

**Rotary Dryers
Coolers and Calciners**

Rotary Dryers

Barr-Rosin

As a member of the GEA Group, Barr-Rosin is one of the foremost companies in the field of industrial drying and cooling. Extensive experience has been gained with a wide range of thermal processing equipment designed to meet the demands of modern day process industries worldwide. With engineering and sales offices in Maidenhead (near London) and Montreal (Canada), as well as GEA offices around the world, a complete service is available - from initial design through to final commissioning. Each Rotary Dryer installation is custom engineered to suit the client's specific requirements and complements the well known range of Barr-Rosin fluid bed, ring, flash, column and 'Rosinaire' paddle dryers.

The Cascade Dryer

Despite the introduction of new technology, the long established *Rotary Cascade 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 a vast range of materials and to operate continuously under the most arduous conditions. The design also permits the use of the highest possible drying temperatures and in contrast to other dryers is not sensitive to wide variations in material size, moisture content or throughput.

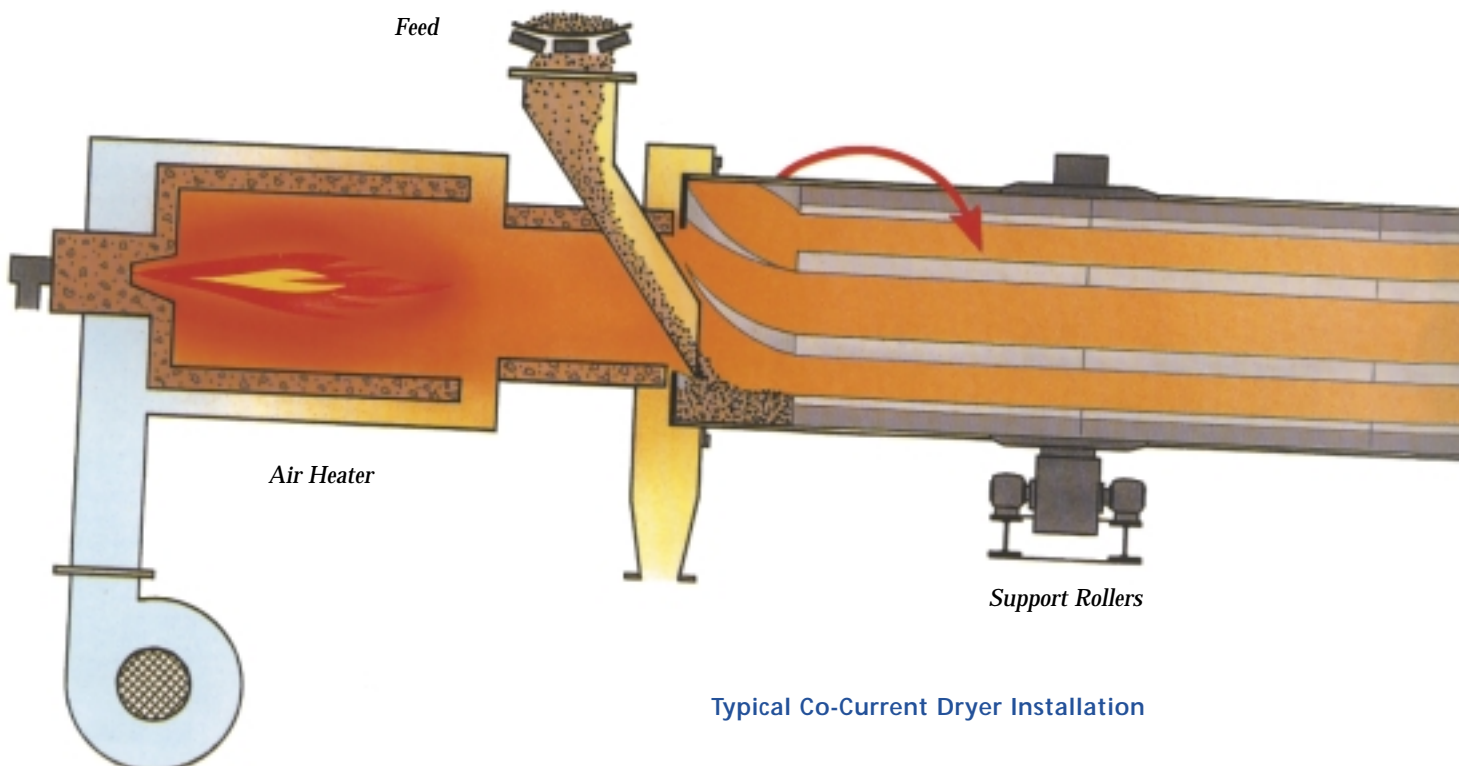
Principles of Operation

In its simplest form, the cascade dryer consists of a slightly inclined rotating cylinder, fitted with a series of peripheral flights arranged to lift, distribute and transport the material. The flights are designed to suit the particular handling characteristics of the material, which may vary with increasing dryness.

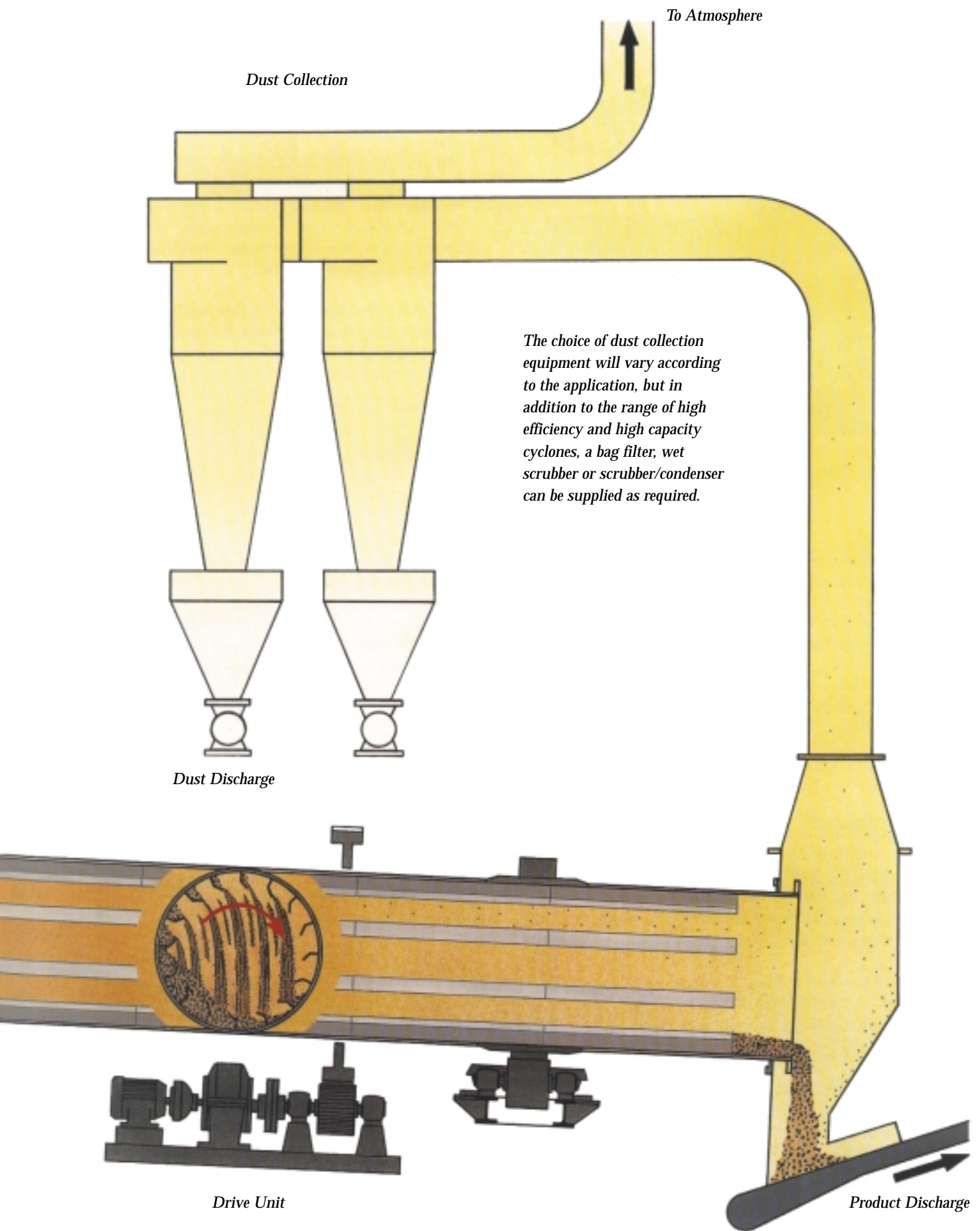
The principle of operation is based on showering, or cascading the wet material through a hot gas stream, flowing either co-current or counter-current to the solids. The hot gas induces the evaporation of the moisture. The heat lost to the material and evaporation of water vapour reduces the gas temperature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

