

# Cement

Lecture - 2

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- ✓ *Method of cement manufacturing*
  - *Dry Process*
  - *Wet Process*
- ✓ *Process involved in cement manufacturing*

# Methods of Cement Manufacturing



Portland Cement is manufactured by two processes.

- **Dry Process**
- **Wet Process**

The main difference b/w two processes is that in the dry process, **calcareous** and **argillaceous** raw material are fed into the burning kilns in a perfect dry state.

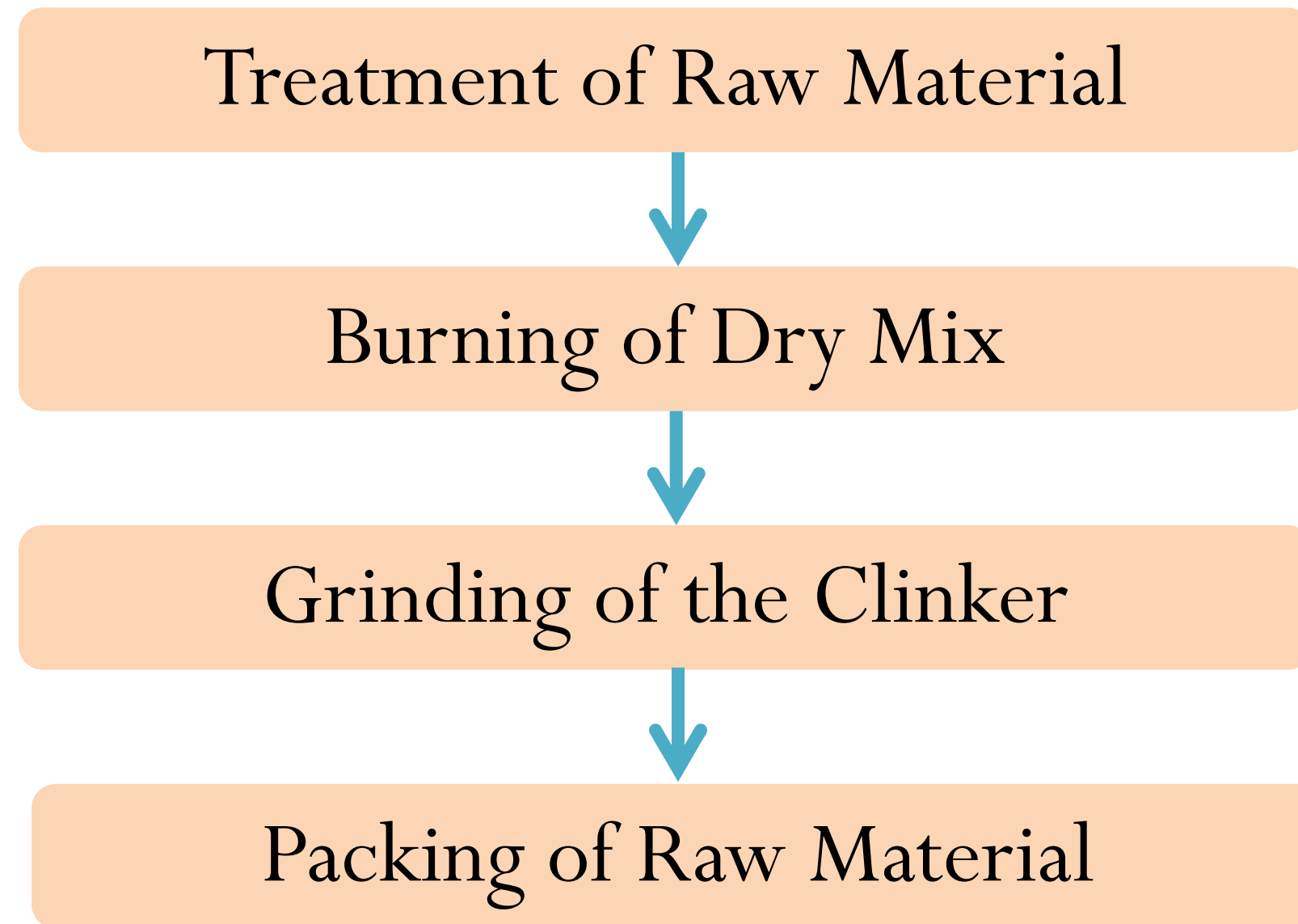
# Methods of Cement Manufacturing



In the wet process, however these material are supplied to the kilns in the form of an intimate mixture with water called  
**SLURRY**

# Dry Process

Following are main steps in this process of manufacture:



# Treatment of Raw Material

- The raw materials- **limestone and clay**, are subjected to such processes as crushing, drying, grinding, proportioning and blending or mixing before they are fed to the kilns for *calcinations* or *burning*.

