Life Cycle Assessment

Mixed Plastic Waste utilization as Alternative Fuel in Cement Kiln

CII Waste Management Summit, Mumbai, 24th November 2016

ITC Limited and
thinkstep Sustainability Solutions Pvt. Ltd.

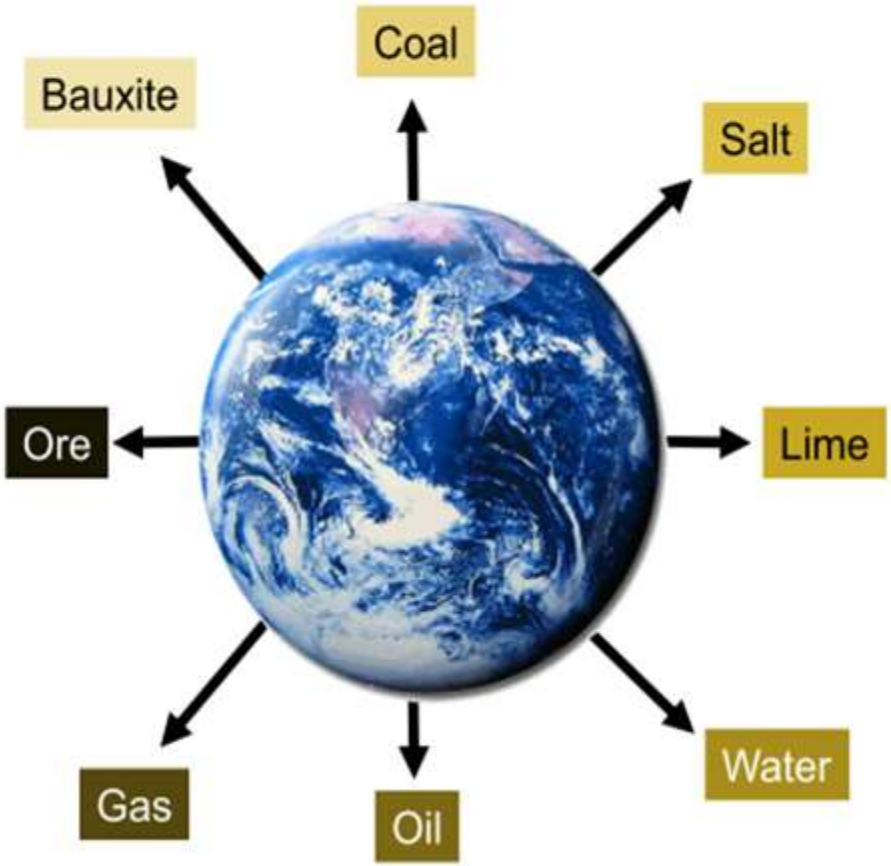
Content

- What is Life Cycle Assessment
- Plastic Waste Situation in India
- Purpose of study
- Conclusion and Way Forward

Life Cycle Assessment- ISO 14040/44

thinkstep

What is included in an LCA of Product?



