dehumidification. It is only possible to state certain general conditions which tend to make dehydration favorable or unfavorable.

Dehydration tends to be favorable where:

1. Steam or gas is available at a cost substantially lower than electricity.

2. Required dry-bulb temperature is high or unimportant in comparison to maintenance of proper relative humidity.

3. Sensible cooling can be supplied by low cost city, well, or river water available at the proper temperature. For comfort conditioning, this temperature cannot normally be higher than 65 F.

4. An abnormally high room latent heat load or a large outside air latent load is encountered (such as in a dance hall, theater, restaurant, etc.).

5. Abnormally low room dew-points are required (such as 40 F or lower for some manufacturing operations).

6. Low temperature water is available but high in cost or limited in quantity.

7. In low temperature driers a complementary heat exchange can be utilized. In such cases, the sensible heat of the dry air from the dehydrator is reduced by the evaporation of moisture within the drier.

Of the factors just enumerated Item 1 is the most important influence, and if favorable, it indicates the desirability of considering dehydration. The other items are of lesser importance as criteria, but each has a direct influence in the economic considerations.

Dehydration tends to be unfavorable where:

1. Electricity is low in cost.

2. Normal comfort dew-points are required with a preponderantly sensible heat load.

3. Mechanical refrigeration is required for sensible heat removal.

4. Water temperature is too high for sensible heat removal. For comfort conditioning, this usually means water above 65 F.

5. Water is available in adequate quantity and at such temperature that it can be used directly for both sensible and latent removal, or can be further chilled more cheaply by mechanical refrigeration. For comfort conditioning, this normally means water below 55 F.

No single item just mentioned will necessarily disqualify dehydration, but will tend to require several favorable factors to make it a possibility for selection.

The previously outlined criteria are general and inclusive. When analyzed with respect to the possible fields of application, it is evident that dehydration equipment can be used, within its legitimate economic limits, for: air conditioning for human comfort, commercial cooling for food products requiring low humidities, industrial air conditioning for processes, and industrial drying. Attention is called to those particularly favorable industrial conditioning and drying applications in which the dried air can be used at effluent temperature without further treatment.

## REFERENCES

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Chapter 25

# 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 requires 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