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ClimaEast

Support to Climate Change Mitigation and Adaptation in Russia and ENP East countries

Cement industry
Industrial emissions – IPPC

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Multiple regulatory frameworks

Regulation	Description / Focus	Main Legal Act
EU ETS	European Emission Trading Scheme – GHG reduction	Directives 2003/87/EC 2009/29/EC
IED	Industrial Emissions Directive – Prevention and Control of Industrial Emissions	Directive 2010/75/EU
IPPC	Integrated Pollution Prevention and Control	Directives 96/61/EC 2008/1/EC
REACH	Registration, Evaluation and Authorization of Chemicals	Regulation (EC) No 1907/2006

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Cement manufacturing
Core process

- **Calcination**
  Decomposition of calcium carbonate ($CaCO_3$) at about 900°C to calcium oxide (CaO, lime) and liberated gaseous carbon dioxide (CO_2)
- **Clinkering**
  The calcium oxide reacts at a high temperature (typically 1400–1500°C) with silica, alumina, and ferrous oxide to form the silicates, aluminates, and ferrites of calcium which comprise the clinker.
- **Grounding**
  The clinker is ground or milled together with gypsum and other additives to produce cement.

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Cement manufacturing
Main process routes

- **Dry process**
  Raw materials are ground and dried to raw meal in the form of a flowable powder. The dry raw meal is fed to the preheater or precalciner kiln or, more rarely, to a long dry kiln
- **Semi-dry process**
  The dry raw meal is pelletized with water and fed into a grate preheater before the kiln or to a long kiln equipped with crosses.
- **Semi-wet process**
  The slurry is first dewatered in filter presses. The resulting filter cake is extruded into pellets and then fed either to a grate preheater or directly to a filter cake dryer for raw meal production
- **Wet process**
  Raw materials (often with a high moisture content) are ground in water to form a pumpable slurry. The slurry then is either fed directly into the kiln or first to a slurry dryer.

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Cement manufacturing process

All processes have the following sub-processes in common:

- **Raw materials** – storage and preparation
- **Fuels** – storage and preparation
- **Use of wastes** as raw materials and/or fuels – quality requirements, control and preparation
- **The kiln systems** – kiln firing processes and emissions reduction techniques
- **Products** – storage and preparation
- **Packaging and dispatch**

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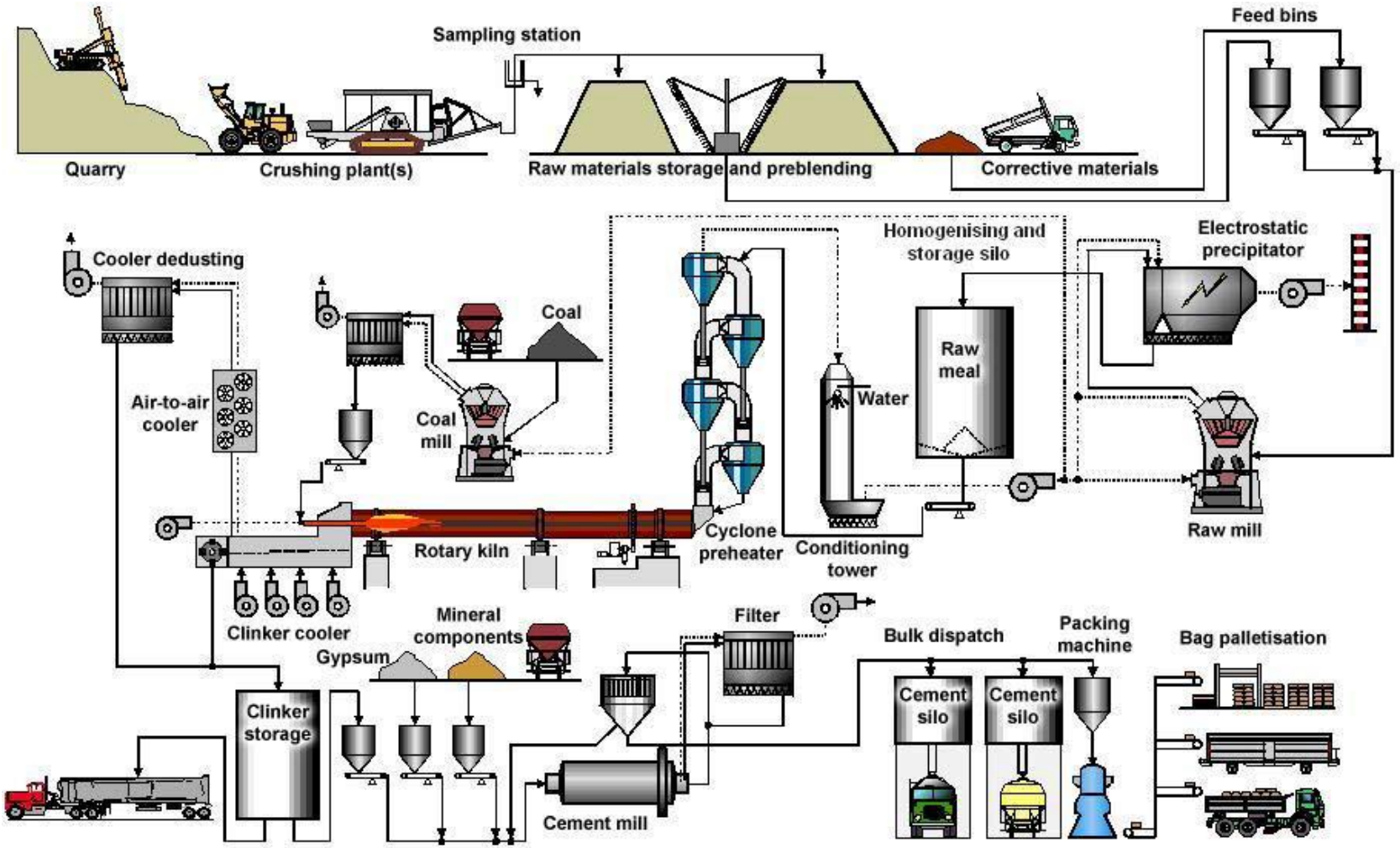
Cement Production Process