1. An inventory of all resources taken out of the earths crust

or

taken from other product systems

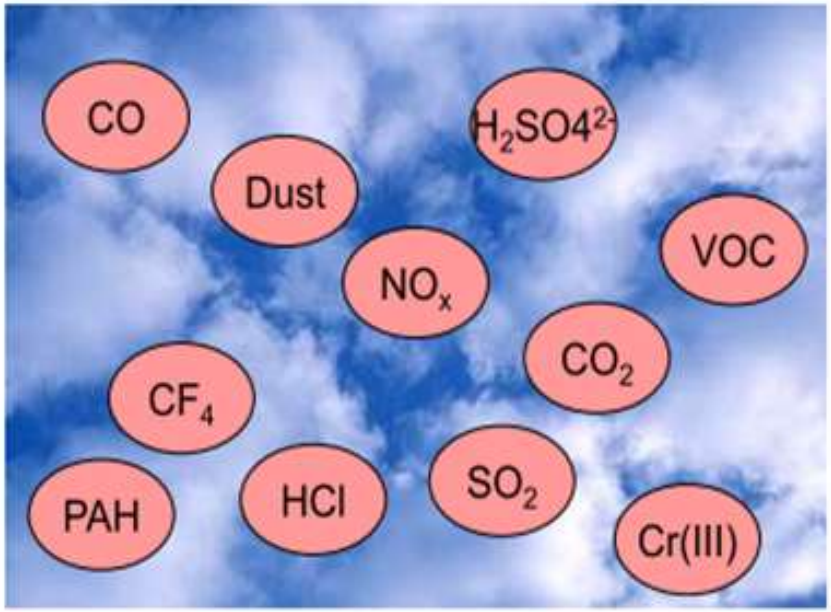
to produce, use and recycle the specified product

 Source: European Aluminum Association

Life Cycle Assessment- ISO 14040/44

thinkstep

What is included in an LCA of Product?



2. An inventory of all emissions to air, water and soil affecting the environment during production, use and recycling of the specified product

 Source: European Aluminum Association

Life Cycle Assessment- ISO 14040/44

thinkstep

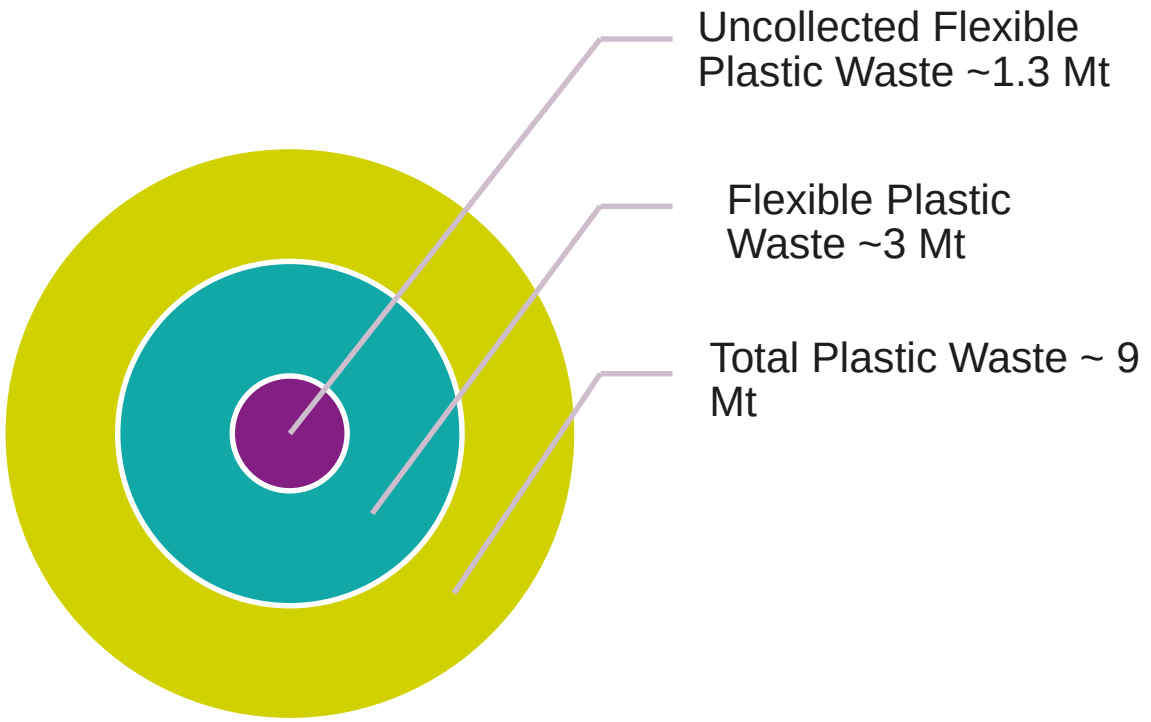
LCA outcome is usually a set of environmental Indicators

In addition to climate change, these indicators help to address the preservation of the natural capital, e.g. bio-diversity, water, air, land, etc.

