

Cement

- 5marks

(Himal Cement factory)

→ Cement is the most important material for construction manufacturing. It is the binding material i.e obtained by burning at 1300°C - 1500°C of Calcareous, siliceous & argillaceous raw materials mixed in definite proportion and crushing & grinding to get a fine powder.

The average composition of portland cement is
 CaO (52-60%), SiO_2 (20-25%), Al_2O_3 (5-10%),
 MgO (2-3%), Fe_2O_3 (1-2%), Na_2O (1%), K_2O (1%).

Raw

Raw Material for Cement Production

1) Calcereous Material [which supply lime]

e.g.: limestone, chalk, clay, shales, note; calcium carbonate from Industrial rock process.

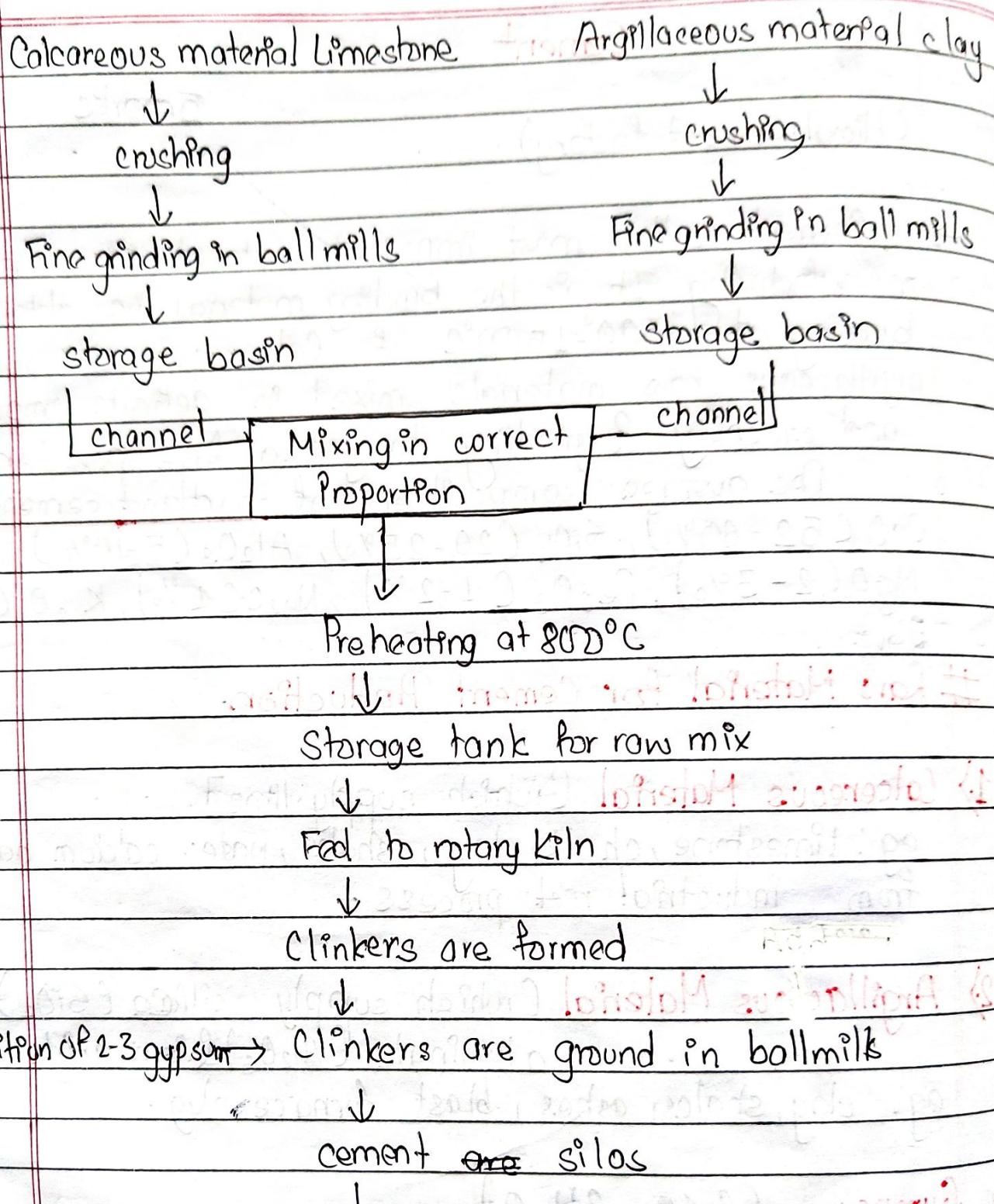
2) Argillaceous Material [which supply silica (SiO_2), aluminate (Al_2O_3) & iron oxide (Fe_2O_3)

