

tion, before evaporation can begin. Radiation losses from the dryer enclosure is the other factor causing deviation from the theoretical adiabatic process.

4 • What is a Zone Dryer?

This term refers to a continuous dryer where the drying medium is divided into two or more sections, in order to have better control of the temperature and humidity gradients through the dryer.

5 • What is meant by high and low temperature drying?

High temperature drying refers to an evaporator process where the temperature used is above the boiling point of water; i.e., 212 F. Low temperature drying utilizes temperatures under 212 F, the range in which humidity is an important consideration.

6 • How may air for high temperature drying be obtained?

By direct oil or gas fired heaters, by indirect oil or gas fired heaters, by hot circulated oil, by high pressure steam, or by electric heaters.

7 • What is meant by the critical point or critical moisture content?

The point in the drying of a hygroscopic substance where all of the free moisture has been evaporated and after which the water is all in the combined or bound state. It is the dividing point between the constant rate drying period and the falling rate. Shrinkage of the material, if subject to shrinkage, will begin to occur at this point.

8 • What is equilibrium moisture content?

The moisture content of a hygroscopic material in the presence of air at a given temperature and humidity which will remain constant no matter how long the material is exposed. The vapor pressure of the bound water in the material is equal to the vapor pressure of the surrounding air at this point.

9 • If a material enters a dryer containing 70 per cent water and 30 per cent solids, and leaves the dryer with 10 per cent water and 90 per cent solids, (a) what is the evaporation per pound of dried product? (b) What is the evaporation per pound of bone dry material?

a. $\frac{90}{30} - 1 = 2$ lb water per pound dried product.

b. Water entering = $\frac{70}{30} = 2.33$ per cent on bone dry basis.

Water leaving = $\frac{10}{90} = 11$ per cent on bone dry basis.

Water evaporated 222 per cent on bone dry basis.

Evaporation = 2.22 lb water per pound bone dry material.

10 • What items must be included in a calculation of the dryer heat requirements?

- Heating water to be evaporated from the entering temperature to the temperature of evaporation.
- Evaporating water to be removed.
- Superheating evaporated water from the temperature of evaporation to the exit temperature of the air.
- Heating material from entering to leaving temperatures.
- Heating residual water from the entering to the leaving temperatures.
- Heating conveyor or other supporting materials.
- Radiation losses through the enclosure.
- Sensible heat in the exit air.

Chapter 42

MOTORS AND THEIR CONTROL

Direct Current Motors, Alternating Current Motors for Single Phase and Polyphase, Special Applications, Classification of Motors, Manual Control, Automatic Control, Pilot Controls, Direct Current Motor Control, Squirrel Cage Motor Control, Multispeed Motor Control, Slip Ring Motor Control, Single Phase Motor Control

THE commonest form of prime mover is the electric motor, which is available in a large number of types for the various services to which it may be applied. The equipment for starting, controlling and protecting these motors varies with the type and with the functions it is desired to attain. Motors used for heating, ventilating and air conditioning applications may be divided into two general classifications as follows:

- For use with direct current.
- For use with alternating current.

DIRECT CURRENT MOTORS

There are three types of direct current motors available:

- Shunt Wound.
- Compound Wound.
- Series Wound.

Shunt Wound motors are suitable for application to fans, centrifugal pumps, or similar equipment, where the amount of starting torque required is relatively small, for the majority of applications are used in the field of heating, ventilating and air conditioning. They may be used on reciprocating pumps and compressors, if started under unloaded conditions.

Compound Wound motors are required for application to compressors, stokers, reciprocating pumps when started under loaded conditions, and also when applied to similar equipment where high starting torque is required. Whenever frequent starting makes high starting and accelerating torque desirable, or where sudden changes of load are encountered, compound wound motors are used.

Series Wound motors find only limited application in a few special cases and are available in only a limited range of sizes.