 Source: European Aluminum Association

Plastic Waste Situation in India

- In India, around 12.8 Mt plastic products are consumed every year.
- The flexible plastic waste recycling rate is around 60%
- These wastes are designated as Low value plastic or mixed plastic waste.
- Countries like Switzerland, Germany, Austria, Denmark, Netherlands and Norway have less than 10% plastic waste to landfill.



The study aims to focus on assessment of environmental benefits associated with use of multi-layer laminates and other low value plastic wastes as an alternate fuel source in cement kiln

Source: Published documents of DCPC, British Plastics Federation, CIPET, Plastindia Foundation and ICPE and PlastIndia Report 2012 – 13

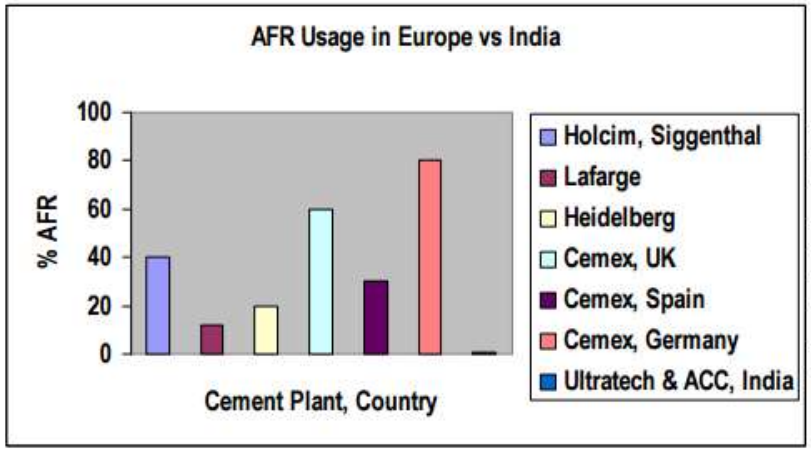
Purpose of Study

- Focus on mixed plastic waste being a valuable resource
- Used in cement kilns with multiple benefits for waste pickers, cement kiln operators and to the nation as a whole due to substitution of fossil energy sources
- Leads to GHG and other environmental impacts benefits
- Alignment with the Sustainable Development Goals.
- Alignment with INDC (*Intended Nationally Determined Contributions*) i.e. it aims to reduce the GHG emission for production of clinker
- Alignment with sustainable and integrated waste management

