FAULTS IN PRESSING CERAMIC TILE

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This deals with the causes and cures for faults in pressing tile: lamination due to air, twisting deformation (buckling), cracking, differences in thickness, pinholes and blobs. By "laminating," the author means the separation of layers of body produced by air trapped pressing. Most often it is encountered through poor air release from the tiles during pressing, sometimes owing to the time factor. To prevent this fault conditions which contribute to its formation should be eliminated as far as possible. Between the upper and lower stamps (plunger and matrix on the one hand, and the rim on the other it is necessary to leave a gap wide enough for the air to escape, bearing in mind the expansion of the body from the electric heating of the forming components of the press. The gaps should be the same on all four sides.

So that the air can escape from the body gradually the plunger should be lowered before the first application of pressure under the force of gravity. It is also important that during pressing the upper stamp never leaves the surface of the partly pressed tile, otherwise air will be trapped.

Each body composition has a certain optimum moisture content at which minimum lamination occurs; in practice it can be determined experimentally. The body composition also affects lamination. It is known that lamination due to air can be due to the high talc content, especially in the form of platelet form, but wollastonite in the same quantities improves the pressibility of the powder. Additions of wollastonite to talc bodies is also favorable. Coarse-grained talc is less dangerous than very fine talc.

The term "twisting" refers to the "nonsquareness" or nonrectangular form of the tiles after firing. It occurs even in normal pressing conditions owing to the difficulty of uniformly pouring the press powder into the molds. The places getting more press powder are denser after pressing. They shrink less and this produces uneven dimensions on the sides of the tiles. The best cure is to use bodies with low shrinkage but it is also important to arrange satisfactory grading and flowability of the powders (it should run as quickly as sugar or flour). The moisture content of the powder also affects the pressibility and should be selected experimentally.

Maintaining the required size grading and moisture content of the powders is especially important in automatic pressing when it is not possible to constantly regulate the press in relation to the state of the powder.

The design of the filling carriage on the press is also important for uniform filling. It should be slightly bigger than the mold and the amount of powder fed to the mold should not be much more than that needed to fill the cavity. Large amounts impair uniformity of distribution.

The carriage should move forward rapidly, striking the stops so that a lot of the material is thrown to the far end of the mold cavity as a result of inertia. Sometimes it is better if the carriage makes several movements back and forth over the press mold.

To prevent too much powder entering those parts of the mold which are close to the point at which the carriage operates, it is proposed to fit the latter with cross rods placed upward at right angles to the direction or movement. These rods are placed over the end of the mold cavity which yields the densest tile, close to each other, so that less powder falls into this section.

To determine the difference in density in the pressed tiles it is useful to employ a special penetrometer consisting of a number of sharp needles which under a spring action are inserted into the pressed tile to a certain depth; it measures and directly records the results on a dial. Starting from these data it is possible to correct the position of the rods at the bottom of the filling carriage. This is normally done without waiting for the tiles to be fired if the relationship between the readings of the penetrometer and the distortion has been established previously.

The end of the mold where the tile has the highest density also creates great friction between the tile and the end during ejection. This end is irregularly worn and the mold cavity becomes nonrectilinear. This position is made worse because the denser part of the tile is elongated owing to the low shrinkage and the distortion is enhanced.

The biggest density differences invariably occur on both sides of the tile in the direction of movement of the filling carriage and there is a corresponding wear of the ring around the press mold. This difficulty can be partly eliminated by turning the ring after the mold's life is half gone.

The mold should, as a rule, be strictly rectangular. However, if from experience or measurements with the pentrometer it is known that there is a great difference between the front and rear ends of the tile after firing then it is possible to make the ring and the press mold not quite rectangular.

In certain conditions it is possible to reduce the effect of the irregular filling by placing the tiles during firing so that the denser parts are facing the source of heat, i. e., toward the burners.

Deformation is normally considered to be a fault of firing but the cause of certain forms of deformation may be irregular mold filling. In particular, deformation along the edges of tiles is normally due to this cause. If the body's density in the middle of the press cavity is higher than at the ends, then the edges will deform. Insufficient body in the middle of the tile causes the surface to be concave when the pressing of the tiles is done with the face side upward and convex if the tile is pressed with the face downward.

Tiles may deform even before firing regardless of filling uniformity. The pressed tile expands in relation to the pressure and moisture content. If after the pressing cycle the plunger is raised from the tile when it is still inside the ring, then the expansion can only occur upward, and if the tile is pressed with face upward it becomes convex. It is necessary that the ring be lowered to relieve the pressure applied by the press plunger. Then the tile freely expands in all directions immediately after withdrawal of the pressure.

Firing cracks may also be due to irregular filling. Differences in density and hence shrinkage may cause cracks on the side where tension is applied. This fault is especially common in shaped tiles (cornices and beading) whose density varies a lot after pressing.

Differences in thickness of tile are normally due to nonparallel matrices and plungers or irregular filling as a result of which the more densely pressed ends expand more.

Pinholes and pock marks are due to contamination of the working surfaces of the mold. Although it is normal to heat both the top and bottom of the mold to prevent body particles sticking to the metal it is necessary from time to time to wash the mold surfaces and then to rub them with clean cloth. Sticking may also be due to too strong or too weak heating of the mold; in these cases they must be washed more often. Often the tendency of the body to sticking is enhanced with rise in moisture content; then the moisture content should be reduced.

Tiles leave the press with flashes on the edges; the flash thickness depends on the width of the gap between the mold and the ring and increases with wear of the mold. These flashes are removed with special cleaning knives made of hardened steel or with abrasive wheels. They are fixed to the cleaning conveyer and the tiles pass under them. At first two opposite edges are cleaned, and then the tile moving forward on the belt is mechanically turned through 90° and the two other edges are cleaned with another row of knives or wheels.

To remove the flashes the degree of compression of the knives or wheels exerted with a spring needs to be carefully regulated, but so that the pressure does not damage the tiles. Often the tiles pass under felt polishers after fettling.

When once firing is used not only the two face edges should be cleaned but also the back and sides. This is done to prevent the flash clay getting into the glaze which is returned to the spraying chamber, and also to prevent particles of body sticking to the tiles when they are assembled on shelves for firing.

It is inadmissible to use badly worn molds since large flashes form on the tiles. This should be avoided even if they are completely removed by fettling since the edges of the tiles under the projecting flashes are less densely pressed than the rest of the article. This may produce the so-called edge crack in the form of very fine cracks running parallel to the edge of the tile.