

of both methods upon climatic conditions beyond the engineers control although these methods are much less expensive than the first two mentioned. Cooling by evaporation is satisfactory only when the air to be cooled is very dry; air motion as a means of producing cooling effect is never entirely adequate in the range of high temperatures. Of the two, evaporative cooling, or adiabatic saturation of the air, is a much more dependable method and will reduce the effective temperature much more than will an increasing air motion within permissible limits.

As an example of this, consider an outdoor condition of 96 F dry-bulb and 80 F wet-bulb. The effective temperature under this condition is 85.7 F and, if the still air is moved with a velocity of 300 fpm, the effective temperature will be reduced only 2.0 F while saturation at the wet-bulb temperature reduces the effective temperature 5.7 F. At 300 fpm velocity this saturated air will reduce the effective temperature to 75.6 F, or a total improvement of 10.1 F.

Evaporative Cooling

Evaporative cooling is accomplished by passing air through a water spray, the water being continually re-circulated. The air entering in an unsaturated condition, evaporates a part of the water at the expense of the sensible heat. As this is an adiabatic transfer, the total heat content of the air remains constant, while the dew-point rises and the dry-bulb falls until the air is saturated. A system¹ of ducts and a propelling fan are used to distribute the air in a proper manner.

It will be seen that the reduction in dry-bulb temperature is a direct function of the wet-bulb depression of the air entering the dehumidifier and that the resulting air temperature is governed entirely by the entering wet-bulb temperature of the outside air. Often it is possible to reduce the dry-bulb temperature by as much as 18 to 20 F and just as often impossible to reduce the temperature more than 2 to 3 F.

Dehumidification by Adsorption and Absorption

Dehumidification may be accomplished in three ways,

1. By cooling the air below the dew-point and causing a part of the moisture contained to precipitate.
2. By extracting the moisture entirely, or in part, by absorption.
3. By extracting the moisture entirely, or in part, by adsorption.

As used in this discussion, the term *adsorption* pertains to the action of a substance in condensing a gas or vapor and holding the condensate on its surfaces without any change in the chemical or physical structure of the substance and with the release of sensible heat. The term, *absorption*, implies a change in the chemical or physical structure in the process of dehydration. Adsorbers include silica gel, lamisilite, etc.; absorbers include sulphuric acid.

Silica Gel System of Adsorption

Silica gel is a chemical composition made from sodium silicate and acid,

¹See Air Washer Performance in Chapter II; also Theory of Atmospheric Cooling in same chapter.

the chemical formula being Si O_2 and has an appearance greatly resembling that of clear quartz sand but differing in structure in that the crystals are highly porous the voids constituting 41 per cent by volume although the pores are microscopic in size. This material possesses the property of being able to adsorb a substantial portion (about 25 per cent) of its own weight of moisture drawn from the air without any increase in the silica gel volume. After the silica gel has become "saturated" or has adsorbed moisture to the limit of its capacity, the moisture may be driven off by the application of heat, again without change in the structure, volume or chemical composition of the adsorbing medium. Thus the cycle may be repeated indefinitely and when applied to air conditioning the medium is exposed to the air which results in reducing the moisture content in the

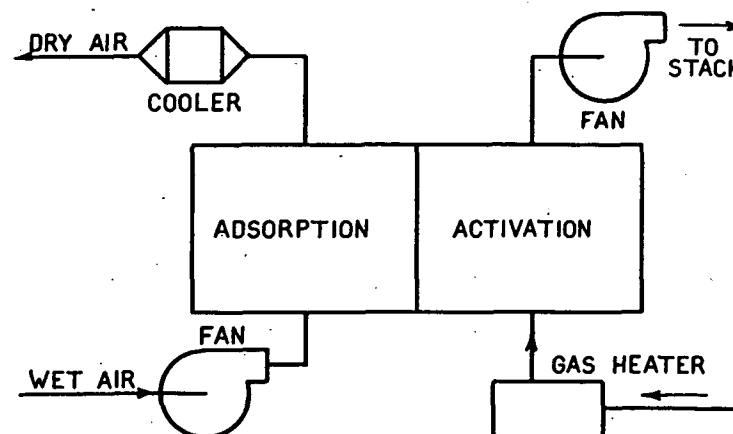


FIG. 1. SILICA GEL AIR-CONDITIONING SYSTEM—SINGLE STAGE ADSORPTION

air and releasing sensible heat which may be readily removed, thus reducing the wet-bulb or total heat of the air. A typical diagram is shown in Fig. 1.

Practical Application of Silica Gel

Silica gel has been used to replace refrigeration in one of two applications. In the one principally used, the air, from which moisture is to be extracted, is taken through silica gel beds by means of suction or pressure fans and by means of this process, the moisture becomes adsorbed by the silica gel and the air leaves at a lower dew-point and a higher sensible temperature. If this air is passed over surface coolers in which tap water or another cooling medium is flowing through the tubes, a certain amount of sensible heat will be removed. The air leaves the surface cooler or interchanger with the same dew-point with which it emerged from the silica gel beds, but with a lower dry-bulb temperature, altho the dry-bulb temperature may be higher than the temperature of the air entering the silica gel beds.

In another method, the first two of the steps outlined previously are duplicated and in addition, the air is carried through a spray type washer.