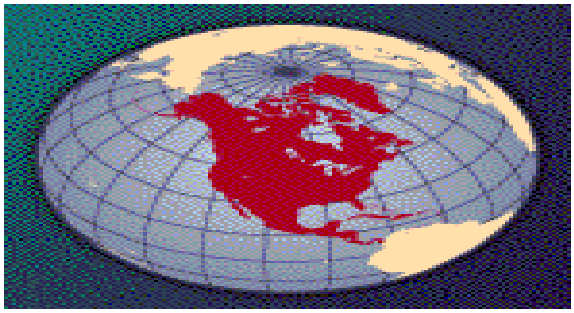
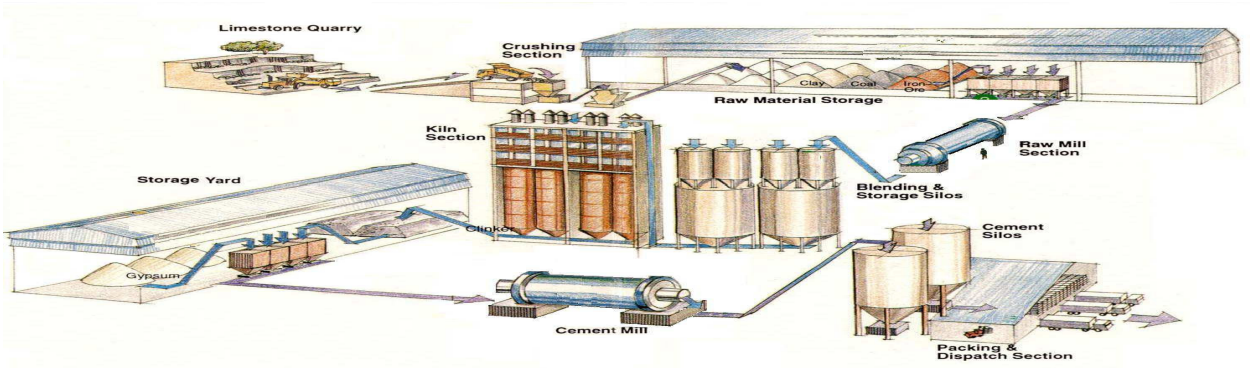
INTERNATIONAL INDUSTRIAL MARKETS MANAGEMENT



BUILDING MATERIALS INDUSTRIAL TECHNOLOGIES

SMALL VSK CEMENT & CLINKER GRINDING PLANTS



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An Introduction to Cement Plants

Close

1 Definition of a 'Small Cement Plant'

Any cement plant producing less than 200,000 tones/annum of cement
(600 tones/day) falls within the category of "Small Cement Plant" (SCP).

2 Concept

The per capita consumption of cement categorizes the level of industrial
growth of a nation. For example, average per capita consumption of cement
in Europe is in the region of 600 kgs where as that of third world countries is
less than 60 kgs.
Many developing countries have scattered cement grade Limestone deposits
which normally go waste as large deposits are required to cater to large
cement plants. Thus installation of a SCP goes a long way for the uplift of
countryside otherwise bereft of natural resources. To exploit available
resources, technology and economic viability of the project are to be explored.

3 Advantages of SCP

* Smaller and scattered Limestone deposits, which would have been wasted otherwise, can gainfully used in manufacture of cement in the countryside.

* A SCP can be set up in rural settings as the plant requirements are not very large in scale for power, water, roads and man power resources.

* Since the plant is small, marketing the product will not be difficult. A SCP can serve communities within 50 km radius of the plant.

* Lower capital investment is attractive to middle level enterpreaneurs and more can participate in nation building activities.

* Quicker return on capital invested due to lower gestation period.

* A large cement plant requires more than 100 acres of land for factory where as a SCP needs only 15 acres of land.

* Dust pollution is negligible and there is no water pollution at all.

