lowering the temperature of the inlet air results in a higher moisture removal efficiency.

Dry Air Coolers. Particularly with the solid adsorbent process, and to a lesser extent with liquid absorbents, a dry air cooler is employed to remove sensible heat from the dehumidified air whenever it leaves the apparatus at an elevated temperature. A cooling coil using city water is usual practice, and is considered economical whenever the difference between effluent air and entering water temperatures is greater than 15 F.

Sensible Heat Coolers. Since the normal conditioning system requires sensible heat removal, auxiliary equipment may be needed for this function. This is almost always in the form of cooling surface using water, brine or direct expansion refrigerant. It is located on the leaving side of the dehumidifier, but frequently treats in addition a large volume of room air which is not circulated through the machine for moisture reduction.

CONTROLS

The use of direct or chemical dehumidifying equipment makes possible the use of a relatively simple control system with a humidistat or, alternatively, a wet-bulb controller, to regulate the operation of the machine, and a thermostat to control the sensible cooling apparatus. Functionally, the relative humidity control may consist of one of the following:

1. *Stop—Start*—Where the humidistat starts the dehumidifier on rising humidity and stops it on falling humidity.

2. *By-pass*—Where the humidistat modulates face and by-pass dampers located at the wet air inlet of the dehumidifier. Thus the quantity of air passing through the dehumidifier is proportioned in accordance with the change in latent heat load.

3. *Vapor Pressure Control* (used with liquid absorbents)—Where the humidistat directly controls the temperature or concentration of the contacting solution, thereby matching the latent heat removal to the load requirement.

EQUIPMENT PERFORMANCE

It is recognized that, whereas the curves relating temperature and vapor pressure of the several dehumidifying agents (Figs. 1, 2 and 3) accurately define the equilibrium limits for these materials, these curves cannot be used for predicting performance of available equipment. This occurs because (*a*) the materials themselves can only be utilized efficiently within certain ranges of moisture concentration, and (*b*) the degree to which the vapor pressure of the air being treated approaches that at the surface of the material depends upon the completeness of the contact. It is obvious, for example, that the thickness of a bed of solid adsorbent for a given air flow will have a profound effect upon the degree of moisture removal attained. However, it will have an inverse effect upon the power required to drive air through the bed. It must also be borne in mind that the moisture removal efficiency of all solid adsorbents and absorbent solutions is related to the temperature of the medium as well as to its state of unsaturation. On the other hand, it will be noted that the lower limits of dehumidification, which can be obtained with absorbent solutions, are likely to be controlled by the equilibrium dew-point at the lowest temperature at which the solution will resist freezing or crystalization. For this reason, actual moisture removing capacity is determined from performance curves of the several materials under practical conditions of temperature, concentration and contacting efficiency as shown in Figs. 7, 8, 9 and 10. While these curves by no means explore all the performance possibilities, they may be considered to be representative of sound design and application practice.

Performance data for standard production designs of silica gel *rotating bed* dehumidifiers are shown in Fig. 7 for a *direct gas fired type*, and in

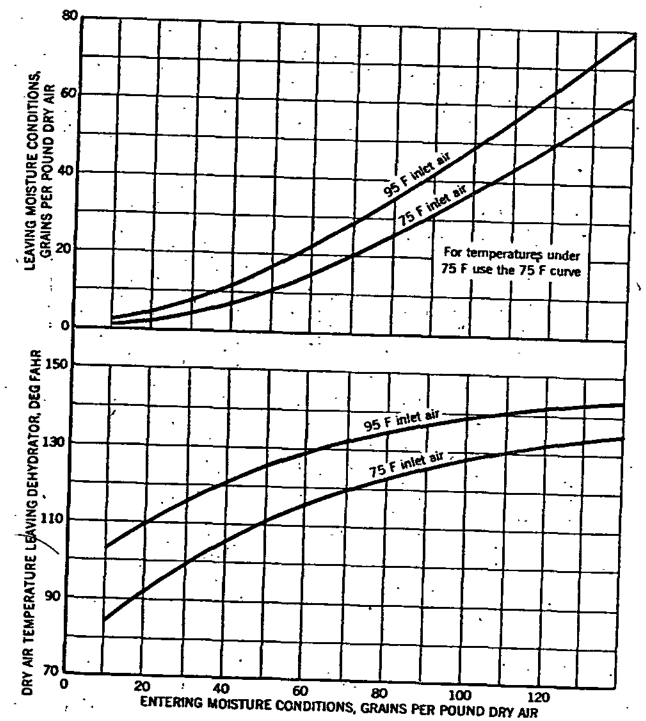

FIG. 7. PERFORMANCE DATA FOR ROTATING BED DIRECT GAS FIRED SILICA GEL DEHUMIDIFIER

Fig. 8 for *steam activation* types for steam pressures of 5 to 80 lb per square inch. They are designed for normal comfort cooling and moderate humidity industrial air conditioning applications. Performance data for a *heavy duty type activated alumina* dehumidifier are given in Fig. 9. This unit has extended surface coils, imbedded in the adsorber, which are supplied with high pressure steam for heating during activation and cool water for direct bed cooling during adsorption. Capacities shown in Fig. 9 are based upon 75 F cooling water. Performance data for *standardized package lithium chloride* equipment are shown in Fig. 10. This is a single unit including both absorption contactor and regeneration section together with necessary heat exchangers.