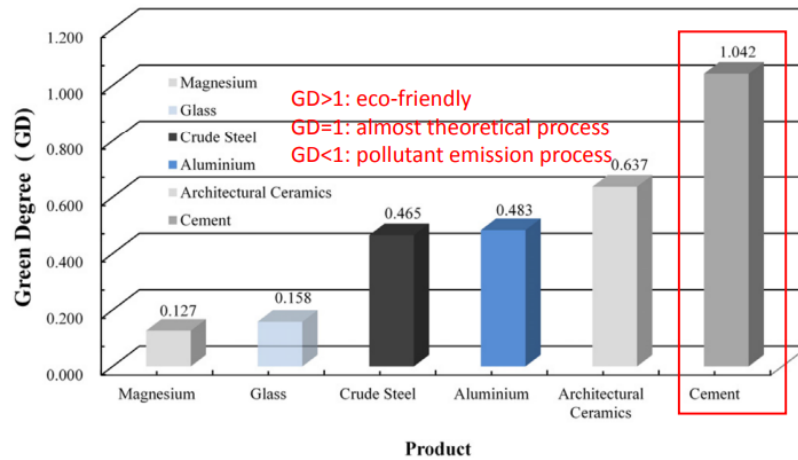


Concrete Materials

Environmental



Comparison of GD of different industries of China (D. Xu et al., 2015)

$$GD = \frac{\text{Theoretical usage of natural resources for unit qualified product}}{\text{Actual usage of materials for unit qualified product}}$$

Advantages

- Durable
- Economical
- Formed on Site
- Energy Efficient
- Inflammable
- Thermal Resistance
- Water Resistant
- Aesthetics

Disadvantages

- Brittle
- Slow Material Development
- Low Strength to Weight Ratio
- Formed on Site
- Volume Instability

Different types of concrete

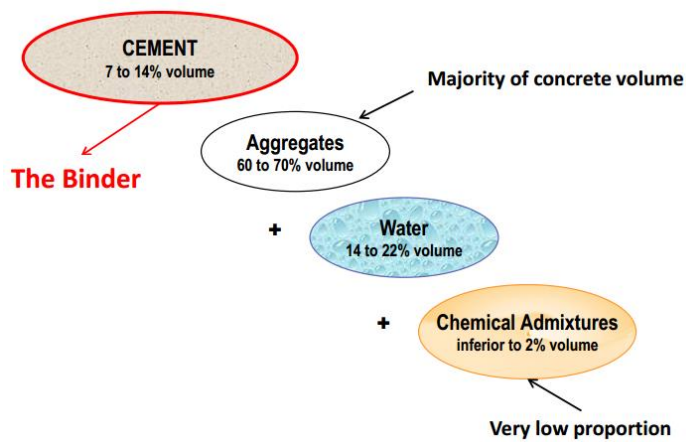
- Mechanical properties
 - o Fiber Reinforced Concrete
 - o Ultra High Performance Concrete
- Workability
 - o Self-compacting concrete
 - o Roller-compacted concrete
- Durability and Environmental Concern
 - o Self Healing Concrete
 - o Alkali Activated Material based Concrete
 - o Self-Cleaning Concrete (photocatalytic concrete)

Scales

- Meso
 - o Coarse Aggregate
 - o Mortar (sand + cement)
- Micro
 - o Fine aggregate
 - o Paste (cement)
- Nano
 - o Resin

Components

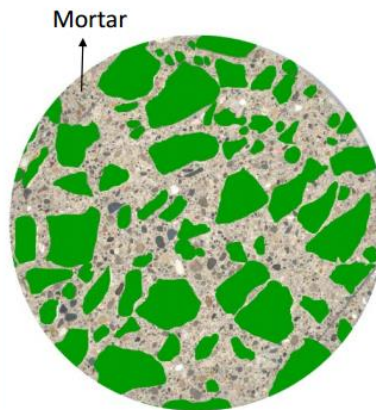
- Cement + Fine & Coarse Aggregate + Water



- • Concrete Proportions



Concrete



Coarse Aggregate

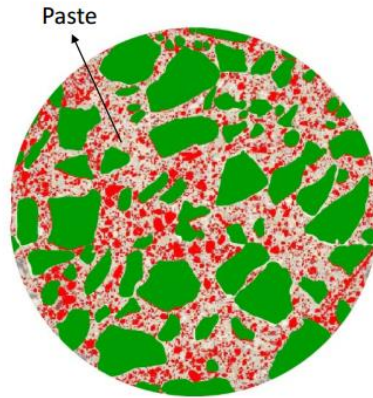
Concrete taken from I-465 outside Indianapolis, Courtesy by J. W. Weiss

- Mortar = Cement + Water + Fine Aggregate
- Mortar = cement + water + fine aggregate

