

Advanced Training Program on Alternative Fuels & Raw Materials

March 5-7, 2024



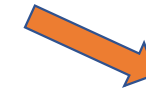
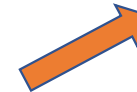
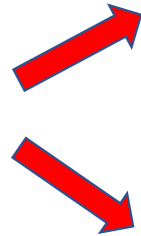
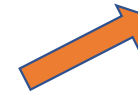
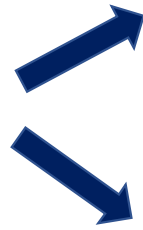
Co-processing: Introduction, insights & Requirements

5th Mar, 2024

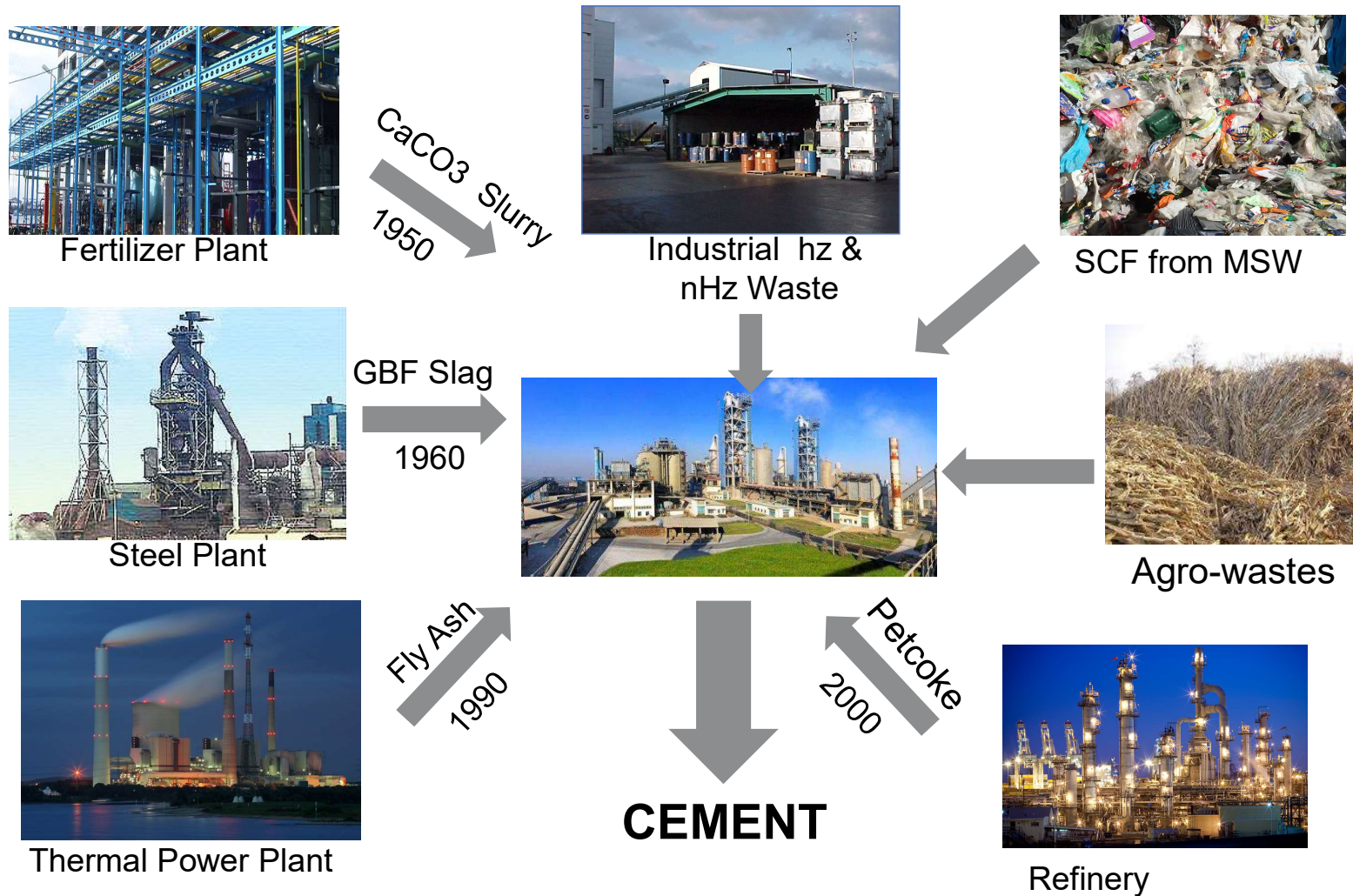
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Conventional Management of Wastes