e.g.: clay, shales, ashes, blast furnace slag.

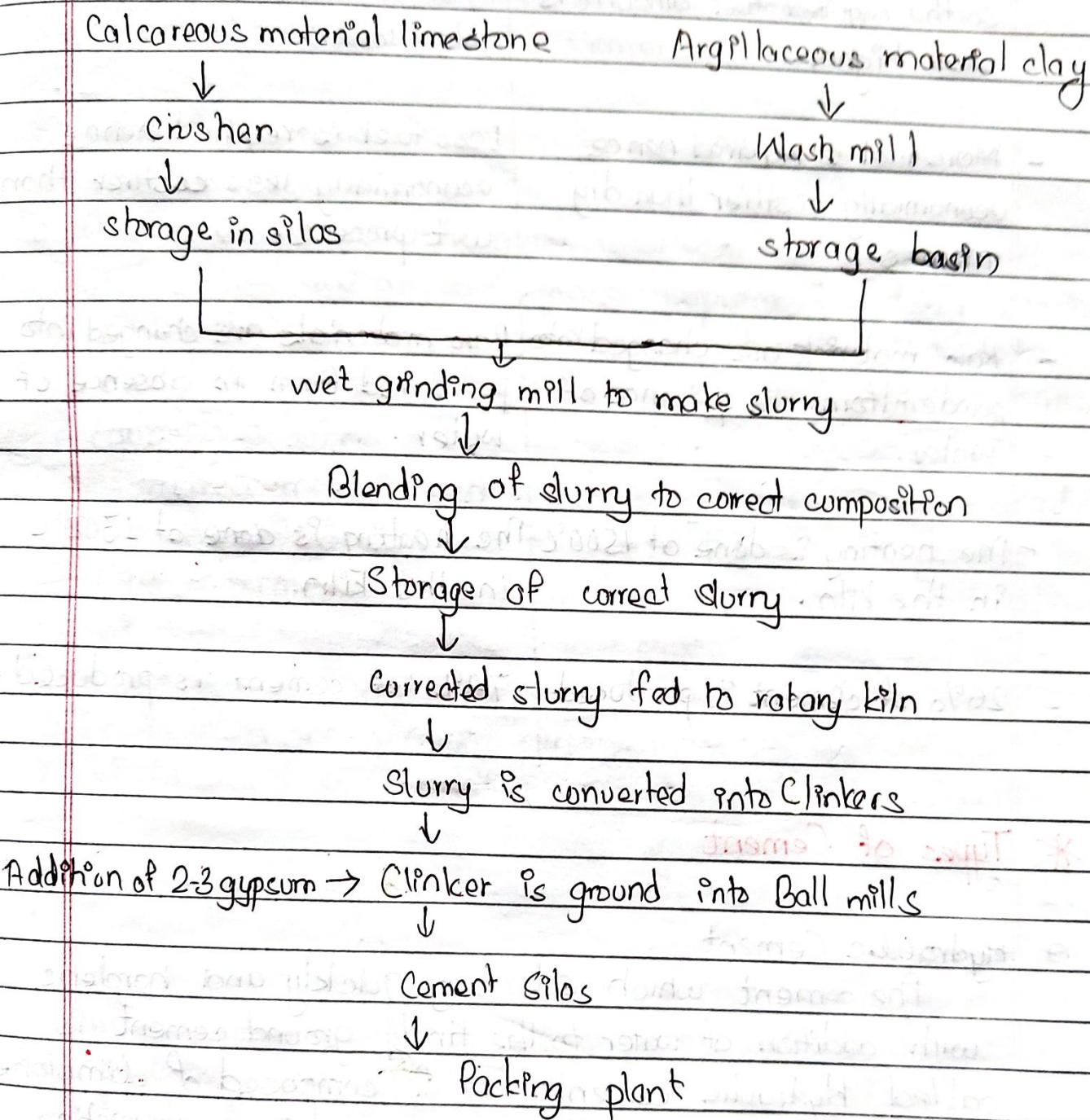
3 Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$)

