vedanta, Hindalco Industries (Knowledge platform)

S.No	Parameter	Existing 2015	Anticipated 2025	Unit
1	Calorific value	4000	4000	Kcal/kg
2	Quantity of SPL generated[14]	0.04	0.07	Million TPA
3	Quantity already in secured landfills	0.09	0.09	Million TPA
4	Total quantity	-	0.16	Million TPA
5	Quantity of SPL available for Co-Processing	-	0.14	@70%
6	Energy Generated from SPL	-	0.057	Million TOE
7	% Energy from Spent pot liner on AF	-	0.81	%
8	% Energy from Spent pot liner on Total thermal energy for cement plant	-	0.20	%

Hazardous waste

As per Central Pollution Control Board (CPCB)[15], there are 41523 number of hazardous waste generating units in India and the Hazardous waste generation in India.

- ➢ Total Generation - 7.90 Million Tonnes/ Annum
- ➢ Land fillable - 3.32 Million Tonnes /Annum
- ➢ Recyclable - 3.98 Million Tonnes /Annum
- ➢ Incinerable - 0.60 Million Tonnes /Annum

Maharashtra (22.84%), Gujarat (22.68 %) and combined state (Andhra Pradesh & Telangana) (13.75 %) are the top three HW generating States in the country. Rajasthan, Tamil Nadu, Madhya Pradesh and Chhattisgarh States are in second line with a generation of more than 2.5 lakh tonnes per annum. These seven States together, are generating about 82% of country's total hazardous waste.

Currently hazardous waste is disposed at captive treatment facilities installed by the individual waste generators or at Common Hazardous Waste Treatment, Storage and Disposal Facilities (TSDFs).

The energy in the fuel is going unutilised by incinerating the waste in TSDFs, otherwise can be used for co-processing in Cement kiln, which will reduce the fossil fuel consumption as well as GHG emissions.

S.No	Parameter	Existing 2011	Anticipated 2025	Unit
1	Incinerable Hazardous waste	0.6	1.02*	Million TPA
2	Average Calorific value[16]	3000	3000	Kcal/kg
3	Percentage of quantity available for co-processing		80	%
4	Quantity available for co-processing		0.81	Million TPA
5	Energy from Hazardous waste		0.24	Million TOE
6	% Energy from HW on AF		3.46	%
7	% Energy from HW on Total thermal energy for cement plant		0.87	%

Biomass

Biomass is organic matter derived from living, or recently living organisms. It is renewable, widely available, carbon-neutral and has the potential to provide significant employment in the rural areas. Commonly used materials include rice & paddy husk, sawdust, and food industry waste

References

15 CPCB report on Hazardous waste generation in India : http://www.cpcb.nic.in/Updated_Inventory_HW_Generation.pdf
16 Holtec Consulting Engineers
17 & 18 Ministry of New and Renewable Energy http://mnre.gov.in/schemes/grid-connected/biomass-powercogen/
19 http://www.eai.in/ref/ae/bio/bio/biomass_concepts.html
* Considering 5% increase per year.

About 32% of the total primary energy use in the country is still derived from biomass and more than 70% of the country's population depends upon it for its energy needs[17].As an energy source, biomass can either be used directly via combustion to produce heat, or indirectly after converting it to various forms of biofuel.

Currently Biomass utilised in power generation in Sugar industry and in independent power stations. Studies sponsored by the Ministry has estimated surplus biomass availability at about 120 – 150 million metric tonnes per annum covering agricultural and forestry residues[18].

The calculations were carried out assuming only 120 million TPA available as surplus and out of which only 6.5% is used for co-processing in Cement kilns.

