Conditioning and Drying

In general, the materials may be exposed to desirable humidities for treatment coincidentally with the manufacture or processing of the materials, or they may be treated separately in special enclosures. This latter treatment may be classified as conditioning or drying. The usual purpose of conditioning or drying is to establish a desired condition of moisture content and to regulate the physical properties of the material. When the final moisture content is lower than the initial one, the term *drying* is applied (See Chapter 46). If the final moisture content is to be higher, the process is termed *conditioning*. In the case of some textile products and tobacco, for example, drying and conditioning may be combined in one process for the dual purpose of removing undesirable moisture, and accurately regulating the final moisture content. Frequently, conditioning or drying is made a continuous process in which the material is conveyed through an elongated compartment by suitable means, and subjected to various controlled atmospheric conditions.

Control of Rate of Chemical Reactions

A typical example of control of the rate of chemical reactions occurs in the manufacture of rayon. The pulp sheets are conditioned, cut to size, and passed through a mercerizing process. It is essential that, during this process, close control of both temperature and relative humidity should be maintained. The temperature controls the rate of reaction directly, while the relative humidity maintains a constant rate of evaporation from the surface of the solution, and maintains a solution of known strength throughout the mercerizing period.

Another well-known example in this class is the *drying* of varnish which is an oxidizing process dependent upon temperature. High relative humidities have a retarding effect on the rate of oxidization at the surface, and allow the internal gases to escape freely as the chemical oxidizers *cure* the varnish from within. This produces a surface free from bubbles and a homogeneous film throughout. Desirable temperatures for *drying* varnish vary with the type. A relative humidity of 65 percent is beneficial for obtaining the best processing results.

Control of Rate of Biochemical Reactions

In the field of biochemical control, industrial air conditioning has been applied to many different and well-known products. 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 temperature of 80 F. A relative humidity of 70 percent is maintained to hold the surface of the dough open to allow the carbon dioxide gases formed by the fermentation to pass through and produce a loaf of bread, when baked, of even, fine texture without large voids.

The curing of fruits, such as bananas and lemons, also comes under this classification. Bananas require a cycle of temperatures and relative humidities for ripening. The starches in the pulp of the fruit must be changed and the skin cured and colored, after which the fruit is cooled to maintain as low a rate of metabolism as possible. Ideal storage conditions range between 56 and 60 F, with about 75 percent relative humidity, and ventilation at the rate of three or four air changes per hour.

The curing of lemons is an entirely different problem. Bananas are cured for a quick market, while lemons are held for a future market. The process, therefore, varies in the temperature used. Temperatures from 54 to 59 F have been found to be best suited for this process. A high relative humidity of 88 to 90 percent is necessary to hold shrinkage to a minimum and, at the same time, develop the rind so it will be sufficiently tough to permit handling.

Tobacco from the field to the finished cigar, cigarette, plug or pipe tobacco, offers another interesting example of what may be done by industrial air conditioning in the control of color, texture and flavor. In the processing of tobacco, control of moisture regain and of chemical and biochemical reactions is involved, and only through close atmospheric control can the best quality of leaf be developed.

Control of Rate of Crystallization

The rate of cooling of a saturated solution determines the size of the crystals formed. Both dry- and wet-bulb temperatures are of importance, as the one controls the rate of cooling, while the other, through evaporation, changes the density of the solution.

In the coating pans for pills, gum and nuts, a heavy sugar solution is added to the tumbling mass. As the water evaporates, each separate piece is covered with crystals of sugar. A smooth, opaque coating is only accomplished by blowing into the kettle the proper amount of air at the right dry- and wet-bulb temperatures. If the cooling and drying are too slow, the coating will be rough and semi-translucent, and the appearance unsightly; if too fast, the coating will chip through to the interior. Only by balancing temperature, relative humidity, and volume of air to the sugar solution, can the proper rate be obtained and a perfect coating assured.

Control of Temperature for Close Machining Tolerances

Where tolerances must be held within 2 or 3 ten-thousands of an inch, as in the manufacture of precision instruments, tools, and high quality lenses, temperature variations may cause expansion and contraction of material to an extent that will seriously affect the quality of the work. This type of work usually requires close temperature control to assure accuracy and uniformity of the product.

Usually the temperature level with respect to the product is not as important as controlling the temperature within close limits. For this reason, conditions are usually selected within the comfort range.

Control of Dew-Point for Protection of Polished Surfaces

In the manufacture of certain metal articles, the presence of finger prints, tarnish, or *etching* can not be tolerated in the finished article. If these articles are manufactured under conditions of effective temperatures that will cause the hands to perspire, an unsatisfactory product will result. The salt and acid contained in body perspiration, when deposited on the highly polished article, can show corrosion and rust within a few hours if examined under a microscope.

It is therefore important to maintain temperatures and relative humidities (dew-point) low enough to prevent sweating of the hands. In addition, the manufacture of polished surfaces usually requires a better-than-average job of air filtering to avoid abrasion of the surfaces.