Global Cement and Concrete Association

GCCA Sustainability Guidelines for co-processing fuels and raw materials in cement manufacturing

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Global Cement and Concrete Association (GCCA) is registered in England & Wales, Company No. 11191992

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Global Cement and Concrete Association

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Executive Summary

The co-processing of alternative fuels and raw materials in cement manufacturing to replace fossil fuels and primary raw materials is a longstanding contribution of the sector towards a circular economy and provides an important service to communities in making beneficial use of a range of society's waste and by-products.

The Global Cement and Concrete Association (GCCA) is committed to support its members and the sector to optimise the use of alternative fuels and raw materials where technically, environmentally and economically viable. This document, and its supporting Annex, provides practical guidance for the successful and safe use of alternative fuels and raw materials in cement operations.

These guidelines also define the KPIs for the co-processing of alternative fuels and raw materials that are considered most relevant for the cement industry. GCCA members are committed to set targets, measure and report these KPIs to the GCCA to drive continuous performance improvement and to meet their obligations under the GCCA Sustainability Charter. These KPIs can also be used to benchmark company performance. The GCCA publishes aggregated results taking into account legal constraints and confidentiality limitations.

1. Introduction

1.1 The Global Cement and Concrete Association

The Global Cement and Concrete Association (GCCA) is the global voice of the cement and concrete sector. One of the objectives is to develop and strengthen the sectors contribution to sustainable construction across the value chain. The GCCA aims to foster innovation throughout the construction value chain in collaboration with industry associations as well as architects, engineers, developers, contractors and innovators. In this way, the association demonstrates how concrete solutions can meet global construction challenges and sustainable development goals while showcasing responsible industrial leadership in the manufacture and use of cement and concrete. The GCCA was established in January 2018 and is headquartered in London.

1.2 GCCA Sustainability Charter

These guidelines for co-processing of fuels and raw materials in cement manufacturing are part of a package of guidelines developed to support compliance with the *GCCA Sustainability Charter*[1]. The GCCA Sustainability Charter has identified five key pillars which encompass the sustainability issues for the cement and concrete sector:

- Health & Safety
- Climate Change and Energy
- Social Responsibility
- Environment and Nature
- Circular Economy

In applying these guidelines GCCA members must implement the general requirements of the *GCCA Sustainability Framework Guidelines*[2].

1.3 Background

Cement and concrete have many positive attributes to support the transition to a circular economy. For example, concrete can enable resource efficient designs that are adaptable for future needs and can be used to create high performance, low-carbon buildings and infrastructure, that are highly durable, low maintenance, resilient and recyclable.

Consumption and use of natural resources has generally followed a linear approach where resources are sourced, used and disposed of as waste. The circular economy concept aims to decouple economic growth from resource consumption. Products and assets are designed and built so that components and their materials are maintained at the highest useful purpose as long as feasible, to minimise waste.

The cement and concrete sectors can make an important contribution by taking action within their own operations and by working across the value chain. Resource efficiency is not new to the sector and these guidelines focus on use of alternative resources in cement manufacturing.

1 GCCA Sustainability Charter, June 2019

2 GCCA Sustainability Framework Guidelines, June 2019

1.4 Relation to other documents

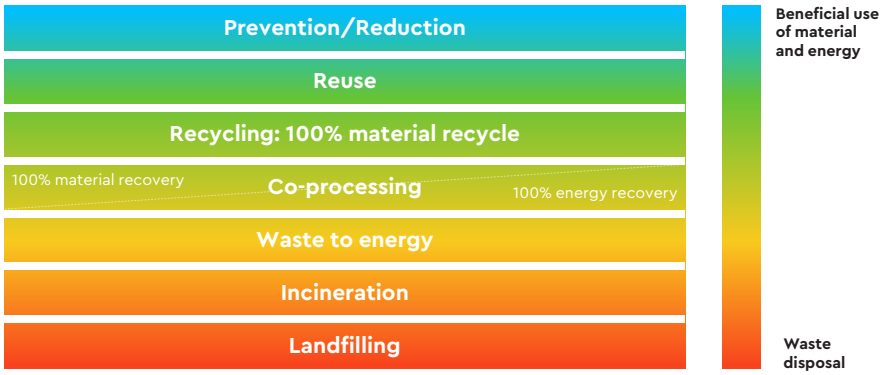
This document, in conjunction with the GCCA Sustainability Framework Guidelines, provides guidance to GCCA members to fulfil the requirements of the GCCA Sustainability Charter relating to Circular Economy and specifically the co-processing of fuels and raw materials in cement manufacturing. It is partially based on and supersedes the WBCSD-CSI document *Guidelines for Co-processing Fuels and Raw Materials in Cement Manufacturing, version 2, July 2014*. These guidelines are accompanied by a supporting Annex and provides additional practical guidance.