Cement Industry & Management of Wastes as Resources



Co-processing Technology

- Co-processing is a thermal treatment process to utilize wastes as resources in the Resource Intensive Industries (RIIs) such as Cement kilns, Thermal Power Plants, Steel Plants, Glass Manufacturing plants, Refractory Manufacture plants and Lime plants.
- Wastes get utilized as Alternative Fuels and Raw materials (AFRs) in the RIIs and replace the fossil fuels and raw materials used traditionally in the RIIs. Among the different RIIs, cement manufacturing process has special features that allow large quantum usage of wastes as AFRs in the cement kiln.
- When wastes get utilized as AFRs, they replace the use of fossil fuels and fossil raw materials thereby conserving them for future use. These special features of the kiln also provide opportunity for wastes to get sustainably managed in the cement manufacturing process without impacting the quality of the clinker.

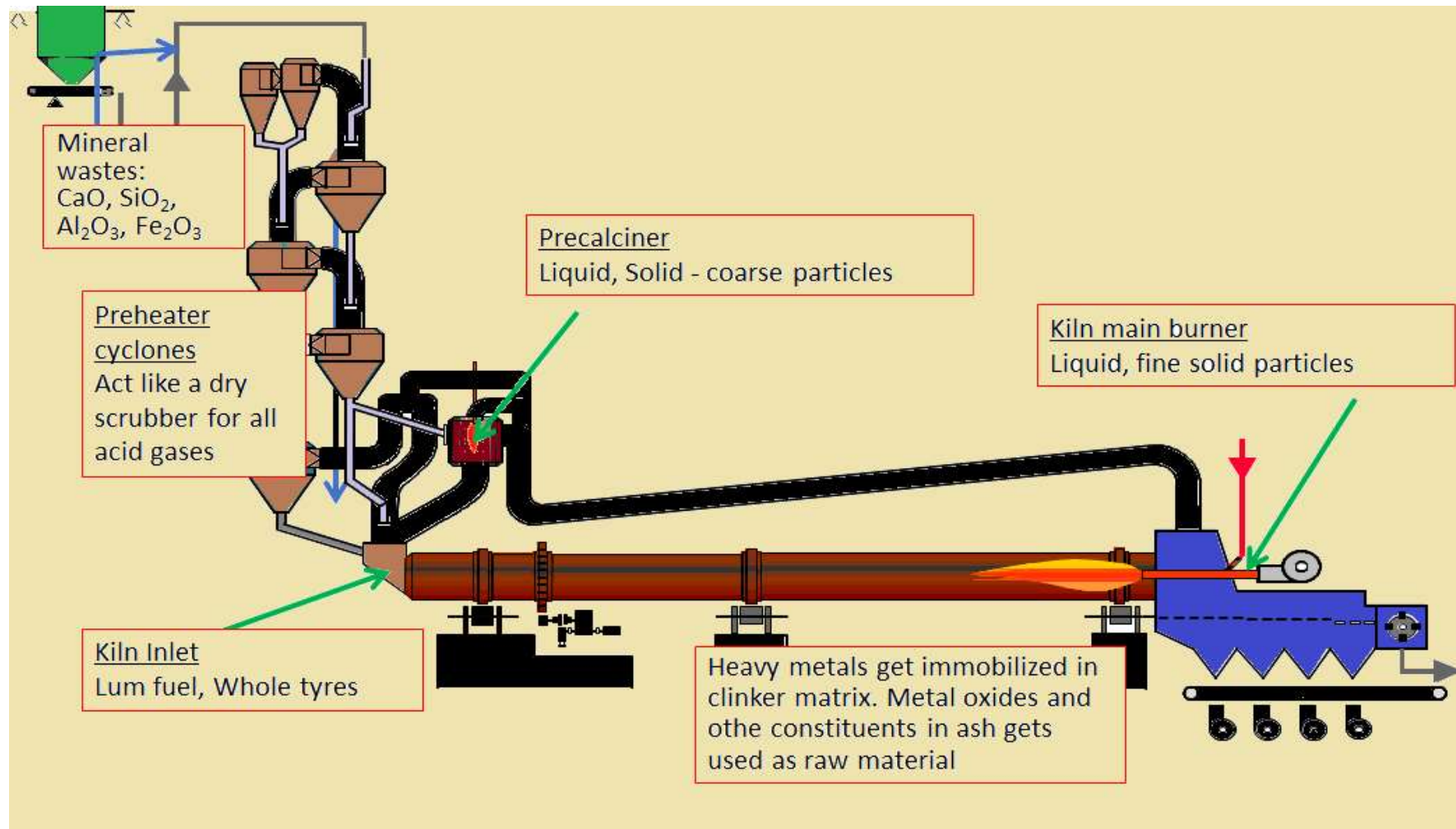


Co-processing Technology

