DRYER ARRANGEMENT AND CONSTRUCTION

Outside handling and storage space usually is 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 to keep the dryer operating at maximum capacity.

An important consideration in construction is to provide tight, well insulated doors which can easily be opened and closed, with minimum labor and loss of time. Fire resistance of doors is also important, in case of outside exposure to fire risks. Insurance rates must be considered in their relation to fire protective arrangements such as automatic sprinklers, fire doors and walls, steam jets for use in smothering fires that may start inside the dryer, etc. Ceilings of dryers should be as flat as possible and the space between the material and the walls and ceiling should be held to a minimum. A factor often overlooked is that of suitable provision for ventilation of the space around the dryer openings so that warm moist air which may escape from the dryer when the doors are opened, may be carried away before it has a chance to condense on the ceiling or windows of the buildings in which the dryer is located, or into which it opens. Convenient arrangements for the operator should also be provided where tests can be made, records kept, and clothes changed, in case it is necessary for the operator to work inside the dryer.

EXPERIMENTAL TECHNIQUE

One vitally important phase of dryer design has been ignored in the preceding discussion, namely, *the time required to dry the stock*, or, what is equivalent to the same thing, *the size of the dryer*, and the character and extent of the *contact surface* between the stock and the air. In general, this cannot be determined except on the basis of experimental data on the specific material to be dried. The source of such data may either be the known performance of actual commercial drying installations handling the same stock or direct experimental determinations in the laboratory. Data of this type for many materials is given in Table 1.

Where it is necessary to determine drying conditions and rate in the laboratory, it is vitally important to properly control the experimental conditions. Where possible, the material upon which the experiments are made should have the same shape and size as that to be treated commercially. Furthermore, the conditions of exposure to the drying air, the temperature and humidity of that air, and its velocity and distribution over the material should be identical with those used in the full scale operation. Where the commercial operation is by batch, it is relatively easy to duplicate commercial conditions in the laboratory. However, where continuous operation is intended, it is usually difficult to build a continuous experimental dryer. In such a case, a preliminary diagram of the type of Fig. 4 should be constructed and the drying conditions of the batch experimental operation controlled in the laboratory to conform to the humidity moisture content relationship of the ultimate continuous operation. In this way, dependable data on the drying rate can be obtained in the laboratory.

As understanding of the mechanisms of drying and of the drying characteristics of the material to be dried, is of the utmost importance in designing successful and economical dryers, especially in the interpretation and extrapolation of plant and laboratory test data. Air velocity has an important influence on the rate of drying in the constant rate period and in the first zone of the falling rate period, but in the second zone of the falling rate period, the rate of diffusion of water to the surface controls the drying, and hence increasing the air velocity past the surface can have little effect on the rate of drying.

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PROBLEMS IN PRACTICE

1 ● What is meant by an adiabatic dryer?

A dryer in which all of the heat required for evaporation is furnished only by the heat in the circulating air.

2 ● What other broad classes of dryers are used commercially beside adiabatic dryers?

Dryers where the heat is furnished by contact with a heated surface, by radiant heat, by electrical induction or by a combination of any of these sources with heated air.

3 ● What makes a commercial adiabatic dryer differ from a theoretical one?

The word *adiabatic* means no heat lost to the outside and that the sensible heat lost by the air is equal to the latent heat of the water evaporated. In an actual dryer, the solid containing the water, and the water itself must be heated to the temperature of evapora-