2. Relevance

Co-processing is a term used to refer to the use of suitable wastes, by-products, co-products or secondary materials (referred to in this document as "alternative fuels" and "alternative raw materials") in manufacturing processes for the purpose of energy and/or resource recovery and the resultant reduction in the consumption of primary fuels and raw materials.

Cement kilns provide the ideal conditions for co-processing. Where waste and by-products cannot be managed technically or economically by prevention, reduction, reuse or recycling, the cement manufacturing process provides a more ecologically sustainable solution compared to waste-to-energy, incineration or landfilling, thanks to full energy recovery and material recycling. Therefore, the use of cement kilns for co-processing is situated in the waste hierarchy in between recycling and energy recovery (Figure 1).

Figure 1: Co-processing in the waste hierarchy



In addition to the use of alternative fuels and raw materials in clinker manufacturing, these guidelines also cover the use of alternative raw materials, blended with clinker, in cement manufacturing.

The use of alternative fuels and alternative raw materials makes an important contribution to the circular economy because:

- It reduces the use of fossil fuels and primary raw materials;
- It can provide economic benefits to local communities, governments and to industry;
- It provides a solution to waste without the large capital expense of incinerators and waste-to-energy plants, or the resource inefficiencies associated with landfills;
- Alternative fuels and alternative raw materials can help to reduce CO_2 emissions. For example, alternative fuels can deliver indirect CO_2 savings and those that contain a biomass part, which can be considered CO_2 neutral, contribute to direct CO_2 emissions.

3. Objectives

This document, in conjunction with the GCCA Sustainability Framework Guidelines, provides guidance to GCCA members to fulfil the requirements of the GCCA Sustainability Charter relating to Circular Economy. However, the importance of monitoring and reporting should not be reduced to a statutory requirement under the GCCA Sustainability Charter – it is the basis of all efforts to support the use of alternative fuels and raw materials as well as transparency towards all our stakeholders.

The GCCA guidelines are intended as a tool for cement companies worldwide. They provide a harmonised methodology for calculating performance, with a view to reporting performance for various purposes. These guidelines address the co-processing of fuels and raw materials in clinker and cement manufacturing process.

4. Operational Context

The use of alternative fuels and raw materials offers many opportunities and advantages to cement manufacturers but they must be used in a responsible way. The key obligations for their responsible use are set out below with additional good practice advice provided in a supporting Annex.

4.1 Health & Safety

At a minimum, Companies must ensure compliance with local Health & Safety regulations. Ensuring safe and healthy working conditions for employees and contractors is a fundamental responsibility of the cement industry. GCCA guidance should be followed. The GCCA document, *Health & Safety in the Cement Industry: Examples of Good Practice*, will be made available and provides guidance on the handling of alternative fuels.

4.2 Communication and stakeholder engagement

Cement plants shall proactively engage with local stakeholders, ensuring that they are appropriately informed, ideally through a formal engagement plan. They shall also put in place procedures for community feedback and to respond to comments or complaints. Companies shall communicate systematically with stakeholders about their performance related to alternative fuels and raw materials use.

4.3 Environment

Companies must operate in strict adherence to local environmental regulations and engage in an appropriate manner with regulators in relation to their use of alternative fuels and raw materials. In general, because of the high temperatures required for kiln operation, the use of alternative fuels and raw materials should not lead to an increase in emissions, provided that they are managed in a responsible way. Experience shows that alternative fuel use can contribute to emissions reduction in some cases (for example, nitrogen oxides). Every cement plant shall respect environmental requirements regarding the acceptance, handling and management of wastes and by-products.

The monitoring and reporting of emissions should be carried out according to local permit specifications and regulatory requirements, or, where these do not exist, as a minimum the requirements in the latest version of the *GCCA Sustainability Guidelines for the monitoring and reporting of emissions from cement manufacturing* shall be followed.

4.4 Selection, acceptance and traceability

Alternative fuels and raw materials must meet (physical and chemical) quality specifications, in the same way as primary fuels and raw materials. Processes must be in place to both determine the suitability of alternative fuels and raw materials, and, once identified, prepare them for use (pre-processing). The physical and handling properties of each new material must be understood and operators should ensure that appropriate storage and handling equipment is installed.

