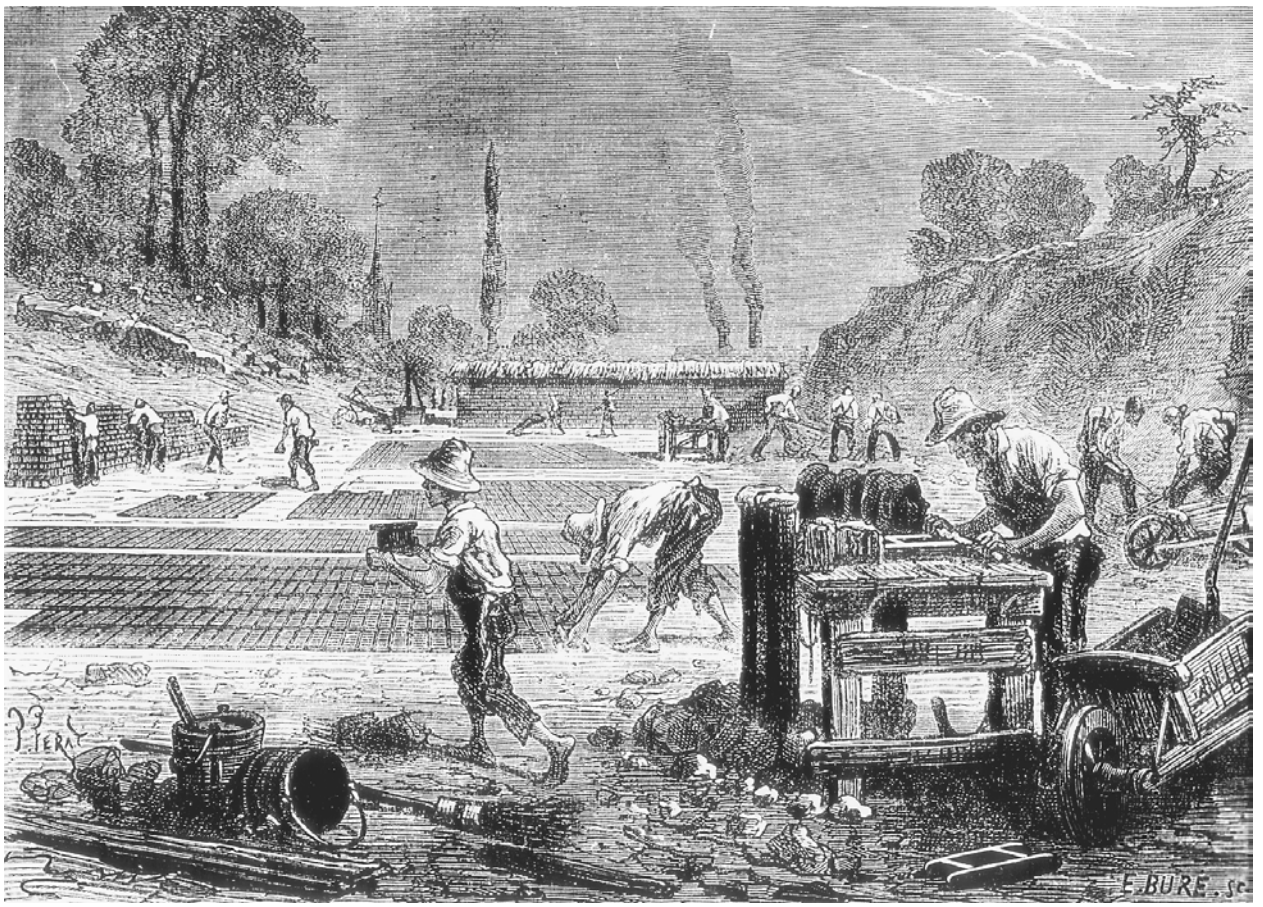

Figure 2-4 Artist's engraving of a colonial brick-making operation. (*Courtesy BIA.*)

burning can begin, most of this excess must be evaporated. The open sheds once used for natural air drying were affected by weather conditions, and the evaporation process took anywhere from 7 days to 6 weeks. Today, brick plants use separate dryer kilns or chambers supplied with waste heat from the exhaust of the firing kilns. Drying time takes only 24 to 48 hours, depending on the original moisture content. Drying temperatures range from 100 to 400°F, but must be carefully regulated, along with humidity, to prevent sudden changes which could crack or warp the units.

