Figure 16-2 Efflorescence.

Hot summer months are not as conducive to efflorescence because the wetting and drying of the wall is generally quite rapid. In late fall, winter, and early spring, particularly after rainy periods, when evaporation is slower and temperatures cooler, efflorescence is more likely to appear.

Three simultaneous conditions must exist in order for efflorescence to occur: (1) soluble salts must be present within the masonry assembly; (2) there must be a source of water sufficiently in contact with the salts to form a solution; and (3) the wall construction must be such that paths exist for the migration of the salt solution to a surface where evaporation can take place (*see Fig. 16-3*). In conventional masonry construction exposed to weather, it is virtually impossible to ensure that no salts are present, no water penetrates the masonry, and no paths exist for migration. The most practical approach to the prevention and control of efflorescence is to reduce all of the contributing factors to a minimum.

Soluble salts may be present in either the masonry or the mortar, or may be absorbed into the wall through rain or groundwater. Since efflorescence usually appears on the face of the units, they are generally assumed to be at fault. This, however, is not usually the case. Virtually all clay brick contains at least some salts, but their efflorescing potential is small. The degree of probability may be easily determined by the wick test included in ASTM C67, *Standard Methods for Sampling and Testing Brick and Structural Clay Tile*. Brick units relatively free from impurities are readily available throughout the United States. Dense to moderately absorptive units are least troublesome. Researchers differ in their opinions on concrete masonry, some saying that it has even less efflorescing potential than clay products, and others recording 2 to 7 times as much soluble material.

Mortars also vary in the amounts of soluble salts they contain, depending on the type of cement used. Cements are generally the greatest source of soluble materials that contribute to efflorescence. Those with a high alkali content and limestone impurities are most likely to cause problems. Some companies have developed special "low alkali" and "non-staining" cements for use in masonry mortars. Hydrated limes are relatively pure and generally have 4 to 10 times less efflorescing potential than cements. Therefore, lime is one of the lesser sources, along with well-washed sand and clean, potable water. Soluble salts from the soil may be absorbed into masonry in contact with the ground through the capillary action of groundwater migrating

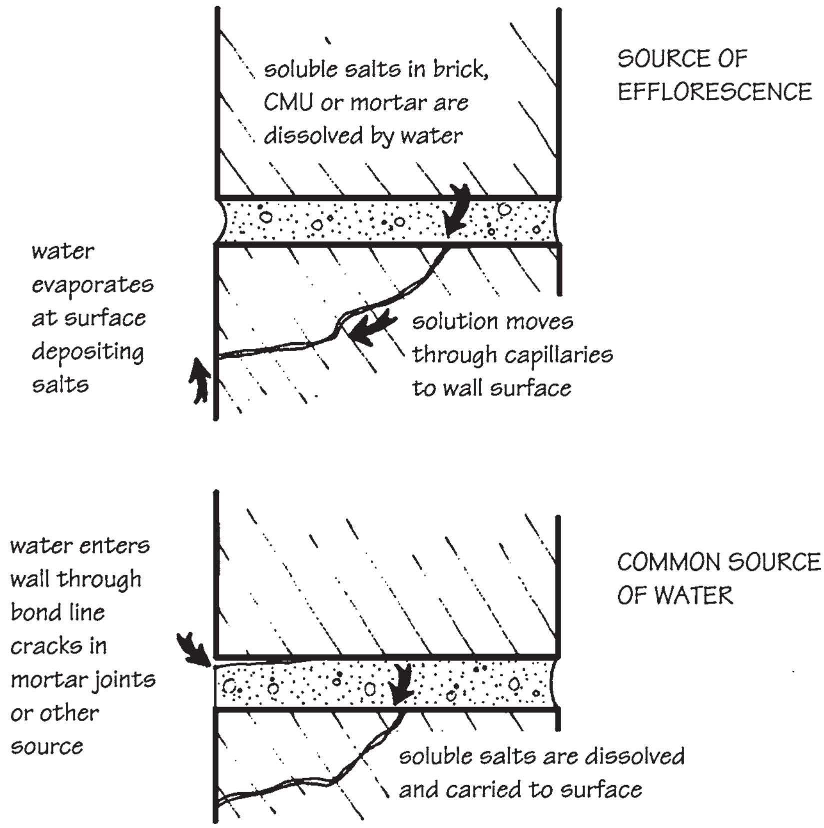

Figure 16-3 Efflorescence in masonry. (*Courtesy Acme Brick Company, Fort Worth, Texas.*)

upward into the units. Sulfurous gases in the atmosphere in highly industrialized areas may also contaminate the masonry with soluble salts through soaking with "acid rain."

The source of moisture necessary to produce efflorescence may be either rainwater or the condensation of water vapor within the assembly. Water may also be present because unfinished walls were not properly protected from rain and snow during construction. "New building bloom" (efflorescence that occurs within the first year of the building's completion) is often traced to slow evaporation of such moisture.

The most common cause of efflorescence is faulty design and construction practices. Regardless of impurities in the materials, it is unlikely that efflorescence will occur if proper precautions and high-quality workmanship are employed. Some of the more common malpractices are:

1. Failure to store masonry units off the ground and protect with waterproof covers
2. Failure to cover and protect unfinished walls
3. Inadequately flashed copings and parapet walls
4. Absence of drips on cornices or projecting members
5. Poorly filled mortar joints
6. Absence of dampproof courses at ground level
7. Failure to repair or patch cracked or broken mortar joints