In the selection of alternative fuels and raw materials, the potential impacts on the clinker and cement manufacturing operations, product quality and the environment must be assessed prior to use. Detailed guidance is provided in the Annex but in particular the following shall be considered:

- Alkali, sulphur, chloride and trace element content
- Heat (calorific) value
- Water content
- Ash content
- Potential impact on stability of operation

In the acceptance of alternative fuels and raw materials from suppliers, the following should be considered:

- The relationship between the supplier and the cement plant should be defined by a commercial contract outlining the specifications to be met.
- All candidate alternative fuels and raw materials should be identified by source prior to acceptance. The materials should be pre-screened to ensure the receiving facility is fully aware of the composition of the materials. Full traceability of the waste streams is recommended.
- Suitable protocols should be developed and implemented governing the delivery and reception of alternative fuels and raw materials on the site.
- The acceptance criteria should be reviewed (and updated) on a regular basis in accordance with local regulation, and in cases where there are no regulations, at least annually.
- The use of alternative fuels and raw materials with high levels of heavy metals can have the potential to impact on either the environment or the product quality. The analytical equipment needed to perform the necessary tests to support screening and acceptance criteria should be available internally or at an accessible external lab.

Further good practice advice on selection, preprocessing and acceptance will be found in the supporting Annex.

4.4.1 Commonly restricted wastes

Waste, which owing to its chemical composition, material properties or potential hazards, may influence the safety or operation of a cement plant, or whose use in a cement plant would lead to significant additional environmental impact, shall not be co-processed in cement plants. It is therefore necessary to specify quality requirements for the waste and in certain cases to restrict the use of particular wastes. As a consequence, the following is a list of waste materials that shall not be considered for co-processing in cement plants:

- Radioactive waste from the nuclear industry
- Electrical and electronic waste (e-waste)
- Whole batteries
- Corrosive waste, including mineral acids
- Explosives and ammunition
- Waste containing asbestos
- Biological medical waste
- Chemical or biological weapons destined for destruction
- Waste of unknown or unpredictable composition, including unsorted municipal waste
- Waste raw materials with little or no mineral value for the clinker.

Individual facilities may also exclude other materials depending on the local raw material and fuel chemistry, the infrastructure and the cement manufacturing process, the availability of equipment for controlling, handling and feeding the waste materials, and site-specific safety, health and environmental issues.

4.5 Transport and storage

GCCA members must act in compliance with local waste transport regulations. Where there are no specific regulations, hazardous wastes and other wastes should be packaged, labelled and transported in conformity with generally accepted and recognised international rules and standards, taking due account of relevant internationally recognised practices.

Only fully qualified and licensed transporters who are conversant with and conform to the applicable legal requirements shall be used in order to avoid accidents and, in particular, incidents due to the incompatibility of poorly labelled or poorly characterised waste or byproducts being mixed or stored together.

Companies proposing to import wastes must take into account the importing country's obligations under national law and the applicable international control regimes concerning transboundary movements of wastes.

The storage of alternative fuels and raw materials shall take into account safety and health, environmental, and emergency response provisions and comply with all applicable local and national regulations.

5. Performance Indicators

Five KPIs have been defined for the assessment of the performance, see Table 1.

Table 1: KPIs

Number	Description	Unit
1	**Alternative fuel rate (kiln fuels)** The energy contained in consumed alternative fuels divided by the total heat consumption from all kiln fuels used in manufacturing the clinker produced during the year.	%
2	**Biomass fuel rate (kiln fuels)** The energy contained in consumed biomass fuels and the biomass content of mixed fossil and biomass fuels divided by the total heat consumption from all kiln fuels used in manufacturing the clinker produced during the year.	%
3	**Specific heat consumption for clinker production** The total energy contained in all fuels consumed divided by the tonnes of clinker produced during the year.	MJ/tonne
4	**Alternative Raw Materials rate (% ARM)** Consumption of alternative raw materials in clinker and cement as a percentage of total raw material used in manufacturing the clinker produced (calculated on a dry basis).	%
5	**Clinker/cement (equivalent) factor** The clinker/cement (equivalent) factor calculated based on the total clinker consumption and cement produced.	%

KPIs 1, 2, 3 and 5 shall be calculated using the Basic Parameters set out in the *GCCA Sustainability Framework Guidelines*[3] and according to *GCCA Sustainability Guidelines for the monitoring and reporting of CO_2 emissions from cement manufacturing*[4].