4 Wet/Dry Process

Before the Second World War, most of the cement plants employed wet process in cement manufacture. This means that Limestone and clay were ground with water in a wet Tube mill and the slurry is homogenized before feeding to the kiln. This process consumed less electric power but used more fuel for burning. Concern for the scarce fuel sources after the war has reversed this trend. Now dry grinding is popular and kiln is fed with dry material. Vertical shaft kiln plants employ dry grinding but nodulises the powder before feeding the kiln by spraying water in a drum noduliser. Hence the process used in VSK is semi-dry process.

5 Kiln Employed

Portland cement was first produced in a vertical brick kiln and cement was produced exclusively in vertical shaft kilns in the earlier days. However, after the Second World War, the need for single kiln with higher output became a necessity for economic reasons and larger rotary kilns of higher capacities developed to cater to the emerging markets in the Europe and America. While the largest known vertical shaft kiln has an output of 320 tones/day that of the rotary kiln exceeds 7500 tones/day.

In SCP, vertical shaft kilns are exclusively used as they are cheaper and they occupy less space.

6 Raw Materials Used for Cement manufacture

The life of a cement plant should be about 30 years for it to be a viable unit. Therefore, raw materials also should be available nearby for that period. About 80% of the material used in cement production is Limestone and this should be available nearby for the life of the plant. Clay also is required for cement production and usually this material is availble closeby.
Gypsum and fuel are the other requirements. These are to be brought from reliable sources and kept in stock for three to four months. While oil or coal
can be used as fuel in a rotary kiln plant, fuel is limited to coke or de-volatilised coal in the case of vertical shaft kilns.

7 Power

In a SCP, daily power requirements are relatively less compared to the large
cement plant. A onemillion tones/annum plant will consume about 3.3 million units of electricity a day compared to that of 100,000 tones/annum SCP at 0.033 million units/day.

8 Man Power

One of the purposes of setting up a SCP is to generate employment potential in rural areas and hence per tone of cement produced, man power index is higher for SCP. For a million tones/annum plant labor index is only 0.2 per tone

whereas for a SCP that would be 0.5 per tone.

9 Water Supply

Water is required in a cement plant for human consumption, cleaning purposes, cooling of equipment and for nodulising in VSK plants. Taking an average of
250 litres/tone of cement produced, we need about 75,000 litres of water/day for a 100,000 tpa cement unit. This is far less than the 350,000 litres needed for a one million tones/annum plant.

10 Conclusion

As a small scale industry, the advantages of a SMALL CEMENT PLANT is considerable over a standard rotary kiln cement plant due to its obvious strengths. Without major modifications to existing infrastructure- like roads bridges. power and phone lines and Technical schools- SCP can be set up to
produce good quality cement for the community at reasonable price.