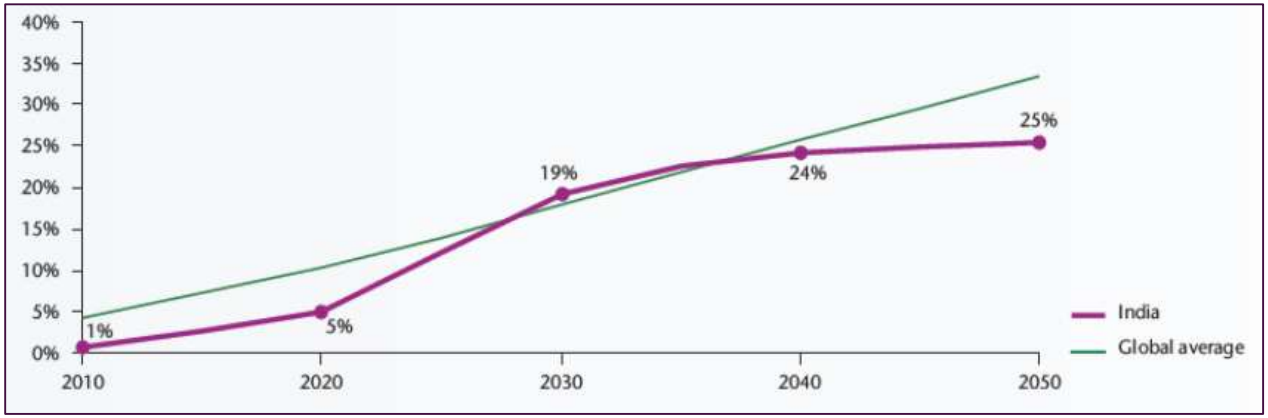
Alignment with SDGs

SDG Goal		Alignment
Goal 1	No poverty	Proposed model of waste segregation, collection and disposal involving through NGO provides sustainable livelihood for the rag pickers
Goal 9	Industry innovation and Infrastructure	Proposed approach will demonstrate this model for the successful operation of mixed plastic waste collection to recycling in cement kiln
Goal 11	Sustainable cities and communities	Promotes efficient waste collection and energy recovery leading to improved waste management in city and active community participation
Goal 12	Responsible consumption and production	Promotes utilization of mixed plastic waste as valuable resource partially replacing coal as energy carrier in cement kiln for clinker production
Goal 13	Climate action	Utilisation of plastic waste leads to reduction in GHG emission for clinker production in cement kiln
Goal 17	Partnership for goals	Proposed model provides good opportunity to establish partnership amongst FMCG companies, packaging producers, Petrochemical industries, Cement industries, municipalities, communities, NGO, waste management companies, rag pickers and workers.

Cement Kiln Fuel Mix



Cement Company	% AFR
Holcim, Siggenthal	40
Lafarge (world average)	12
Heidelberg	20
Cemex, UK	60
Cemex, Spain	30
Cemex, Germany	80
Ultratech & ACC, India	1



Source: http://shaktifoundation.in/wp-content/uploads/2014/02/white-paper-on-increasing-co-processing-in-cement-plants.pdf

Scope of the Project

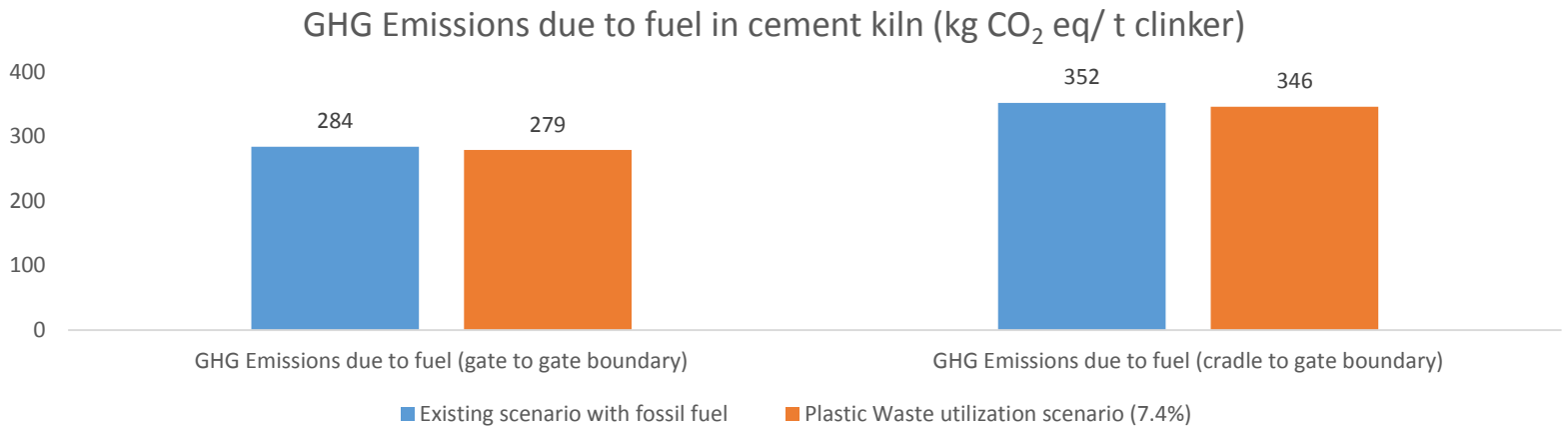
- To assess and evaluate the environmental benefits associated with use of mixed plastic waste including the multi-layer laminates as Alternative Fuel in Cement Kiln.
- The environmental benefits are to be calculated in terms of:
  - Amount of coal substituted by mixed plastic waste
  - Greenhouse gas emission savings due to plastic waste substitution in cement kiln
  - Reduction in other air pollutant emissions
  - Reduction in Life Cycle environmental impact indicators
- Study is independently verified by renowned expert from Cement Industry

