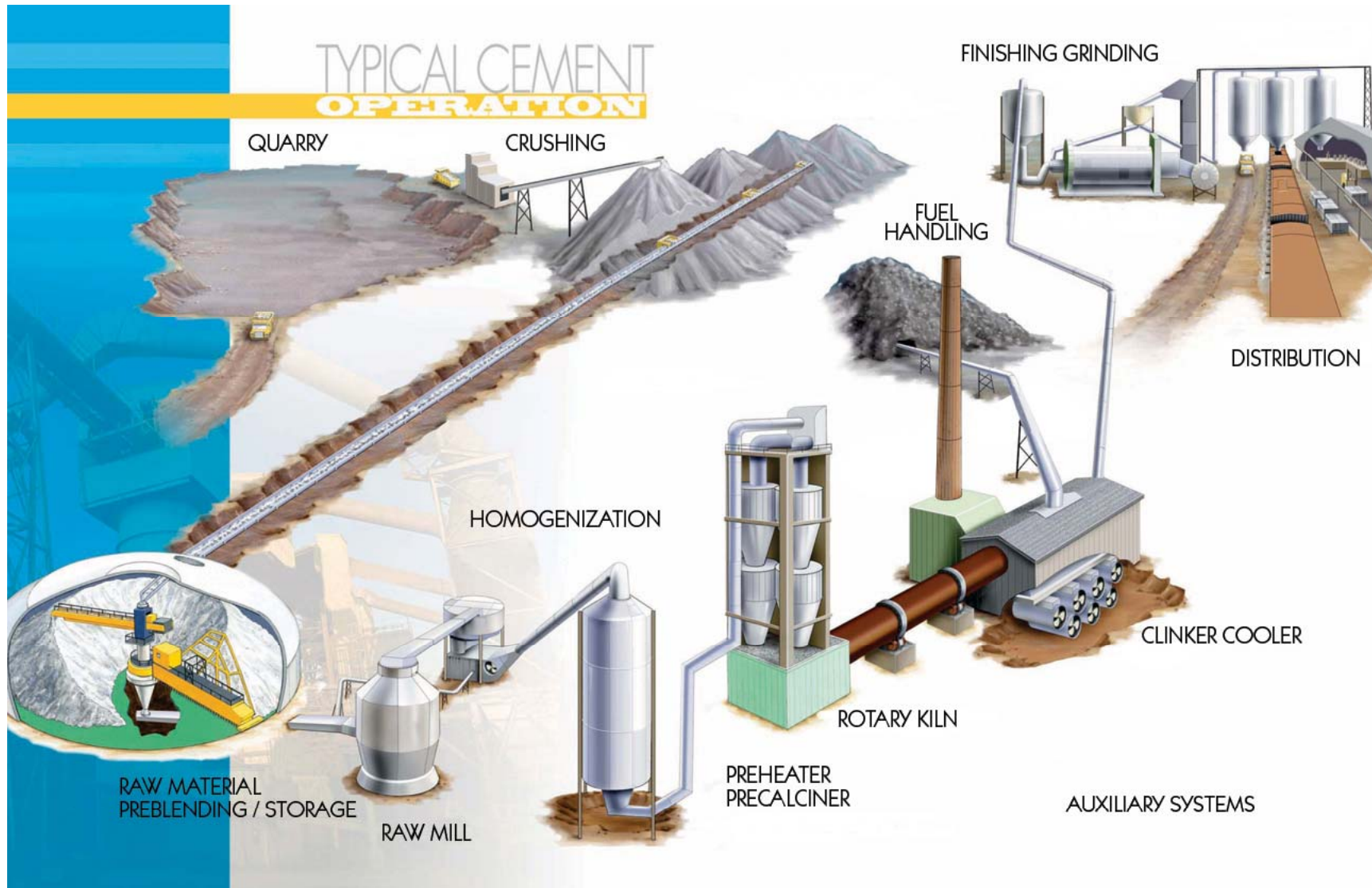


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- Quarry

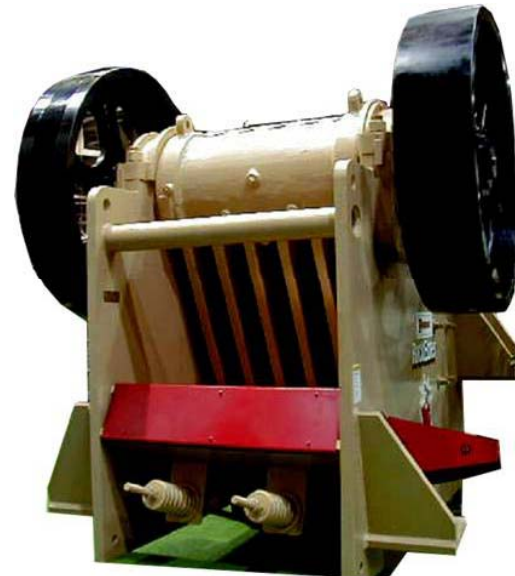
- The manufacturing process begins in a limestone quarry. Mining methods such as ripping, dozing, drilling and blasting are commonly employed. Limestone provides the first essential component, calcium, for the manufacture of cement. Materials are transported to the crushing plant for further size reduction. Common methods of transport are trucks, loaders and belt conveyors.
- Bearing Applications – mounted spherical and tapered roller bearings, both set screw and adapter mount. Spherical roller, ball and cylindrical roller bearings are also used.
- Items to consider – Bearings are subjected to abrasive dust and fine dirt. Some bearings may need to withstand very wet conditions. Bearings should be fitted with robust seals. Closed end housings and protective covers should be considered. Bearing housings are often struck by heavy materials requiring cast iron or solid steel, pillow block construction.



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- **Crushing**

- Quarried limestone is usually too large for effective use in the remaining steps of the production process. Impact and hammer crushers reduce the size of relatively soft material, while compression crushers are used for larger rock. Effective size reduction aids material transport, material blending and further size reduction through various grinding methods.
- Bearing Applications - mounted spherical roller bearings, spherical and tapered roller bearings.
- Items to consider – This application is subjected to heavy shock loads which require all steel or cast iron pillow block construction. The area is heavily laden with abrasive dust and dirt, requiring robust bearing seals.



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- **Pre-blending**

- Crushed material is transported on belt conveyors to a stacker assembly. The stacker assembly builds a bed of material in either circular piles or long, linear rows. These “pre-blending beds” are built in layers and then reclaimed at right angles to the pile. This has a homogenizing affect on the material, providing a consistent product to the Raw Mill.
- Bearing Applications - mounted spherical and tapered roller bearings, both set screw and adapter mount. Ball bearings in idlers. Head and tail pulley contain spherical roller bearings.
