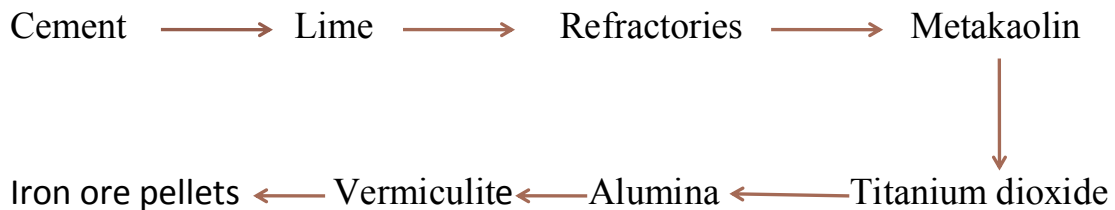


About Rotary Kiln



A rotary kiln is a pyroprocessing device used to raise materials to a high temperature (calcination) in a continuous process. Materials produced using rotary kilns include:



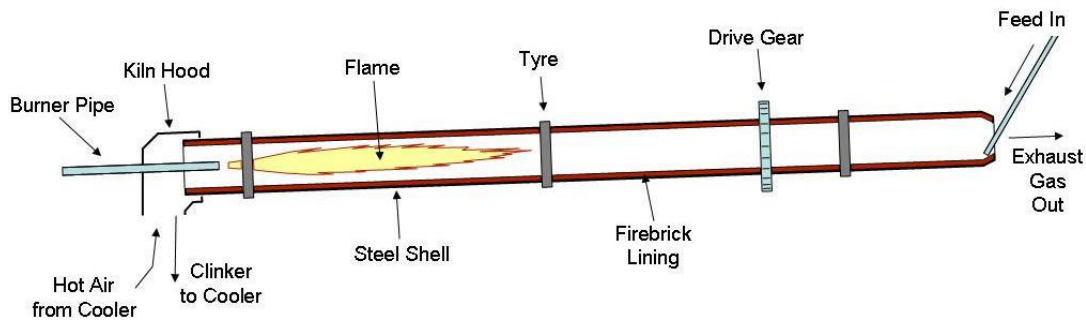
1.Principle of operation

The kiln is a cylindrical vessel, inclined slightly to the horizontal, which is rotated slowly about its axis. The material to be processed is fed into the upper end of the cylinder. As the kiln rotates, material gradually moves down towards the lower end, and may undergo a certain amount of stirring and mixing. Hot gases pass along the kiln, sometimes in the same direction as the process material (co-current), but usually in the opposite direction (counter-current). The hot gases may be generated in an external



furnace, or may be generated by a flame inside the kiln. Such a flame is projected from a burner-pipe (or "firing pipe") which acts like a large bunsen burner. The fuel for this may be gas, oil, pulverized petroleum coke or pulverized coal.

General layout of a direct fired countercurrent rotary kiln used in cement manufacture:



2. Construction

The basic components of a rotary kiln are the shell, the refractory lining, support tyres and rollers, drive gear and internal heat exchangers.

3. History

The rotary kiln was invented in 1873 by the Englishman Frederick Ransome.

4. Kiln shell



This is made from rolled mild steel plate, usually between 15 and 30 mm thick, welded to form a cylinder which may be up to 230 m in length and up to 6 m in diameter. This will be usually situated on an east/west axis to prevent eddy currents.

Upper limits on diameter are set by the tendency of the shell to deform under its own weight to an oval cross section, with consequent flexure during rotation. Length is not necessarily limited, but it becomes difficult to cope with changes in length on heating and cooling (typically around 0.1 to 0.5% of the length) if the kiln is very long.

5.Refractory lining

The purpose of the refractory lining is to insulate the steel shell from the high temperatures inside the kiln, and to protect it from the corrosive properties of the process material. It may consist of refractory bricks or cast refractory concrete, or may be absent in zones of the kiln that are below around 250 ° C. The refractory selected depends upon the temperature inside the kiln and the chemical nature of the material being processed. In some processes, such as cement, the refractory life is prolonged by maintaining a coating of the processed material on the refractory surface. The thickness of the lining is generally in the range 80



to 300 mm. A typical refractory will be capable of maintaining a temperature drop of 1000 ° C or more between its hot and cold faces. The shell temperature needs to be maintained below around 350 ° C in order to protect the steel from damage, and continuous infrared scanners are used to give early warning of "hot-spots" indicative of refractory failure.

6. Tyres and rollers



Tyres, sometimes called riding rings, usually consist of a single annular steel casting, machined to a smooth cylindrical surface, which attach loosely to the kiln shell through a variety of "chair"

arrangements. These require some ingenuity of design, since the tyre must fit the shell snugly, but also allow thermal movement. The tyre rides on pairs of steel rollers, also machined to a smooth cylindrical surface, and set about half a kiln-diameter apart. The rollers must support the kiln, and allow rotation that is as nearly frictionless as possible. A well-engineered kiln, when the power is cut off, will swing pendulum-like many times before coming to rest. The mass of a typical 6 x 60 m kiln, including



refractories and feed, is around 1100 tonnes, and would be carried on three tyres and sets of rollers, spaced along the length of the kiln. The longest kilns may have 8 sets of rollers, while very short kilns may have only two. Kilns usually rotate at 0.5 to 2 rpm, but sometimes as fast as 5 rpm. The Kilns of most modern cement plants are running at 4 to 5 rpm. The bearings of the rollers must be capable of withstanding the large static and live loads involved, and must be carefully protected from the heat of the kiln and the ingress of dust. In addition to support rollers, there are usually upper and lower "retaining (or thrust) rollers" bearing against the side of tyres, that prevent the kiln from slipping off the support rollers. Now rotary kiln length is 84 meters.

7. Drive gear

The kiln is usually turned by means of a single Girth Gear surrounding a cooler part of the kiln tube, but sometimes it is turned by driven rollers. The gear is connected through a gear train to a variable-speed electric motor. This must have high starting torque in order to start the kiln with a large eccentric load. A 6 x 60 m kiln requires around 800 kW to turn at 3 rpm. The speed of material flow through the kiln is proportional to rotation speed, and so a variable speed drive is needed in order to control this. When driving through rollers, hydraulic drives may be used. These



have the advantage of developing extremely high torque. In many processes, it is dangerous to allow a hot kiln to stand still if the drive power fails. Temperature differences between the top and bottom of the kiln may cause the kiln to warp, and refractory is damaged. It is therefore normal to provide an auxiliary drive for use during power cuts. This may be a small electric motor with an independent power supply, or a diesel engine. This turns the kiln very slowly, but enough to prevent damage.

8.Internal heat exchangers

Heat exchange in a rotary kiln may be by conduction, convection and radiation, in descending order of efficiency. In low-temperature processes, and in the cooler parts of long kilns lacking preheaters, the kiln is often furnished with internal heat exchangers to encourage heat exchange between the gas and the feed. These may consist of scoops or "lifters" that cascade the feed through the gas stream, or may be metallic inserts that heat up in the upper part of the kiln, and impart the heat to the feed as they dip below the feed surface as the kiln rotates. The latter are favoured where lifters would cause excessive dust pick-up. The most common heat exchanger consists of chains hanging in curtains across the gas stream.

