Safeguarding the health, safety and efficiency of workers requires control of dusts, fumes, smokes, mists, fogs, vapors, and gases, and control of the effective temperature, which includes temperature, humidity and motion of air about the worker.

General ventilation may be relied upon in some cases to control air contaminants. Chapter 9 gives information on natural ventilation. If mechanical ventilation is to be used, Chapter 32, Fans; Chapter 40, Air Distribution; Chapter 41, Air Duct Design; Chapter 33, Air Cleaning Devices; and Chapter 37, Spray Apparatus, furnish information on a broad range of industrial design conditions. If ventilation is to be provided for isolated areas using booths or enclosures, or if local exhaust ventilation is to be employed using hoods, exhaust slots or flexible tubes, fundamental design information will be found in Chapter 46, Industrial Exhaust Systems.

In controlling effective temperature, or in providing appropriate air conditions for storage and for processing, it may be necessary to humidify or dehumidify, to heat or cool, to clean and to transport the air. These subjects are treated in other chapters in the Guide. When exhaust ventilation is used, care should be taken to properly admit a supply of air into the building to replace that removed; otherwise the exhaust system may fail to perform its intended function. Chance infiltration should not be depended upon for this supply. Optimum results are most probable if the industrial process or project and its air conditioning system are designed together.

TYPICAL APPLICATIONS IN STORAGE AND PROCESSING

Air conditioning in storage and processing may have one or more of the following objectives: (1) air quality control, (2) control of moisture regain, (3) control of rate of chemical reactions, (4) control of rate of biochemical reactions, (5) control of rate of crystallization, and (6) elimination of static electricity.

Air Quality Control

The control of humidity has proved to be useful in blast furnace operations; better uniformity of product and increased rate of production are the result. Very low humidity, with or without control of air flow and temperature, is essential in preserving stored machinery and instruments against corrosion. Control of temperature is necessary in high precision manufacturing. If, in addition to temperature, humidity is controlled and air cleanliness maintained, good conditions for gaging laboratories, for optical goods production, and for such processes as photographic film and pharmaceutical manufacturing may be provided. In libraries and museums, control of humidity and temperature is important to the preservation of the materials stored there; air cleanliness is of almost equal importance in minimizing damage during use or when cleaning the materials. In drafting rooms, control of temperature and humidity to eliminate sweating of workers reduces damage to drawings and tracings, improves accuracy of work that is to be used in direct transfer processes, and improves worker efficiency.

Moisture Content And Regain

In the manufacture or processing of hygroscopic materials such as textiles, paper, wood, leather, tobacco and foodstuffs, the temperature and relative humidity of the air have a marked influence upon the rate of production and upon the weight, strength, appearance and general quality of the product. The moisture content of materials having a vegetable or animal origin, and to a lesser extent minerals in certain forms, comes to equilibrium with the moisture of the surrounding air. This is the fundamental basis for the control of certain physical qualities of the material during manufacture. With increase in moisture content, hygroscopic materials ordinarily become softer and more pliable. Standards of regain are fixed in the trade.

Manufacturing economy therefore requires that the moisture content be maintained at a percentage favorable to rapid and satisfactory manipulation and to a minimum loss of material through breakage. A uniform condition is desirable in order that high speed machinery may be adjusted permanently for the desired production with a minimum loss from delays, wastage of raw material and defective product.

In the processing of hygroscopic materials, it is usually necessary to secure a final specified moisture content suitable for the goods as shipped. *Moisture content* refers to free moisture (as in a sponge) and 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 bone-dry 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 imply that the material as a whole has been completely dried out and has re-absorbed moisture.

A basis for calculating the regain of textiles is obtained by drying, under standard conditions, a sample from the lot; and the dry weight thus obtained is used in the calculations to determine the regain.

Table 2 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. 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. The rate of absorption or drying varies with the nature of the material, its thickness and density.

During the preparation processes in a cotton mill, the cotton fibers should be in a condition to be easily carded. These preliminary processes are carried out best in a relative humidity of 50 to 55 per cent. As the cotton fiber comes to the spinning operation, more flexibility is needed and the relative humidity is increased in this department. Winding, warping and weaving are all processes calling for great flexibility and a consequent need for higher humidity.

Rayons, like cotton, require different humidities and temperatures at different steps in manufacture, but on account of great loss of strength with the higher regains, should be finished in a relative humidity of 55 to 70 per cent.

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