- Cement kiln co-processing technology provides opportunity for the sustainable management of wastes from Municipal, Industrial and Agricultural sectors.
- These wastes have organic content and inorganic content. Organic content is a combustible material and it gets combusted during co-processing releasing the energy present in it. Release of this energy in the kiln causes reduction in the fossil fuel consumption of the kiln.
- The inorganic content present in the waste stream is generally a mixture of oxides of Calcium, Iron, Silicon, Aluminium and other metals. The raw materials used in cement manufacture is also a mix of the similar types of metal oxides. Hence, this inorganic content gets utilized as raw material in the cement manufacture.
- Therefore, the waste material gets utilized as Alternative Fuels & Raw Materials (AFRs) in the cement kiln co-processing.



Salient Features of Co-processing Technology



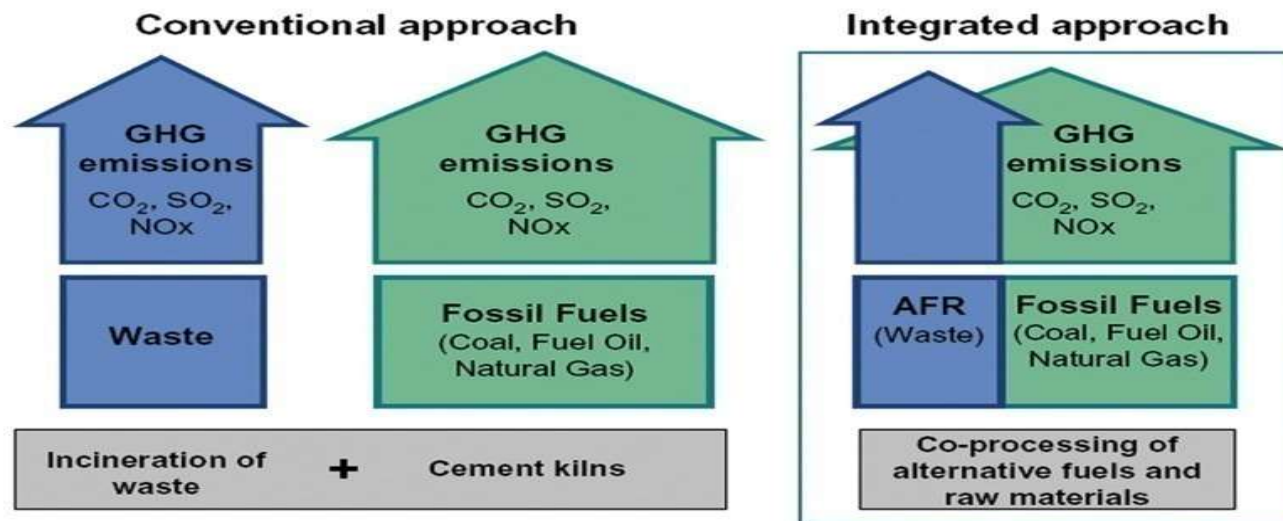
Important Considerations related to Co-processing