## Crushing Stage

- Breaking raw material to small fragments (*Sizes 6-14 mm*). Crusher is used for this Purpose.

# Treatment of Raw Material



## Drying Stage

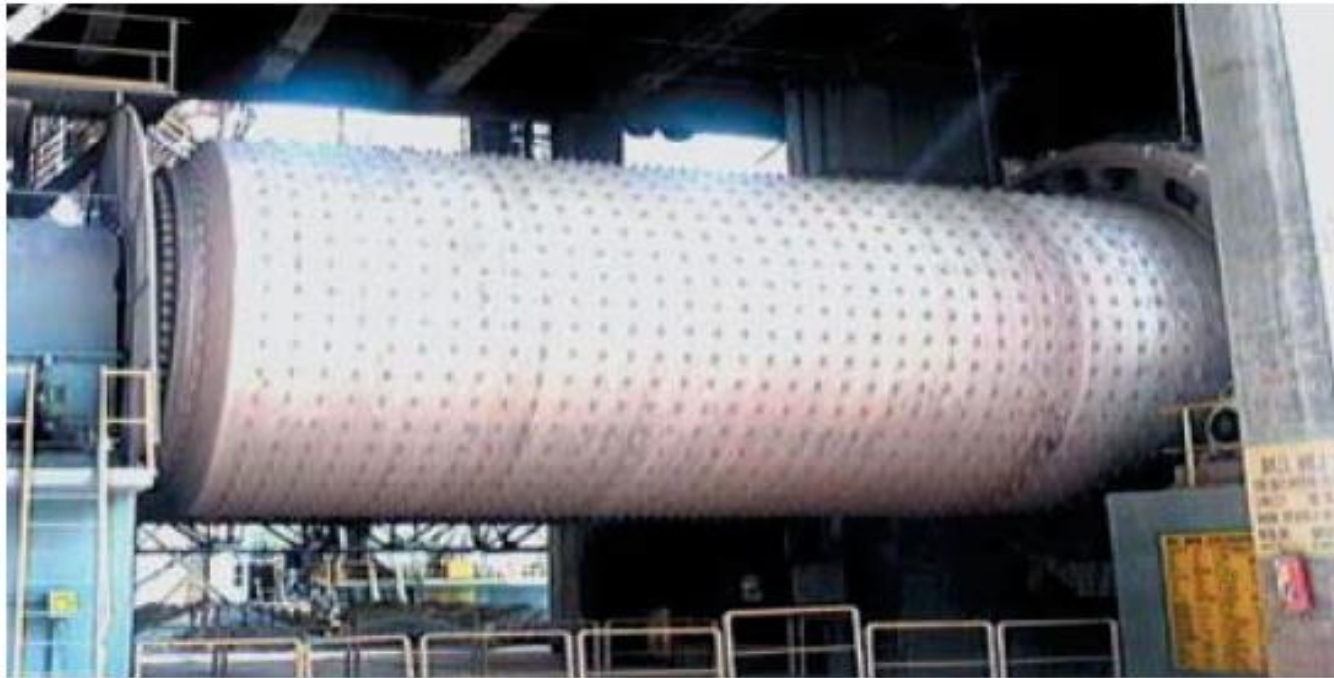
- Heating the material at high temperature in a drying kiln which are generally of rotary type.