The efficiency of the dryer is largely dependant on the differential between the inlet and exhaust gas 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 temperatures 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.

For special applications, the rotary cascade design is adapted to provide a shortfall, or 'Cruciform', lifter configuration. Similarly, *Rotary Cascade Coolers and Combined Dryer/Coolers* are available as required.



Typical Co-Current Dryer Installation



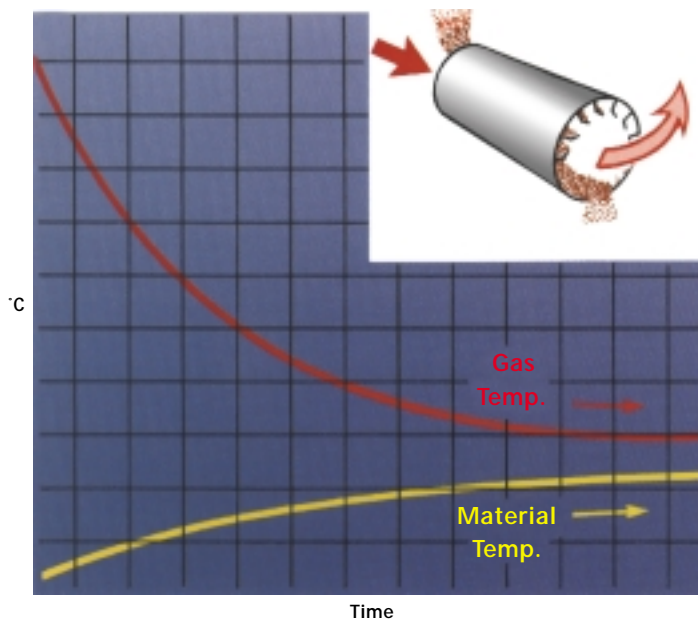
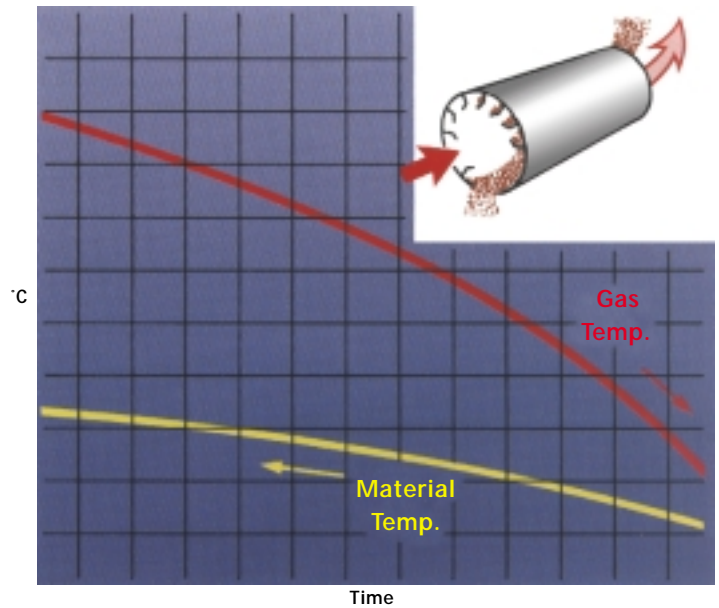
Direct Fired Dryers

Co-Current Principle

Co-Current dryers are the most widely used and are particularly suitable for drying materials containing a 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.