TSR

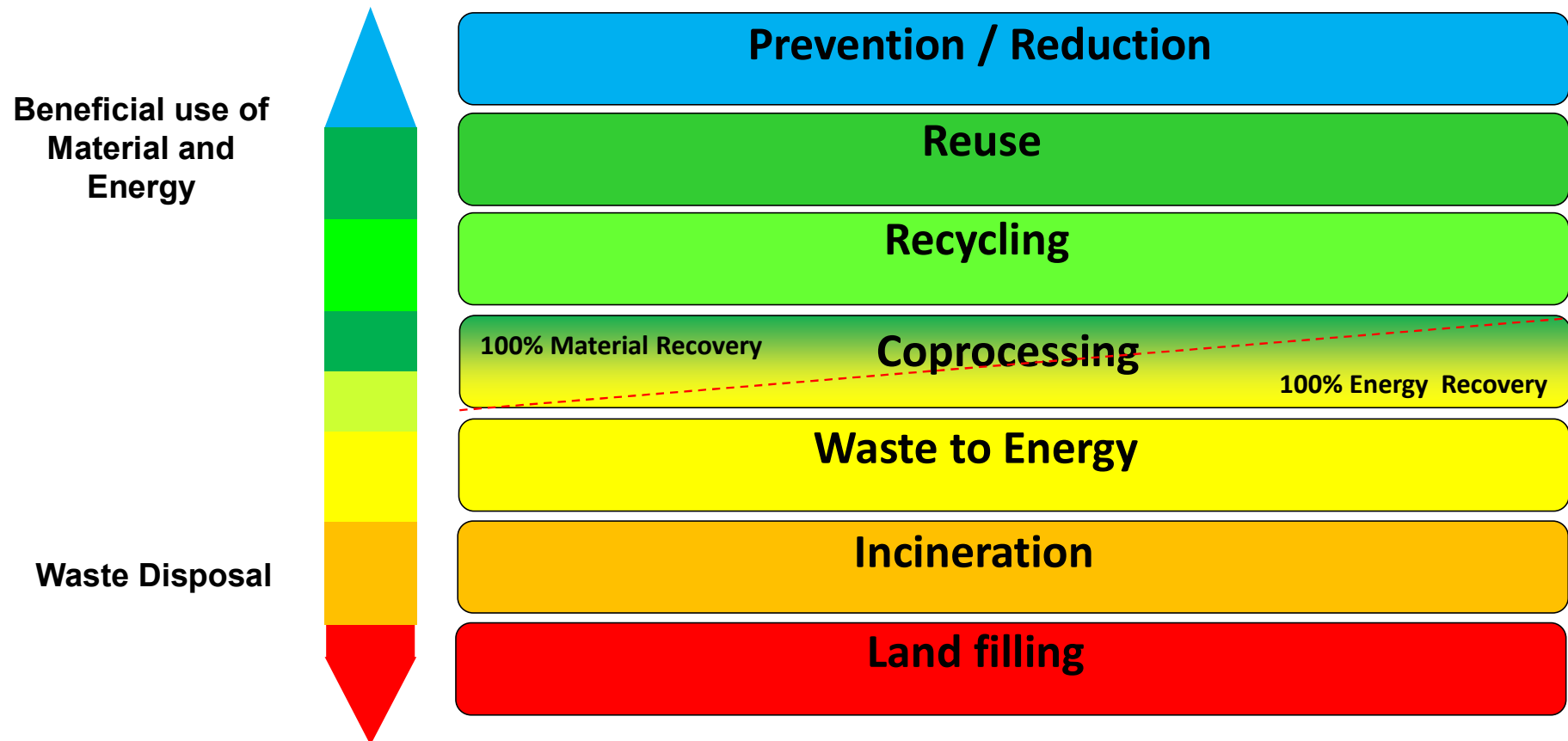
TSR stands for Thermal Substitution Rate. It signifies the percentage of energy utilized from waste & AFR in the clinker in the manufacturing process. It is calculated using following equation.