## Grinding Stage

Two stages

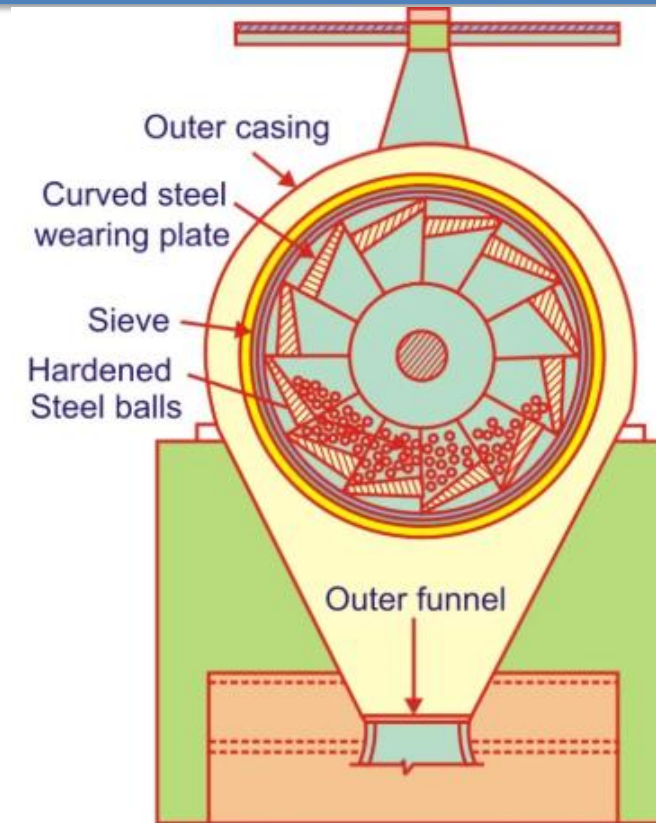
- Preliminary grinding-material reduced to a fineness of 50 mesh (0.297 mm). Ball mills are generally used for preliminary grinding.
- Second, the fine grinding ; Size of material reduced to 200 mesh (.074 mm).

# Treatment of Raw Material



RAW MILL

The proportioned raw materials are transported by belt conveyor to Raw Mill for grinding into powder form before burning.



Ball mill is a rotating steel cylinder in which there are hardened steel balls. When the mill rotates, the steel balls pulverise the raw materials which forms into a solution with water. This liquid mixture is known as slurry. This slurry is then passed into storage tanks known as silos where their proportioning is finally adjusted to ensure the correct chemical composition.



# Treatment of Raw Material



- Further, it is stored in storage tank called **SILOS** or bins wherefrom it can be drawn out conveniently in requisite quantity.



<https://www.indiamart.com/proddetail/silo-cement-20984820133.html>

## Proportioning and Blending

- The finely dried and ground raw materials are mixed together before they are fed into kiln. Mixing can be done by either mechanical or by pneumatic methods.