- Items to consider – Bearings are subjected to abrasive dust and fine dirt. Bearings should be fitted with robust seals. Closed end housings and protective covers should be considered.

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- **Raw Mill**

- Blended limestone and clay are introduced to a grinding mill with sand, fly ash, and iron ore. Correct proportions are important to product quality, requiring a high level of automation and analysis. Raw materials are ground to a fine powder using vertical roller mills, rotary ball mills, or a roller press. Fineness is controlled with a material separator using airflow and rotating vanes to classify product. Coarse product is returned to the mill while fine product is conveyed to storage. Bucket elevators, screw conveyors, and air slides are utilized for material conveyance.
- Bearing Applications – Pillow block and flange mounted spherical and tapered roller bearings are typically found on screw conveyors, belt conveyors and bucket elevators. Large fans may utilize babbitt lined, oil lubricated sleeve bearings. Smaller fans utilize mounted ball and spherical bearings. Some cylindrical but mainly spherical roller bearings (depending on design).
- Items to consider - Bearings are subjected to fine, abrasive dust. Bearings should be fitted with robust seals. Closed end housings and protective covers should be considered

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- **Homogenization**

- Ground raw meal is stored in large silos that are air activated to promote blending of the raw meal, reducing chemical variation and promoting stable sintering in the kiln. Some systems utilize a series of mass flow silos: individual silos are sequentially filled, while product is withdrawn from all silos simultaneously. Dry material is conveyed pneumatically or by bucket elevator to the rotary kiln.
- Bearing Applications – A variety of bearings are used. Mounted spherical and tapered roller bearings, are typically found on larger conveyors and bucket elevators, while smaller conveyors may utilize setscrew mount ball bearings. Fans may utilize mounted ball and spherical bearings. Agitator – sealed single row deep groove ball bearings on the fixed end and cylindrical roller bearings on the free end. Housed or mounted spherical and ball bearings for bucket elevators.
- Items to consider - Bearings are subjected to fine, abrasive dust. Bearings should be fitted with robust seals. Closed end housings and protective covers should be considered.

