permissible temperature. Washing, purifying and recirculating of the air may be desirable. Good distribution is essential to the control of air motion and for the prevention of undesirable conditions. Accurate, sensitive and reliable automatic control of humidity or temperature, or both, is vital in most cases.

Ordinarily, outside weather conditions and the ventilation required for workers are of secondary importance in relation to the total work to be done by the air conditioning system. In extreme cases of high concentration of industrial heat from machinery and ovens the error of entirely omitting the heat gain through the building structure would not be serious. At the other extreme, where low temperatures must be produced with refrigeration and where comparatively little power is used for driving the machinery, the heat gain through the building structure will become the major factor in determining the size of equipment and in this case the ventilation requirement assumes a normal degree of importance.

Buildings which are to be air conditioned should therefore be designed with careful consideration of over-all cost and efficiency. Condensation resulting from high humidities must be prevented by suitable materials and construction, or else collected and drained to prevent loss of product or quick deterioration of the structure. Air leakage or filtration may add greatly to operating costs or make the maintenance of low humidities (relative or absolute) wholly impossible. Low temperatures require good insulation.

In the general application of industrial air conditioning, the conditions to be maintained are governed almost entirely by the requirements of the product. If any consideration is to be given to the comfort and, therefore, the efficiency of the occupants, it is secondary. In a great many cases, the requirements of the product must necessarily govern, for the physical properties of the material are more important for maximum production than the efficiency of the worker. There are, however, many cases where the worker can and should be given equal consideration and better overall results may be obtained by a proper compromise.

AIR CONDITIONING OF LIBRARIES[1]

Temperature has little effect on the preservation of books. A temperature over 100 F, combined with low relative humidity, may cause the book materials to become brittle, while a temperature much below freezing may cause permanent deterioration of the glue in the binding. The relative humidity should be maintained between 40 and 70 per cent, although these limits need not hold for short periods of time. If the relative humidity gets much below 40 per cent, first the glue and then the paper will tend to become brittle which will not cause any permanent damage unless the book is used while in this condition, as a subsequent increase in humidity will bring the materials back to their normal condition. If the relative humidity gets above 80 per cent, the growth of mildew may be expected.

One of the principal agents of destruction and deterioration of paper

[1] *U. S. Bureau of Standards Bulletin No.* 128 entitled A Survey of Storage Conditions in Libraries, by Kimberly and Hicks.

and books in libraries is sulphur dioxide gas in the air. If air containing sulphur dioxide is allowed to come in contact with cellulose, the principal constituent of paper, sulphuric acid is formed on the surface. This acid is not volatile at ordinary temperatures and therefore accumulates throughout the life of the paper. The destructive effect of the acid on the paper is independent of the relative humidity of the surrounding air. Low alkaline concentration spray water may be used in an air washer to neutralize the acid condition. Such an air washer must be especially constructed to resist corrosion.

GREENHOUSES

Table 3 lists customary dry-bulb temperature ranges for different types of plants and flowers raised in greenhouses.

TABLE 3. CUSTOMARY TEMPERATURES FOR DIFFERENT TYPES OF GREENHOUSES[a]

Type of House	Temperature Range Deg F	Type of House	Temperature Range Deg F
Carnation	55 to 65	Orchid, cool	50 to 60
Conservatory (general collection)	65 to 70	Palm, warm	65 to 75
Cool	50 to 60	Palm, cool	55 to 65
Cucumber	65 to 70	Propagating	55 to 60
Fern, Common	60 to 65	Propagating, Bottom heat	70 to 75
Fern, Tropical	65 to 75	Rose	65 to 70
Forcing	60 to 70	Sweet pea	50 to 60
General purpose	60 to 70	Tomato	65 to 70
Lettuce	55 to 65	Tropical	65 to 75
Orchid, warm	65 to 75	Violet	45 to 55

[a] Lower values may be considered approximate night temperatures and higher values approximate day temperatures.

PROBLEMS IN PRACTICE

1 ● Why is air conditioning required for some industrial processes?

To control the physical properties of the materials being processed.

Example. In the manufacture of chewing gum, it is rolled into slabs and scored. The scored slab must then be broken at the score marks to form the sticks. If the slab is too warm, breaking is impossible, if the slab is too cold or too dry, it becomes brittle and shatters, thereby producing much material to be reworked.

2 ● Why is it necessary to control the physical properties of the material being processed?

To permit permanent adjustment of machinery.

Example. In the manufacture of cigarettes, the amount of tobacco fed upon the paper tape is determined by pressure against springs. When the tobacco is over-moist and, therefore, over-soft, a great excess will go into the finished cigarette; when the tobacco is too dry and, therefore, harsh, too little goes into the finished cigarette.

3 ● A condition of 75 F dry-bulb temperature and 55 per cent relative humidity is being maintained in a cigarette manufacturing department. What will be the regain and moisture content of the tobacco?

$$\text{The regain, from Table 1} = 17.75 \text{ per cent.}$$

$$\text{The moisture content} = \frac{17.75 \times 100}{100 + 17.75} = 15.1 \text{ per cent.}$$