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 hr 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 reacti-

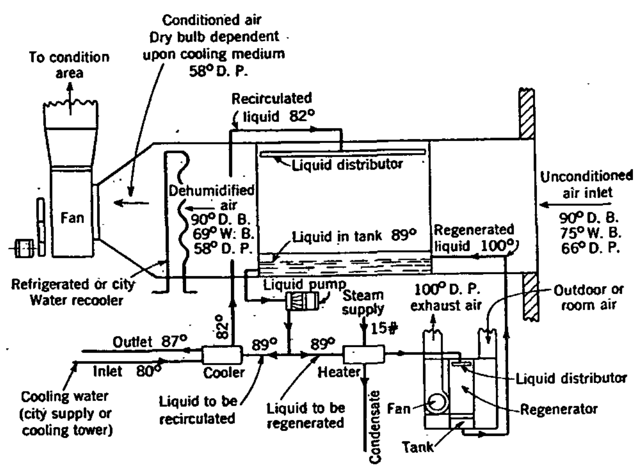

FIG. 10. DIAGRAM OF LITHIUM CHLORIDE ABSORPTION SYSTEM

vation. 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.

OPEN ABSORPTION SYSTEMS

The cycle of liquid absorbents are fundamentally the same. A diagram of a lithium chloride absorption system is shown in Fig. 10. The liquid absorbent is brought in contact with air having a certain vapor pressure due to its contained water vapor. The absorbent having a lower vapor pressure, absorbs moisture in the form of water from the water vapor that is in the contacting air. A change of state takes place because there is a rise in temperature in the liquid absorbing the moisture, which is a function of the amount of water vapor condensed from the air stream.

Absorption of moisture by the liquid weakens the concentration of the liquid so that its absorbing capacity is reduced and regeneration, or the driving off of the excess moisture in the liquid, must be performed. A constant density can be maintained by continuously withdrawing a small portion of the total liquid for intensive concentration without varying the vapor pressure of the total mass.

There are two methods of regeneration. One is to boil off the excess moisture by raising the temperature of the solution above the boiling point of the particular concentration. As the salt in the solution does not vaporize, it is not carried off in the boiling process. In the small amounts of liquid diverted to the regenerator for concentration, care should be taken that too much moisture is not driven off, which may cause freezing or solidification of the salts.

The second method of regeneration is to raise the temperature of the solution with ordinary steam coil interchangers to about 225 F, and then passing the solution at this temperature over various types of scrubbers, through which untreated air is circulated. The increase in temperature of the liquid raises its vapor pressure to such an extent that there is an exchange of vapor between the liquid and the air, as well as an equalization of temperature between the air and the liquid absorbent. The air is then capable of taking up part of the moisture from the liquid and carries this excess moisture into the atmosphere with the leaving air.

After this vaporization has taken place, the highly concentrated, hot brine is circulated through an interchanger through which the water used in cooling the main solution can be re-used to reduce the temperature of the concentrated solution to a point where it may be introduced into the main solution tank at only a slightly higher temperature than the main body of the solution.

There are two places in the operation where there is a tendency to raise the temperature of the liquid. One is the absorption of vapor from the air, which changes the latent heat of the vapor absorbed to sensible heat, thus raising the temperature of the liquid and consequently, the temperature of the air. The other is the heat added to the regenerator liquid in order to re-evaporate and carry off the excess moisture which has been condensed in the first stage.

CLOSED ABSORPTION SYSTEMS

The fundamental rule governing the absorption (in a closed system) of a gas by a liquid is Raoult's Law, which states that at any given temperature the ratio of the partial pressure of a volatile component in a solution to the vapor pressure of the pure component at the same temperature is equal to its *mol* fraction in the solution. The mol fraction, in turn, is equal to the number of mols of substance divided by the total number of mols present. The number of mols in a given weight of a compound is equal to the weight divided by the molecular weight.

This law applies strictly, only to what is known as an ideal solution, that is, one in which the intermolecular forces between the substances present in the solution are equal. Actually, no such solutions exist, so that deviations from Raoult's Law are always found in practice. The