

nozzles required depends upon their design, the quantity of air handled, and the arrangement of the nozzles.

Scrubbers generally consist of eliminator-type baffle plates placed in the air stream to cause several reversals of the direction of air flow. The scrubber plates are more effective as air cleaners than as humidifiers. All washer chambers should have inlet diffuser plates to aid in producing more uniform air flow through the washer spray chamber. These inlet vanes also aid in preventing spray water from being thrown into the air duct ahead of the washer. At the outlet end of the washer suitable flooded eliminator plates, which will cause from 4 to 6 reversals of the direction of air flow, should be installed for the purpose of removing drops of unvaporized water from the leaving air. When the air carries

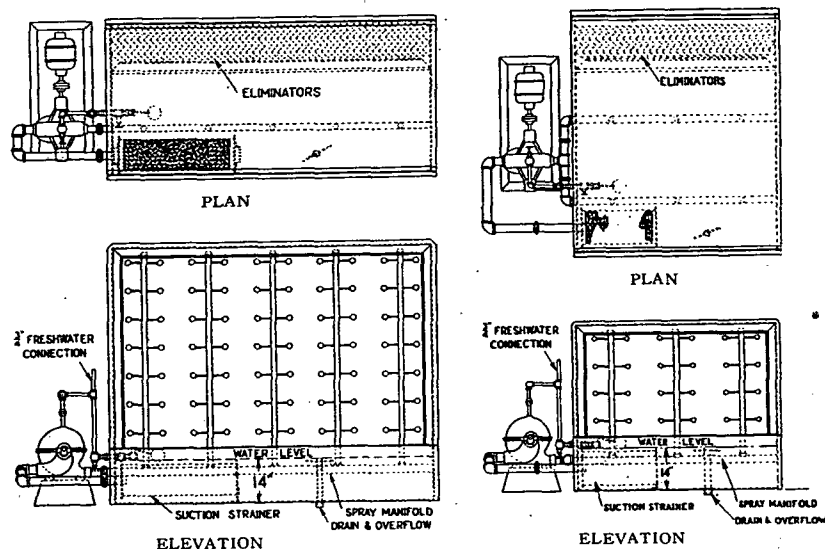


FIG. 1. TYPICAL SINGLE BANK AIR WASHER FIG. 2. TYPICAL TWO BANK AIR WASHER

certain substances mixed with it, the spray water may become acidulated and special consideration must be given to the materials used, to reduce the corrosive action.

Essential items in air washer operation are: uniform distribution of the air across the chamber section above the level of the water in the sump; moderate velocities of air flow, 300 to 600 fpm in the spray chamber; an adequate amount of spray water broken up into a fine mist throughout the air stream; sufficient length of air travel through the water spray and over thoroughly wetted surfaces; and the elimination of free moisture from the air as it leaves the unit.

Washers are sometimes arranged in two or more stages to cool through long ranges or to increase the overall efficiency of heat transfer between the air and the heating or cooling medium. A multi-stage washer is

equivalent to a number of washers in a series arrangement. Each stage is in effect a separate washer.

Usually the catalog capacity of a washer is expressed in cubic feet of air per minute and is based upon an air velocity of 500 fpm through the gross cross-sectional area of the unit above the tank. At this rating spray type washers handle about $2\frac{1}{2}$ gpm of water per bank per square foot of area, that is, about 5 gpm per bank per 1000 cfm. These proportions of air, water, area, and velocity may be departed from to meet the needs of some particular job, but certain limiting relationships should be observed.

For a single stage air washer, a 15 F drop in dry-bulb temperature of the air passing through the washer is about the maximum that should be anticipated. For greater decrease in dry-bulb temperature, multi-stage washers should be utilized. A rise of 6 F should be the calculated maximum for the spray water.

The area of a washer may be dictated by space limitations outside the washer, such as headroom, or by the inside space requirements, such as face area needed by a bank of cooling coils. The length of a washer is determined by the number of spray banks, or scrubber plates, and if cooling coils are installed in the unit, by the number of banks of coils. Roughly, a spray space of about 2 ft 6 in. in length is required for each bank of sprays, (the leaving eliminators require about 1 ft 6 in., entering eliminators about 1 ft).

The resistance to air flow through an air washer varies with the type of eliminators, number of banks of sprays, direction of spray, air velocity, type of scrubber plates, size and type of cooling coils if located in the washer. Manufacturers should be consulted to obtain the resistance for a particular installation.

HUMIDIFICATION WITH AIR WASHER

Air humidification can be accomplished in three ways with an air washer. These are: (1) use of recirculated spray water without prior treatment of the air, (2) preheating the air and washing it with recirculated spray water, and (3) using heated spray water. In any problem of air washing the air should not enter the washer with a dry-bulb temperature less than 35 F so that there will be no danger of freezing the spray water.

When method 1 is used the principles of adiabatic saturation described in Chapter 1 are involved. The process is one of evaporative cooling as the dry-bulb temperature of the air is reduced and the total heat of the air and water-vapor mixture is unchanged. Moisture is added to the air and a part of the sensible heat of the initial mixture is transformed to latent heat as evaporation of some of the spray water takes place. Theoretically the spray water and the dry- and wet-bulb temperatures of the air should come to the wet-bulb temperature of the air entering the washer, and the air should leave the washer adiabatically saturated at the entering wet-bulb temperature. Due to limitations of air washer construction and operation, air is not completely adiabatically saturated. This introduces an item into the calculations which is known as humidifying or saturating efficiency. This efficiency is the ratio of the actual