→ To slowdown the setting process of cement)

Dry process for Cement Production



Wet Process



* Difference between:

Wet Process

- In this process, the mixing and grinding of raw material are done by adding 30-35% water.
- Moisture content of the slurry is 35-40%.

Dry process

- In this process, the mixing and grinding of raw material are done in a dry state.
- Moisture content of the pallets is 12%.

| of heat is | |
|---|---|
| - The required amount is higher so the required fuel amount is also higher. | The required amount of heat is lower so the required fuel amount is also lower. |
| - More fuel is required hence economically costlier than dry process. | Less fuel is required hence economically less costlier than wet process. |
| - Raw materials are changed into powdered form in presence of water. | Raw materials are changed into powdered form in absence of water. |
| - The heating is done at 1500°C in the kiln. | The heating is done at 1300°C in the kiln. |
| - 26% of cement is produced. | - 74% of cement is produced. |

* Types of Cement

a. Hydraulic Cement

The cement which sets very quickly and hardens with addition of water to the finely ground cement is called Hydraulic cement. It is composed of limestone & gypsum clay. It is non-corrosive, non-rusting & non-shrinkable substance widely used in construction. Eg: Portland cement.

b. Non-Hydraulic Cement

The cement which sets very slowly by the absorption of carbon dioxide from the atmosphere and cannot harden while in contact with

water is called Non-Hydraulic Cement. It is composed of lime, gypsum, plaster & oxychloride. For eg: gypsum and magnesium cement.

* Commercially available types of Cement

a Ordinary portland Cement (OPC)

It is one of the most popular building material used all over the world for construction. The main chemical constituent of OPC are Calcium, Silica, Alumina & Iron.

The cement available in the market has 3 grades namely OPC 33, OPC 43 & OPC 53. These grades imply the maximum strength of the particular cement after 28 days.

- Uses
- It is used for general purpose.
- It is used for making grounds & mortars.
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b Portland Pozzolana Cement (PPC)

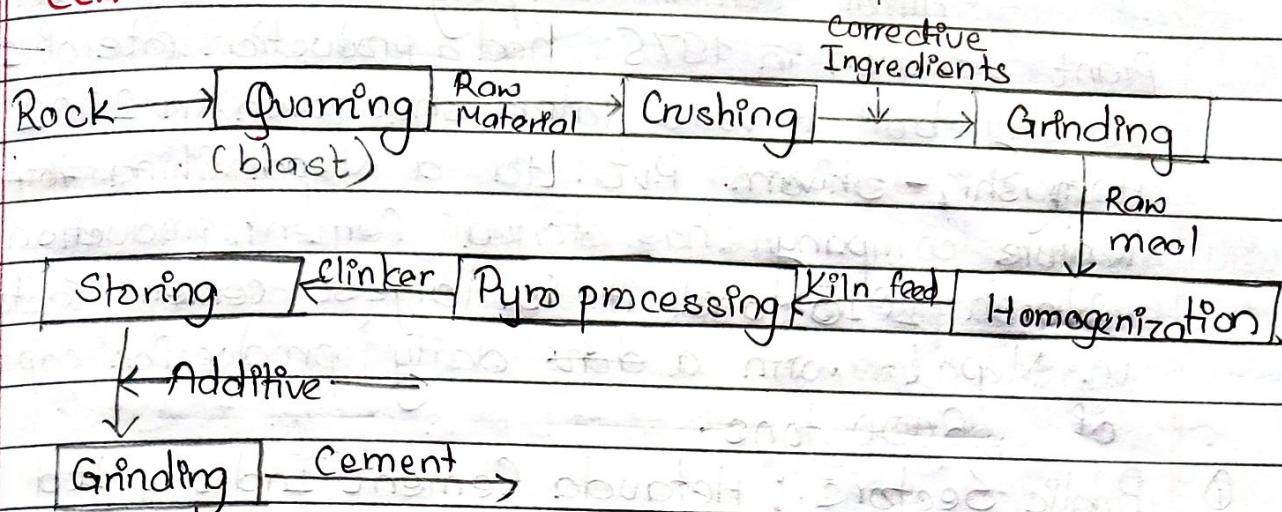
It is a kind of blended cement which is produced by grinding the portland clinker with gypsum & pozzolanic material (containing silica in a reactive form such as flyash) in measured proportion. The main composition of PPC are OPC + clinkers, gypsum, pozzolanic material & the proportion of pozzolana may vary from 15-35% by weight of cement. It is used in hydraulic structure, marine structure, dam construction etc.

