2. Water temperature is too high for practical sensible heat removal (above 65 F).

3. Cold water (below 55 F) is available in adequate quantities so that it can be directly used for both sensible and latent heat removal, or can be further chilled cheaply by mechanical refrigeration.

4. Electricity is low in cost compared with gas or steam.

No single unfavorable item listed will necessarily disqualify a method, but generally there will be several offsetting favorable factors required to make it the choice on a purely economic basis.

When analyzed with respect to the broadening scope of applications for air conditioning, it is now evident that direct or chemical dehumidification

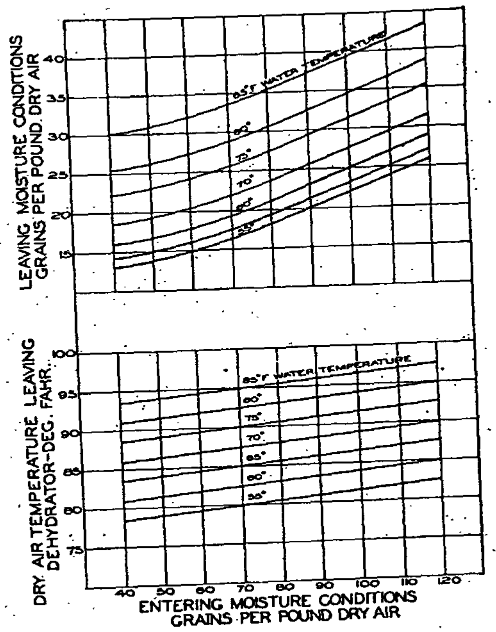

FIG. 10. LITHIUM CHLORIDE EQUIPMENT PERFORMANCE DATA

can be used, within its legitimate economic limits, for human comfort, commercial drying or storage of food products requiring low humidities, and industrial processing and drying.

It provides an additional choice as to the type of equipment best suited to meet the requirements of special applications and conditions. Particular attention is called to those industrial and drying applications in which the dried air can be used at effluent temperature without further treatment.

REFERENCES

Direct Evaporative Cooling for Homes in the Southwest, by A. J. Rummel (A.S.H.V.E. TRANSACTIONS, Vol. 46, 1940, p. 381).

Chemical Dehumidification Agents, by F. R. Bichowsky (A.S.H.V.E. JOURNAL SECTION, *Heating, Piping and Air Conditioning*, October, 1940, p. 627).

CHAPTER 24

Refrigeration

Mechanical Refrigeration, Characteristics of Compression System, Absorption Systems, Expansion Valves, Condensers, Evaporators and Coolers, Refrigerant Pipe Sizes, Ice Systems, Storage Systems, Equipment Selection, Reverse Cycle

COOLING and dehumidification in air conditioning work usually require refrigeration equipment. The localities where cold water from a natural source is at a sufficiently low temperature for comfort air conditioning are rare, and evaporative cooling is generally restricted to sections of the country where humidities are naturally low.

The important difference between the refrigeration equipment used for comfort air conditioning and that used for commercial refrigeration is the use of a relatively higher evaporator temperature. This temperature is usually above freezing in air conditioning refrigeration equipment. The higher evaporator temperature (that is high suction pressure) affects the design of the system used, and makes possible the use of systems that are not always practical for commercial refrigeration.

MECHANICAL REFRIGERATION

The fundamentals of mechanical refrigeration systems are similar, although they differ in the methods used for compression of the refrigerant vapor.

Refrigerant vapor, usually saturated or slightly superheated, is drawn into the compressor as diagrammed in Fig. 1. It is then compressed and discharged at a higher pressure to a condenser. The vapor is condensed as it contacts a heat transfer surface over which is flowing a cooling medium such as water, air or a combination of the two. The liquid refrigerant flows to the evaporator through an expansion valve which reduces its pressure and regulates its flow. In the evaporator, the refrigerant absorbs heat from the medium which is to be cooled. When this medium is water or brine, the evaporator is known as a water or brine cooler and the refrigeration system, if used for air cooling, is known as an indirect system. When the medium cooled is air, the evaporator is known as a direct expansion cooler and the system is known as a direct expansion system.

Fundamentally, the function of the system is to absorb heat at one temperature and pump it to a higher temperature, where it may be removed by an available cooling medium. In order to conserve refrigerant, virtually all refrigeration systems are completely closed and the same refrigerant is recirculated.

The fundamental heat equations (disregarding losses) which should be kept in mind are: (1) the heat absorbed in the evaporator plus the heat added to the refrigerant during compression equals the heat rejected by the condenser; (2) the heat added to the refrigerant during compression is equal to the input to the compressor shaft less the heat dissipated from the compressor to the surroundings.

In the case where the compressor is driven by an electric motor, the heat due to compression is equal to the motor input less the electrical