Counter-Current Principle

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/preheaters.

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.

Heating System

In both co-current and counter-current systems, the material is in direct contact with the hot drying gases, which are normally supplied as products of combustion from an oil, gas or solid fuel fired furnace in the temperature range 250°C to 1000°C, as required.

However, for low temperature and heat sensitive applications, or where contamination must be avoided, indirectly heated air can be supplied via an electric or steam tube type exchanger.

The dryer normally operates on a two fan, balanced draught system, whereby the gas inlet is maintained under slightly negative pressure to minimise air in-leakage.

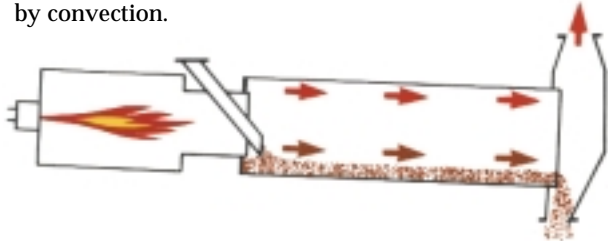
When drying (and/or preheating) materials which are unaffected by heat or exposure to a flame, an oil or gas burner can be arranged to fire directly into the drum.

The combined effects of the very high temperature (800°C-1300°C) and the radiation from the flame, ensures maximum thermal efficiency while reducing the size of dryer and the capacity of the exhaust system.

In this case the quench (or dilution) air is induced around the burner by the exhaust fan, thus preventing overheating of the dryer shell.

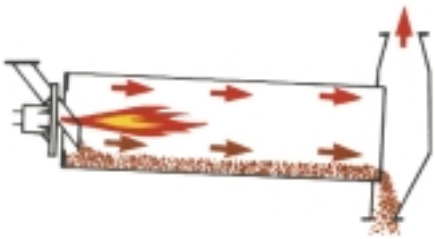
Co-Current Applications

- 1 Wet feed in contact with the hottest drying gases supplied from an external source, where heat transfer is by convection.



Suitable for filter cakes, minerals, fertilisers, beet pulp, de-greased bone, floatation concentrates, coal/coke, clays, phosphates, animal feeds, germ, stillage, sludges.

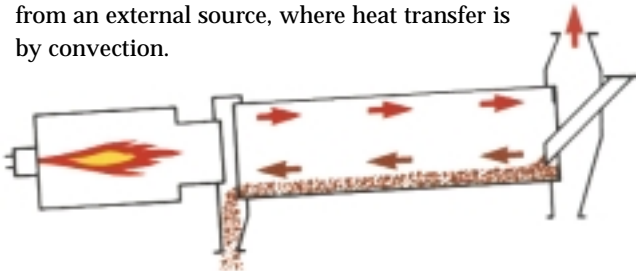
- 2 Wet feed in contact with the hottest drying gases from an internal burner, providing higher thermal efficiency, where heat transfer is by convection and radiation.



Suitable for heavy ores, crushed rock and stone, sand, slag, refractory materials, limestone/clay separation.

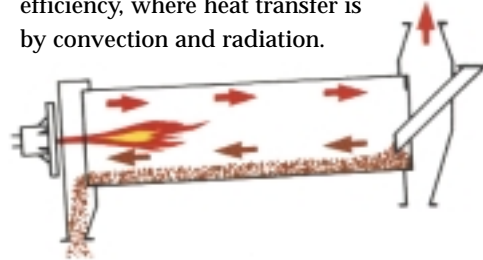
Counter-Current Applications

- 3 Final product in contact with the hottest drying gases supplied from an external source, where heat transfer is by convection.



