Driving the Cement and Concrete Industry's Journey Towards Net Zero Carbon by 2050

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Geopolymer – Low Carbon Concrete

Cement and Concrete Industry

- **Largest used materials on earth**

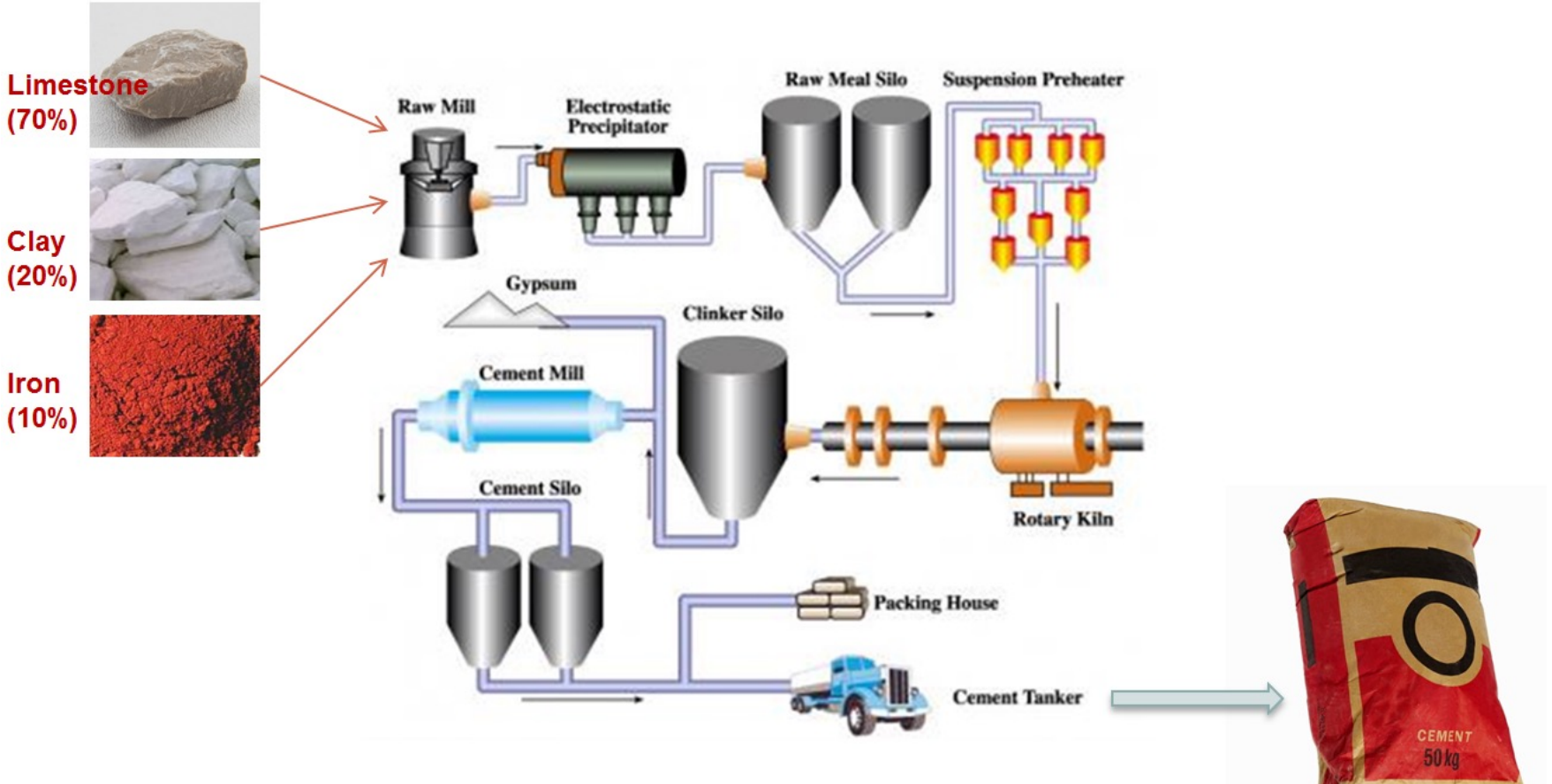
  Annual cement production 3.5 billion tonnes, consequently concrete production is 35 billion (5 ton/person).

- **Buildings and infrastructure**

  The base of our modern life.

- **Cheapest in strength build-up**

Cement Production



Cement and Concrete

- Raw materials: limestone and clay - 4 billion tons; aggregates – 30 billion tons; water 2 billion liter.
- Energy: third largest industrial energy consumer (1400°C calcination, 900°C preheating and milling).
- Carbon emission: 4 billion tons of greenhouse gas (8% of global emission).