$$\text{TSR}\% = \left\{ \frac{\text{Thermal energy utilized from waste or AFR}}{\text{Total Energy utilized in the kiln process}} \right\} \times 100$$

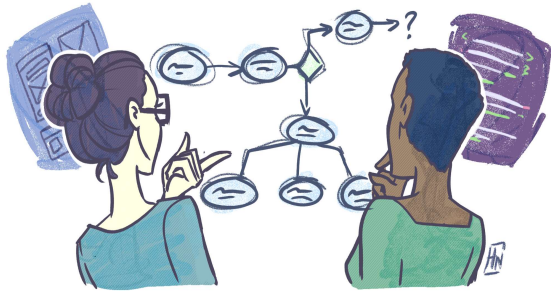
Co-processing mitigates Climate Change Impacts



Co-processing & Waste Management Hierarchy



QA / QC is key!!!



1. Waste Assessment



2. Waste Transportation



3. QA/QC Waste & Resource



4. Waste Processing



5. Waste Utilization

Advantages of co-processing in cement kilns

- Reduces
 - required number of landfills
 - pollution caused by dumping
 - greenhouse-gas emissions
 - environmental impact of extraction through mining
 - dependence on primary resource markets
 - cost of production of Cement
- Mitigates Climate Change Impacts
- Conserves Energy and Material resources
- Involves highly organised industrial sector
- Promotes Circular Economy

Principles of Co-processing

Principle I - Co-processing shall not be used in cement kilns if better ecological ways of recovery are available.

Principle II - During AFR co-processing, emissions from the cement kiln shall not be higher than those with traditional fuel.

Principle III - The clinker, cement & concrete shall not be abused as a sink for heavy metals.

Principle IV - Companies & personnel engaged in co-processing should have good environmental and safety compliance track records.

Principle V - Implementation of co-processing has to take into consideration country specific regulations and procedures.

Principle VI - Availability of proper infrastructure to control AFR feed rate

Wastes Suitable For Co-processing

Municipal sector:

There are three kinds of waste that are derived out of MSW which can be utilized as AFRs in the cement kilns.

1. Non-recyclable plastic waste:

Non-recyclable Plastic waste includes Single Use Plastic, Multi-Layer Packaging, contaminated plastic scrap, thermo-set plastic waste, etc. Generally, this kind of plastic waste is available from (a) agencies who are recycling plastic waste, (b) brands who have obligation under Extended Producer Responsibility (EPR), (c) Material Recovery facilities of Municipalities, etc.



2. Segregated Combustible Fraction (SCF):

SCF from MSW is a mix of waste plastics, paper, rexin pieces, rubber, shoes, chappals, tires pieces, tubes pieces, old and torn clothes, contaminated plastics, paper & clothes, wood pieces, coconut shells & other biomass, etc. SCF is generally available from agencies who are processing garbage in an integrated MSW treatment facility, agencies who are processing dry fraction of MSW and agencies who are implementing dump yard remedying, etc.



3. Dried Sewage sludge (DSS):

DSS is generated during treatment of the sewage sludge. The desired moisture content in DSS for use as AFR in cement kiln is less than 10%.



Wastes Suitable For Co-processing

Industrial sector

Hazardous as well as non-hazardous wastes are generated during industrial manufacturing processes. These can be in the form of solid, liquid and sludges. Hazardous wastes consist of date expired medicines, ETP sludges, Distillation residues, process residues, paint sludges, chemical sludges, obsolete pesticides, failed batches containing hazardous substances, etc. Non-hazardous wastes consist of packaging items, date expired products from FMCG and Food sector, etc.



Wastes Suitable For Co-processing

Agricultural sector

This includes non-cattle feed bio-waste such as agricultural waste, Biomass, Tree / leaves felling, Pulse stems, crop residue, residue from food processing industries, etc.