S.No	Parameter	Existing 2015	Anticipated 2025	Unit
1	Bio mass generation in India[19]	500	-	Million TPA
2	Surplus bio mass availability	120	120	Million TPA
3	Average Calorific value		3000	Kcal/ kg of material
4	Available for co-processing		6.5	%
5	Quantity from Bio mass for co-processing		8	Million TPA
6	Energy from Bio mass		2.40	Million TOE
7	% Energy from Bio mass on AF	-	33.97	%
8	% Energy from Bio mass on Total thermal energy for cement plant	-	8.49	%

Tyre Waste

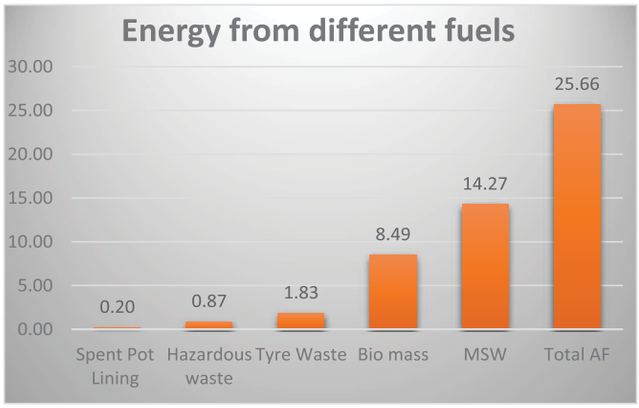
Tyre waste is another source of alternative fuels. In India as per all India Tyre Manufacturing Association (ATMA) about 0.83 million Tonnes[20] of used tyres are generated annually in 2011-2012. The average calorific value is around 6500 kcal/ kg[21] of waste makes it superior alternate fuels to use in cement co-processing.

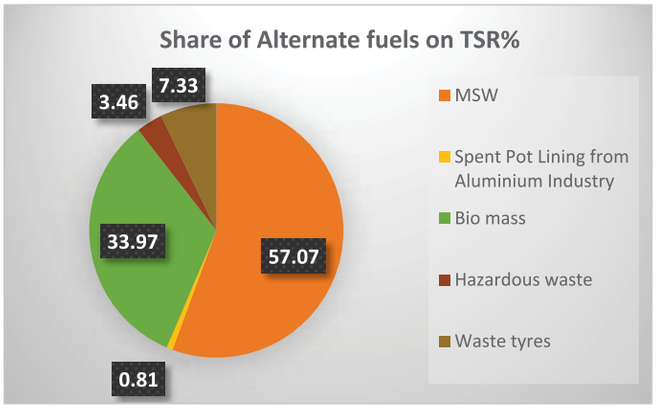
Tyre waste or Tyre Derived Fuel (TDF) was first used in cement kilns, in Germany, in the 1970s. Few years later, kilns in the USA began using TDF, which proved quite a popular step. At present, USA produces over 300 million used tyres annually, out of which around 150 million are converted into TDF, USA cement industry using approximately 60 million tyres worth in its kilns[22].

Utilising tyre waste in cement kiln co-processing will reduce the environmental impacts and also results in safe and effective disposal of tyre waste in the country.

S.No	**Parameter**		**Anticipated**	**Unit**
1	Used tyres availability	0.83	1.32[23]	Million TPA
2	Average Calorific value		6500	Kcal/kg
3	Percentage of quantity available for co-processing		60	%
4	Quantity available for co-processing		0.79	Million TPA
5	Energy from Tyre waste		0.51	Million TOE
6	% Energy from Tyre waste on AF	-	7.33	
7	% Energy from Tyre waste on Total energy for cement plant	-	1.83	

References
20 All India Tyre Manufacturing Association (ATMA)
21 HOLTEC Comsulting
22 www.nbmcw.com
23 Considering 5% increase per year





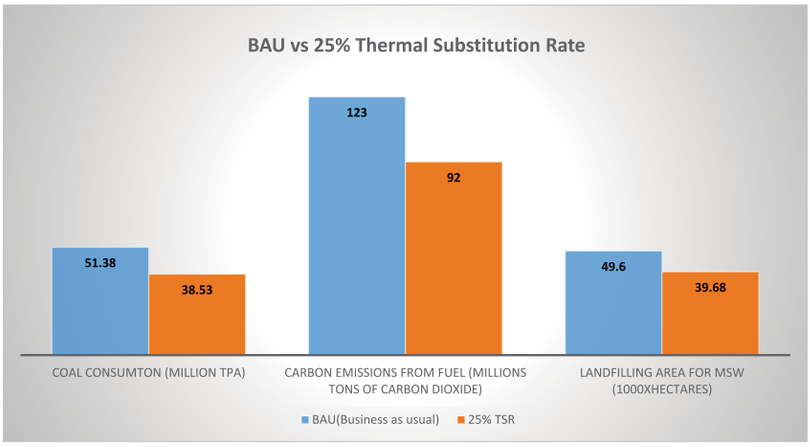
Summary of energy available from different waste streams

