DEHUMIDIFICATION PROCESSES

Dehumidification may be accomplished in any of three ways, or by a suitable combination of them:

1. By cooling the air below its dew-point temperature thus causing a part of the moisture contained to condense and precipitate.
2. By extracting moisture by adsorption.
3. By extracting moisture by absorption.

As in the case of air cooling, the best dehumidification method can be determined only by a complete analysis taking into account all the circumstances of the particular case being considered. In Chapter 2 the nature of the adsorption and absorption processes are explained and the principal properties of the materials used are presented.

PRACTICAL COMBINATION METHODS

As applied in actual practice these several processes frequently have to be combined in order to produce the desired results. Any or all of the three processes of air cooling listed may be combined with any or all of the three dehumidifying processes to produce both air cooling and dehumidification. One form of combination consists of a multi-stage method whereby moisture is removed from the air and then the resulting mixture is cooled. Stage methods are common where dehumidification is accomplished by the use of adsorbent or absorbent substances. Another method, and one in common use, is to combine the air cooling and dehumidification processes into one step. This is made possible by keeping the temperature of the surface or liquid spray used for cooling below the dew-point temperature of the air to be conditioned. It is the method most commonly associated with comfort air conditioning in current practice. Still another general method consists of what may be called a parallel-flow method wherein the cooling or dehumidification, or both, may be performed by splitting the air stream, performing the process on part of it and then bringing the two parts back together again.

Obviously with so many possible combinations much leeway is left to the designer to determine what shall be done in a practical case. The remainder of this chapter is devoted to a discussion of some of these possible practical methods and the equipment used in applying them. Space does not permit discussing all the great variety possible and only those in reasonably frequent use are included here. Others will occur readily and can be analyzed in a fashion similar to those here treated.

COMPRESSION SYSTEMS

Comfort air conditioning imposes requirements on refrigeration equipment not usually found in general cooling applications so that specially designed apparatus is often required to replace that normally used for industrial cooling. Standard equipment can be adapted to meet air conditioning requirements but extreme care must be taken to determine the limits of its applicability.

In industrial or process cooling systems the load is fairly constant,

noise in operation is not of paramount importance, space is available or relatively cheap, and the cooling system is to a great extent separate or independent of other mechanical equipment. By contrast, air conditioning for space cooling and comfort work in office buildings, theaters and places of public assemblage requires special consideration of all these factors. Space in public buildings is limited, noise interferes with the occupants and the cooling equipment must be adaptable to the other air handling apparatus. Most important, the load fluctuates tremendously and is seasonal.

Types of Compressors

There are many different types of compressors, a number of refrigerants, different types of evaporators, condensers and arrangements of cycle and each type has its particular place in usage. Compressors generally used are of the following types:

1. Reciprocating compressors using a volatile refrigerant.
2. Centrifugal compressors.
   a. Using a volatile refrigerant.
   b. Using water as a refrigerant.
3. Rotary compressors using a volatile refrigerant.
4. Steam jet or vacuum systems using water as a refrigerant.

Reciprocating compressors are generally used with any low pressure refrigerant such as dichlorodifluoromethane, monofluorotrichloromethane, methyl chloride, ammonia and sulphur dioxide. These compressors have been developed to a point where their efficiency is high and their operation very satisfactory. Relatively low speed operation makes them desirable for general use in large installations. Generally they are of two types, vertical and horizontal either single or double acting. The horizontal double-acting compressor is not generally used in air conditioning, except when carbon dioxide is used as a refrigerant in the larger industrial systems. Vertical, single acting, encased crank, reciprocating compressors of the uniflow type with valves in the pistons have proven reliable and are used in capacities from 1 hp to more than 100 hp. At present reciprocating compressors are used with more refrigerants than any other type of compression unit. When carbon dioxide is used as a refrigerant, a reciprocating compressor is required because of the extremely high pressures and the relatively high ratio of compression.

Centrifugal compressors using monofluorotrichloromethane, methylene chloride or water vapor can theoretically be used with any of the other refrigerants, but the resulting loss in efficiency with the higher pressure gases limits the centrifugal compressor to the refrigerants cited. At the present time centrifugal compressors are limited to air conditioning systems of a minimum of about 50 tons. Centrifugal compressors are usually built in two or more stages where the compression ratio is high and their design follows closely that of any other centrifugal equipment such as is found in general service pumps and fans.

Rotary compressors are expanding in use due to the development of new refrigerants. These units are of four common designs, consisting of rotating elements generally referred to as centrifugal, eccentric, gear and blade types. The rotation of the shafts and blades traps the refrig-