Banned Wastes For Pre-processing & Co-processing

Wastes that can be co-processed only after pre-processing



Wastes that cannot be pre-processed or co-processed



Sources of AFR

S. No.	Waste	Source
1	Biomass / Agro-waste	Local Farming community, Forest Department, Grain processing industries, Food processing industries, wood processing industries, Municipalities, Traders dealing with biomass supply, etc.
2	SCF	Material Recovery Facilities created by Municipalities, Integrated Waste Management Facilities, Dump yard remedying project sites, NGOs, EPR projects implemented by PIBOs
3	RDF	SCF to RDF processing plants, Plastic Pyrolysis projects.
4	Plastic waste	Plastic recyclers, Municipalities, PIBOs implementing EPR projects.
5	Tire Chips	Tire manufacturers, Tire processing agencies, rubber Crum manufacturing industries, pyrolysis plants, imports.
6	Rubber waste	Rubber products manufacturing industries, Shoe sole manufacturing companies, shoe manufacturing companies.
7	Hazardous wastes	TSDF operators, Industries generating hazardous wastes, Hazardous waste processing industries, FRP & SMC products manufacturing companies, Pharmaceutical Companies for date expired medicines, etc.
8	Non-hazardous Wastes	Non-hazardous waste generating industries, tire pyrolysis projects, sponge iron industries, FMCG, Food & kindred companies, water treatment projects.



Important Considerations For Smooth Co-processing

1. Pre-processing of wastes into AFRs

Generally, wastes do not have quality specifications. They vary considerably from lot to lot and source to source. In cement kiln, uniformity in the quality of all input materials is very important from the point of view of smooth kiln operation and clinker quality. Hence, for achieving desired quality of AFR from waste streams, their pre-processing is required. For co-processing higher level of AFRs, standard deviation in the quality of pre-processed AFR needs to be lowered. Pre-processing can be carried out either by cement plant or by a third-party agency depending upon the convenience of the relevant business model.

2. Permissions for co-processing of wastes

Co-processing operation involves utilizing wastes as resources. Wastes have liabilities and uncertain in their behaviors. Therefore, as per regulatory frameworks of the respective countries, the pre-processing and co-processing of wastes get monitored and controlled by authorities who have been assigned the relevant responsibilities of granting permissions.

These permissions are of two kinds.

- (1) Setting up facilities for pre-processing and co-processing of wastes and AFRs and
- (2) for handling, storage, pre-processing and co-processing of the waste materials in these facilities.



Important Considerations For Smooth Co-processing

3. Monitoring and control of AFRs while co-processing

AFRs are derived out of waste materials and may therefore contain constituents that can influence emissions, impact product quality and disturb the clinkerization process. Hence, it is important to monitor the AFR quality in required details to ensure smooth operation of the cement kiln. Following are the important quality parameters that need to be evaluated for smooth and trouble-free cement kiln co-processing operation.

- Net Calorific Value
- Ash Content
- Moisture Content
- Chlorine content
- Sulphur content
- Ash analysis in terms of CaO , SiO_2 , Al_2O_3 , FeO & Other oxides
- Heavy metal content.
- Viscosity if liquid waste stream
- Unacceptable constituents present in AFR
- Flash point

Therefore, an important aspect is to also set up a laboratory with suitable instruments at the co-processing site.



Important Considerations For Smooth Co-processing

4. Emission Monitoring during co-processing

As AFRs are derived out of waste materials and everything present in waste may not have been analyzed (example Heavy Metals, complete Ash analysis), it is important to monitor the emissions from the kiln on real time basis using Continuous Emission Monitoring System (CEMS).

Currently CEMS with different design considerations are available for installation on the cement kiln stack. Some of these provide online assessment of individual parameters such as dust, SO_x, NO_x, VOC, etc. There are others which are more versatile and in a single probe can provide online monitoring of various parameters simultaneously such as SO_x, NO_x, H₂O, HCl, HF, CO₂, CO, VOC, NH₃, etc.

The statutory provision in India demands that the output from the online CEMS installed on the kiln stack measuring Dust, SO_x and NO_x is connected to the data servers of the pollution control boards of state and the center.



Which wastes can be Pre & Co-processed?