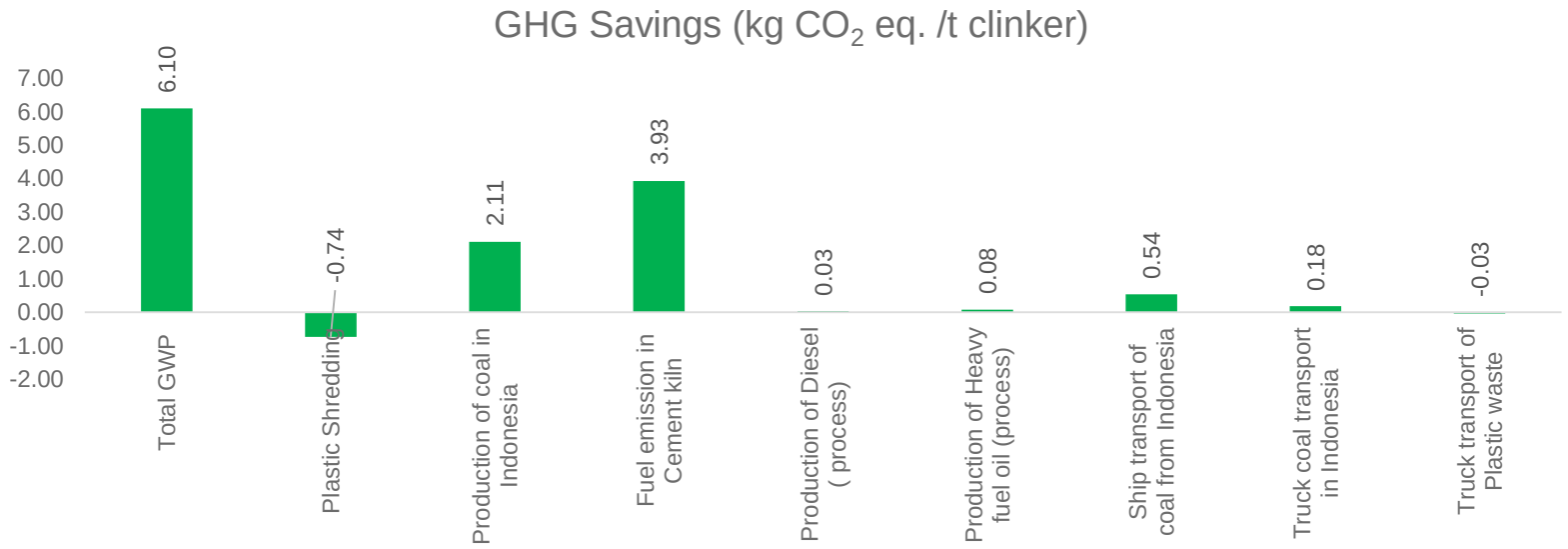
Scope of the Project

The study has been divided into three stages:

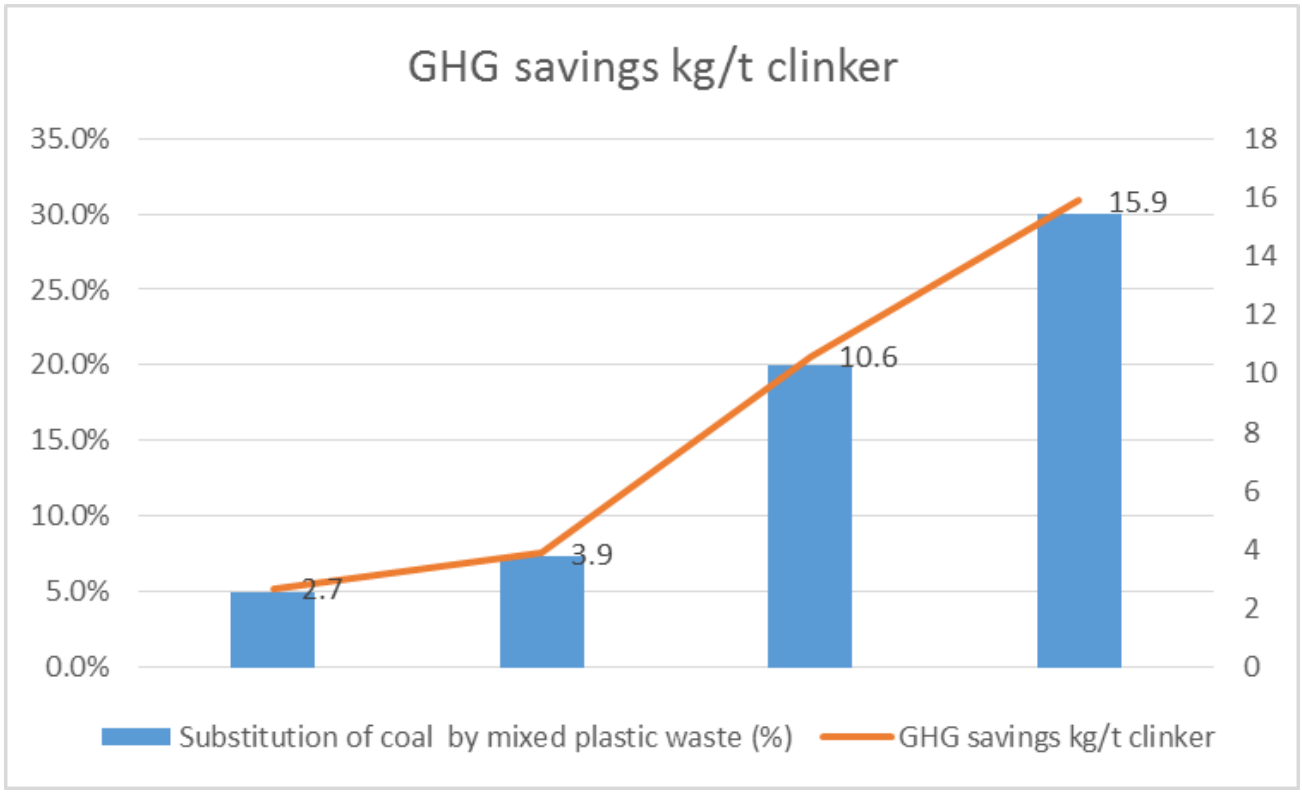
- Stage-1:
  - Assessment of coal substitution with mixed plastic waste (average thermal energy consumption of kiln in India with 100% coal as fuel)
  - Reduction in GHG emission achieved due to utilization of 1.28 Mt of mixed plastic waste.
- Stage-2:
  - Select one case study of the cement plant having majority of thermal energy input as coal
  - Data collection for cement kiln fuel consumption based on publically available information.
  - Scenarios of 5%, 10%, 20% & 30% of mixed plastic waste as alternative fuel in clinker
- Stage-3:
  - Expanding the study from “gate to gate” to “cradle to gate” based on life cycle assessment approach.
  - All the life cycle environmental impact indicators for assessment of existing (fossil fuel) and mixed plastic waste utilization scenario (project).