# Burning and Calcination

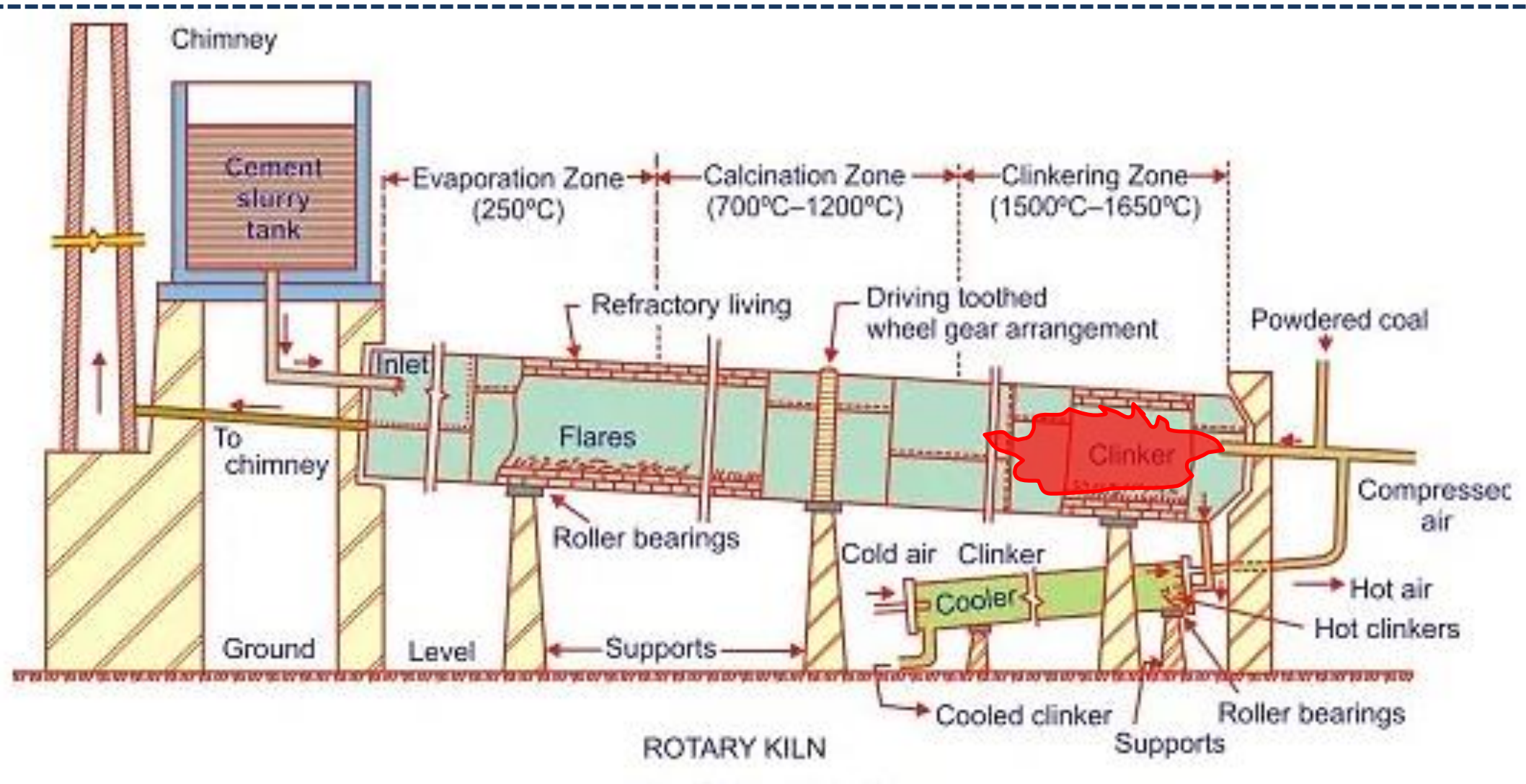


- The final powder mixture is put into **Rotary Kiln** (Long steel cylinder). Kiln is adjusted in an inclined position (**15° with the horizontal**). It has a charge end and a burner end.
- **Charge end**- Introduced the materials (Called feed).
- **Burner end**- for supplying fuel.

# Burning and Calcination

- Length of rotary Kiln- 100 to 180 m.
- Diameter- 3 to 5 m.
- Rotation- 60 to 90 revolution per hour
- The raw material (calcareous and argillaceous) is burnt in a kiln, till, the greenish black and vitreous lustre is achieved.

# Rotary Kiln



Water completely  
Evaporate  
250°C

Dissociation of  
carbonates  
700°C-1200°C

Compound  
formation  
1500°C-1650°C



# Burning and Calcination



- **Complete Dehydration-** Water is completely driven off at the very initial stage of burning at temperatures as low as  $400^{\circ}\text{C}$ .
- **Dissociation of carbonates -  $800^{\circ}$ - $900^{\circ}$** 
  - ✓  $\text{CaCO}_3$  (Calcium carbonate) =  $\text{CaO}$  (calcium oxide) +  $\text{CO}_2$  (Carbon dioxide)
  - ✓  $\text{MgCO}_3$  (Magnesium Carbonate) =  $\text{MgO}$  (Magnesium oxide) +  $\text{CO}_2$  (Carbon dioxide)

# Burning and Calcination



## Compound Formation

Lime combined in this stage with

- ✓ Silica
- ✓ Alumina
- ✓ Ferric Oxide

to form the basic compound of cement namely

✓ **Tri-calcium and di-calcium silicate**

✓ **Tri-calcium Aluminates**

✓ **Tetra Calcium Alumino Ferrite**

*Compound formation start at around 1200°C as high as 1500°C*

# Burning and Calcination



- Clinker placed near to the burner end to eliminate alkalies, moisture and other harmful gases.
- This burnt material, now called **clinker** is cement in **composition but not in size**. It is about **walnut-sized lumps** when it came out of the kiln.