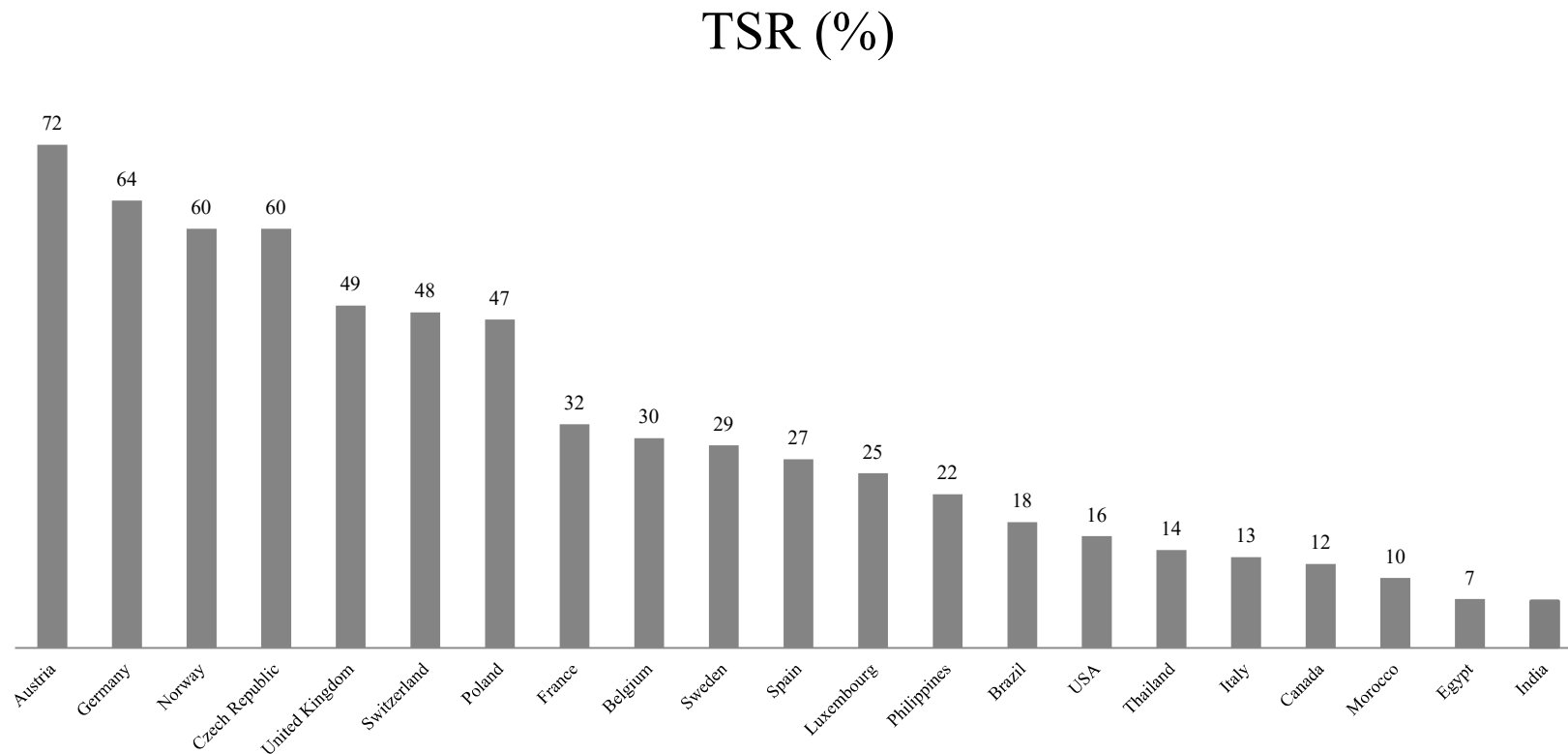
As per CPCB Guidelines on co-processing

- All non-recyclable, non-hazardous wastes
- All non-recyclable H&OWs belonging to Schedule I, II & III Category
- All non-cattle feed agro-wastes
- All kinds of expired food and other products
- All kinds of expired FMCG products.
- All kinds of non-recyclable plastic wastes
- SMC and FRP waste materials, etc.

Co-processing trial is not required for authorizing co-processing of any waste stream.



Amount of Wastes used in cement kilns



Huge Opportunity exists for utilising large quantum of wastes as AFRS in the Indian Cement Industry



Thanks!



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