air up to about 8 or 10 per cent of the weight of the adsorbing material, after which the adsorption falls off gradually as the saturation point is approached. The application is quite similar to that employed for silica gel; that is, the material is exposed to the air flow and after reaching about 75 per cent saturation is reactivated by removing the moisture adsorbed by means of applied heat. The actual scheme generally followed in the use of this material for continuous service varies somewhat from silica gel inasmuch as the material is placed in three units which are used consecutively for the different steps. These steps permit each unit to operate as follows:

a. In series with the preceding unit.
b. Alone.
c. In series with the following unit.

This plan allows for adsorption, reactivation, and cooling, in a manner similar to that used with silica gel.

Taking a single unit, when it is in the *a* step and operating with the preceding unit, the alumina adsorbs approximately 25 per cent of the moisture in the air and takes up about 1.3 per cent of its weight of water. During the second step when it is operating alone, it takes up 100 per cent of the moisture in the air until the weight of the water adsorbed is brought up to about 6.7 per cent. During the third step when the unit is operating with the succeeding unit, it extracts about 75 per cent of the moisture in the air until the water weight adsorbed comes up to about 10 per cent of the weight of the adsorber. The time allowable for reactivating is equal to the time occupied by the second unit adsorbing alone, plus the time when the second and third units are adsorbing in series, plus the time when the third unit is adsorbing alone, at the expiration of which time the first unit will be again required.

The temperature of air used for alumina reactivation is usually between 300 and 700 F and the air flow rate will have to be higher with the low temperature air than it will be with reactivating air of higher temperature. For example, air at 400 F for reactivating will, at 10 cu ft per hour per pound of alumina, require about 6 hours for reactivation. In the three unit system, after reactivation the cooling of the activated alumina may be carried out with considerable rapidity by using dry air from the adsorption unit for circulation through the unit which has just completed reactivation. The final temperature of the unit before it goes back into service should be not over 200 F. As a basis for computing the amount of cooling air required for reactivation, each cubic foot of cooling air has been found capable of removing 2.2 Btu when heated from 85 to 200 F and of providing a sufficient margin of safety in operation.

Lithium Chloride Adsorption System

Practically all salt solutions have the property of adsorbing or condensing moisture from a gas. The amount depends on the character of the solution, its gravity, temperature and viscosity. One of the best known dehydraters, calcium chloride, for instance, has been long known for this property. Its characteristics, however, present a limiting factor of about 30 per cent relative humidity, so that the resultant dew point of air brought in intimate contact with calcium chloride is usually too high for comfort work without further refrigeration.

The cycle of solid dehydraters or adsorbers and liquid adsorbers are fundamentally the same. A diagram of a lithium chloride adsorption system is shown in Fig. 1.

The liquid adsorber is brought in contact with air having a certain vapor pressure due to the moisture of water vapor that is in it, and the chloride, either sodium, lithium, calcium, or whatever is used, having a lower vapor pressure, adsorbs moisture in the form of water from the water vapor that is in the contacting air. Thermodynamically, it is definitely possible to measure this change and to know definitely that a change of state takes place because of the fact that there is a definite rise in temperature in the liquid adsorbing the moisture, which is definitely a function of the amount of water vapor condensed from the air stream.

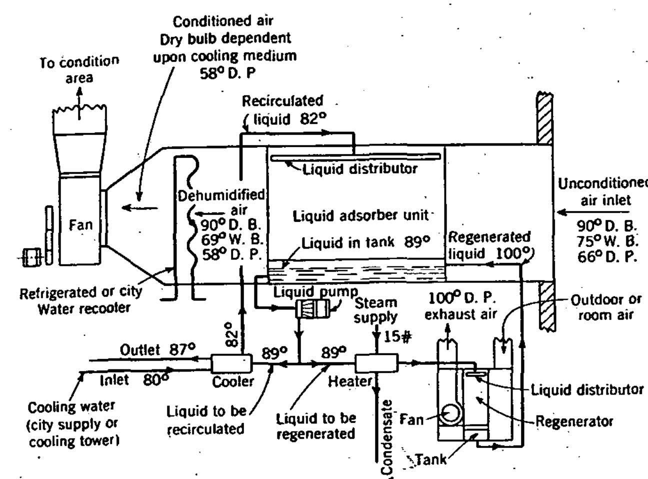

FIG. 1. DIAGRAM OF LITHIUM CHLORIDE ADSORPTION SYSTEM

Of course, the liquid adsorber, contrary to the solid adsorber such as silica gel, takes on two functions: one, as an adsorber, and that adsorption, as has been stated, tends to create a rise in temperature; on the other hand, the mass of liquid in the adsorber tends to keep down the rise in temperature, so that by cooling the adsorber below a certain temperature, a definite temperature can be maintained in both the liquid and the air, which is a function of the heat balance between the total heat of the air and the total heat of the liquid.

Adsorption of moisture by a liquid adsorber weakens the concentration of the liquid so that its adsorbing capacity is reduced and regeneration, or the driving off of the excess moisture in the liquid, must be performed, just as the driving off of the liquid adsorbed by a solid adsorber must be accomplished. However, with a liquid adsorber a very definite condition can be maintained; that is, a condition of density, by continuously withdrawing a certain small portion of the total liquid for intensive concentration and the concentrated liquid added to the mass of the liquid continuously, without varying to any marked degree the vapor pressure