Types of Dryers-mechanical dryers, batch, continuous, mixing and non-mixing dryers- working principle

1. Re-circulatory Batch Dryer

This is a continuous flow non mixing type of grain dryer. The dryer consists of two concentric circular cylinders made of perforated (2mm diameter) mild steel sheet of 20 gauge. The two cylinders are set 15 to 20cm apart. These two cylinders are supported on four channel sections. The whole frame can be supported by a suitable foundation or may be bolted to a frame made of channel section. A bucket elevator of suitable capacity is used to feed and recirculate the grain into the dryer. A centrifugal blower blows the hot air into the inner cylinder which acts as a plenum. The hot air from the plenum passes through the grain moving downward by gravity and comes out of the outer perforated cylinder. A torch burner is employed to supply the necessary heat with kerosene oil as fuel. The designs of this dryer for 0.5, 1 and 2 tones holding capacity are available.

Advantages

1. Price is reasonable.
2. Simplest design amongst all flow type dryers
3. Easy to operate
4. It can be used on the farm and rice mill as well.
5. Operating cost is low with husk fired furnace.

Disadvantages

1. Drying is not so uniform as compared to mixing type.
2. Holes of the cylinders may be clogged with the parboiled paddy after using it for a long time.

2. Louisiana State University Dryer

This is a continuous flow-mixing type of grain dryer which is popular in the U.S.A. It consists of 1) a rectangular drying chamber fitted with air ports and the holding bin, 2) an air blower with duct, 3) grain discharging mechanism with a hopper bottom, and 4) an air heating system.

1) **Rectangular bin**:

Usually the following top square sections of the bin are used for the design of LSU dryer.

i) 1.2m x 1.2m, ii) 1.5m x 1.5m, iii) 1.8m x 1.8m and iv) 2.1m x 2.1m the rectangular bin can be divided into two sections, namely top holding bin and bottom drying chamber.

2) **Air distribution system**: Layers of inverted V-shaped channels (called inverted V-ports) are installed in the drying chamber. Heated air is introduced at many points through the descending grain bulk through these channels. One end of each air channel has an opening and the other end is sealed. Alternate layers are air inlet and air outlet channels. In the inlet layers, the channel openings face the air inlet plenum chamber but they are sealed at the opposite wall, where as in the outlet layers, the channel openings face the exhaust but are sealed other side. The inlet and outlet ports are arranged one below the other in an offset pattern. Thus air is forced through the descending grain while moving from the feed end to the discharge end. The inlet ports consist of a few full size ports and two half size ports at two sides. All these ports of same size are arranged in equal spacing between them.

3) **Grain discharging mechanism**: Three or more ribbed rollers are provided at the bottom of the drying chamber which can be rotated at different low speeds for different discharge rates of grains. The grain is discharged through a hopper fixed at the bottom of the drying chamber. Causing some mixing of grain and air the discharge system at the base of the dryer also regulates the rate of fall of the grain.

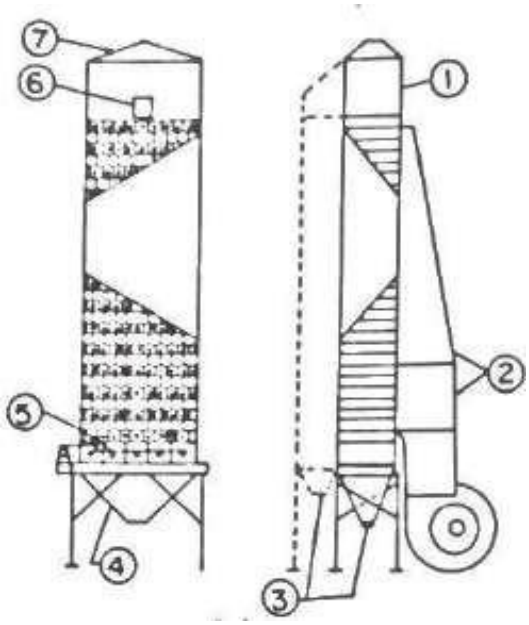
4) **Air heating system**: The air is heated by burning gaseous fuels such as natural gas, butane gas, etc, or liquid fuels such as kerosene, furnace oil, fuel oil etc, or solid fuels like coal, husk, etc. Heat can be supplied directly by the use of gas burner or oil burner or husk fired furnace and indirectly by the use of heat exchangers. Indirect heating is always less efficient than direct firing system. However, oil fired burner or gas burners should be immediately replaced by husk fired furnace for economy of grain drying. The heated air is introduced at many points in the drier so as to be distributed uniformly through the inlet ports and the

