Section 1

Chapter 1

What is a Green Cement Plant

1.1 Definition of a Green Cement Plant

Natural colour of cement is grey, varying between lighter and darker shades. What then is Green about a 'Green' Cement Plant.

Obviously, 'green' does not refer to the colour of the cement. It refers to the philosophy that lies behind the design concepts of new cement plants.

A green cement plant is one that is designed to conserve natural resources of all kinds and that contributes to the release of the 'Greenhouse Gases' (GHG) to the atmosphere to the least possible extent consistent with the quality of cement produced.

1.2 Blended Cements

Release of CO_2 a Greenhouse Gas is inherent in the process of manufacture of cement as CO_2 is released from limestone – the basic raw material of cement during the process of calcining. 1 kg of calcium carbonate releases 0.44 kg of CO_2. Therefore in making 1 kg clinker, ~ 0.51 kg CO_2 gets released into the atmosphere.

The quantity gets reduced when computed in terms of cements made from the clinker

OPC : ~ 0.49-0.50 kg/kg

PPC : ~ 0.34-035 kg/kg

BFSC : ~ 0.19-0.20 kg/kg

This itself is a pointer in reducing GHG emissions. Blended cements release less GHG as compared to OPC per ton of cement.

1.3 Combustion of Fuel

A vital component of total carbon dioxide released to the atmosphere is the CO_2 released in the process of combustion of fuel fired in the kiln and calciner in the Clinkerisation process. Quantum released is directly related to the quantum of fuel fired and the quantum of carbon in it.

Again by the same logic, the obvious way to reduce emission is to reduce quantity of heat required to be supplied or what is called specific fuel consumption and or use fuels with less carbon or those that are 'carbon neutral'.

1.4 Alternate Fuels

Alternate fuels have been successfully used in many countries in kilns and calciners. In Europe the cement industry is progressing towards zero fuel costs. Great possibilities exist for using wastes of industry and agriculture that have heat value to be used as secondary fuels in kiln and calciner.

Certain modifications and additions are of course required to be made in the existing fuel storing, preparation and firing systems to fire secondary fuels along side of the basic fossil fuels.

Whereas blended cements can be easily made in an existing plant, introduction of alternate fuel would require careful planning and engineering and also capital investment.

1.5 Electrical Energy

Production of cement also requires supply of electrical energy expressed as kwh/ton of cement. Electrical energy is presently produced mostly by burning fossil fuels like coal and oil. Thus reduction of electrical energy in making cement indirectly means reduction in electrical energy produced and thereby GHG released to the atmosphere. If 1 kwh is used in cement plant, the generating station has to produce much more to allow for transmission losses and for its own inputs. In some countries transmission losses are small – say 10 % but in some countries (India for one) they are more than 30 %.

Any saving in electrical energy in the cement plant, howsoever small has a still greater impact on saving GHG emissions when energy generated at Thermal Power Stations is taken into account.

1.6 Waste Heat Recovery

Cement Plants can further contribute significantly to reducing GHG emissions by converting waste heat in the exhaust gases from kiln and cooler into electricity by setting up waste heat recovery systems (WHRS). There is plenty of scope in existing dry process cement plants to produce power from waste heat.

Due to recent developments in technology it is now possible to generate power even from waste gases in modern cement plants with low heat contents by using Organic Rankine Cycle and Kalina Preocess. It is estimated that between 20 to 30 % of the energy required by a cement plant can be generated by installing WHRS. Energy so generated can be used in the plant or fed to the grid.

1.7 Renewable Energy

All fossil fuels emit CO_2. Biomass fuels are carbon neutral. Sources of energy like, wind, solar and hydraulic are not only totally free of carbon but on top are renewable – inexhaustible also. Increasing attention is being paid to make them viable sources of energy.

Cement Plants in various parts of the world are beginning to use wind and solar energy to meet part of their energy requirements.

1.8 Thus making or designing a cement plant ‘green’ in effect means :

1 provide facilities for making blended cements in an adequate measure

2 design components like calciners to reduce obnoxious gases like NO_x, SO_2 etc.

3 provide for processing and firing alternative fuels which will reduce quantum of CO_2 released

4 design burners and firing systems for available alternative fuels

5 if required provide for bypass of kiln gases which can contain excessive alkalies and chlorides as a result of firing certain alternate or waste fuels

6 provide for waste heat recovery system to generate power/other or for applications

7 consider making composite cements which are a form of blended cements

1.8.1 To this list would be added soon

1 using/making substitute cements
2 using renewable energy

1.9 Carbon Capture

There are developments which aim at reducing the GHG emissions by physically collecting CO_2 emitted and storing it and making it available to other industries who have use for it and even for making cements of new types.

1.10 Other Aspects

Apart from the two major aspects described viz sustainability and GHG emissions there is more to making a cement plant green.

1 keep environment green by planting trees and taking up schemes for afforestation
2 adopt more scientific mining methods to cause minimum damage to the environment by minimizing mining 'footprint'
3 reclaim used mines for landscaping, creating water reservoirs etc.
4 create green belts in and around plant and colony
5 install water conservation schemes like rain water harvesting, recycling of water by treating it
6 design and construct 'green' buildings in the cement plant wherever possible to make maximum use of natural light, ventilation etc.

In short the cement plant should blend beautifully with its surroundings.

1.11 Scope for making and Designing Cement Plants Green

Cement Industry is consciously making efforts in various areas listed in para 1.8 and is very much interested in making existing plants green and in designing new plants as green plants.

1.11.1 Blended cements

Presently almost all cement plants, the world over are making blended cements. In India itself ~ 74 % of cement made is blended cement. Slag which can be added up to 60 % has been used up. Fly ash is available but further increase in quantum of PPC is limited unless the ceiling to which fly ash can be added is raised. This change can be sanctioned only by National Bodies that lay down standards of cement like Bureau of Indian Standards in India.

1.11.2 Alternate fuels

The main problem would be the selection of a fuel that is steadily available in required quantities over long period of time and one which would have reasonably uniform properties – physical and chemical like calorific value.

1.11.3 Waste heat recovery

Introducing Waste Heat Recovery System would require heavy capital investment and therefore requires careful planning and engineering.

In the subsequent sections and chapters all these aspects have been covered in detail so as to present a comprehensive picture of what it takes to make a green cement plant.