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Industrial Emissions Directive

IED Principles	Description
Integrated approach	Permits must take into account the whole environmental performance of the plant
Best Available Techniques	BAT shall be the reference for setting permit conditions
Flexibility	Allowing the licensing authorities to set less strict emission limit values in specific, justified cases
Inspections	The IED requires a site visit shall take place at least every 1 to 3 years
Public participation	The public has a right to participate in the decision-making process

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Integrated Polution Prevention and Control

- **I**ntegrated **P**ollution **P**revention and **C**ontrol – a permitting system for industrial plants based on an EU IPPC Directive 96/61/EC.
- The IPPC permit as a permit for operation of an installation replaces previous decisions defining:
  - volume of gas emissions or dust from the installation introduced into the air,
  - permissible noise level,
  - terms for waste production and methods of dealing with waste,
  - requirements to be met by waste discharged to sewage network,
  - terms for water consumption,
  - permissible electromagnetic field

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Integrated Polution Prevention and Control

- The key benefits for companies are:
  - Single integrated permit covering all environment protection related components
  - Single application procedure
- The directive concerns the most polluting industry sectors. Some sectors are only covered if exceeding certain capacities. The six categories are:
  - Energy industry
  - Production and processing of metals
  - **Mineral industry incl. Cement industry**
  - Chemical industry
  - Waste management
  - Other activities

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Integrated Polution Prevention and Control

- The idea of developing a mechanism of IPPC permits was to create effective legal mechanisms enforcing prevention of emissions, limitation of installations' impact on the environment and establishment of uniform environmental protection requirements across the EU.
- The requirements aim at limitation of business inequality on the international market.
- At least once every 5 years, relevant environmental authorities analyse the issued IPPC permit.
- In order to implement common environment protection standards in the EU and to gradually raise the standards and decrease industry's environmental impact, IPPC permit imposes on the operator the necessity to apply in the installations the Best Available Techniques – BAT.

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Best Available Techniques

Best	Most effective in achieving a high general level of protection of the environment as a whole
Available	Possible to implement under economically and technically viable conditions, taking into consideration the cost and advantages – cost/benefit.
Techniques	Includes both the **technology** used and the **way** in which the installation is designed, built, maintained, operated and decommissioned

- EU has formed the "European Integrated Pollution Prevention an Control Bureau" which is situated in Seville.
- This organization works on and issues BAT reference documents (BREFs).

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Best Available Techniques

- Once the EU Commission publishes the BAT notes, these must be taken into account when determining BAT for an installation in the member states.
- The introduction of the BAT principle means that the best available techniques will have to be implemented in all enterprises in the future.
- If a company is not living up to the standards for its sector, an action plan to reach the goals will be negotiated with the authorities.
- The Pollution Prevention approach and the holistic approach will characterise the applications and the permitting procedure in the future.