downward grain bulk. It escapes through the outlet ports. This type of dryer is sometimes equipped with a special fan to blow ambient air from the bottom

cooling section in which the dried or partially dried warm grain comes in contact with the ambient air. In general, the capacity of the dryer varies from 2 to 12 tons of grain, but sometimes dryers of higher capacities are also installed. Accordingly, power requirement varies widely. Recommended air flow rate is 60-70 m3/min/tone of parboiled paddy and optimum air temperatures are 600C and 850C for raw and parboiled paddy respectively. A series of dryers can also be installed.

Advantages & Disadvantages

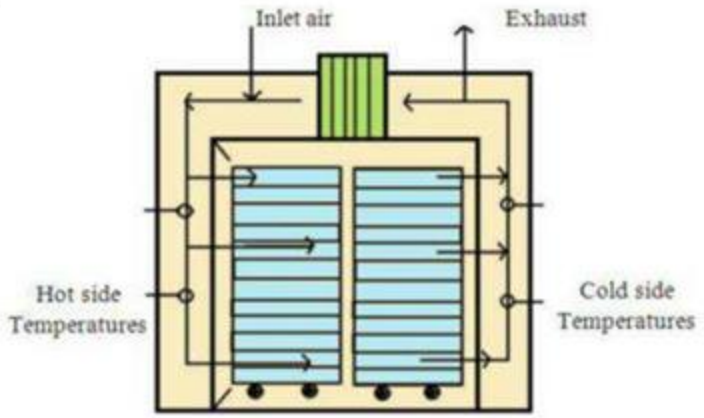
- Uniformly dried product can be obtained if the dryer is designed properly.
- The dryer can be used for different types of grains.
- High capital investment
- Cost of drying is very high if oil is used as fuel.



1. Garner
2. Duct
3. Dry material outlet
4. Hopper
5. Continuous flow
6. Door
7. Roof

3. Tray Dryer

Tray dryers usually operate in batch mode, use racks to hold product and circulate air over the material. It consists of a rectangular chamber of sheet metal containing trucks that support racks. Each rack carries a number of trays that are loaded with the material to be dried. Hot air flows through the tunnel over the racks. Sometimes fans are used to on the tunnel wall to blow hot air across the trays. Some moist air is continuously vented through exhaust duct; makeup fresh air enters through the inlet. The racks with the dried product are taken to a tray-dumping station.



These types of dryers are useful when the production rate is small. They are used to dry wide range of materials, but have high labor requirement for loading and unloading the materials, and are expensive to operate. They find most frequent application for drying valuable products. Drying operation in case of such dryers is slow and requires several hours to complete drying of one batch. With indirect heating often the dryers may be operated under vacuum.

4. Drum Dryer

In drum dryers a liquid containing dissolved solids or slurry carrying suspended solids forms a thin layer on the outside surface of a large rotating drum. For a single drum unit thickness of the film can be controlled by an adjustable scraping blade. In case of a double drum unit thickness can be controlled by the gap between the drums. A gas, normally air may be blown over the surface for rapid removal of moisture.

The rotation of the drum adjusted so that all of the liquid is fully vaporized and a dried deposit can be scrapped off with the help of flexible or adjustable knife. This type of dryer mainly handles the materials that are too thick for a spray dryer and too thin for a rotary dryer. The solid collects on an overall in front of the knife and rolls to a container or to a screw conveyor.

The operation of the drum drier is continuous. The drum is rotated continuously by a gear driven by a pinion that receives its motion through a belt, a chain, or a reduction gear from. The speed of the drum may be regulated by a variable-speed drive to adopt the speed to any slight variation in the feed quality.

5. Fluidized Bed Dryer

Fluidized bed dryer consists of a steel shell of cylindrical or rectangular cross section. A grid is provided in the column over which the wet material is rests. In this type of dryer, the drying gas is passed through the bed of solids at a velocity sufficient to keep the bed in a fluidized state. Mixing and heat transfer are very rapid in this type of dryers.

The dryer can be operated in batch or continuous mode. Fluidized bed dryer is suitable for granular and crystalline materials. If fine particles are present, either from the feed or from particle breakage in the fluidized bed, there may be considerable solid carryover with the exit gas and bag filters are needed for fines recovery.

The main advantage of this type of dryer are: rapid and uniform heat transfer, short drying time, good control of the drying conditions.