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GENERAL OUTLOOK ON INDUSTRIAL DRYERS[1/]

by

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Rotary driers have been used extensively in many of the industrial processes due to fact that they are continuous, easy to operate and relatively inexpensive. They are used for conveying solids as well as heating devices. Different types of rotary dryers are described in the literature(1) taking into consideration their deign, function and the mode by which heat is transferred.

The factors affecting the hold up in rotary dryers were treated by previous investigators(2, 3, 4). These factors affecting the hold up can be classified as follows:

dryer variables, material characeristics and operating conditions. There are direct-contact dryers in which the solids are dried by exposure to hot air or a flue gas and indirect-dryers in which heat is tansferred to the material from the heating medium through a metal wall(5).

A rotary dryer consists of a revolving cylindrical horisontal shell or slightly inclined toward the outlet, wet feed enters o one end of the cylinder, dry material discharges from the other end. As the shell rotates, internal flights lift the solids and shower them down through the interior of the shell. Rotating dryers are heated by direct contact of air or gas with solids, by hot gases passing through an external jaccket on the shell or by steam condensing in a set of longtudinal tubes mounted on the inner surface of the shell. The last of these is called a steam tube rotating dryers.

A typical counter-current direct-contact air heated dryer was reported by Warren and Julian (4) and it consists of a rotating shell made of sheet steel which is supported on two sets of rollers and driven by a gear and pinion. At the upper end there is a hood which connects through a fan to a stack and a spout which brings in the wet material from the feed hopper into the shell. Flights which lift the material being dryed and shower it down through the current of hot air, are welded inside the shell. At the lower end , the dried product discharges into a screw conveyor. Just behind the screw conveyor is a set of a steam heated extended-surface pipes which preheat the air. The air is moved through the dryer by by a fan, which may if desired, discharge int the air heater so that the whole system is under positive pressure. Alternatively, the fan may be placed in the stack so that it draws the air through dryer and keeps the system under a slight vacuum. This is desirable when the material is dust. The allowable mass velocity of the gas in a direct-contact rotary dryer depends on the dusting characteristics of the solids being dried and ranges from 400 lb/ft^2 -hr for fine particles to 5,000 lb/ft^2-hr for coarse heavy particles. The dryer diameter vary from 1 to 10 ft.

In our Pilot-Plant Department, National Research Centre, a pilot scale rotary (direct-contact) dryer was built (6) on the basis of the results of previos investigators and a sand was subjected to drying(sand particles pass 0.8 mm sieve). The dryer used, consists of a steel shell 1 ft ID and 6 ft long which rotates on a system of rubber coated pulleys and is chain driven by 1 HP electric motor coupled to a gear box which reduces the speed of rotation to 6 rpm. The shell is freely rotated between two breechings. A feeding shute for solids is placed on the top of the feeding breeching and the rate of feeding the solids to the dryer is controlled by a knife gate at the bottom of the feed shute. The solids are collected from the bottom of discharge breeching, at the other end of the dryer to which a discharge hopper is connected which has a rotating on-off gate to control the collection of solids at the required intervals. Air is produced from an electric fan connevted to heaters-chamber and introduces co-current or counter-current air flow.

The results are formulated in an equation as follows:

$$X = K \frac{F\, n^{0.5}}{S_d\, N^{0.9} D}$$

X = Hold-up in dryer (% of dryer volume)
K-Constant (0.1103)
F= Feed rate of solids to dryer ($ft^3/hr\ ft^2$)
n= Number of flights
N= rate of rotation (rpm)
S_d= Dryer inclination (ft /ft)
D= Dryer diameter (ft)

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B - 323

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