

All permanent circular joints should be lap-jointed, riveted and soldered, and all longitudinal joints either grooved and locked or riveted and soldered. Circular laps should be in the direction of the flow, and piping installed out-of-doors should not have the longitudinal laps at the bottom. Every change in pipe size should be made with an eccentric taper flat on the bottom, the taper to be at least 5 in. long for each inch change in diameter.

All pipes passing through roofs should be equipped with collars so arranged as to prevent water leaking into the building.

The main trunks and branch pipes should be as short and straight as possible, strongly supported, and with the dead ends capped to permit inspection and cleaning. All branch pipes should join the main at an acute angle, the junction being at the side or top and never at the bottom of the main. Branch pipes should not join the main pipes at points such that the material from one branch tends to enter the branch on the opposite side of the main.

Cleanout openings having suitable covers should be placed in the main and branch pipes so that every part of the system can be easily reached in case the system clogs. Either a large cleanout door should be placed in the main suction pipe near the fan inlet, or a detachable section of pipe, held in place by lug bands, may be provided.

Elbows should be made at least two gages havier than straight pipe of the same diameter, the better to enable them to withstand the additional wear caused by changing the direction of flow. They should preferably have a throat radius of at least one and one-half times the diameter of the pipe.

Every pipe should be kept open and unobstructed throughout its entire length, and no fixed screen should be placed in it, although the use of a trap at the junction of the hood and branch pipe is permissible, provided it is not allowed to fill up completely.

The passing of pipes through fire-walls should be avoided wherever possible, and sweep-up connections should be so arranged that foreign material cannot be easily introduced into them.

MAINTENANCE OF SYSTEM

Because of its simplicity the exhaust system usually receives but little attention once it is installed; however, to obtain the best results, it should be inspected at suitable intervals and necessary adjustments made.

The exhaust fan should be given proper attention the same as any other high-speed machine. It should be kept in proper alignment and tightly bolted to its foundation.

Suction hoods, which have been removed to adjust the machines, should be replaced as soon as the adjustments are completed.

Never start a machine with the blast gate closed, as the slight air leakage past the blast gate may draw material into the pipe and clog it.

Disconnect furnace feeders from the furnaces when not in operation, and do not overload the system by ill-advised additions.

CHAPTER 29

DRYING BY EVAPORATION

Definitions; Methods of Drying; Types of Dryer Construction; Mechanism of the Drying; Control of the Drying Operation; Dryer Design; Dryer Arrangement and Construction; Experimental Technique.

DEFINITION OF TERMS

THE term drying, in its broader sense, refers to the removal of water or other volatile liquid from a gaseous liquid, or solid material. Except in the case of solids, the term is not ordinarily used unless the water or other liquid removed is present in a relatively small amount. In a more restricted sense, drying is the removal of water by vaporization from a non-volatile liquid or solid. This chapter deals with drying thus defined.

Where the solid material to be dried contains large amounts of free water, the actual drying process is frequently preceded by the removal of part of the water by filtration, settling, pressing, centrifuging, or other mechanical means. Removal of as much water as possible by such methods is usually advisable, as the cost of these operations, per pound of water removed, is in general much less than by vaporization.

METHODS OF DRYING

Classification of Methods According to Heat Supply

Drying methods may be classified basically in accordance with the means by which heat is supplied to the material to be dried. Thus, in some cases, as in *air current dryers*, the heat of vaporization is transferred to the material from the atmosphere surrounding it. In *natural air dryers*, this heat is merely the sensible heat of the outdoor atmosphere; while in so-called *artificial air dryers* heat is added to the air by means of radiators or the addition of a heated gas such as superheated steam or products of combustion, the air being almost entirely displaced by such gases in some drying processes. Where products of combustion can be used, a particularly high overall efficiency of the dryer is possible.

In other types of dryers, known as *contact dryers*, heat is supplied by direct contact between the material and a heated surface such as a pan or shelf, such surfaces being heated by products of combustion, steam, hot water, heated oil, electrical resistance, or latent heat of condensation. In both air dryers and contact dryers, additional heat may be supplied by direct radiation from hot surfaces which are *in sight* of the material. In the *sun drying* of raisins and other fruits, this radiant heat comes from the sun, while in artificial dryers it is derived from heated surfaces such as steam coils.