Industrial Flooring

TMI Coatings Moisture Guidelines for Flooring

One of the problems in applying non-permeable (impervious) floor coatings to concrete is moisture vapor transmission. Because concrete is a water permeable material, all concrete floors will transmit some amount of water vapor. High moisture vapor transmission can cause problems with the installation and performance of monolithic flooring systems. By recognizing potential problems, testing and mitigating them, steps can be taken to ensure a long-lasting flooring installation.

Moisture testing is the responsibility of the Owner. Upon request, TMI Coatings, Inc. (TMI) can arrange to have an independent laboratory perform testing. A core sample may also be required to determine the presence of sodium silicates, which can adversely affect adhesion of flooring systems to concrete.

What are “high moisture levels”? Most companies who manufacture floor coverings have established a moisture vapor transmission level of 3-4 pounds per 1,000 square feet/24 hour period as the limit to how much moisture a concrete slab can contain.

Where does this moisture come from?
1. Excessive moisture from the concrete mix. This type of moisture will usually decrease as the slab ages and dries out. Periodic testing of the slab will determine when the slab can be coated.
2. Absence of a moisture barrier/retarder under the slab. It is particularly important that a concrete slab poured at or below grade have a moisture barrier/retarder installed and is kept intact. Often a moisture barrier will be installed only to be torn during construction. In some cases, it may never be installed. This provides a pathway for moisture from the soil, or saturated shallow wells to leak into the slab.
3. Irrigation systems, broken pipes, and leaking sewer lines are all sources of moisture into the slab.

How does moisture move through the slab?
Capillary moisture: Ground water touches the bottom of the concrete slab, and wicks into the concrete through microscopic bleeder water channels until it reaches the coating surface. As the water comes through the slab it brings calcium/sodium salts with it that degrade the bond causing the coating to delaminate.

Osmotic Moisture: Actual water vapor transmission through the concrete slab condenses again at the bond line and causes the same problem as in the capillary moisture case.

Hydrostatic: The surrounding water table is higher than the concrete slab on grade, and because water seeks its own level, the water is forced through the slab under pressure. Both the pressure and the water itself causes the coating to delaminate.

How is moisture vapor transmission measured?
There are four common test methods to use:

The “plastic sheet method” (ASTM 4263) is a qualitative (yes/no, not how much) test method that tells you whether there is excessive moisture in the slab. This method involves taping an 18” x 18” sheet of 4 mil polyethylene sheet to the slab, making sure the edges are all sealed. One test is done for every 500 sf of floor. The sheet is allowed to stay on the slab undisturbed for >16 hours. It is then removed and the underside is inspected for moisture condensation. Unfortunately, the moisture vapor transmission levels could be as high as 8 lbs/1000 sf/24 hrs before you get a “fail” by this method.

An electronic moisture meter usually gives a percentage reading. This is also a qualitative test, but it has the advantage that results are obtained in a matter of a few minutes. By systematically taking measurements every 500 square feet, it can be used to tell you where potential problems may exist. In these potential problem areas, a calcium chloride test can be done.
The calcium chloride test (ASTM F-1869) is a more definitive, quantitative method to determine moisture vapor transmission rates in a concrete slab. This test involves weighing a petri dish of calcium chloride (a material that absorbs moisture), putting it onto a prepared area of concrete under a sealed dome, and allowing it to absorb moisture vapor for between 60 and 72 hours. The petri dish is then re-weighed. This weight and the number of hours of the test are plugged into a formula to give you a moisture vapor transmission rate expressed in pounds (of moisture vapor) per 1000 square feet (of concrete floor) per 24 hours. One test should be done for every 1000 sq. ft. of floor.

The calcium chloride test is only a good snapshot of a moment in time. Changes in drainage, broken piping, excessive precipitation, etc. can yield a slab with a completely different moisture content in the future. These tests will not be good indicators if the testing is done before the area is climatized.

In-situ Relative Humidity Testing: ASTM F-2170-02 is also a quantitative test method. Holes are drilled into the concrete slab (3 for the first 1000 square feet, and 1 for every 1,000 square feet thereafter). Sleeves are then inserted into the holes, and relative humidity probes are placed into the sleeves. Readings can be made as needed. The results are less impacted by ambient temperature and relative humidity conditions in the building than are the calcium chloride results. The testing can also be done at various depths in the slab, allowing for a more comprehensive picture of where there is moisture.

It is important that any curing compounds or existing floor coatings be removed before testing is done, because they can give false low readings.

What can be done if the concrete has a high moisture level?
1. Do not install a non-permeable polymeric flooring system.
2. Investigate the possibility of installing a “moisture mitigation system”. These are commercially available and used to either limit the amount of moisture vapor the flooring system will be exposed to, or completely stop the vapor transmission through the top of the slab. These systems usually require that the floor be prepared by shotblasting, followed by the application of either silicate-based chemistries, epoxy dispersions, or styrenebutadiene/aggregate matrices.

What are some of the symptoms that your installed floor is failing due to a moisture vapor transmission problem?
Symptoms of high moisture vapor transmission on an already installed floor may include bubbles, blisters, pinholes, a brown, oily liquid being liberated through the floor, and/or delamination. The brown liquid sometimes found when the bubbles or blisters break may have a glycol-like odor. Analysis of the liquid shows that it is comprised mostly of water (and is water soluble), iron (due to corrosion of the rebar or reinforcing wire) and alkali from the concrete mix. The color is due to dissolved or suspended soil, rust and salts. The pH will be >10. This liquid is not a component of the polymeric system, nor is it oil. Sometimes you will see delamination of a section of the floor. In this case, the bottom of the delaminated piece will be very smooth, and there will be traces of a white residue (efflorescence) or rust (which the moisture has delivered to the bottom of the coating from the rebar/reinforcing wire).

What do you do to repair these areas?
Remove a 50 square foot section of the coating, wait 48 hours, and test to determine what the moisture levels are. Do not merely recoat the area; chances are the same problem will re-occur.

TMI has installed moisture-mitigating systems prior to installation of floor coatings. Ask a TMI representative for additional information or for a quote.