Outcome: GHG Savings





Outcome: Stage 2



Thermal Energy and GHG Emission for various fuels are calculated based on their Emission Factors

Substitution by mixed plastic waste having TSR (5%, 7.4%, 20% and 30%)

Outcome: Stage 3

thinkstep

Life Cycle Environmental Impact (CML2001 - Apr. 2013)	Norm	Coal baseline+ Pre co-processing	7.4% Plastic during Co-processing	7.4% Plastic Post Co-processing
Abiotic Depletion (ADP elements) [kg Sb-Equiv.]	100.00%	100.0%	99.3%	99.3%
Abiotic Depletion (ADP fossil) [MJ]	100.00%	100.0%	93.9%	93.9%
Acidification Potential (AP) [kg SO2-Equiv.]	100.00%	43.2%	36.8%	36.0%
Eutrophication Potential (EP) [kg Phosphate-Equiv.]	100.00%	84.7%	78.5%	79.9%
Freshwater Aquatic Ecotoxicity Pot. (FAETP inf.) [kg DCB-Equiv.]	100.00%	37.5%	35.7%	35.5%
Global Warming Potential (GWP 100 years) [kg CO2-Equiv.]	100.00%	100.0%	98.3%	98.3%
Human Toxicity Potential (HTP inf.) [kg DCB-Equiv.]	100.00%	12.6%	13.3%	13.0%
Photochem. Ozone Creation Potential (POCP) [kg Ethene-Equiv.]	100.00%	52.1%	45.7%	45.2%
Terrestric Ecotoxicity Potential (TETP inf.) [kg DCB-Equiv.]	100.00%	25.6%	9.5%	12.5%
Primary energy demand from ren. and non ren. resources (net cal. value) [MJ]	100.00%	100.0%	93.9%	93.9%
USEtox, Ecotoxicity (recommended) [CTUe]	100.00%	38.3%	35.1%	35.1%
USEtox, Human toxicity, cancer (recommended) [CTUh]	100.00%	27.6%	9.7%	13.1%
USEtox, Human toxicity, non-canc. (recommended) [CTUh]	100.00%	28.0%	9.8%	13.3%

Conclusion

- Mixed plastic waste generation in India is 1.28 Mt which can replace around 1.69 Mt of coal during clinker production in cement kiln,
- Mixed plastic waste has good calorific value (34.24 MJ/kg)
- If we utilize entire plastic waste, AFR rate in India would be 7.4%. Current AFR rate including all wastes is around 4%. Plastic consumption in kiln would be around 6.4 kg/t of clinker.
- GHG savings with utilization of entire 1.28 Mt of mixed plastic waste in cement kiln would be 0.85 Mt.
- GHG savings of 4 kg and 6 kg CO_2 eq per tonne clinker in gate to gate and cradle to gate boundary; similar savings in other environmental impact categories
- Over the years, demonstrated by cement companies that the air emissions pre, during and post co-processing of mixed plastic waste usage as AFR in cement kiln are well within the stipulate limit.

Study undertaken by ICPE and ACC for one of the cement plant in 2008 and their results were compared with the norms prescribed in recent notification dated 10th may 2016 for cement industry.

Sustainable Solution

- LCA study insights – benefits/use of Light Weight Plastics (LWP)/Multi-layered packaging (MLP) as alternate fuel
  - Approved practice – meets air emissions norms
  - Accredited lab tested for high calorific value (8500 kcal/kg)
  - Segregated MLP with consistent characteristics and quality parameters
  - An integrated MSW management approach -
    - Source segregation is the key, driven by:
    - Value realization for different post-consumer waste streams
    - Capacity building and awareness

Thank you For Your Kind Attention

thinkstep Sustainability Solutions Pvt Limited, a subsidiary of thinkstep AG Germany
Andheri Kurla Road, Andheri East,
Mumbai, India 400059
Phone +91 22 42667693
Website: www.thinkstep.com