

Fly Ash

Reduces Vapor Transmission in Concrete Floors

Although it appears solid, concrete is actually a maze of capillaries and channels formed by bleed water escaping the concrete after placement. These capillaries and channels provide an avenue for internal and external moisture to be drawn through the concrete to the slab surface. The moisture reacts chemically with alkali hydroxides deposited on the surface of the concrete during hydration, and can destroy water-based adhesives (most VOC-based adhesives have been eliminated due to health concerns), which bond vinyl or carpeting floor coverings to concrete. The moisture can also warp wood surfaces like basketball courts, and cause blistering and complete delamination of flooring materials.

Moisture accumulated under flooring also fosters the growth of mold, mildew, and fungus, which contributes to "sick building syndrome". Hospitals, schools and office buildings are prime environments for this occurrence, because of the large floor area and the artificial heating systems that keep the building warm during the day, but are turned down or off after hours. When the lower temperature reaches the dew point at the adhesive/concrete interface, condensed water is generated, creating a perfect environment for mold growth. Molds release toxins that can be harmful to other living organisms, including people and animals.

This detrimental side effect makes it common for the flooring supplier or contractor to specify how "dry" a concrete surface must be before applying

Fly ash can play a role in reducing vapor transmission in concrete floors, which can help prevent mold growth, warping, and delamination of flooring materials.

flooring materials. Most solid vinyl sheeting, vinyl backed carpeting, and non-porous backed carpeting manufacturers require the maximum vapor transmission rate from the surface of a concrete slab to fall to 3 pounds of moisture over a 1,000 square foot area during a 24 hour period before installation of flooring materials.

Concrete cracks and joints provide pathways for intrusion of moisture, so it is important to note that no additive will eliminate vapor transmission. However, testing indicates that using fly ash does reduce vapor transmission, because of reduced permeability. ASTM F 1869, "Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride", shows that moisture transmission is reduced as fly ash content is increased. Therefore, fly ash can play a role in making concrete dry out faster, allowing placement of flooring materials sooner.

There are three major ways fly ash helps reduce vapor transmission.

1. Fly ash concrete bleeds less, which creates fewer bleed channels and lowers permeability.

2. Pozzolanic action seals off capillary channels to further reduce permeability. Lower permeability concrete dries out more quickly.
3. Pozzolanic action consumes alkali hydroxides, which makes them unavailable for adhesive destruction.

Eco Material Technologies, in cooperation with CSI Share Group in Portland, OR, conducted tests to determine the effect of fly ash content on vapor transmission on five concrete mixes containing zero to 50% Class F fly ash. Two slabs of each mix were cast. One set of samples was placed on a perfect vapor barrier so that moisture from surrounding sources could not supply water vapor to affect the test. The second set of samples was placed on wet sand to reflect real world site conditions where a vapor barrier is damaged or non-existent. Results show that in both cases, the transmission of water vapor is reduced as fly ash content is increased. The tests were carried out up to 28 days, and although none of the specimens reached the target of 3 pounds per 1,000 square feet in 24 hours, the data indicates the concrete mixtures with higher ash content will reach the target more quickly than straight cement concrete.

As the fly ash quantity was increased, drying shrinkage was also reduced and the water required for workability

was decreased due to the “ball bearing” action of the fly ash particles. The amount of water used in the mix is directly linked to moisture transmission in the concrete slab, so the less water used, the lower the moisture transmission. Additional research is needed in order to reach the industry standard of 3 pounds per 1,000 square feet in 24 hours; however, since it has been shown that the vapor transmission is reduced by the addition of fly ash, that should be enough to convince specifiers to include it in slab specifications where previously it has not been allowed.

For more information or answers to questions about the use of fly ash in specific applications, contact your nearest Eco Material Technologies Technical Sales Representative or call 1-770-684-0102.