2.1.7 Glazing

Glazing is a highly specialized, carefully controlled procedure used in the production of decorative brick. *High-fired ceramic glazes* are the most widely used. The glaze is a blend of clays, ceramic frit, fluxes, and base metals sprayed on the units before burning, and then subjected to normal firing temperatures to fuse it to the clay body. Glazes with a higher flux content will burn to a glossy finish, while more refractory mixes produce a matte glaze. After the basic glass material is prepared, ceramic pigments are used to stain it to the desired color. Cobalt, vanadium, chrome, tin, nickel, alumina, and other metals are used singly or in combinations to produce standard,

custom, or color-matched blues, greens, ochers, pinks, lavenders, buffs, grays, and blacks. Color consistency is easier to maintain with high-gloss glazes, both within batches and between kiln runs.

Low-fired glazes are for colors which cannot be produced at high firing temperatures such as bright red, bright yellow, burgundy, and orange. If fired too hot, bright red, for instance, will craze or burn transparent because the cadmium and lead in the glaze are unstable at high temperatures. The glaze is applied after the brick has been burned to maturity, and then requires a second firing at lower temperatures of 1300 to 1800°F. Low-fired glazes are much more expensive because of the two-step process.

Clay coat glazes (sometimes called slip glazes) produce a dull, nonreflective, vitreously applied surface in softer tones than ceramic glazes. *Salt glazes* are produced by applying a vapor of sodium-iron silicate to the brick while it is at maximum firing temperature. The transparent finish shows the natural color of the fired brick under a lustrous gloss.

Producing some ceramic glazes leaves contaminants in the kiln which can affect the next batch of brick. The residue from ceramic glazes is also classified by the Environmental Protection Agency as hazardous waste which must be recovered for reuse or disposal.

2.1.8 Burning

After excess moisture has been evaporated from the clay units and desired glazes, if any, have been applied, the bricks are ready for burning. This is one of the most specialized and critical steps in the manufacture of clay products. Burning is accomplished by controlled firing in a kiln to achieve ceramic fusion of the clay particles and hardening of the brick. Since so many of the properties of brick and clay tile depend on the method and control of firing, the development over the years of more sophisticated kilns has been instrumental in improving the quality and durability of clay masonry.

Originally, bricks were cured by sun drying. This permitted hardening by evaporation, but did not achieve the chemical fusion necessary for high strength. High-temperature kiln firing of clay brick was done as early as 3500 B.C. Early scove kilns heated by wood fires were eventually replaced by beehive kilns. The heat source was originally at the bottom of the kiln, and could not be controlled effectively, so uneven firing resulted in hard-burned “clinker” brick nearest the fire and soft, under-burned “salmon” brick at the top of the kiln. Salmon bricks were sometimes used in unexposed locations such as filler courses in multi-wythe walls, but clinker bricks were usually discarded. Builders in colonial Williamsburg, Virginia, however, were fond of clinker brick and often used shiny, black, overburned units as headers to create checkerboard patterns with ordinary red brick. Tudor style homes of the early 1900s also used clinker brick in the same way. Some manufacturers still produce and sell clinkers for use, not only in restoring or renovating old buildings which used clinkers originally, but in new construction as well. The dark-colored, warped, or twisted shapes provide textures which are unusual in brick walls.

Beehive kilns were later heated by more precisely controlled gas and oil fires in separate fireboxes. Heat was circulated by a system of ducts from both the bottom and the top of the kiln, which resulted in more uniform firing of the brick. However, the excessive time required for burning in a “periodic” kiln of this nature yields only a limited quantity of bricks.

Most plants now use continuous straight-line tunnel kilns, with sophisticated computer equipment for precisely controlled firing temperatures (*see Fig. 2-5*). The clayware, which is stacked on flat rail cars for drying, is moved