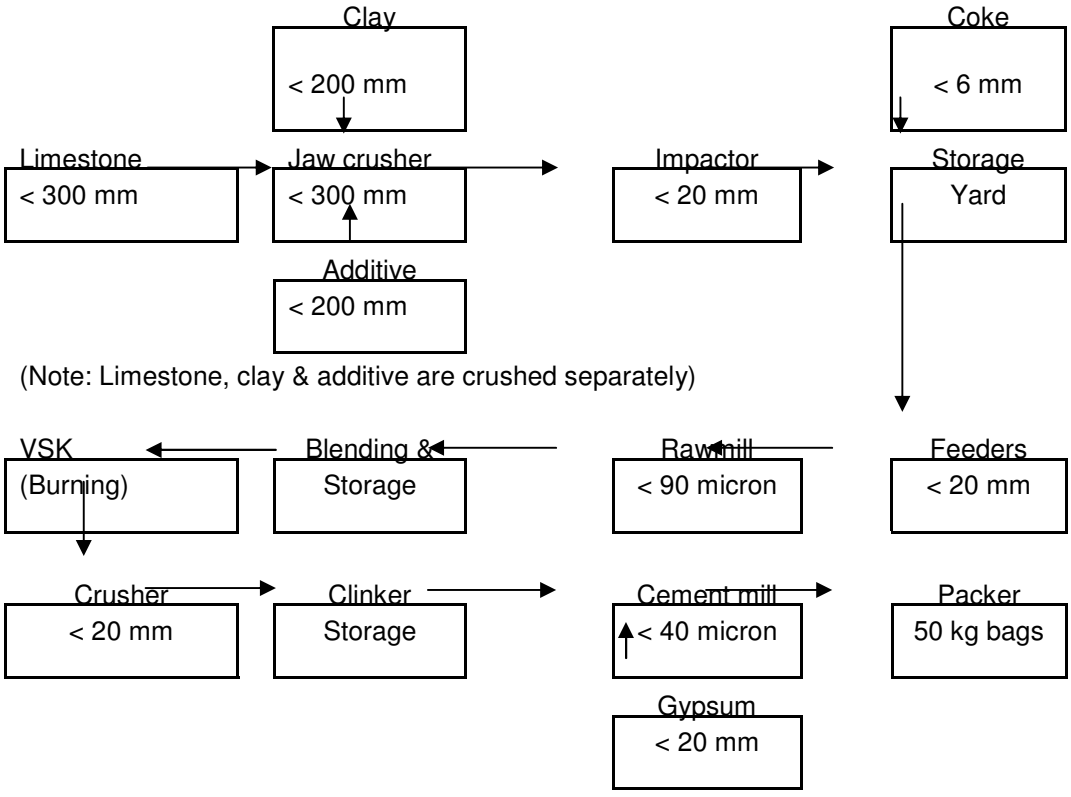
Raw Materials

Close

Major raw materials used in cement manufacture are Limestone and Clay. If all the chemical components required are not available in these two, additive materials are used to compensate. Normally used additive materials are Bauxite, Laterite and Sand stone.

Coke breeze is the fuel generally used in VSK plants. Gypsum is ground along with clinker to produce Ordinary Portland Cement.

Block diagram of manufacturing process is given below:



LIMESTONE

CaO	:	> 48%
MgO	:	< 3.5%
SiO_2	:	< 8%
Al_2O_3	:	to satisfy LSF & SM in raw mix
Fe_2O_3	:	to satisfy LSF & SM in raw mix
Mn_2O_3	:	< 0.5%

R_2O	:	< 0.6%
S	:	< 0.6%
P_2O_4	:	< 0.6%
TiO_2	:	< 1.3%
Cl	:	< 0.02%
SO_3	:	< 0.8%
Crushing strength	:	950-1000 kgf/cm^2
Limestone deposit	:	1.8 million of indicated reserve 2.7 million of inferred reserve for a 100 tpd SCP

CLAY

		Kaolinite	**Montmorillonite**
SiO_2	:	43-47	50-52
Al_2O_3	:	35-38	14-20
Fe_2O_3	:	0.25-1.5	0.5-1
CaO	:	0.1-1.5	1-4
MgO	:	0.3-0.5	3-7
Na_2O	:	0.05-0.06	0.05-0.06
K_2O	:	0.2-0.6	0.05-0.5
TiO_2	:	0.1-1.28	< 0.02
Atterberg's plasticity	:	7-15	

CHEMICAL COMPOSITION OF CORRECTIVE MATERIALS

Components	**Laterite**	**Bauxite**	**Sandstone**
LOI	2-5	2-5	0
SiO_2	8-35	4-18	85-97
Al_2O_3	20-45	35-55	85-97
Fe_2O_3	18-45	2-12	1-3
CaO	1-5	2-4	1-3
MgO	1-2	1-2	1-3
Alkalies	minor	minor	1-2
Cl	minor	minor	minor
TiO_2	2-5	2-6	0

WATER

		Litres
For process	:	26,000
For human consumption	:	5,450
Mill cooling & make-up	:	9,550
		41,000

