Mechanical Draft

Mechanical circulation is produced either by blowers of the centrifugal type outside of the dryer, or by multiple fans of the propeller type inside the dryer, or by a combination of the two.

In some designs, the general volume movement is taken care of by an external blower and the velocity over the surface of the material is obtained from internal fans, placed to furnish a transverse circulation. In any mechanical system, it is important to secure as high a volume of recirculation in the dryer as possible, as this adds to the thermal efficiency and cuts down power cost.

Mechanical systems are best suited to rapid drying under close control of both temperature and humidity and may be designed with automatic control instruments so as to hold the temperature within a range of 2 deg. fahr., and the humidity within a range of 4 per cent relative humidity. Indirect heaters of high efficiency are usually placed in the blower ducts and humidity is controlled either by steam jets, air washers or refrigerating coils in the duct system or steam sprays in the dryer itself. In such dryers, a higher thermal efficiency may be obtained by the use of interchangers, by which the saturated air from the washers is partially heated by absorption of heat from the warm, moist air returning from the dryer.

MOISTURE REMOVAL

More or less of the moisture evaporated from the material is taken care of by loss of warm moist air, either through leakage or ventilators, and corresponding influx of outside air, either by infiltration or through special openings for the purpose. It is a mistake to attempt to obtain a practically saturated condition of the leaving air, as this is apt to slow down the speed of drying and cause undesirable condensation in the moist air ventilators or ducts returning to the blower. A saturation of from 50 to 75 per cent is usually as high as can be obtained without sacrificing speed.

ESTIMATING HEAT AND AIR VOLUME REQUIRED

It is necessary to figure 2½ lb. of steam furnished to the dryer, per pound of water to be evaporated, although under the most favorable conditions of high thermal efficiency, 2 lb. of steam is sufficient. In very slow drying of thick, bulky materials such as lumber, it may require as much as 10 lb. of steam per pound of water evaporated.

The temperature will drop approximately 8½ deg. fahr. per grain of water evaporated per cubic foot of air (measured at 70 deg. fahr.) or approximately 0.62 deg. fahr. per pound of air at any temperature. Approximate calculations may be based on air *volume*, but for exact determinations, the *weight* of the air should be used, since the weight is a fixed quantity at any temperature.

CONTROL OF THE DRYING OPERATION

The wet bulb temperature is far more important, in determining the moisture absorbing power of the air, than the dry bulb temperature.

In drying very wet materials, the material takes the temperature of the wet bulb. This is important in rapid drying with hot, dry air, as the wet bulb temperature in such a case, is the only temperature that need be kept below the critical temperature limits of the material.

The higher the temperature, other things being equal, the faster will the moisture in the material transfuse to the surface, and the faster will the drying operation proceed. Hot water passes through the material more rapidly than cold water both because of its increased vapor pressure as well as its decreased viscosity. Increasing surface evaporation by greater circulation at low temperatures does not produce faster drying unless a corresponding increase in the rate of transfusion is obtained.

Several types of automatic thermostatic control instruments are available for controlling both the temperature and humidity of the air in the dryer. For many types of dryers, hand operation of valves as determined by periodic reading of thermometers and hygrometers is all that is required for good results. In other cases, such crude control would result in serious losses of material. In some operations, time controllers are used which automatically alter the conditions according to a predetermined schedule and finally bring the drying operation to a close. With other dryers, regulation is obtained in accordance with loss in weight of samples of the material suspended on sensitized scales within the dryer, the drying being automatically terminated when the samples reach the desired degree of dryness.

Extremely sensitive materials may be dried successfully in air which is kept in a continued state of practical saturation. This can be done either if the material is warmer than the surrounding air, in which case it must be heated by conduction or radiation, or if a certain amount of condensation is taking place in the surrounding air which will permit a corresponding evaporation from the material.

Suitable facilities should be provided for sampling and testing the material, and watching the conditions within the dryer. Systematic record forms are usually desirable for recording the movement of material, the length of the drying period, the temperatures and humidities at critical points in the dryer, and other operating data. Standard schedules of drying time and drying conditions for material of different thickness and moisture content are also very useful in estimating production and regulating the operation of the dryer.

DRYER ARRANGEMENT AND CONSTRUCTION

Outside handling and storage space is usually an important consideration in dryer design. Continuous dryers have an advantage in this respect since they provide storage for a considerable proportion of the material in process, while for charge dryers enough outside space must be provided to handle at least one full charge awaiting the dryer and one full charge upon removal. The more rapid the drying operation, the more efficient must be the handling facilities, in order to hold operating costs to a minimum and keep the dryer operating at maximum capacity.

An important consideration in construction is to provide tight, well-insulated doors which can be opened and closed easily, with minimum