Difference between OPC & PPC.

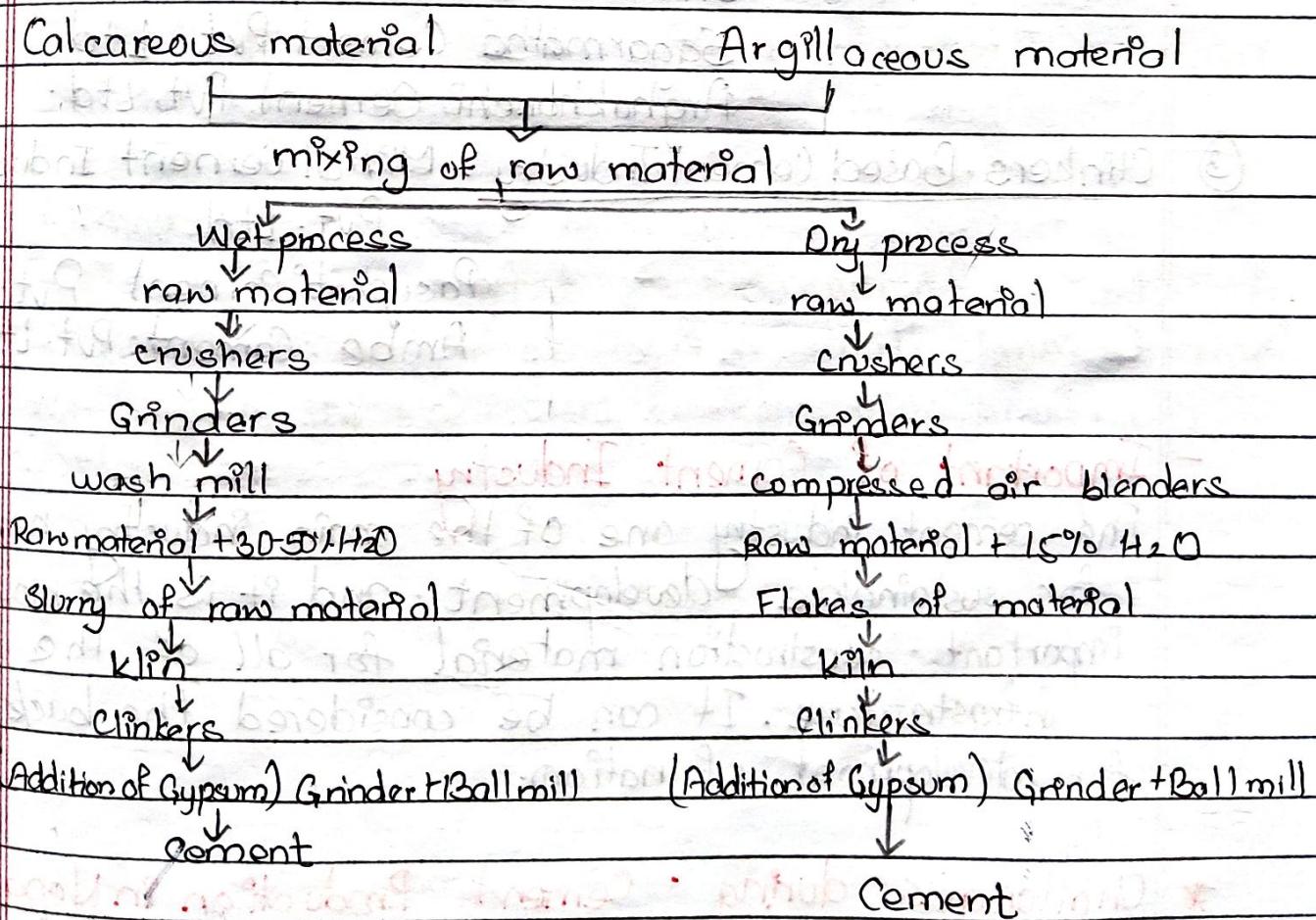
~~My notes zone~~

| OPC | PPC |
|---|--|
| <ul style="list-style-type: none"> - A mixture of limestone & other raw materials like argillaceous, calcareous, gypsum is prepared & then grinded to prepare OPC. | <p>PPC is prepared by adding pozzolanic material to OPC, Pozzolanic material namely fly ash, volcanic ash are added to the OPC to produce PPC.</p> |
| <ul style="list-style-type: none"> - It has high heat of hydration which makes it unfavourable for mass concreting. | <p>The hydration process is slower than OPC and hence it is suitable for mass concreting.</p> |
| <ul style="list-style-type: none"> - It has shorter setting time than PPC & hence it has higher strength than PPC in the initial stage. | <p>It has longer setting time than OPC & the strength of PPC is better than OPC in longer term.</p> |
| <ul style="list-style-type: none"> - It is less durable in aggressive weather. | <p>It is more durable in aggressive weather.</p> |
| <ul style="list-style-type: none"> - It causes more environmental pollution than PPC production. | <p>It causes less environmental pollution than OPC production.</p> |
| <ul style="list-style-type: none"> - It is available in 3 grades. | <p>It has no specific grades.</p> |
| <ul style="list-style-type: none"> - It is slightly costlier than PPC. | <p>It is cheaper than OPC.</p> |

* Flowsheet Diagram of manufacture of Portland Cement.



* Flowsheet Diagram of manufacture of OPC.



* Cement Industry in Nepal

(1950) first cement used