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IED – Cement Industry

- In 2013 the European Commission implemented Decision 2013/163/EU establishing the BAT conclusions on industrial emissions for the production of Cement, Lime and Magnesium oxide (CLM)
  - General BAT conclusions
    - Environmental Management System (EMS)
    - Noise
  - BAT conclusions for cement industry

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Cement industry – BAT

BAT conclusions for Cement industry cover:

- General primary techniques
- Monitoring
- Energy consumption and process selection
- Use of waste
- Dust emissions
- Gaseous compounds
- PCDD/F emissions
- Metal emissions
- Process losses/waste
- Description of techniques – dust, SO_2, NOx emissions

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Cement industry
BAT conclusions

- General primary techniques
  - Process control optimisation, including computer-based automatic control
  - Using modern, gravimetric solid fuel feed systems

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Cement industry – BAT

Energy consumption and process selection

- In order to reduce energy consumption, BAT is to use a dry process kiln with multistage preheating and precalcination

Process	Unit	BAT-associated energy consumption levels
Dry process with multistage preheating and precalcination	MJ/tonne clinker	2 900 – 3 300

Industrial Emissions – BAT

In order to reduce/minimize thermal energy consumption, BAT is to use a combination of the following techniques:

- Applying improved and optimised kiln systems and a smooth and stable kiln process, operating close to the process parameter set points
- Recovering excess heat from kilns, especially from their cooling zone
- Applying the appropriate number of cyclone stages
- Using fuels with characteristics which have a positive influence on the thermal energy consumption
- Using optimised and suitable cement kiln systems for burning wastes
- Minimising bypass flows

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Cement industry
BAT conclusions

In order to reduce primary energy consumption BAT is to consider:

- The reduction of the **clinker content** of cement and cement products

- **Cogeneration**/combined heat and power plants by recovering waste heat from the clinker cooler or kiln flue-gases using the conventional steam cycle processes or other techniques

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Cement industry
BAT conclusions

In order to reduce/minimise electrical energy consumption, BAT is to use one or a combination of the following techniques:

- Using power management systems
- Using grinding equipment and other electricity based equipment with high energy efficiency
- Using improved monitoring systems
- Reducing air leaks into the system
- Process control optimisation

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Industrial Emissions – BAT

Use of waste – Best Available Techniques cover:

- Waste quality control
  - to guarantee the characteristics of the wastes to be used as fuels and/or raw materials in a cement kiln and reduce emissions,
- Waste feeding into the kiln
  - to ensure appropriate treatment of the wastes used as fuel and/or raw materials in the kiln
- Safety management for the use of hazardous waste materials
  - to apply safety management for the storage, handling and feeding of hazardous waste materials

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Industrial Emissions – BAT

Dust emissions – Best Available Techniques cover:

- **Diffuse dust emissions**
  - to minimise/prevent diffuse dust emissions from dusty operations
  - to minimise/prevent diffuse dust emissions from bulk storage areas
- **Channeled dust emissions** from dusty operations such as: the crushing of raw materials, raw material conveyors and elevators, the storage of raw materials, clinker and cement, the storage of fuels and the dispatch of cement
  - to apply a maintenance management system which especially addresses the performance of filters applied to dusty operations

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Industrial Emissions – BAT

Dust emissions – Best Available Techniques cont.

- **Dust emissions from kiln firing processes**
  - In order to reduce dust emissions from flue-gases of kiln firing processes, BAT is to use dry flue-gas cleaning with a filter
- **Dust emissions from cooling and milling processes**
  - In order to reduce dust emissions from the flue-gases of cooling and milling processes, BAT is to use dry flue-gas cleaning with a filter

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Industrial Emissions – BAT

NOx emissions

- In order to reduce the emissions of NOx from the flue-gases of kiln firing and/or preheating/precalcining processes, BAT is to use one or a combination of the following techniques:
  - Primary techniques
    - Flame cooling
    - Low NOx burners
    - Mid-kiln firing
    - Addition of mineralizers
  - Staged combustion
  - Selective non-catalytic reduction (SNCR)
  - Selective catalytic reduction (SCR)

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Industrial Emissions – BAT

SOx emissions

- In order to reduce the emissions of SOx from the flue-gases of kiln firing and/or preheating/precalcining processes, BAT is to use one or a combination of the following techniques:
  - Absorbent addition
  - Wet scrubber
- In order to reduce SO_2 emissions from the kiln, BAT is to optimise the raw milling processes by adjusting the following factors:
  - Raw material moisture
  - Mill temperature
  - Retention time in the mill
  - Fineness of the ground material

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Industrial Emissions – BAT

Other industrial emissions – recommended techniques cover:

- CO emissions and CO trips
- Total organic carbon emissions (TOC)
- Hydrgene choride (HCl)
- Hydrogene Fluoride (HF)
- Dioxins and Furans (PCDD/F)
- Metal emissions
- Process losses/waste

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Cement Industry – Emissions Limits

Emissions	Unit	Limit Values IED – Annex VI
Total dust	mg/Nm^3	30
HCl	mg/Nm^3	10
HF	mg/Nm^3	1
NOx Preheater NOx Lepol and long kiln	mg/Nm^3	500 < 800 until 2016
Cd + Tl	mg/Nm^3	0,05
Hg	mg/Nm^3	0,05
Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V	mg/Nm^3	0,5
Dioxins and Furans	ng/Nm^3	0,1
SO_2	mg/Nm^3	50
TOC (Total Organic Compounds)	mg/Nm^3	10

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