deterioration. Re-activation is generally accomplished with air or other gases at temperatures not over 350 F. Volume of the capillary pores is reported to be from 50 to 70 per cent of the total solid volume. Silica gel is available commercially in a wide variety of sizes of graded granules ranging from 3 to 8 mesh granules to impalpable powder (through 325 mesh). The 6 to 16 mesh granules are generally used in atmospheric dehydration applications and will vary in density from 40 to 45 lb per cubic foot.

There are other solid substances having marked adsorbent properties, but details concerning them are not available. Among such substances are activated charcoal and lamisilate. Most adsorbents have the ability to absorb some gases and condensible vapors other than water vapor, a property sometimes useful in air conditioning applications, and one which accounts for the extensive use of adsorbent materials in the field of chemistry.

Air to be dehydrated or dehumidified is drawn or blown through a screened bed of dry, solid adsorbent and the water vapor in the air-vapor mixture is caught and retained in the pores of the medium. The exact nature of the process which goes on during adsorption is not known but it is stated that the action is brought about by surface condensation, and also by a difference between the vapor pressure of the water condensing inside the pores and the partial pressure of the water vapor in the air-vapor mixture. The adsorbing process in the bed can continue until the vapor pressures reach equilibrium. The amount of vapor adsorbed will depend on the characteristic of the adsorbent being used, the temperature of the air and the bed, the vapor pressure of the water vapor in the air being passed through it, and its final vapor pressure or moisture content.

As the bed of material adsorbs moisture, its vapor pressure approaches that of the contacting air and the efficiency of adsorption gradually decreases. Equilibrium throughout the whole bed will not be reached for an extended period depending on bed thickness. Because of this diminishing efficiency of adsorption, commercially designed systems do not approach the state of equilibrium, but generally operate on a predetermined cycle or contact time and at partial saturation.

As the process of adsorption goes on heat is liberated in the bed. The total heat so liberated consists of the latent heat of the water vapor condensed together with the so-called heat of wetting of the adsorbent. For silica gel, the total heat of adsorption will amount to approximately 1293 Btu per pound of water vapor adsorbed from the air-vapor mixture being passed through the bed. The heat of wetting varies with the substance used as adsorbent while the latent heat of condensation depends only on the temperature and pressure of the water vapor.

Since the adsorptive ability of an adsorbent depends on the temperature of the bed and on the vapor pressure difference between the pores and the air-vapor mixture, it is important to know the pressures and temperatures at which pressure equilibrium is reached.

Evidently the equilibrium conditions represent the limits beyond which adsorption of vapor cannot continue. This relationship for one commercial silica gel of 0.70 density is shown graphically in Fig. 1. These curves indicate the general manner in which adsorbents may be expected

to perform, though the exact form and values of the curves will vary for each specific adsorbent and may vary even within the same generic group.

As an example in the interpretation of the chart consider the case when moist air at a temperature of 80 F and a partial vapor pressure of 0.5 in. of mercury flows through a bed of silica gel which is at a temperature of 80 F. The chart indicates that the equilibrium of pressure between the

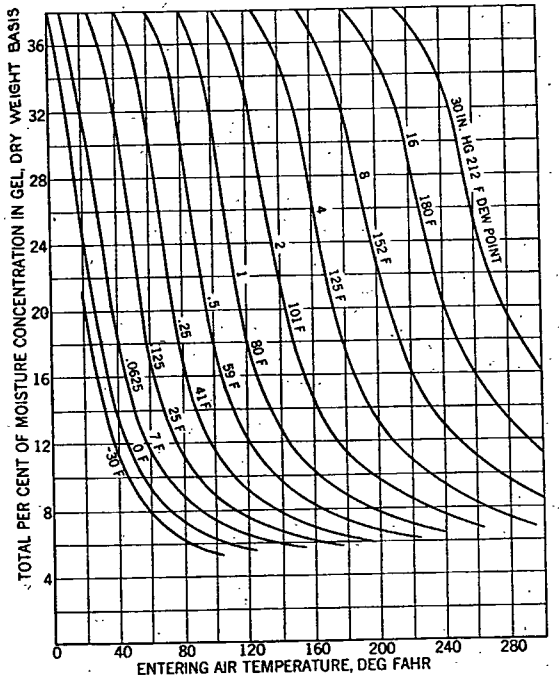

FIG. 1. TEMPERATURE—VAPOR PRESSURE—CONCENTRATION RELATION FOR A SILICA GEL BED AT CONSTANT TEMPERATURE

air-vapor mixture and the bed is reached when the dry bed has adsorbed moisture to the extent of 30 per cent of the weight when dry. When this happens the bed can adsorb no more moisture unless its temperature is decreased or the air vapor pressure increased.

The effect of temperature upon the adsorptive capacity of silica gel may be observed by following the 59 F dew-point line in Fig. 1. At 80 F gel temperature equilibrium is reached at 30 per cent moisture concentration while at 120 F and 200 F equilibrium is reached at 12 and 6.6 per cent moisture respectively.

Under normal reactivation temperatures the residual water content of silica gel is between 5 and 6 per cent.

In practice, the temperature rise in the dehydrated air caused by the