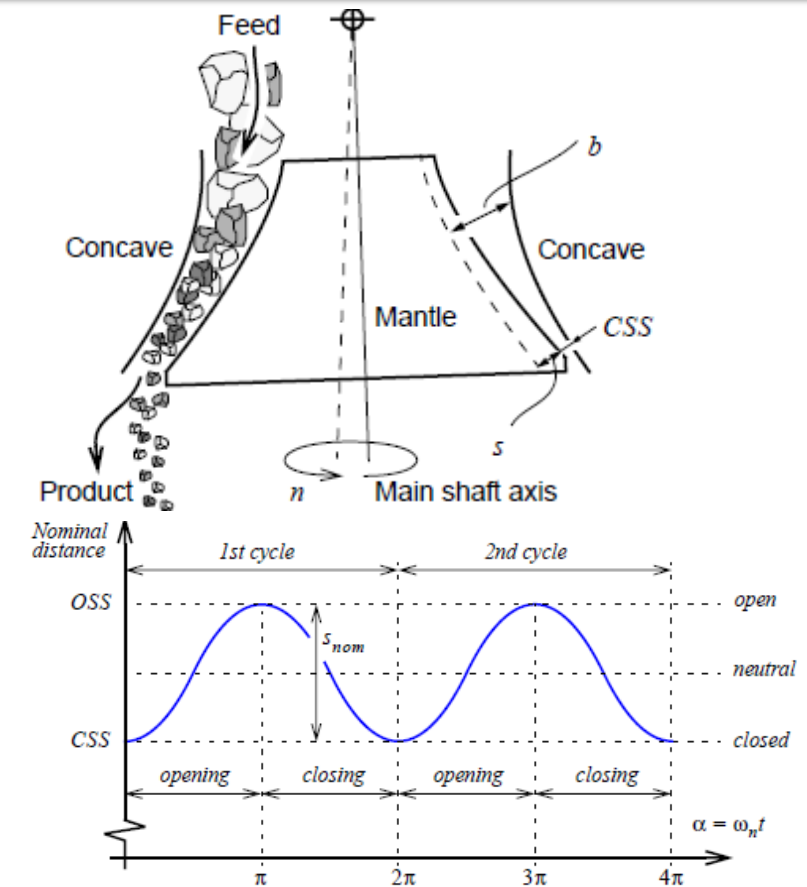
# Grinding of Clinker



- The extremely hot clinker obtained from the kiln first cooled down in a clinker coolers. A predetermined batch of gypsum is added to the cooled clinker and both are sent for pulverizing.
- In the pulverisers the mixture is reduced to an extremely fine powder by grinding it in two stages:
  - ✓ Preliminary grinding- **Gyratory type of crusher**
  - ✓ Fine grinding- **Tube mills**

# Grinding of Clinker

Gyratory crushers feature a conical head and concave surface (often lined with manganese steel) and break apart material by compression through what is known as eccentric movement. Like jaw crushers, gyratory crushers are often utilized in primary crushing stations, though they may sometimes be used as secondary crushers, as well



*For a fixed point in the chamber the distance between mantle and concave varies cyclically with time.*

**Breakage of particles can be by;**

- *Single Particle*- particles are broken b/w cone and mantle
- *Inter Particle* - between other particles
- CSS – Closed Side Setting
- OSS – Open side Setting

<https://www.kemperequipment.com/blog/rock-crushers-everything-you-need-to-know/>

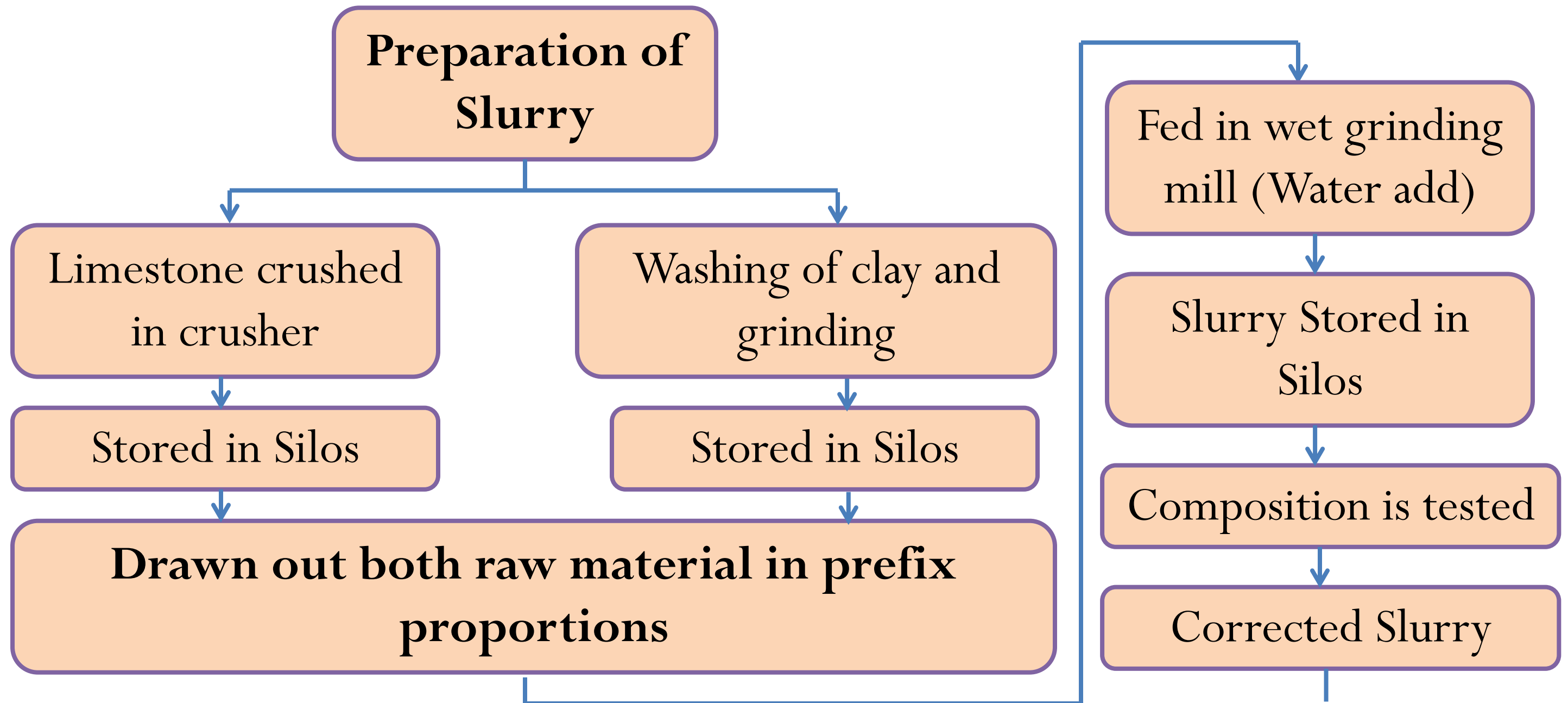
Magnus Evertsson, Cone Crusher Performance