 Himal Cement Company was the first cement plant established in 1975 had a production rate of 160 tons per day but it was later shutdown in 2002. Homgshi-Shivam Pvt. Ltd a Nepal China joined Venture company has started Cement production in March 2013 and it is largest cement factory in Nepal with a daily production capacity of 6000 tons.

- ① Public Sectors : Hetauda Cement Industry Ltd
Udayapur Cement Industry Ltd
- ② Private Sectors : Jagdhamba Cement Industry Pvt. Ltd
Shivam Cement Pvt. Ltd
Sagarmatha Cement Pvt. Ltd
Arghakhanchi Cement Pvt. Ltd
- ③ Clinkers Based Cement Industry : Mittal Cement Industry Pvt. Ltd
Pasupati Cement Pvt. Ltd
Ambe Cement Pvt. Ltd

- Important of Cement Industry

The cement industry one of the main industry necessary for sustainable development and it is the most important construction material for all of the infrastructure. It can be considered the backbone for development of nation.

* Challenges during Cement Production in Nepal

- Lack of modern technology & equally skilled work-force.
- Lack of adequate infrastructure such as road, house construction etc.

- Issue of frequent power crises.
- Issue of lack of raw material & supplementary material.

* Strategies to cope with challenges.

- The government should invest a lot in infrastructure development particular roads, housing construction etc.
- Replacing fossil fuels to cost effective renewable energy sources such as solar & hydroelectricity.

① Name any two instruments to check the quality of cement.

They are:

- Vicat's apparatus (Setting time of cement is measured)
- Mortar Permeability

* Cement

The fused product of aluminates & silicates of calcium in the form hard & small stones obtained by fusing the limestone & clay are known as clinkers.