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

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

Films and Film Laboratories. Drying cabinets, printing rooms, perforating rooms, projection assembly rooms, moving picture studios, celluloid and color 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, chickens and similar hatching.

Laboratories. All kinds.

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

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

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

Minerals. Gold beater rooms, gold and silver leaf manufacturing, metal enameling, 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 weighing 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. A few of the salient points of the general subject are covered in this chapter.

CLASSIFICATION OF PROBLEMS

The problems of industrial air conditioning fall into four general classes:

1. Control of Regain.
2. Control of Rate of Chemical Reactions.
3. Control of Rate of Biochemical Reactions.
4. Control of Rate of Crystallization.

CONTROL OF REGAIN

In the first class the textile plant offers a good example. The regain or moisture content affects the physical properties of textiles to a marked degree, changing the strength, pliability and elasticity.

The fact that the regain of textiles will come into equilibrium with the conditions of the surrounding air and vary with its temperature and relative humidity is the fundamental basis for the control of physical

qualities during manufacture. During the preparation process in a cotton mill, the fibers should be in a condition easily to be brought parallel to each other.

A relative humidity of 50 to 55 per cent gives the best result for these preliminary processes. As the cotton fiber comes to the spinning operation, more flexibility is needed and the relative humidity is increased in this department. For many years, 65 per cent relative humidity was considered the optimum. As pointed out in a paper presented before the *Cotton Manufacturers Association* in 1926, a higher relative humidity is necessary to offset the extra work performed on the fiber as the spindle speed was increased. Today many cotton mills carry 70 per cent relative humidity in the spinning rooms. Winding, warping and weaving are all processes calling for great flexibility and a consequent need for higher humidity.

Other textile fibers, due to their different natural characteristics, are processed under relative humidities and temperatures applicable to each.

Rayons, on account of great loss of strength with the higher regains, should be processed in a relative humidity of 57 per cent. Acetate silk, another chemical fiber, with approximately 50 per cent of the regain of rayon, may be processed between 60 and 65 per cent relative humidity.

All hygroscopic materials, when absorbing moisture, release sensible heat equivalent to the latent heat of the moisture taken up by the material. This may account for a large percentage of the total load.

CONTROL OF RATE OF CHEMICAL REACTION

Typical examples of the second classification, the control of the rate of chemical reactions, occur in the manufacture of rayon. The pulp sheets are conditioned, cut to size, and passed through a mercerizing process. It is essential that this be under close control of both temperature and relative humidity. Temperature controls the rate of reaction directly, while the relative humidity maintains a constant rate of evaporation from the surface of the solution and gives a solution of known strength throughout the mercerizing period.

Another well known example of this class is the *drying* of varnish which is an oxydizing process dependent upon temperature. High relative humidities have a retarding action on the rate of oxydization at the surface and allow the gases to escape as the chemical oxydizers *cure* the varnish film from the bottom. This produces a surface free from bubbles and a film homogeneous throughout.

Temperatures for *drying* varnish vary with the type. A relative humidity of 65 per cent is beneficial. In the field of biochemical control, industrial air conditioning has been applied to so many different and well known products that it is difficult to select an outstanding example.

CONTROL OF RATE OF BIOCHEMICAL REACTIONS

All problems involving fermentation are classed under this heading. As biochemistry is a subdivision of chemistry, subject to the same laws, the rate of reaction may be controlled by temperature. An example of this is the dough room of the modern bakery. Yeast develops best at a