ical corrosion. A list of the materials which may be used to resist the action of certain fumes is given in Table 7. Hoods and ducts, when short, may frequently be constructed of wood and be quite effective. Rubberized paints are available and may be applied as protective coatings in handling such gases as chlorine and hydrochloric acid.

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CHAPTER 47

DRYING SYSTEMS

Mechanism of Drying, Omissions in Drying Cycle, Factors Influencing Drying Rates, Drying Methods and Equipment, Radiant Drying, Conduction Drying, Convection Drying, Dryer Calculations, Typical Solution of Dryer Problem

THE term drying, in a broad sense, encompasses the removal of water, and occasionally other liquids, from gases, liquids, or solids. However, the common usage of the word confines the meaning principally to the removal of water or solvent from solids. Dehumidification is the term that is commonly assigned to the drying of gases. This is usually accomplished by condensation or adsorption by various drying agents and is treated in Chapter 38. Distillation and more particularly fractional distillation is associated with the drying of liquids.

It is usually more economical to employ, whenever possible, mechanical means of separating as much water as is practicable from the solid materials before undertaking drying or dehydration steps. These mechanical methods such as filtration, screening, pressing, centrifuging, or settling usually require much less power and frequently less capital outlay, thereby making the operation cheaper in terms of cost per pound of water removed.

MECHANISM OF DRYING

The removal of moisture from solids is largely dependent on the difference in vapor pressure between the moisture in the pores of the material and the surrounding air, and the rate of diffusion of internal moisture to the surface of the material. As long as the vapor pressure of the moisture within the material is greater than the vapor pressure of the surrounding air, moisture will travel outward to the surface of the material and be evaporated. While the magnitude of the vapor pressure difference is the force or potential that causes the drying, it is not representative of the actual results in terms of time or removed moisture.

Water existing on the surface or held in the voids of a solid is known as *free* or *unbound* moisture and its vapor pressure will be equal to that of water at the same temperature. *Bound, hygroscopic* or *chemically combined* moisture on the other hand is intimately associated with the physical nature of the material and its vapor pressure during drying is less than that of free water at the same temperature.

The course of drying of any substance under constant conditions of temperature, humidity and air velocity and distribution follows a definite pattern which can be represented by graphs such as Fig. 1 and Fig. 2.[1]

Fig. 1 may be considered a typical *drying time* curve for solid material. Fig. 2 is the *drying rate* curve derived from Fig. 1, the ordinate in this case being the drying rate which can be expressed as pounds of water evaporated per hour per square foot or pounds of water evaporated per hour per pound of dry stock.

In Fig. 2 the section CB is attributed to a warming up period during which the surface of the solid is reaching a uniform temperature. This temperature is maintained constant during the period of a *constant drying*