as activated alumina, silica gel, activated bauxites, and activated charcoal, have this property. The action of adsorbents, most of which adsorb some gases and condensable vapors besides water vapor, is selective. Thus, in the case of a mixture containing both water and organic vapors, activated charcoal would remove the organic vapors in preference to the water vapor, while the reverse would be true for the other adsorbents mentioned. The selective property of adsorbents is utilized in some instances for the removal of objectionable and contaminating vapors from an air or gas mixture. (See Chapter 11.) In other cases, the component adsorbed from a mixture may be the desirable one.

LIQUID ABSORBENTS

A liquid absorbent has the property of absorbing moisture from, or adding moisture to, the air, depending upon the vapor-pressure difference between the air and the solution. The equilibrium vapor pressure of the solution is dependent upon the temperature and concentration of the solution.

Absorbents for a liquid dehumidifying system should have the following characteristics:

1. Suitable vapor-pressure characteristics.
2. Ability to remain in solution without formation of crystals at temperatures 10 to 15 deg below the temperature range used in the operating cycle.
3. Should be noncorrosive, odorless, nontoxic, and nonflammable.
4. Stability. It should not break down within the range of use.
5. Low viscosity and good heat-transfer characteristics.
6. Availability and low cost.
7. Capability of being regenerated at temperatures obtainable with low-pressure steam.

The equilibrium dew point, plotted against contact temperature for various concentrations of a typical organic liquid absorbent is shown in Fig. 3. The same data for a typical inorganic absorbent are shown in Fig. 4. The concentration of the liquid absorbents used in commercial equipment is dependent on the temperature of the cooling medium, and on the latent and sensible heat-removal requirements.

The equilibrium contact dew points in Figs. 3 and 4 show the dew point of air in equilibrium with the liquid absorbent. Equilibrium data are never quite achieved in commercial dynamic systems. Reference should be made to the published performance data for commercial apparatus for the solution of air-conditioning and air-dehumidification problems. Typical performance data for commercial liquid absorbent dehumidifiers are presented in Chapter 85 of the 1964 GUIDE AND DATA BOOK.

LIQUID ABSORPTION SYSTEMS

The flow diagram for a typical liquid absorption system with extended-surface contactor coils is shown by Fig. 5. For dehumidifying operation the strong absorbent solution is pumped from the sump of the unit and sprayed over the contactor coils.

The hygroscopic solution at the required temperature and concentration is in intimate contact with the air which is flowing over the coil surface in the same direction as the liquid absorbent. Equipment is also available for flow counter-current to the flow of liquid absorbent.

Moisture is absorbed from the air by the solution due to the vapor-pressure difference between the air and the liquid absorbent. The moisture content of the outlet air can be maintained at a constant condition by automatically regulating the flow of water through the cooler by means of a modulating water valve.

The heat generated in absorbing moisture from the air consists of the latent heat of condensation of water vapor and the heat of solution, or the heat of mixing, of the water and the absorbent. The heat of mixing varies with the liquid absorbent used and with the concentration and temperature of the absorbent. The solution is maintained at the required temperature by cooling with city, well, refrigerated, or cooling-tower water, or refrigerant flowing inside the tubes of the contactor coil. The quantity of water required is a function of the water temperature and the total heat, either sensible, latent, or both, removed from the air by the hygroscopic solution.

The dry-bulb temperature of the air leaving the liquid absorbent contactor at constant flow rate is a function of the temperature of the liquid absorbent and the amount of contact surface between the air and the solution. In most commercial equipment the dry-bulb temperature of the air leaving the dehumidifier will be within 1 to 5 F deg of the liquid absorbent temperature.

Cooling and heating coils are installed in the ductwork leading from the dehumidifier if the air is to be cooled or heated.

