Dryer Types Adiabatic Dryers

- Flash
- Ring
- Airless
- Rotary
- Fluid Bed
- Turbo
Flash Dryer...

Wet material injected in a stream of heated air that conveys it through a drying duct. Material dries as it is conveyed. Product is separated using cyclones, and/or bag filters. Elevated drying temperatures are used with many products since the “flashing” the surface moisture instantly cools the drying gas without greatly increasing the product temperature. Backmixer is used to help convey slurry. Food products, dry milk powder.
Ring Dryer...

Same as the flash dryer - material is dispersed and conveyed through the dryer in a hot air stream.

Uses a centrifugal classifier allows selective internal recirculation of semi-dried solids, lengthening the retention time of larger particles in the dryer.

Finer, or dryer material which dries more rapidly, exits the dryer with the exhaust air.
Ring Dryer...

**Manifold Classifier deflector blades** to select and classify airborne particles based densities.

**Centrifugal action**, wetter (heavier) particles follow the manifold contours more closely than the lighter and drier fractions which are carried along with the airstream. The blades are adjusted to direct the lighter, drier particles out of the dryer for collection, while the larger, heavier particles are recycled through the ring duct for an additional pass of drying.
Rotary Dryers...

consists of a slightly inclined rotating cylinder, fitted with a series of peripheral flights arranged to lift, distribute the material; cascading wet material through a hot gas stream.

Gas flow co-current or counter-current to solids.

The hot gas induces moisture evaporation.

The heat lost to the material and evaporation of water vapor reduces the gas temperature.
AST Drying System
Typical Counter-Current Dryer Installation

Food
Air heater
Support Rollers
Ejector
Suction Unit
Product Discharge

The preceding production processes can use this counter-current or counter-flow configuration to provide a shearless or 'C' action. Other configurations are available as required.

Similarity, Rotary Cascade Gardens and Combined Dryer Catalysts are available as required.
Co-current vs. Counter-current Flow
Airless Dryers...

Airless Dryer is a rotary drum dryer that features superheated water vapor at atmospheric pressure as the drying medium. It’s also an indirect heated dryer. The products of combustion are isolated from the process loop of the dryer by a heat exchanger.
**Airless Dryers...**

- There is minimal risk of in-drum fires because of the oxygen-starved environment.
- Minimal odor control equipment is needed.
- There is no visible plume of dryer exhaust.
- The dryer’s exhaust is essentially water vapor, which can be condensed to recover thermal energy. This energy can be used elsewhere in the plant.
- No pressure vessel is required because the dryer operates at atmospheric pressure.
- Exhaust volume is much less than comparable heated air dryers.
Fluid Bed Dryer

Product is “fluidized” Hot air flows through the bed via perforated distributor plate; velocity high enough to lift the particles in a fluidized state. Bubbles form and collapse within the material bed, creating particle movement.

Solids are like a boiling liquid. Very high heat and mass transfer coefficients occur with this type
Turbo dryer... consists of a stack of rotating circular trays. Material is fed in top tray. After one revolution the material is wiped onto the next lower tray where it is mixed, leveled, and then after one revolution, is wiped to the next tray etc. Trays are contained in a heated enclosure; heated air or gas is circulated by internal fans.
Delivers very uniformly dried product, material is redistributed with plug-flow operation. Has uniform inside temperature or zoned temperature regions. The closest product temperature control of any dryer possible. Can give the lowest residual moisture of any dryer, gentle handling, little dust, fines. Small product degradation, even with fragile materials such as crystals and pellets. Good for phama applications.
Non-Adiabatic Dryers

When a dryer does not use heated air or other gasses to provide the energy required the drying process is considered a non-adiabatic.

Heat transferred to the product by contact with a jacketed surface that is usually heated by steam or a thermal fluid.

An application - drying paper passed over a jacketed mandrel. The steam condenses in the vessel that allows the product to give up moisture linearly through the length of the steam-jacketed section.
Jacketed cylinder with a high-speed paddle rotor that creates a highly agitated, dense, thin layer of material against the jacketed vessel wall. Dryer's adjustable paddles can convey materials with poor flowability, as well as adapt to variations in the conveyance of materials whose flow characteristics change during drying.
Inferential Control

An inferential calculation of the exit product moisture can be made based on the dryer’s steam and temperature measurements. Basis for this calculation is that the heat transfer coefficient, $U$, is a function of the average moisture of the product in contact with the surface. Assume the product’s solid specific heat value is constant, for water is 1.0. This resulting mixture heat transfer should be proportional to the weight percentages of each in the product.