3 GCCA Sustainability Framework Guidelines, June 2019

4 GCCA Sustainability Guidelines for the monitoring and reporting of CO_2 emissions from cement manufacturing, GCCA, June 2019

Examples

KPI 4 Alternative raw materials rate

The calculation is made on a company basis for the clinker and cement production stages using data for the reporting year. The company shall record the amount (in tonnes) and average moisture content of each primary raw material and alternative raw material consumed in clinker and cement production.

Raw materials consumed in clinker produced:
Clinker produced: 1419553 tonnes

	Primary raw materials		Alternative raw materials		
	Raw Material 1	Raw Material 2	Fly ash	Iron additive	Slag
Wet basis	1136175 t	1305950 t	68674 t	11473 t	7053 t
Moisture	9.6%	10.2%	20.7%	9.9%	5.8%
Dry basis	1027102 t	1172743 t	54458 t	10337 t	6644 t

Total primary raw materials consumed in clinker produced (dry) = 2199845 tonnes
Total alternative raw materials consumed in clinker produced (dry) = 71439 tonnes
Total raw materials consumed in clinker produced (dry) = 2271284 tonnes

% alternative raw materials consumed in clinker produced (dry) = (71439/2271284) x 100
= 3.15%

Raw materials consumed in cement produced (excluding clinker):
Cement produced: 3013166 tonnes

	Primary raw materials		Alternative raw materials		
	Raw Material 1	Raw Material 2	Fly ash	Slag	Synthetic gypsum
Wet basis	50000 t	120000 t	150000 t	400000 t	230000 t
Moisture	9.6%	7.5%	0.2%	5.4%	4.5%
Dry basis	45200 t	111000 t	149700 t	378400 t	219650 t

Total primary raw materials consumed in cement produced (dry) = 156200 tonnes
Total alternative raw materials consumed in cement produced (dry) = 747750 tonnes
Total raw materials consumed in cement produced (dry) = 903950 tonnes

% alternative raw materials consumed in cement produced (dry) = (747750/903950) x 100
= 82.72%

Clinker/cement (equivalent) factor = 0.70

Alternative raw materials rate (% ARM):

% ARM = (% alternative raw materials in clinker produced x clinker/cement (eq)) +
(% alternative raw materials in cement produced x (1-clinker/cement (eq))
= (3.15 × 0.70) + (82.73 x (1 – 0.70))
= 27.0%

6. Glossary and Definitions

Alternative fuels (AF):
Fuel derived from non-primary materials that can be further divided into biomass, fossil and mixed (fossil and biomass) alternative fuels.

Alternative raw material (ARM):
Raw materials derived from non-primary materials (waste, secondary materials, by-products or co-products).

By-product:
A substance or object resulting from a production process where the primary aim of the production process is not to produce that item (i.e. a production residue). A by-product can be used directly in normal industrial practice without requiring chemical transformation; it fulfils all relevant product, environmental and health protection requirements and will not lead to adverse environmental or human health impacts.

Cement:
Building material made by grinding clinker together with various mineral components such as gypsum, limestone, blast furnace slag, coal fly ash and natural volcanic material; includes special cements such as the ones based on calcium aluminates.

Circular economy:
A new economic model that is regenerative by design. The goal is to retain the value of the circulating resources, products, parts and materials by creating a system with innovative business models that allow for long life, optimal (re)use, renewability, refurbishment, remanufacturing and recycling. By applying these principles, companies can collaborate to innovate in our products and design out waste, while maximising the benefit for the society and environment by co-processing waste of human origin and other industries, increase resource productivity and maintain resource use within our planetary boundaries.

Clinker:
Intermediate product in cement manufacturing and the main substance in cement; clinker is the result of calcination of limestone in the kiln and subsequent reactions caused through burning.

Co-processing:
The use of alternative fuels and raw materials in manufacturing processes for the purpose of energy recovery and/or material recycling and resultant reduction in the use of primary fuels and/or raw materials through substitution.

KPI:
Key Performance Indicator

Secondary material:
Material recovered from previous use or from waste which substitutes primary materials.

Waste:
Any substance or object which the holder intends to discard or is required to discard.

Waste hierarchy:
A tool used in the evaluation of processes that protect the environment alongside resource and energy from the most favourable to the least favourable actions (see Figure 1).