# Wet Process

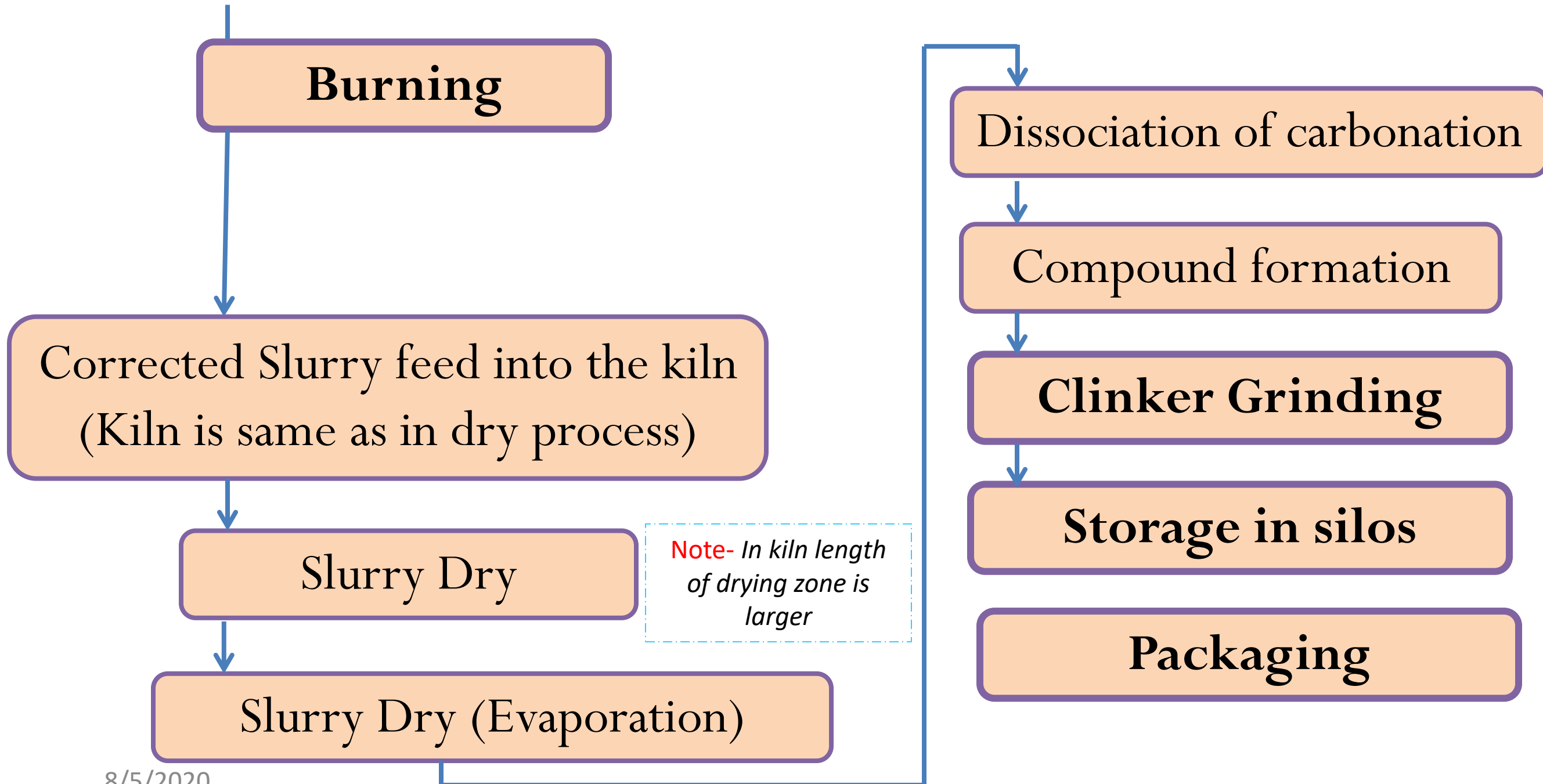
It is better and convenient process for the manufacture of cement, especially where limestone of soft variety is available in abundance.