Suitable for silica gel, sugar, chemical salts and crystalline products (low temperature range) ammonium nitrate, ores and minerals, pigments, removal of floatation reagents.

- 4 Final product in contact with the hottest drying gases supplied from an internal burner, providing even higher thermal efficiency, where heat transfer is by convection and radiation.



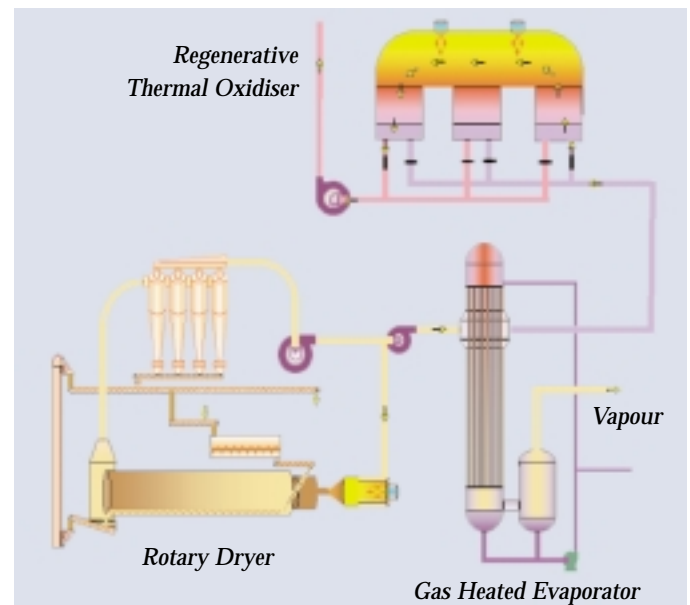
Suitable for roadstone, sand, gravel, crushed rock, limestone, slate, pigment 'fixing', combined drying/pre-heating and calcining.

Gas Recycle and Integrated systems

For even greater thermal efficiency, or when potentially hazardous materials are processed, exhaust gas recycle is often employed. On direct fired systems this facility provides for the recycling of a high proportion of the dryer exhaust gas back to the air heater, as dilution. The high humidity creates a safer, inert environment, by displacing most of the oxygen with water vapour.

In addition, substantial energy savings are achieved due to the recovery of heat from the dryer exhaust, while greatly reducing the final off-gas volume.

As a result, further dedusting, heat removal or odour treatment of the humid off-gas can then be more economically achieved by integration of a wet scrubber, scrubber/condenser or evaporator system, with optional regenerative thermal oxidiser.

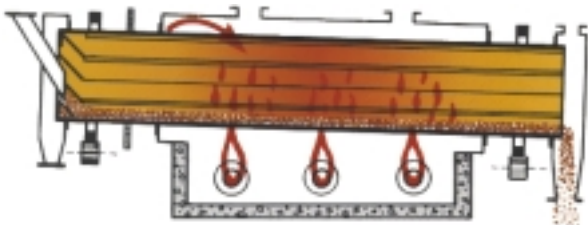


Other Rotary Systems

Direct Fired Calciners

Direct Fired, Refractory Lined Calciners are also supplied for high temperature applications where it is necessary to change the 'state' of the material. Since this process usually requires a long residence time, the length to diameter ratio is often in excess of 10:1. In most cases an oil or gas burner fires directly into the discharge end of the unit. The material is heated in three ways - by radiation from the burner flame, conduction from the refractory lining and convection by contact with the hot gases.

Indirectly Heated Units



Indirectly Heated Rotary Dryers and Calciners are available for dusty, finely divided materials and low to medium temperature calcining applications. The rotary drum is partially enclosed and externally heated by a series of burners mounted in an insulated stationary chamber or jacket. Alternatively, the products of combustion from an external heater may be recirculated to increase thermal efficiency. Since heat transfer is by radiation and conduction via the cylinder wall, the internal flights are arranged to distribute the material around the inner periphery of the drum. The entrainment of 'fines' is minimal as a low air flow is only required for removing the water vapour, little or no de-dusting equipment is therefore necessary.