• Concrete Proportions



Concrete



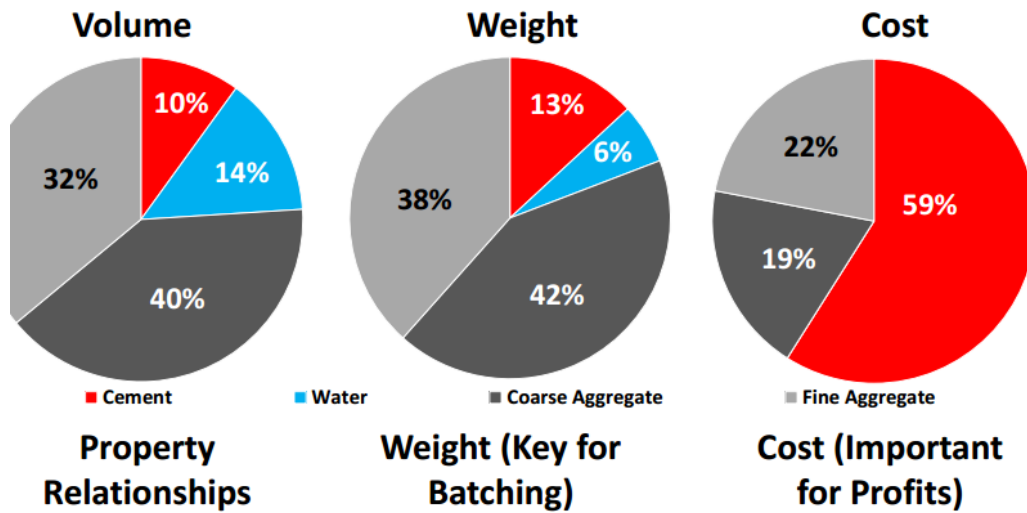
Fine Aggregate

Concrete taken from I-465 outside Indianapolis, Courtesy by J. W. Weiss

- Paste = Cement + Water
- Paste = cement + water

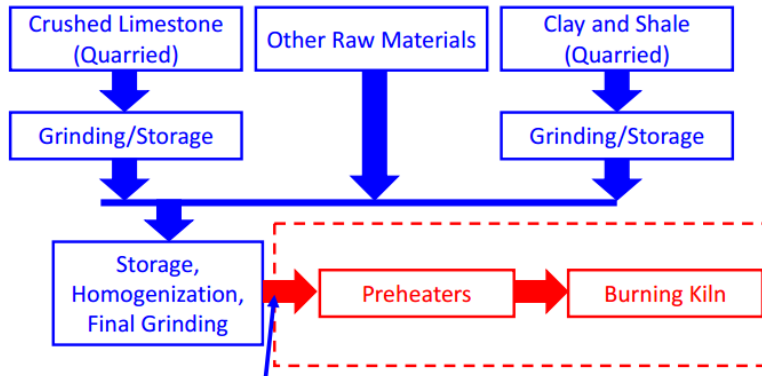
Proportions

- Cement = 3.15 x water
- Agg = 2.6 x water



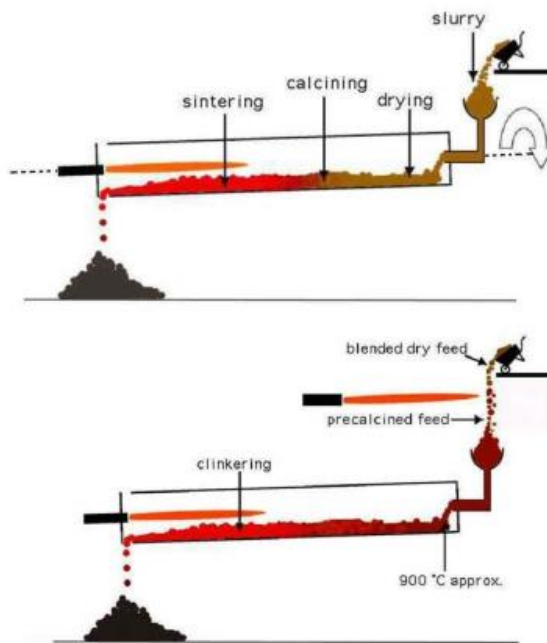
Cement

- Powder Binder to bind materials together
- Based from limestone, factory usually near limestone mine
- Limestone mined then crushed, then grinded into powder



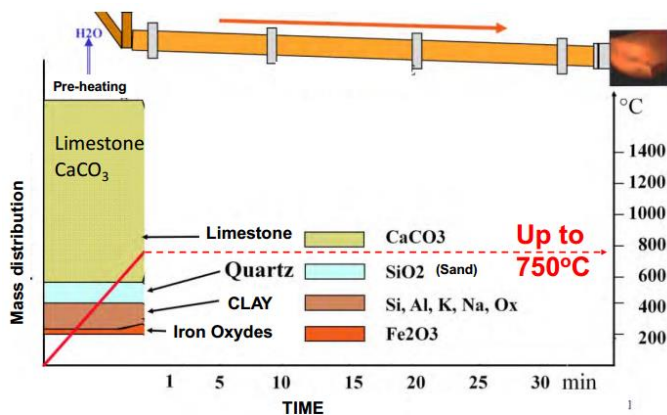
- Material is ready to be processed further

- Wet-Process Kiln vs. Dry-Process Kiln



- o Wet – heat transfer not very efficient
- o Dry is better, kiln can be shorter and heat transfer is more efficient

Kiln Zones



- Dehydration Zone (up to ~500 or 750 °C)