

be produced having a final moisture content of 5 per cent wet basis and having initial moisture content of 85 per cent, the weight of solids involved is 95 lb and the initial amount of water is 538 lb. The water to be removed is therefore 533 lb. If the initial moisture content should be increased to 87 per cent, then the initial amount of water is 636 pounds and 631 pounds must be removed. Hence a 2 per cent variation in initial moisture content results in almost 20 per cent increase in required drying capacity. The use of the dry basis, however, is not misleading.

FACTORS INFLUENCING DRYING RATES

Temperature

The driving force for evaporation is directly proportional to the difference between the absolute humidity of the air being used and the absolute hu-

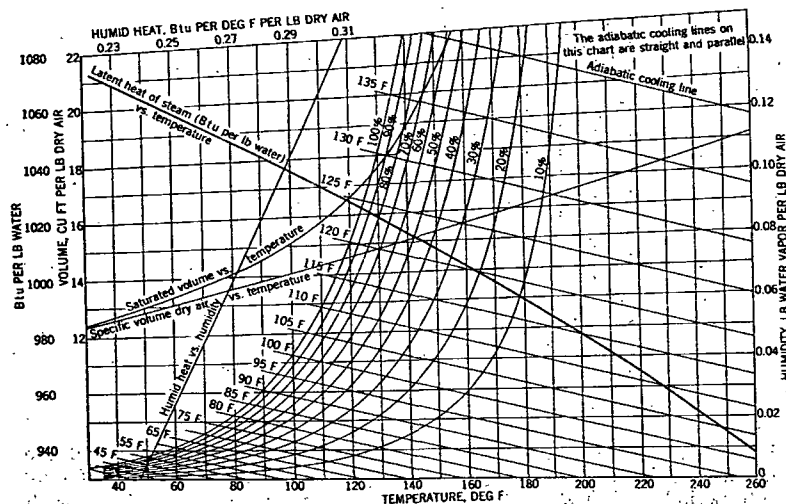


FIG. 3. PSYCHROMETRIC CHART

midity of saturated air at this temperature. It may be seen from the psychrometric chart, Fig. 3, that as the temperature increases the humidity of saturated air corresponding to that temperature increases immensely. For example, at 100 F one pound of dry air will carry about 0.04 pounds of water, while at 120 F this figure has become 0.08 pounds. Thus during the constant rate and uniform falling rate periods an increase in temperature will increase the drying rate. During the varying falling rate period, i.e., sub-surface drying where diffusion is the controlling factor, an increase in temperature will lower the viscosity permitting a more rapid drying. Temperature and thickness of the material are the only external variables which affect the drying rate during the variable falling rate period. The drying rate varies inversely with the square of the thickness.

In general, then, it is preferable to use as high a temperature as possible for any drying operation because of the faster rate of drying and the greater capacity of the air to remove water. During the constant rate

Drying Systems

period of drying, the temperature of the material approximates the wet-bulb temperature of the air. Therefore, high dry-bulb temperatures may be employed.

The nature of the material and its characteristics often determine the temperatures that can be employed with safety. For example, chemically combined water may be lost, cells may be steam exploded, charring may take place or exothermic reactions initiated if the product temperature exceeds a critical value.

To illustrate the effect of temperature refer to Fig. 4, a typical vegetable drying curve.² Fig. 5 shows the change in drying time as affected by dry-bulb temperature change—other variables remaining constant.

Humidity

As previously pointed out, absolute humidity is the driving force for evaporation, therefore, a low humidity increases the drying rates. However, certain materials if dried too rapidly may case harden, i.e., form a

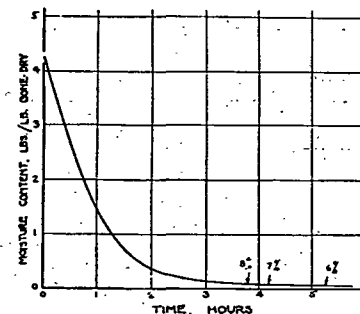


FIG. 4. TYPICAL VEGETABLE DRYING CURVE
Russet potato, blanched $\frac{1}{4}$ -in. strips, wood-lat tray, load 1.5 lb. per square foot, cross-circulation, air velocity 500 fpm, air temperature 150 F, wet-bulb temperature 90 F.

nearly impermeable skin which greatly reduces the drying rate. Also, certain undesirable physical changes may take place such as the cracking and warping of lumber. In such instances, it may even be necessary to increase artificially the humidity to assure satisfactory drying by the recirculation of moist air or the use of water or steam jets.

In the case of substances that must be dried at relatively low temperatures (120–140 F) it is often necessary to dehumidify the air to secure satisfactory drying rates. In such instances, a closed system using the adsorptive methods described in Chapter 38, is frequently applicable.

Fig. 6 shows the effect of change in humidity on the rate of drying curve for the same material considered in Figs. 4 and 5.

Air Circulation

Air velocity and distribution are important factors only in the first two periods of drying when surface evaporation is taking place. During the varying falling rate period of gaseous diffusion enough ventilation must