- Preparation of Slurry
- Calcination
- Treatment of Clinker

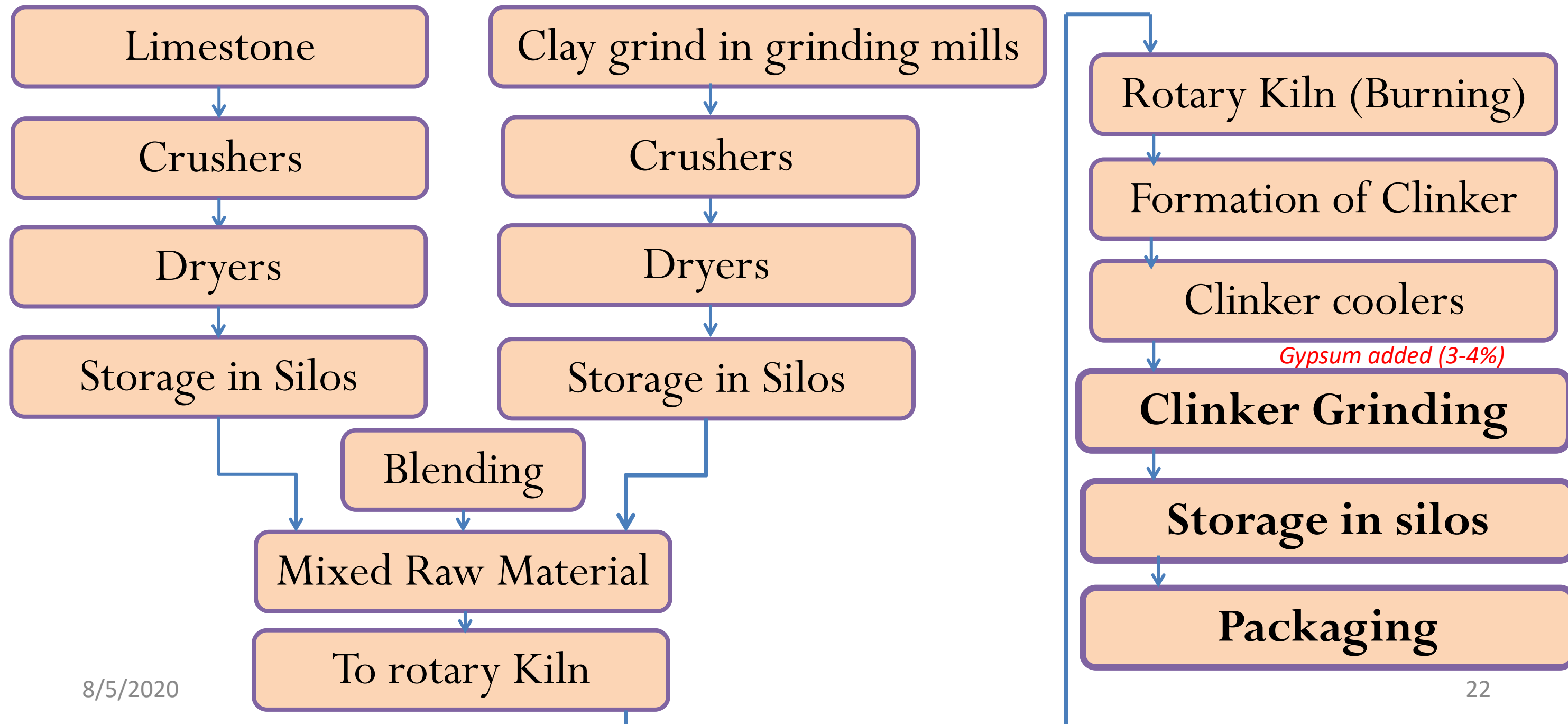
# Flow Diagram of **Wet Process** for Cement Manufacturing



