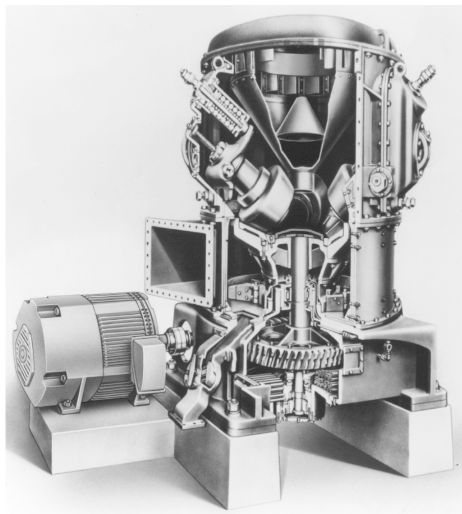
Raymond® Bowl Mills

Coal and Petroleum Coke Applications

The Raymond® Bowl Mill is widely used throughout the cement and lime industries for grinding coal and petroleum coke to be used as fuel to fire kilns or flash calciners on preheater-type kilns.

In operation, raw fuel is fed to the bowl mill by means of a weigh feeder. The metered fuel enters the mill through a rotary vane-type feeder or hydraulically operated triple gate feeder. These feeders act primarily as air seals on the mill. The raw fuel is then directed into the center of a rotating bowl-shaped grinding table and is thrown to the outside by centrifugal force. In doing this, the material is forced between the rotating bowl and the rolls of the three journal assemblies. The journal assemblies are fixed to the mill housing and are equally spaced around the circumference of the bowl. The journals can be adjusted to vary the clearance between the rolls and the rotating bowl. A spring assembly is used to supply the grinding force for the journals. This spring assembly is adjustable so the grinding force can be varied to suit the fuel being ground. The pulverized fuel then flows over the rim of the bowl and is picked up by hot gases that are introduced into the mill from beneath the bowl. Material that is still too coarse to be entrained in the hot gases falls to the bottom of the mill and is rejected.

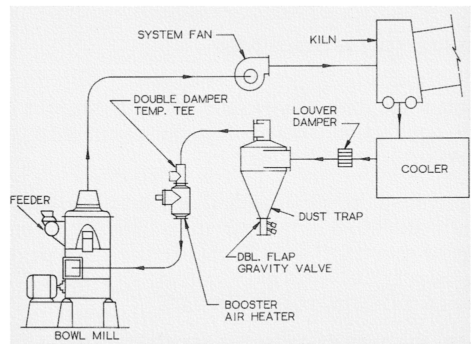


The mixing of fuel and hot gases flash dries the pulverized fuel and conveys it to a static classifier that can be adjusted to produce the desired fineness. The coarse material that is rejected from the classifier is returned to the bowl for regrinding.

The mill can be incorporated into various types of firing systems; these include direct, semi-direct and indirect.

Direct Fired System

From the discharge of the mill, the drying gases and pulverized fuel enter a material handling fan that then conveys the material into the kiln. In this arrangement, all of the gases that flow out of the mill are used in the firing circuit. The mill outlet temperature is controlled at 170-180°F (75-80°C) for a direct fired system. The temperature of the hot gases used for drying in the mill vary depending on the amount of moisture in the fuel. A maximum inlet temperature of this type of system is 700°F (370°C).

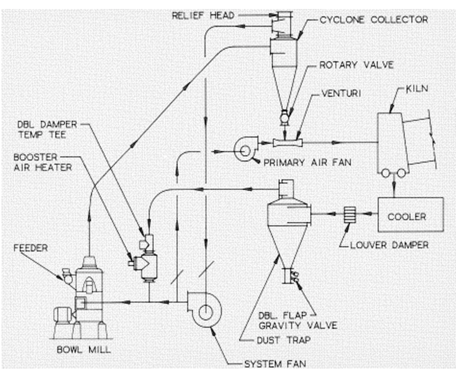


Semi-Direct System

In a semi-direct system, the drying gases and pulverized fuel leave the mill and are conveyed to a cyclone collector where the pulverized fuel is collected and discharged through a rotary valve. The gases leave the collector and flow through a system fan that provides the draft for the system. From the discharge of the fan, the gases are recirculated back to the mill. A portion of these gases must be vented from the system. The material collected in the cyclone is discharged into a venturi pickup section and conveyed to the kiln by a firing fan utilizing the vented gases from the mill circuit.

Thus, in a semi-direct system only a portion of the gases flowing through the mill are used for firing.

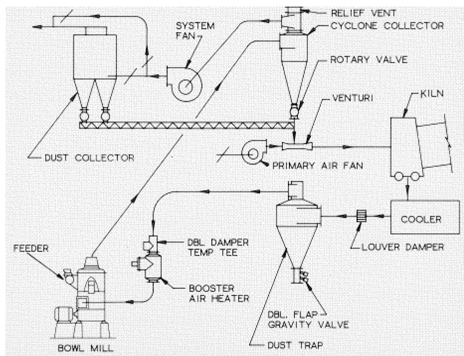
The temperature of the gases in the vent line is used as the controlling factor and is generally set for 150°F (65°C) maximum. The lower temperature in the semi-direct system is required because the gases are retained in the mill system longer than they are with the direct fired system. The inlet temperature of the gases entering the mill is limited to 350°F (180°C) because of the recirculation. The semi-direct is limited to use with low moisture fuels only, due to the reduced drying capability imposed by the 350°F (180°C) inlet temperature.



Indirect System

The indirect system is quite similar to the semi-direct system. After leaving the discharge of the cyclone, however, the gases flow first to a dust collector (baghouse) to collect the fuel still remaining in the gas stream. After leaving the dust collector, the gases flow through the vent fan and is then discharged to the atmosphere. In this system none of the mill system gases are used in the firing circuit. Material discharged from the cyclone and dust collector are collected by a screw conveyor and fed to a storage bin or to the firing circuit that generally consists of a dense phase pump and a small firing fan.

The indirect system is controlled by using the cyclone discharge (vent) temperature and is limited to approximately 150°F (65°C), much as with the semi-direct system. The maximum temperature at the inlet of the mill for this type of system is 450°F(230°C).



This type of system is better suited to handle both high and low moisture fuels. The only other restriction on the indirect system is the dust collector. Care should be taken to avoid condensing the water vapor in the dust collector, thus wetting down the bags. This will ultimately lead to caking of coal dust on the bags which, if left long enough, could cause a fire. We recommend that a 45-50°F(25°C) temperature differential be maintained between the dew point temperature and controlled vent temperature.

One other important point needs to be addressed. With all three of the systems described, we have assumed that we have been using hot gases from the kiln hood or from the first or second cooler compartments.

Those gases, for the most part, consist of normal hot air with 21% oxygen content. On preheater-type kilns, another source of hot air for drying in the mill system is the preheater off-gases. These gases that are actually the products of combustion from the burning of fuel in the kiln, are generally high in carbon dioxide and water vapor and low in oxygen. They may be, therefore, considered to be inert. Please refer to NFPA Code 69 for detailed information.

Raymond Operations has experience in designing these types of systems, including the use of safeguards to prevent or suppress explosions when the equipment is properly operated and maintained.

The Raymond Bowl Mill, as described in this article, can be used in wide range of systems to pulverize fuel for burning in a kiln or related equipment. It is simple to operate, has little maintenance and is a very dependable piece of equipment. It has gained this reputation based on over 65 years of operation in a wide variety of industries.

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