

TEMPERATURE AND HUMIDITY CONTROL

Air washers require method of control of temperature to prevent freezing by too low temperature and of overhumidification by too high temperatures of the air entering and leaving the washer. There is available one method of hand control and five methods of automatic or semi-automatic control. The method of hand control is by tempering coils divided into two or more sections in series; the outer coil being turned on by hand whenever the outside temperature approaches freezing; the successive coils being turned on as the temperature drops below freezing. Where two sections are available it is usual to turn on the second section when the outside temperature goes below zero, and the third section, where provided, at temperatures below zero. The first, or outside section, must always be turned on full for all temperatures to prevent freezing of the coils. The steam supply to the second, or inside section, may be hand regulated at all temperatures above 10 deg. above zero.

The five systems of automatic regulation are:

1. Substitution of automatic regulation for hand regulation and operated in a similar manner; the coils being controlled both by variations in the outside temperature conditions and also by an auxiliary control for one inside coil from a thermostat located on the discharge side of the air washer. (It is not possible to control the temperature of the air entering the washer except where there is an unusually long tunnel or duct for the thorough mixture of the air leaving the tempering coils before coming in contact with the thermostat.)
2. By heating the spray water so as to maintain a temperature or dew point (as the air is then saturated), between 35 and 40 deg. of the air leaving the washer. This method does not necessarily require a tempering coil, it is preferable, however, to use one tempering coil for the purpose of tempering the air should the washer be shut down and prevent freezing of the water when the apparatus is not in operation. More than one tempering coil should never be used except where temperatures may go considerably below zero, then the tempering coils may be turned on, one at 20 deg. fahr. and the second at 0 deg. fahr. The tempering coil may be operated manually or by a thermostat connected with the outside air. The steam supply for water heating should be sufficient to heat and saturate the air from 10 to 35 deg. fahr., when water heating is used in conjunction with a tempering coil. This is to allow for sufficient margin for safety of operation. The steam requirements for this are given later.
3. By regulating the heat supplied either through tempering coils or through the spray water so that the water in the tank shall be kept well above the freezing point. Inasmuch as the wet bulb temperature of the air and the water in the tank are but few degrees apart when the water in the tank is not heated directly, it is a fairly effective and simple control. One permissible variation of this method is to use a thermostat in the air leaving the washer controlling the dry bulb temperatures at this point through regulation of the steam supply to the inside tempering coil. The wet bulb temperature of the air is controlled by means of water leaving the eliminator plates and is held at the desired point by means of adding heat to the spray water. This will control exactly the temperature and relative humidity of the leaving air. Two or more tempering coils are required for this method.
4. The fourth method is desirable where recirculation is used and consists in maintaining the temperature leaving the washer at about 40 deg. by means of a thermostat located at this point and controlling the admixture of fresh and return air through automatically operated dampers. This effectively prevents overhumidification and also danger of freezing and prevents the highest economy in cost in ventilation as no steam is required for either tempering or humidifying except after the air has passed the washer.

5. The fifth method of automatic control is to reheat the air leaving the air washer to a definite thermostatic controlled temperature and to control the relative humidity of the air by means of a hygrostat which operates either on the tempering coils to heat the air or to heat the spray water through a water heater.

STEAM REQUIREMENTS FOR AIR WASHERS AND FOR HUMIDIFICATION

Where the spray water is not heated it is necessary that the wet bulb temperature of the incoming air be above the freezing point otherwise the eliminator plates will coat with ice and stop up even if the dry bulb temperature of the leaving air is above freezing point. It is necessary to heat zero air to 48 deg. in order that the wet bulb temperature may be 35 deg. The temperature of the leaving air may then be expected to be approximately 39 deg. dry bulb and 35 deg. wet bulb with a dew point of 31 deg. The additional heat required due to humidification is that indicated by the temperature drop of 9 deg. or 162 B.t.u. per 100 cu. ft. of air, or 1 b.h.p., for every 3400 cu. ft. of air per min. These are the minimum requirements for humidification above that required for heating the air. The following Table 102 gives the heat required from various outside entering wet bulb temperatures to various dew points temperatures corresponding to a relative humidity of 70 deg.

TABLE 102. HEAT REQUIRED FROM VARIOUS OUTSIDE ENTERING WET BULB TEMPERATURES TO VARIOUS DEW POINT TEMPERATURES CORRESPONDING TO A RELATIVE HUMIDITY OF 70 DEG.

See Mark's Engineers Handbook.

WET BULB TEMPERATURE OF ENTERING AIR, DEG. FAHR.	RELATIVE HUMIDITY, PER CENT AT 70 DEG. FAHR. (AND DEW POINT, DEG. FAHR.)					
	30% (37.25)	40% (44.5)	50% (50.5)	60% (55.3)	70% (59.6)	80% (63.5)
-10	1194	1452	1653	1860	2044	2245
0	984	1246	1447	1663	1840	2039
10	750	1025	1228	1445	1621	1822
20	510	779	983	1200	1377	1581
30	300	496	700	920	1097	1300
40	-----	178	384	603	783	987
50	-----	-----	-----	220	394	619
60	-----	-----	-----	-----	-----	181

These values are for the total heat required for both heating and humidifying the air. The amount of heat required for humidifying only may be found by subtracting from the values given the heat required to raise the temperature of 1000 cu. ft. of air per min. between the limits specified. The heat required for heating the air is given by the formula

$$H = 1000 \frac{t_2 - t_1}{55.5}$$

DUST REMOVAL

The comparative efficiency of various air cleaning devices, on the basis of dust removal can be determined by means of standardized tests operated at rated capacities and when handling air at a definite standard