POWER

Units/tone of OPC (avg)	:	120	kwh/t
Units reqd/year	:	4,158,000	kwh

FUEL

Coke Breeze			
Calorific vlue of coke	:	5000	kcal/kg (avg)
Heat required	:	1050	kcal/kg of clinker (max)
1 ton of clinker requires	:	1,050,000	kcal
Coke required	:	**210**	kg/tone of clinker
ALTERNATELY			
Petroleum Coke			
Calorific vlue of Petroleum Coke	:	8000	kcal/kg (avg)
Heat required	:	1050	kcal/kg of clinker (max)
1 ton of clinker requires	:	1,050,000	kcal
Coke required	:	**131.3**	kg/tone of clinker

Section-wise capacities

100 TONES/DAY VSK CEMENT PLANT

GENERAL

Clinker production	:	100	tones/day
Number of vertical shaft kilns	:	2	Nos
Capacity of one kiln		100	tones/day

LIMESTONE REQUIREMENT

Daily requirement	:	135	tones/day
Monthly requirement		4050	tones/month

CLAY REQUIREMENT

Daily requirement	:	17.5	tones/day
Monthly requirement	:	525	tones/month

COKE BREEZE REQUIREMENT

Daily requirement	:	17.5	tones/day
Monthly requirement	:	525	tones/month

ADDITIVE REQUIREMENT

Daily requirement	:	2.5	tones/day
Monthly requirement	:	75	tones/month

GYPSUM REQUIREMENT

Daily requirement	:	5	tones/day
Monthly requirement	:	150	tones/month

A CRUSHING SECTION

Weekly Limestone requirements	:	945	tones/week
Working hours/week	:	31.5	hours
Crushing capacity	:	30	tones/h
Primary crusher	: Jaw crusher		
Secondary crusher	: Impactor		

B RAW MATERIAL STORAGE YARD

	Limestone stock	:		4050	tones
	Clay stock	:		525	tones
	Coke breeze stock	:		1575	tones
	Additive stock	:		450	tones
C	**RAW MILL SECTION**				
	Raw meal required	:		1190	tones/day
	Working hours/week	:		113	hours
	Mill capacity	:		10.5	tones/h
D	**BLENDING & STORAGE**				
	Capacity of one blending silo	:		52.5	tones
	No. of blending silos	:		2	nos
	Storage capacity	:		600	cu.m
	Silo diameter	:	same as cement silo		
	No. of storage silos	:		1	no.
E	**VSK SECTION**				
	No. of VSKs	:		1	nos.
	Capacity of each VSK	:		100	tones/day of clinker
F	**STORAGE YARD FOR CLINKER & GYPSUM**				
	Clinker stock	:		1500	tones
	Gypsum stock	:		450	tones
G	**CEMENT MILL SECTION**				
	Daily cement production	:		105	tones/day
	Weekly requirement	:		735	tones/week
	Working hours	:		113	hours/week
	Cement mill capacity	:		6.5	tones/h
H	**CEMENT STORAGE**				
	Silo capacity	:		600	cu.m
	Silo diameter	:	same as raw meal silo		
	No. of silos	:		1	no.
	Cement blending arrgt	:		Provided	
J	**PACKING PLANT**				
	Weekly requirement			735	tones/week
	Working hours			49	hours/week
	Capacity of packer			15	tones/h

Environmental Control in Cement Plants

- Based on VSK Technology -

1 Introduction

Environmental control aspects are being given increasing importance in recent years. Of the two aspects of immediate concern, viz, water and air pollution, VSK cement plants are free of water pollution completely as there is no effluent production. Even in the case of air pollution, which can be caused by dust and undesirable gases, Vertical Shaft Kiln (VSK) emits negligible amounts as to cause serious health concerns. The small amounts of Nitrous oxide and Carbon monoxide emissions are the result of unsatisfactory burning in the kiln during initial stages which will subside once the operators get more experience in the burning techniques. Dust generation, though negligible, is inherent in the burning process and better burning techniques reduce the emission levels considerably. In the following paragraphs of this report, we give the dust generation sources, their characteristics and the methods presently employed to limit dust emission are detailed.