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- Preheater / Precalciner

- Dry, homogenized Raw Meal is fed into a Preheater / Precalciner where it is dried, heated and partially calcined before introduction to the rotary kiln. Calcination occurs at around 900° C and involves the disassociation of carbon dioxide (CO_2) from calcium carbonate (CaCO_3). The resulting calcium oxide is then free to combine with alumina, silica, and iron oxide to form new mineral crystals.
- Bearing Applications –Large fans may utilize babbitt lined, oil lubricated sleeve bearings. Smaller fans utilize mounted ball and spherical bearings. Mainly spherical roller bearings.
- Items to consider - Bearings are subjected to fine, abrasive dust. These bearings are usually mounted in outdoor applications, so rain is a concern. Bearings should be fitted with robust seals. Closed end housings and protective covers should be considered.

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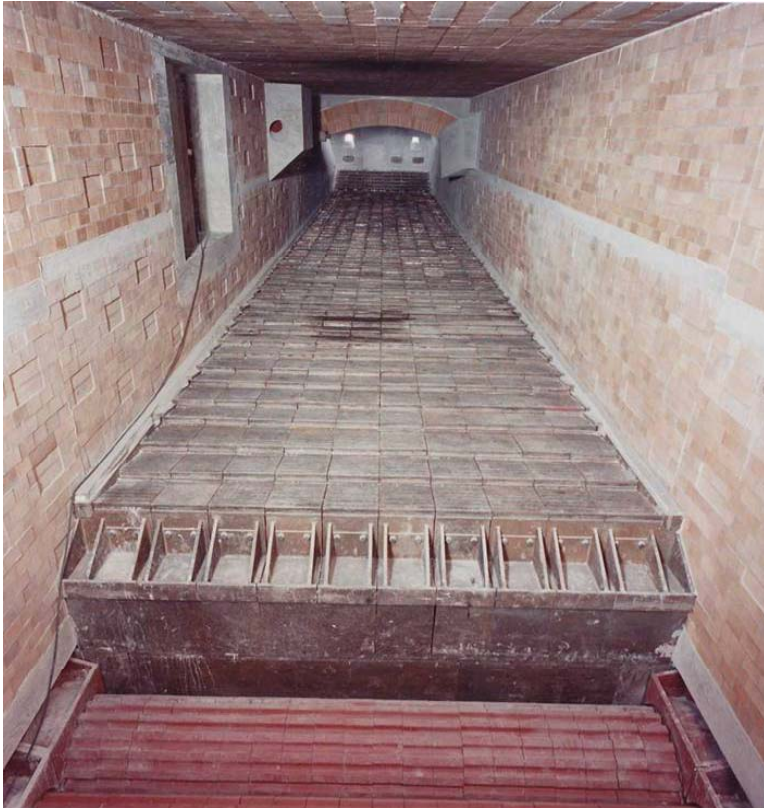
- Rotary Kiln

- Partially calcined material flows to the kiln, where heat drives the reactions necessary to sinter the raw meal. Maximum temperatures, inside the kiln, will approach 2000° C. Cement clinker is formed when the raw meal components combine, under heat, to form clinker minerals. The resulting minerals have the ability to chemically react and harden when mixed with water. Fossil fuels, preferably coal, provide the thermal energy required to drive this process. Alternative fuels, with good heat value, are also utilized.
- Bearing Applications – Large fans may utilize babbitt lined, oil lubricated sleeve bearings. Smaller fans utilize mounted ball and spherical bearings. Double row cylindrical roller, cylindrical roller, spherical roller, and tapered roller bearings.
- Items to consider - Bearings are subjected to fine, abrasive dust, heat and rain. Bearings should be fitted with robust seals. Lubricant for high temperature applications should be used when applicable. Closed end housings and protective covers should be considered.



