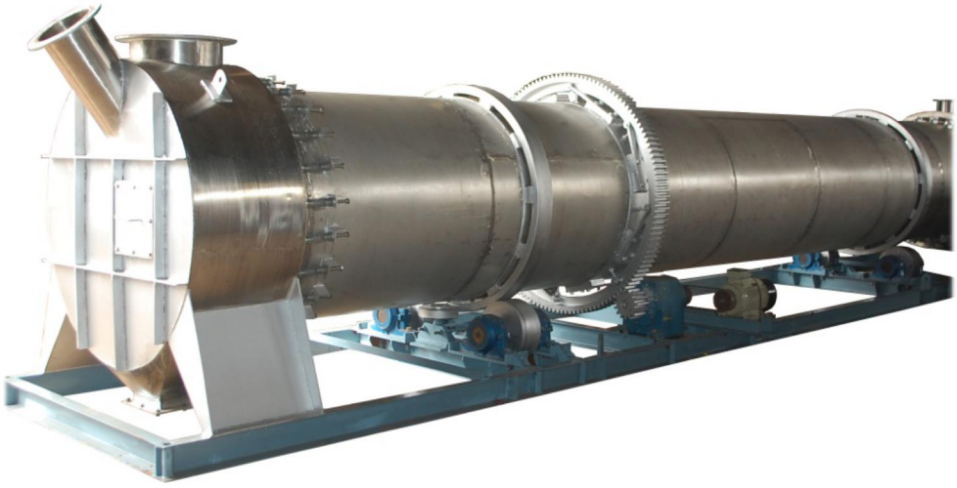
## ROTARY DRYER

The Rotary Dryer is a type of industrial dryer employed to reduce or to minimize the liquid moisture content of the material it is handling by bringing it into direct contact with a heated gas to evaporate the water. Rotary Dryers are suitable for drying of wide range of materials continuously because of its ability to process materials having considerable variation in size and composition.

Despite introduction of new technologies the long established Rotary Dryer is still widely regarded as the workhorse of many process industries. The robust yet simple construction combines flexibility with reliability enabling this type of dryer to handle vast range of materials.

## ROTARY DRYER CONSTRUCTION



The dryer is made up of large rotating cylindrical tube, supported by two nos. riding rings(tyres) running over a set of support rollers with a stationary feed and a discharge hood, mounted over a channel frame with suitable sealing arrangement between the shell ends and hoods. The dryer slopes slightly so that the discharge end is lower than the material feed end in order to convey the material through the dryer under gravity. Fabricated in carbon, stainless steel and MS + rubber lined with flights or lifters are welded or bolted internally to produce the cascade of particles falling through hot gas stream. The mechanical lifting of the material allows drying the materials from filter cake to coarse minerals through hot gas stream, also helps in breaking-up lumps for uniform drying. The length of the drum may range from 4 to 10 times of its diameter and usually operates with 12 to 15% of their volume filled with the material. The Hot Air Generator, the feeding equipment and the dust collection equipments like cyclone and bag filter are the part of the Rotary Dryer system.

**LIFTERS**

The lifter design inside the rotary dryer is also engineered around the material's unique characteristics. The objective with flight design is to create the ideal "curtain" of material. The curtain refers to the span of material created as the material is dropped from the flights, through the drying air. Ideally the curtain will span the width of the interior of the drum, evenly falling from one side to the other. The optimal curtain is created through designing the flights and flight pattern around material.

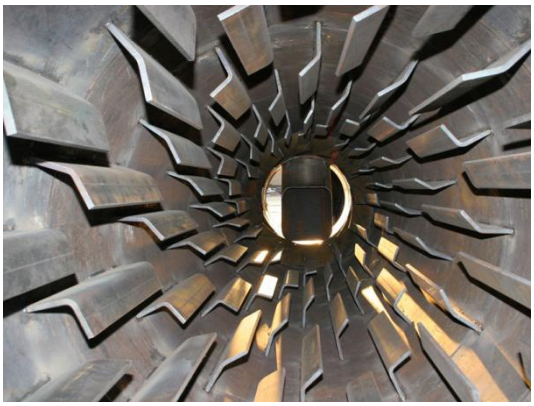


Diagram: The diagram above illustrates how flights create the curtain in a rotary dryer to maximize heat transfer

## MATERIAL OF CONSTRUCTION

Carbon Steel, Stainless Steel & MS + Rubber lined.

## PRINCIPLE OF OPERATION

The principle of operation is based on showering or cascading the wet material through a hot stream, flowing either co-current or counter-current to the solids. The hot gas induces the evaporation of the moisture. The heat lost to the material and evaporation of water vapour reduces the gas temperature rapidly, such that it leaves the dryer at a comparatively low temperature.

The efficiency of the dryer is largely dependent on the differential on the differential between the inlet and exhaust temperatures, although the heat transfer rate is also influenced by the relationship between the design of flights and the speed of rotation. However, irrespective of the gas and material temperature, the drying or residence time may be critical, as this is governed by the rate of diffusion of water from the core to the surface of the material.