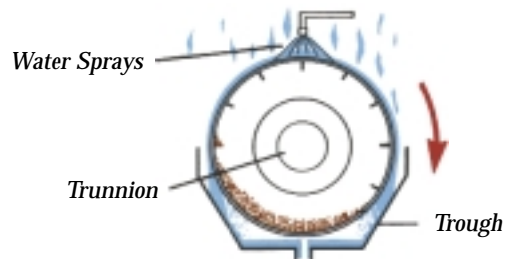
Rotary Coolers

The *Cascade Cooler* always operates in counter-flow, but is otherwise similar to the cascade dryer, the hot gases being substituted by ambient or chilled air, which is in direct contact with the material. In general this type of cooler is used for lower temperature, coarse product applications or in conjunction with an indirect system.

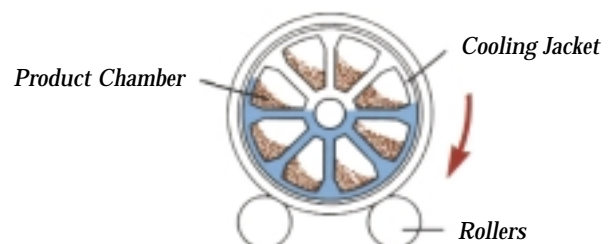
For dusty and/or high temperature applications, where space is limited, or where the material must be cooled to a temperature approaching ambient, *Indirect Rotary Coolers* can be supplied. These require either a continuous or recirculated water supply and are available in two forms - external spray and sectional coolers. Either system may be used for cooling hot products discharged from kilns, calciners or ovens at temperatures up to 1000°C.



External Spray Type Water Coolers are of simple design and operate on the principle of heat transfer through the rotating cylinder wall, which is continuously irrigated by a series of external water sprays mounted above the unit. The water is partially evaporated as steam, while the excess is collected from the underside of the unit and recirculated.

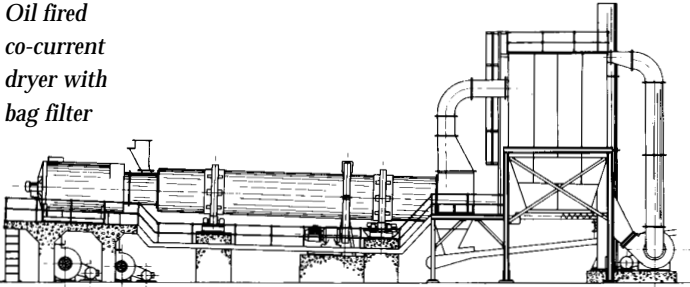


The *Sectional Cooler* offers an efficient indirect system, which has the advantage of presenting a much larger cooling surface, while maintaining the water in closed circuit. The sectional design ensures that the hot material is in continuous contact with the water-cooled walls of the vessel. The individual product chambers also ensure gentle action thus avoiding degradation of the material.

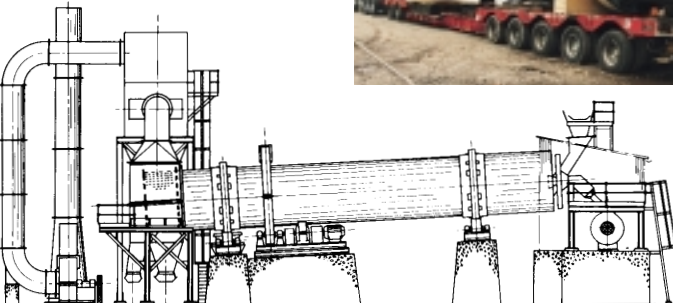


Typical Installations

*Oil fired
co-current
dryer with
bag filter*



*Direct-flame
type dryer
with trommel
screen*





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