mercial silica gel of 0.70 specific gravity 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 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 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 dehumidified air caused by the adsorption heat is approximately 10 deg for each grain of moisture removed per cubic foot of air at atmospheric pressure. This temperature rise occurs progressively through the adsorbent bed and is an important consideration in predetermining the performance of a given design of apparatus. Data such as these together with information covering other characteristics, such as specific heat, resistance to air flow, etc., are of value in the basic design of adsorption apparatus. In the solution of air conditioning problems, however, reference must be made to performance data on established apparatus designs such as are presented later in this chapter.

Absorbents

Any absorbent substance may be used as a dehumidifying agent if it has a vapor pressure lower than the vapor pressure in the air-vapor mixture from which the moisture is to be removed.

Solid Absorbents. The substances used are in general the solid forms of the liquid absorbents. Calcium chloride is frequently used because of low cost. At present they are used principally in small dessicating chambers, and in small dryers of the cartridge type, through which air is forced under pressure.

Liquid Absorbents. These are characteristically water solutions of materials in which the vapor pressure is reduced to a suitable level by governing the concentration and temperature of the dehydrating solution. In addition to having suitable vapor pressure characteristics a practical absorbent must also be widely available at economical cost, be non-corrosive, odorless, non-toxic, non-inflammable, chemically inert against any impurities in the air stream, stable over the range of use and especially it must not precipitate out at the lowest temperature to which the apparatus is exposed. It must have low viscosity and be capable of being economically regenerated or concentrated after having been diluted by absorbing moisture.

Water solutions, or brines, of the chlorides or bromides of various inorganic elements such as lithium chloride and calcium chloride are the absorbents most frequently used in connection with air conditioning applications and detailed attention is confined to these two in this chapter.

The application consists of bringing the air-vapor stream into intimate

contact with the absorbent, permissibly by passing the air stream through a finely divided spray of the brine but more generally by passing the air over a contacting pack where the liquid absorbent presents a large surface to the air stream. The difference in vapor pressure causes some of the vapor in the air-vapor mixture to migrate into the brine. Here it condenses into liquid water and decreases the concentration of the absorbent.

As the water vapor is added to the absorbent and condenses, it gives up its latent heat of condensation. For every pound of water absorbed and condensed the heat released is obtainable from steam tables. For in-

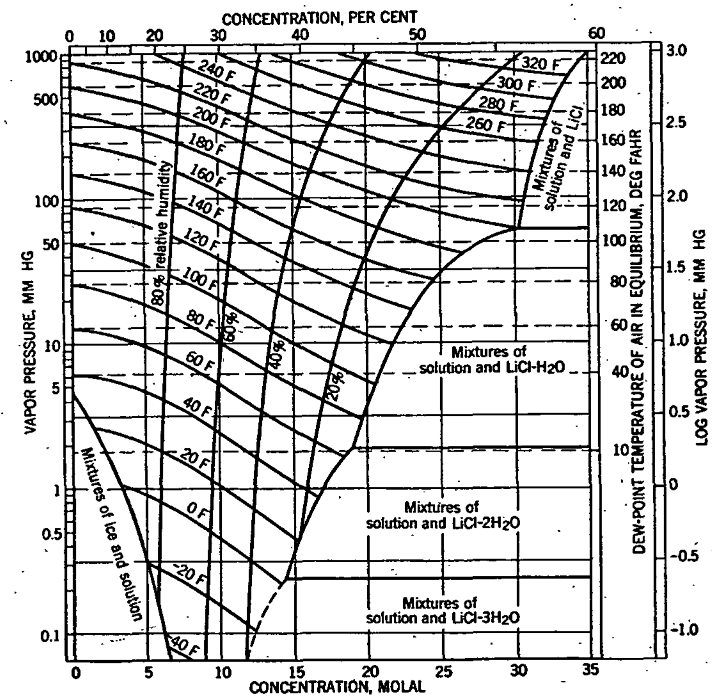

Fig. 2. Temperature—Pressure—Concentrations for Lithium Chloride

stance, at a dew-point temperature of 60 F the amount of this heat is about 1057 Btu. In addition to this heat there is involved also the so-called heat of mixing which is frequently considerable. The heat thus produced in the contacting packs of the average air conditioning installation is to a large extent transferred to the chemical solution itself and the balance to the air being dried.

A more complete cycle involves heat removal from the contacting medium, either within or external to the interchanger. Thus the temperature of the medium may be higher than, equal to, or lower than that of the air, depending on the agent used and the function to be performed. In such a cycle, the process may be accompanied by cooling or heating, or either, and such effect, if present, may be either a necessary by-product of the process, or for the specific purpose of obtaining both latent and