- Huge amount of construction materials to meet the demand.
- Requirement for energy efficiency and environmental friendly.
- Concrete producers needs new, eco-compatible and cost-effective materials for energy efficient building materials.
- Waste management is an increasingly complex and challenging task

  - abundant availability of fly ash (700 million tons per year, and only 14%. was utilized).
  - ground granulated blast furnace slag
  - red mud (from aluminum production industry)
  - river sludge

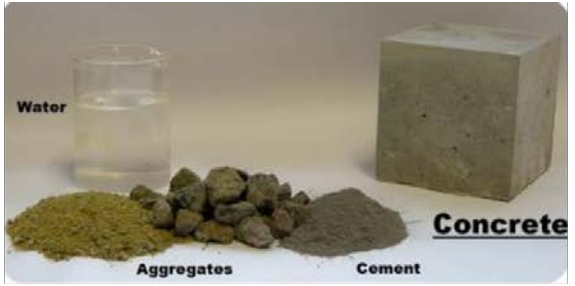
Old Fly Ash – ash pond

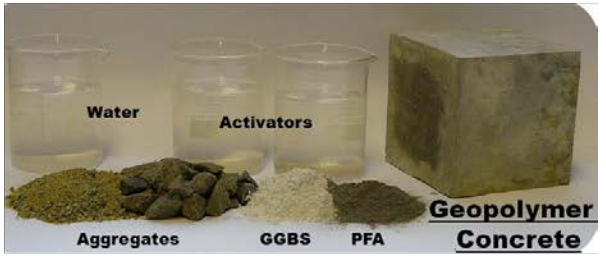
Billions of tonnes of fine grade fly ash currently reside within ash ponds alongside current coal burning power stations

Net Zero Strategies

1. Current OPC Production: Energy efficiency, new energy options, centralized plants.
2. Low Carbon Cement: Geopolymer.

Fly ash and/or slag provide the source of aluminosilicate



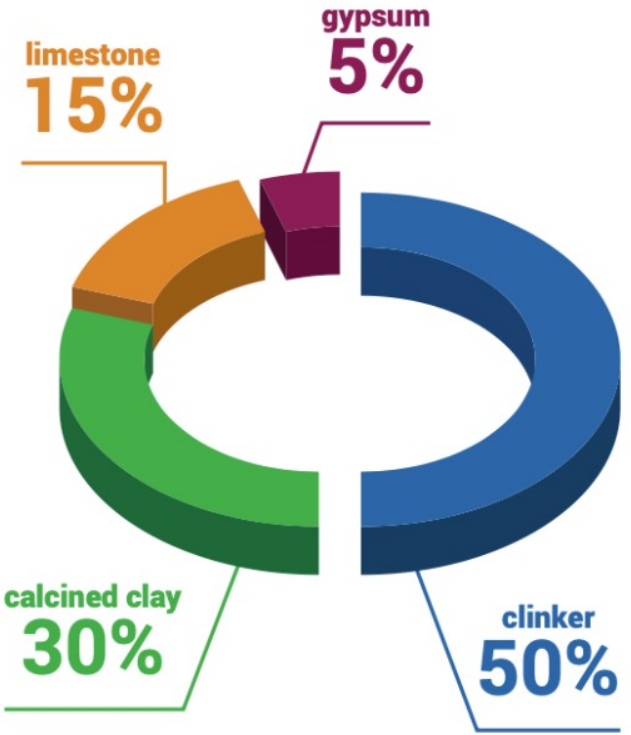


Industrial wastes + **Alkaline solution** → (room temp) **Green cement**

3. Low Cement Concrete:

- Supplementary Cementitious Materials: fly ash, slag, silica fume, calcium carbonate natural pozzolans
- LC^3, limestone calcined clay cement

- reduce CO2 emissions by up to 40%, is made using limestone and low-grade clays which are available in abundant quantities.
- cost effective and does not require capital intensive modifications to existing cement plants.



4. High strength and high durability:

- Ultra-high performance concrete (UHPC): 200MPa
- High durability concrete

5. Demolished concrete utilization:

- Coarse aggregate: Crushed concrete as coarse aggregate in new concrete mixes.
- Subgrade layer of pavements.
- Filler.
- Supplementary cementitious material.
- Feedstock for clinker production

- Challenges in using demolished concrete
  - Demolished concrete may have a large variation of raw materials and a higher rate of water absorption.
  - There are still challenges concerning the adoption and eco-efficiency of using recycled concrete.
  - There are still operational barriers that prevent the complete re-recycling of waste concretes.

Australia Low Carbone Concrete Projects

Wellcamp airport, Toowoomba (2013-2015)

Geopolymer concrete used throughout: 40,000m^3, and 8,640 t CO_2 emission saving

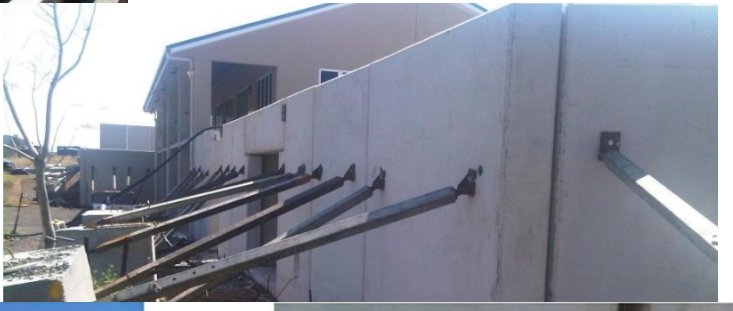
- Turning node - 16,000 m^2, 435 mm thick.
- Aprons and taxiways - 32,000m^2, 435 mm thick.
- Hangars - 2,500 m^2 , 435 mm thick.

The Global Changing Building, UQ, Brisbane

- 5 storey building
- 33 precast geopolymer floor beams

Retaining wall, Toowoomba, QLD, Australia

40 MPa



Bridge deck, Brisbane, QLD, Australia

Footpath, Toowoomba, QLD, Australia

Conclusion

Cement and concrete industry’s journey towards net zero is challenging but very rewarding. It needs all stakeholders to work together.