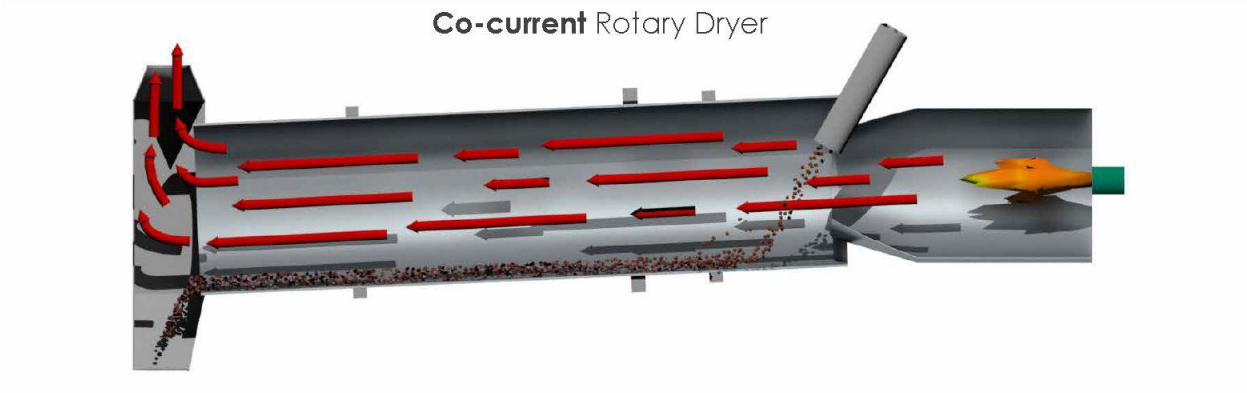
Rotary dryer adopts the direct flow type of heating with heat source from the heat exchanger. The material to be dried enters the rotating dryer shell, in a regulated way through a screw feeder and through a feed chute attached with the feed hopper, is mounted over the stationary

feed hood. As the dryer is installed in slope the material flows to the back end under gravity and rotation force and is lifted by lifters repeatedly and thrown down, which make the material form even curtain and exchange heat sufficiently with the inner heat flow and repeated scattering. The water separated by the hot air flow is changed in to vapour and discharged in to the atmosphere either direct or through a dust collection system. The dried material is discharged from the other end of the shell through a stationary discharge hood.

## CO-CURRENT & COUNTER CURRENT FLOW

Depend on character of material, the gas stream moving toward the discharge end from the feed end known as co-current flow or toward the feed end from the discharge end known as counter-current flow.

## CO-CURRENT DRYER




Co-current dryers are particularly suitable for drying materials containing high moisture content, which are heat sensitive or have a tendency to stick or cake.

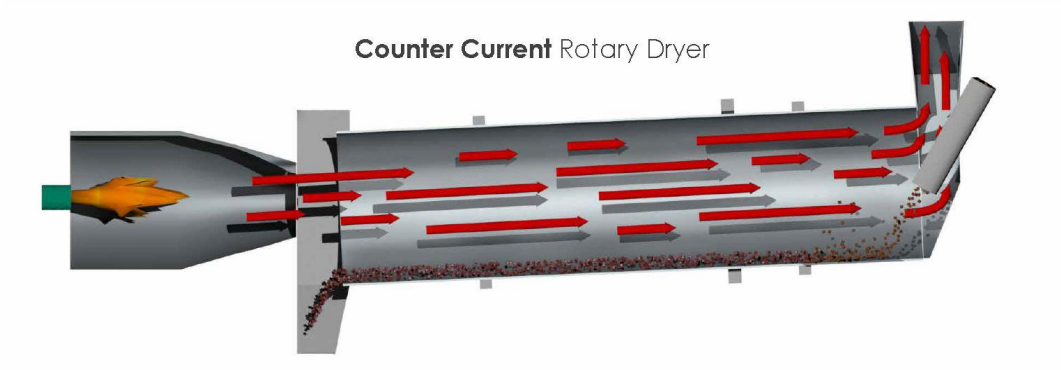
The wet material is in contact with the gas at its highest temperature, which rapidly evaporates surface moisture. The initial heat transfer rate is high, causing an immediate and considerable drop in gas temperature, which prevents overheating of the material and the dryer shell.

The final product is in contact with the gas at its lowest temperature, enabling the moisture content to be readily controlled, usually by maintaining the dryer exhaust gas temperature at a pre set value.

**CO-CURRENT APPLICATION:**

Wet feed in contact with the hottest drying gases supplied from an external source, where the heat source is by convection. Suitable for filter cakes, minerals, fertilizers, floatation concentrates, coal/coke, clay, phosphates, animal feeds & sludge.