The liquid absorbent is maintained at the proper concentration for moisture removal by automatically removing from the liquid the water vapor absorbed from the air. A small quantity of the solution, usually 10 to 20 percent of the flow to the contactor coils, is passed over the regenerator coil where the liquid is heated with steam or other heating medium. The liquid absorbents commonly used may be regenerated with steam at 2 to 25 psig. The vapor pressure of the liquid absorbent at temperatures corresponding to 2 psig steam is considerably higher than that of the outdoor air. The hot solution at the relatively high vapor pressure is in contact with outdoor air in the regenerator where water is absorbed from the solution by the scavenger air due to the vapor-pressure difference between the outdoor air and the hot solution. The hot-moist air from the regenerator is discharged to the outdoors, and the concentrated solution flows to the sump. The solution is then ready for another cycle.

The steam flow to the regenerator coil is regulated by a control responsive to the concentration of the solution circulated over the contactor coils such as a level control, specific gravity control, or boiling point control.

For humidifying operations the liquid absorbent is main-

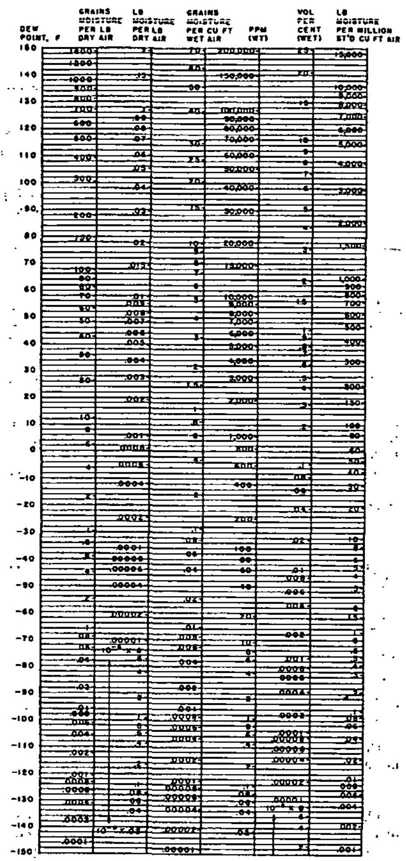

Fig. 1 .... Moisture Content of Air at One Atmosphere Pressure

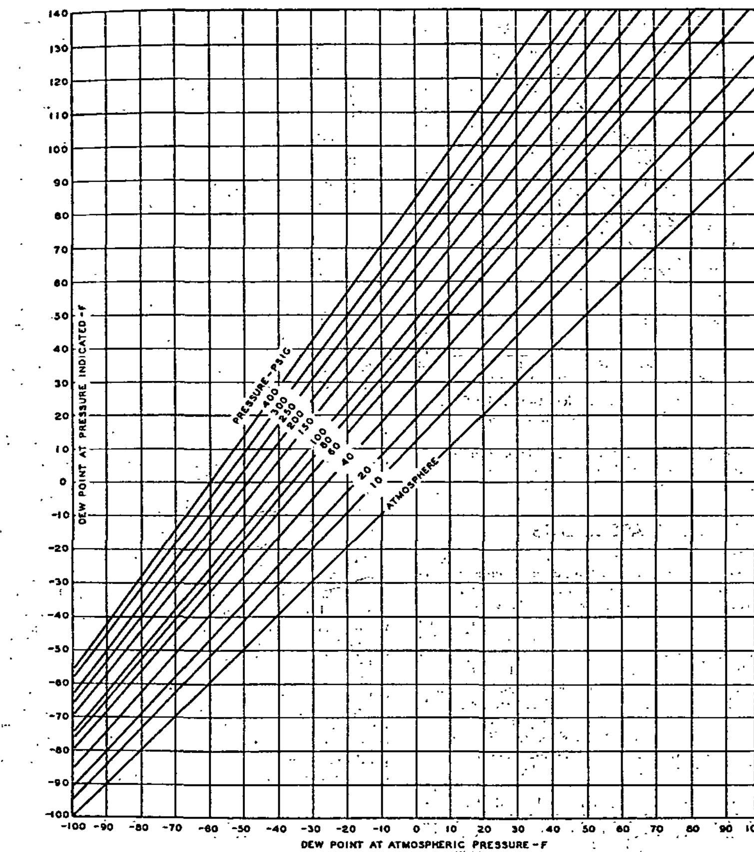

Fig. 2 .... Dew-Point Conversion Chart