2 Process of Manufacture

The cement manufacturing process in VSK cement plants is described below:

* **Limestone mining and Crushing**
  Mined limestone is reduced to < 25 mm in size in the crushing section.
* **Proportioning of raw materials and fuel**
  Crushed raw materials are then extracted along with fuel and fed to mill in the right proportion.
* **Grinding and homogenizing of rawmeal**
  In the Raw mill these materials are ground to powder and then blended in a pneumatic blending system.
* **Nodulising**
  The rawmeal powder is then nodulised by spraying water in a nodulising drum.
* **Burning the nodules in VSK**
  The nodules are then fed to the kiln and burned to clinker.
* **Clinker storage**
  The clinker and Gypsum are stored in a storage yard. Clinker is allowed to naturally cool for 15 days.
* **Cement grinding**
  Clinker along with a small per cent of Gypsum is ground in to cement in the Cement mill.
* **Cement storage, packing and despatching**
  The cement is stored in a RCC Silo. As and when required this cement is extracted from silo and packed in to 50 kgs bags and despatched by truck or train to the customers.

3 Dust Generation sources and characteristics

3.1 Mining

Manual mining is employed in VSK cement plants and dust generation is low. However, sometimes free dust is generated while drilling and this is suppressed using water sprays.

3.2 Crushing

Main dust generation source is the Secondary Crusher and a Bag filter system is provided to collect and remove this dust.

3.3 Raw Mill

While grinding the raw materials in the Ball mill, some dust is produced. This is collected in Cyclones and bag Filters.

3.4 Blending & Storing

Dust generated during this process is collected in Bag filters and fed back in to the storage silo.

3.5 Kiln section

The kiln feed is in the form of moist nodules and do not generate dust. This bed ensures that dust entrained in the lower portions of the kiln is filtered during its upward movement.

Kiln chimneys operate under natural drafts and do not generate any dust emission. The low velocity of gas in the c himney allows the dust to settle. Movers (India) have provided a Wet Scrubber at the chimney which ensures further that whatever dust generated in the kiln is entrapped in the water spray of the scrubber. The slurry formed is fed back in to the Noduliser.

3.6 Cement grinding

Cement mill is provided with bag filter to collect the dust generated during grinding.

3.7 Storage and Packing

For the storage silo as well as the packer, bag filter is provided to collect the dust generated.

4 Control of fugitive dust

Specific instances of fugitive dust generation may include dust blown by wind from raw material stock piles, dust generated by vehicular traffic within the factory premises, dust leakages from equipment, storage hoppers and packer. Good house keeping and maintenance of equipment can eliminate these dust emissions completely.

While preparing the plant layout Movers (India) locates the kiln chimneys in such a manner that most of the year the wind blows the smoke away from inhabited areas near the plant.

5 Dust generation

a) **Measured/Calculated Quantity**

Exhaust gases	:	2.42 Nm3/kg of clinker
CO	:	2000 mg/m^3 at 80 deg.C
SO_2	:	80 mg/m^3 at 80 deg.C
Dust content	:	400 mg/m^3 at 80 deg.C (This is brought down to 100 mg/m^3)

b) **Process involving burning**

SO_2	:	< 2000 mg/1000000 kcal (for coke as fuel)
Dust	:	<120 mg/1000000 kcal (for coke as fuel)

c) **For Bag house**

Dust emission	:	< 100 mg/m^3

d) **At Kiln Chimney**

SO_2	:	< 1000 Mg/Nm^3
Dust	:	< 100 mg/Nm^3
CO	:	0.60%

(Initially the value of CO might be higher due to improper burning in the kiln. This will come down to 0.6% during the next 3 months when feed proprtion is stabilized.)

e) **Others:** NOx

The main pollutant under this category is Nitric oxide and Nitrogen dioxide and Nitrogen oxide. These are either not emitted or is in negligent quantity.

6 Conclusion

Compared to a rotary kiln plant, dust generation points are very few in a VSK plant. Dust collecting or suppressing arrangements have been provided where they are needed. With good house keeping, dust emission norms can easily be maintained in VSK plants.