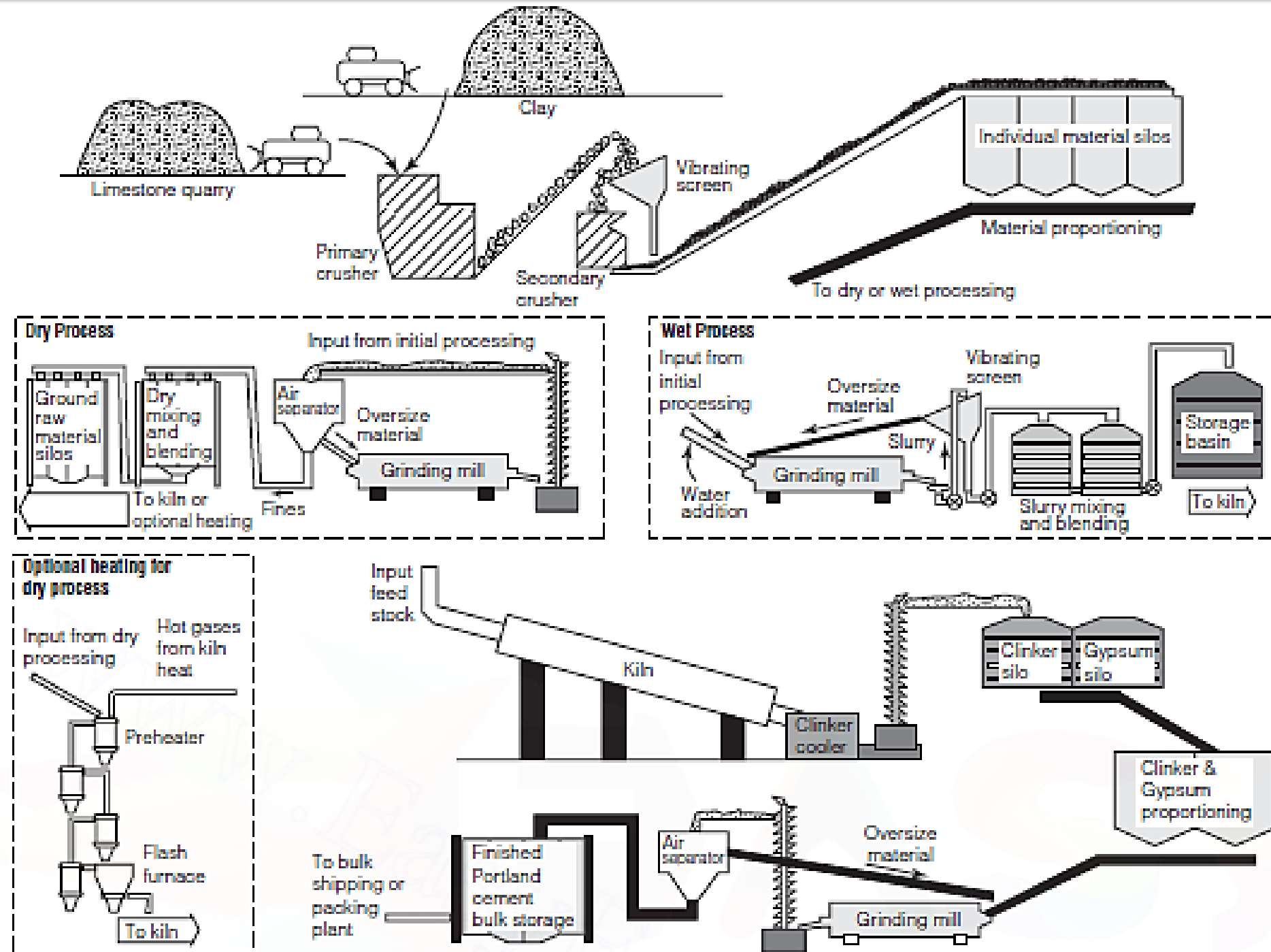
# Flow Diagram of Wet Process for Cement Manufacturing



# Flow Diagram of **Dry Process** for Cement Manufacturing



# Steps in Manufacture of Portland Cement



# Summery



- ✓ Method of manufacturing the cement
- ✓ Complete process of manufacturing the cement using dry process
- ✓ Complete process of manufacturing the cement using wet process
- ✓ Flow Diagrams of Wet and Dry Process



THANK YOU