Brewery. Fermentation in vat rooms.

Chemical. Powders (including explosives and baking powder), drying of salts of all kinds, hydroscopic compounds and drugs, glues and gelatines.

Clay Products. Bricks, pottery and ceramics.

Confectionery. Chocolates, bon bons, hard candy, gum drops, marshmallows, caramels, chewing gum and starch and various sugars.

Drugs and Pharmaceuticals. Drugs and pharmaceuticals might also be included under chemicals, but definitely to be added to this group are capsules, hydroscopic colloidal crystals, serums and toxins.

Electrical Goods. Toll cable manufacture, telephone exchanges, winding rooms, lamp manufacture, filament departments.

Films and Film Laboratories. Drying cabinets, printing rooms, perforating rooms, projection assembly rooms, moving picture studios, celluloid and colored photography.

Foods. Bread and cake, cereals, macaroni, meats (cold storage markets), yeast, enzymic products, fruits, including apples and bananas, both for preserving and ripening.

Furs. Fur storage.

Incubators. Human babies, and chickens and similar hatching.

Laboratories. All kinds.

Leather. Drying and processing of hides, skins and manufacture of bags, shoes, findings.

Linoleum. Drying, printing, oil cloth, and linseed oil buildings.

Matches. Storage of raw materials and machine drying and packing.

Minerals. Gold beater rooms, gold and silver leaf manufacturing, metal enamelling, and mottled ware, particularly all cutting on iron.

Paper and Paper Products. Moisture absorption in manufacture, cutting, folding, binding and furnishing bags, including gluing, parchment paper, cellophane containers, paste board containers, paste board bottles and egg containers.

Pearls. Artificial pearls.

Printing, Lithography and Rotogravure. Playing cards, process work, storage, offset work, binding, rollers and ink.

Soap. Crystallizing under the cold process.

Textiles. Cotton: drying, spinning and weaving. Rayon: chemical house, spinning, drying, twisting, reeling, winding, inspection and storage. Silk: storage, twisting and reeling, spinning, weaving, knitting, tin and lead weighting and regain rooms (hosiery and underwear).

Tobacco. Cigarettes: storage, mixing, blending, paper and machine manufacture. Cigars: storage, curing, cleaning, wrapping and packing.

It is apparent that the subject of air conditioning for industrial processes is extensive and greatly involved, and that a detailed treatment is therefore beyond the scope of this book. Volumes have been written on individual phases of it. A few of the salient points of the general subject are covered in this chapter.

MOISTURE CONTENT AND REGAIN

The terms *moisture content and regain* refer to the amount of moisture in hygroscopic materials. *Moisture content* is the more general term and refers either to free moisture (as in a sponge) or to hygroscopic moisture (which varies with atmospheric conditions). It is usually expressed as a percentage of the total weight of material. *Regain* is more specific and refers only to hygroscopic moisture. It is expressed as a percentage of the *bone-dry* weight of material. For example, if a sample of cloth weighing 100.0 grains, is dried to a constant weight of 93.0 grains, the loss in weight, or 7.0 grains, represents the weight of moisture originally contained. This

expressed as a percentage of the total weight (100.0 grains) gives the moisture content or 7 per cent. The regain, which is expressed as a percentage of the bone-dry weight, is $\frac{7.0}{93.0}$ or 7.5 per cent.

The use of the term regain does not necessarily imply that the material as a whole has been completely dried out and has re-absorbed moisture. In the case of certain textiles, for instance, complete drying during manufacturing is avoided as it might appreciably reduce the ability of the material to re-absorb moisture. In measuring moisture it is necessary to dry out a sample so that the loss in weight may be used as a basis for calculating the regain of the whole lot.

The moisture content of an hygroscopic material at any time depends upon the nature of the material and upon the temperature and especially the relative humidity of the air to which it has been exposed. Not only do different materials acquire different percentages of moisture after prolonged exposure to a given atmosphere, but the rate of absorption or drying out varies with the nature of the material, its thickness, density, etc.

Table 1 shows the regain or hygroscopic moisture content of several organic and inorganic materials when in equilibrium at a dry-bulb temperature of 75 F and various relative humidities. The effect of relative humidity on regain of hygroscopic substances is clearly indicated. The effect of temperature is comparatively unimportant. In the case of cotton, for instance, an increase in temperature of 10 deg has the same effect on regain as a decrease in relative humidity of one per cent. Changes in temperature do, however, affect the rate of absorption or drying. Sudden changes in temperature cause temporary fluctuations in regain even when the relative humidity remains stationary.

CONDITIONING AND DRYING

Exposure of hygroscopic materials to an atmosphere of controlled humidity and temperature for the purpose of establishing a specified moisture condition in the material is called *conditioning.* Where the desired final moisture content is relatively low, the term *drying* is usually used. In any case, control of relative humidity, temperature, air velocity and length of exposure are all of more or less importance.

The conditioning treatment may be undertaken in a special enclosure (conditioning room) or it may be accomplished in the same room and at the same time as some regular manufacturing process. For instance, in the weaving of textiles a high relative humidity is commonly employed to keep the yarn strong and pliable, thus assisting in the weaving process and at the same time leaving the product in a satisfactory condition of regain for commercial reasons.

As a rule, commercial regain standards are specified percentages which by test have been found equivalent to a so-called *standard atmosphere* to which the goods would be in hygroscopic equilibrium after prolonged exposure. Committee D13 on Textiles of the *American Society for Testing Materials* has adopted a relative humidity of 64 to 66 per cent and a temperature of 70 to 80 F as the standard atmosphere for textile testing.