## COUNTER CURRENT DRYER




Counter Current dryers are more suitable for materials that must be dried to very low levels of moisture, where the last traces of moisture are difficult to remove, or where an elevated product temperature is desirable. They are also used effectively as combined dryer/pre-heaters. However, since the final product is in contact with the gas at its highest temperature the counter-current dryer is often unsuitable for heat sensitive materials. Although this system can be more efficient, moisture which is to remain in the product is not so readily controlled.

**COUNTER-CURRENT APPLICATIONS :**

Wet feed in contact with the hottest drying gases supplied from an external source, where the heat source is by convection. Suitable for silica gel, sugar, chemical salts & crystalline products (low moisture range),

ammonium nitrate, potassium nitrate, barium nitrate, potassium chloride, ores & minerals, pigments, removal of floatation reagents etc.


## DRIVE ARRANGEMENT

The drives of Rotary Dryers are designed for the reliable operation of the dryer under any operating conditions. All drive components are designed for the installed motor torque plus all safety factors and not only for effective torque generated at nominal capacity. The installed reserves and safety factors ensure the extremely flexible operation of the Rotary Dryer, including higher product throughput, without overloading the drive.

## END CLOSER SEALS

Both ends of the drum are closed by steel fabricated hoods with air inlet/outlet chute with suitable seals in between the hood and the dryer drum. Normally spring loaded friction seals are provided where two rubbing surfaces are in contact under spring pressure.

## AIR FILTER

It is an essential component of the air intake system of Rotary Dryer and is tasked with trapping any dirt or debris in the air entering the intake system. It is important that foreign material is not allowed to enter the Rotary Dryer.

## AIR HEATING SYSTEM

In co-current and counter-current systems, the material when drying or pre-heating which are unaffected by heat or exposure to a flame, an **Oil or Gas Burner** is used to fire directly into the drum. For low temperature and heat sensitive applications, indirectly heated air can be supplied via **Finned Tube Heat Exchangers** and induced by a centrifugal fan located at up steam of the air heater with filter at fan inlet.

### OIL OR GAS BURNER

An oil burner is a heating device which burns oils, diesel fuel and other similar fuels. The fuel is atomized into a fine spray usually by forcing it under pressure through a nozzle which gives the resulting flame a specific flow rate, angle of spray and pattern (variations of a cone shape). This spray is usually ignited by an electric spark with the air being forced through around it at the end of a blast tube, by a fan driven by the oil burner motor. The fuel pump is typically driven via a coupling connecting its shaft and motor. Oil burners also include combustion-proving devices to prevent out-of-control combustion - Primary Control; Safety Control; Cad Cell Control; Master Control; Fire-Eye Control are all common names for the 'combustion safety control'.

### FINNED TUBE HEAT EXCHANGERS

Heat exchanger with finned heating surfaces, so-called finned tube heat exchangers are widely used in Rotary Dryer which offers the possibility of heat transfer between Air and liquids significantly space-saving and is more. Finned tube heat exchangers are designed to transfer heat from clean air and gases with high efficiency on liquids or vapors. In this way the Air can be heated in a closely space.

## AIR HANDLING SYSTEM

In Rotary Dryer the flow of air is induced by a centrifugal fan located at upstream of the air heater and the exhaust air is removed either direct at outlet or by a second centrifugal fan at the outlet through Dust Collector.

### INDUCED DRAFT FAN (ID Fan)

Induced draft fan (ID fan) is located between dust collector and chimney of Rotary Dryer. ID fan will take the hot flue gases from Rotary Dryer via dust collector (dust separation system or Fume Extraction system) and will deliver to chimney. ID fan will handle the flue gases i.e. hot air. ID fan will produce the negative pressure in the Rotary Dryer to remove the flue gases from Dryer via Cyclone and bag Filter and to push the flue gases to chimney.

### FORCE DRADT FAN (FD Fan)

Force draft (FD fan is used basically for providing the required quantity of hot air to the Rotary Dryer for smooth and uniform combustion of fuel. FD fan will produce the positive pressure inside the Rotary Dryer.

## DUST COLLECTION SYSTEM

The choice of dust collection equipment will vary according to the application, but in addition to the range of high efficiency and high capacity Cyclone Separators is used.

### CYCLONE SEPARATORS

In Rotary Dryer application this is the most widely used type of dust collection equipment, in which dust-laden gas from the rotary dryers enters a cylindrical or conical chamber tangentially at one or more points and leaves through a central opening . The dust particles, by virtue of their inertia, will tend to move toward the outside separator wall, from which they are led into a receiver. A cyclone is essentially a settling chamber in which gravitational acceleration is replaced by centrifugal acceleration. At operating conditions in rotary dryers commonly employed, the centrifugal separating force or acceleration may range from 5 times gravity in very large diameter.

## APPLICATION

Rotary dryers are suitable for a wide variety of products, ranging from granular, powdered and crystalline materials, through to filter cakes and sludges for the food, chemical and mineral industries.