FGD Gypsum Use in Cement
Worldwide Cement Production

#1 China
#2 India
#3 United States
US Cement Industry

- 39 Companies
- 118 Cement Plants
- 38 States
- 105 MM Metric Tons Consumed
- 25 MM Metric Tons Imported
US Cement Industry

Announced Expansions:

- 2007 2,430M metric tons
- 2008 7,400M Metric tons
- 2009 2,550M Metric tons
Cement Clinker Chemistry

\[(\text{CaO})_3 \cdot \text{SiO}_2 \text{ and } (\text{CaO})_2 \cdot \text{SiO}_2\]

\[\text{Al}_2\text{O}_3\]

\[\text{Fe}_2\text{O}_3\]
Raw Feed Components for Cement Plant

- **Calcereous Materials (providing Lime CaO)**
  - Limestone
  - Lime Mud (paper industry)

- **Argillaceous Materials (SiO$_2$, Al$_2$O$_3$, and Fe$_2$O$_3$)**
  - Sand
  - Fly ash (power generation)
  - Bottom ash (power generation)
  - Iron fines (steel industry)
  - Sand Blasting Waste (ship building industry)
  - Spent Catalyst (oil refining)
There are five jobs to be done:
- Drying
- Preheating
- Calcining
- Sintering
- Cooling

Dry Process Preheater/Precalciner System

60% Fuel Split
40%
Hot “Clinker” Inside Kiln
Finish Grinding Mills (Cement Mill)
Ball Mill

First Compartment
Used to crush clinker.

Second Compartment
Used to grind clinker.
Gypsum

- Gypsum Added to Control Setting
- Set Time Increases as Gyp Increases
- Various Cement and Masonry Products Have a Range of $\text{SO}_3$ Content
- $\text{SO}_3$ at 3.5% is a Typical Value
Gypsum

“a product composed essentially of calcium sulfate in any hydration state…”

- $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
- $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$
- $\text{CaSO}_4$
Gypsum Handling

- Natural Gypsum Generally Handles Easily
- FGD Gypsum Generally More Difficult
  - Slurry to Filter Cake
  - Moisture
  - Sticky
Gypsum Handling

- Avoid Bucket Elevators
- Mass Flow Cone Silo Bottoms
- Materials of Construction
- Reclaim Auger Assemblies
- Reclaim Arm Assemblies
Marine Silos
Cement Barge