Based on the existing quantity of waste generation and future forecasting of different waste derived fuels, 25% alternate fuel substitution is possible in Indian cement industry by 2025. 25% TSR substitution will benefit individual organisations and also support nation in achieving Indended Nationally Determined contribution (INDC)

S.No	Waste streams	% share on AF	% share on total thermal energy
1	MSW	57.07	14.27
2	Spent Pot Lining	0.81	0.20
3	Bio mass	33.97	8.49
4	Hazardous waste	3.46	0.87
5	Tyre waste	7.33	1.83
	Total		**25.66**

25% TSR by Alternative fuel in 2025 – Anticipated benefits

- Support India's INDC: Reducing the emission intensity of GDP by 33 to 35 percent in 2030 from 2005 level.
- Co-processing ranks higher in the hierarchy in comparison to disposal activities such as landfilling or incineration.
- Utilization of 0.86 million TPA hazardous waste in cement kiln will reduce the environmental impacts of incineration or land filling and additional benefit of ensuring safe disposal of hazardous waste in the country
- Since the waste generated becomes a resource for other and due to its environmentally effective waste management system, co-processing will support the country in moving towards "Zero waste to Environment"
- By pre-processing the waste before utilizing in cement kilns will support in getting a more homogenous fuel and higher substitution rates. Pre- processing the waste will generate additional economic activity.
- Potential to reduce coal usage in cement kiln by 25% , which will also reduce the coal imports and conservation of fossil fuels, reduce the environmental impacts of the extraction (mining or quarrying), transporting, and processing of fossil fuels.
- 20 % reduction in landfilling area requirement and reduce the pollution caused by the disposal of waste
- Reduction on GHG emissions and prevention of Methane emissions.



Confederation of Indian Industry (CII)

The Confederation of Indian Industry (CII) is a non-government, not-for-profit, industry-led and industry-managed organization, playing a proactive role in India's development process. Founded in 1895, India's premier business association has around 8000 members, from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 200,000 enterprises from around 240 national and regional sectoral industry bodies.

CII – Sohrabji Godrej Green Business Centre (CII – Godrej GBC), a division of Confederation of Indian Industry (CII) is India's premier developmental institution, offering advisory services to the industry on environmental aspects and works in the areas of Green Buildings, Energy Efficiency, Water Management, Renewable Energy, Green Business Incubation and Climate Change activities. CII-Godrej GBC works closely with the stakeholders in facilitating India emerge as one of the global leaders in Green Business by the year 2022.

CII Godrej GBC in association with Cement Manufactures' Assocaition (CMA) is working on an initiative to facilitate use of urban & industrial waste as Alternate Fuel & Raw Materials (AFR) in Indian cement industry. This Project is supported by Shakthi Sustainable energy foundation (SSEF), a part of Climate Works Foundation.

The main objective of the project is to accelerate AFR initiatives in the country through capacity building, data availability and facilitating exchange of waste by working closely with Central Pollution Control Board (CPCB), State Pollution Control Boards (SPCB) Cement Plants and other stake holders, thereby reducing environmental impacts of waste generation and raw material usage and supporting the Nation in moving towards a low carbon economy.

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Shakthi Sustainable energy foundation (SSEF)

Shakti Sustainable Energy Foundation works to strengthen the energy security of India by aiding the design and implementation of policies that support renewable energy, energy efficiency and sustainable urban solutions.

Shakti works collaboratively with national, state and local decision-makers to craft sound energy policies to build India's new energy economy. Shakti bring together experts from every sector — industry, academia, law, finance, civil society, think tanks, and more - to drive this change. Shakti have a reputation for meticulous research and analysis, and provide policy makers with concrete, specific, and practical policy recommendations for an energy secure future

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