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- **Clinker Cooler**



- Fully formed cement clinker falls from the rotary kiln, into a reciprocating grate cooler. Fans force ambient air through slotted grates, which transport the hot material while channeling cooling air to the clinker. The heated air is recovered for combustion, reducing the kiln's fuel requirement. Cooled clinker is conveyed by pan conveyors, bucket elevators, drag chains and belt conveyors to storage silos. Screw conveyors are used to transport dust from dust collectors.
- **Bearing Applications** – Pillow block and flange mounted spherical and tapered roller bearings are typically found on screw conveyors, belt conveyors and bucket elevators. Large fans may utilize babbitt lined, oil lubricated sleeve bearings. Smaller fans utilize pillow block spherical bearings. Spherical roller bearings, spherical thrust bearings, and thrust ball bearings.
- **Items to consider** - Bearings are subjected to fine, abrasive dust, and high temperature. Bearings should be fitted with robust seals. Lubricant for high temperature applications should be used when applicable. Closed end housings and protective covers should be considered. Occasionally, auxiliary bearing coolers may be required.

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- **Finish Grinding**

- Cement clinker is drawn from storage silos using apron weigh feeders and ground with gypsum. The product is a fine powder referred to as Portland Cement. Grinding takes place in the same way as in the Raw Mill. Common systems are rotary ball mills and vertical roller mills. Product is classified with a separator and transported around the mill circuit with air slides, screw conveyors and bucket elevators. The final product is pneumatically conveyed to cement storage silos for later distribution to customers.
- **Bearing Applications** – Pillow block and flange mounted spherical and tapered roller bearings are typically found on screw conveyors, belt conveyors and bucket elevators. Fans utilize mounted ball and spherical bearings. Spherical roller bearings.
- **Items to consider** - Bearings are subjected to fine, abrasive dust. Bearings should be fitted with robust seals. Closed end housings and protective covers should be considered.



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- **Distribution**

- Cement stored in silos is withdrawn for bulk shipment by truck, rail or barge. Redi-mix plants combine the cement with aggregate and water to form concrete. Cement is also packaged in 50 to 100 pound bags and palletized for use by smaller customers or for sale in places like home improvement stores.
- Bearing Applications - Pillow block and flange mounted ball, spherical and tapered roller bearings are typically found on screw conveyors, belt conveyors and bucket elevators. Fans utilize mounted ball and spherical bearings. Spherical roller and cylindrical bearings. Fans use thrust ball bearings and thrust spherical roller bearings.
- Items to consider - Bearings are subjected to fine, abrasive dust. Bearings should be fitted with robust seals. Closed end housings and protective covers should be considered.



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- Fuel Handling



- Kilns require copious amounts of fuel to generate the heat required to drive the clinkering process. This fuel can be liquid, natural gas, coal, pet coke or automotive tires. Coal is the most common fuel, requiring handling systems to offload, stack, reclaim and grind the coal for firing in the kiln. Grinding occurs in vertical mills which are similar to, but smaller than those in the Raw Mill or Finish Grinding departments.
- Bearing Applications – Pillow block and flange mounted spherical and tapered roller bearings, are typically found on screw conveyors, belt conveyors and bucket elevators. Fans utilize mounted ball and spherical bearings. Tapered roller bearings in vertical mills.
- Items to consider - Bearings are subjected to fine, abrasive, corrosive dust. Bearings should be fitted with robust seals. Closed end housings and protective covers should be considered.

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	Deep Groove Ball Bearings	Cylindrical Roller Bearings	Tapered Roller Bearings	Spherical Roller Bearings
Quarry	X	X		X
Crushing			X	X
Preblending	X			X
Raw / Finish Grinding		X		X
Homogenization	X	X		
Preheater				X
Kiln		X	X	X
Clinker Cooler				X
Distribution		X		X
Fuel Handling		X	X	X