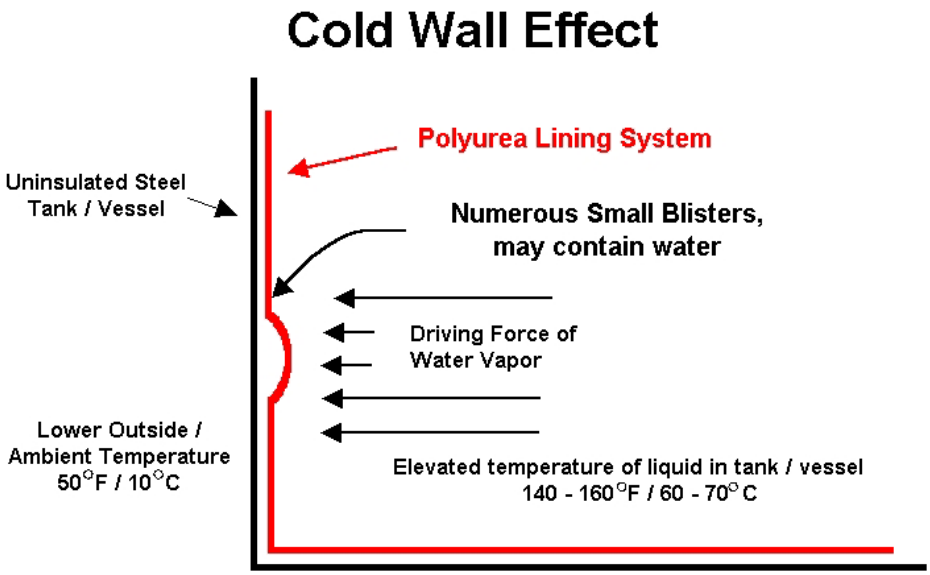
Primeaux Associates LLC
161 Forest Drive
Elgin, Texas 78621
1-512-285-4870 FAX 1-512-281-4933
Polyurea@flash.net

Cold Wall Effect

Cold Wall Effect is a condition that exists in structures such as tanks, vessels, buildings, and other structures that have coatings / linings applied on areas where their opposite sides have a temperature lower than the face of the side that is being coated / lined. In other words, when there is a thermal gradient between one side of a contained area and another. Blisters may occur between the liner and the surface. An example is a steel tank that holds a heated liquid inside, and outside the tank it is a lower or cold temperature. This is forced condensation of moisture on the back-side of the liner system.



The water vapor pressure is higher on the warm side of the lining than on the cool side. This vapor pressure gradient causes moisture vapor to pass into and through the lining, by osmosis, more rapidly than it egresses. There is a continuous force drawing liquid from the warm side to the cold side and blisters occur at weakly bonded areas beneath the liner. The greater the thermal gradient between the hot and cold sides, the larger and more numerous the blisters. A temperature spread of 100°F, 38°C (Example: 140°F, 60°C inside and 40°F, 4.5°C outside) will produce more blisters than a difference of 50°F, 10°C. **Where there are soluble salts present on the substrate the process is greatly accelerated!**

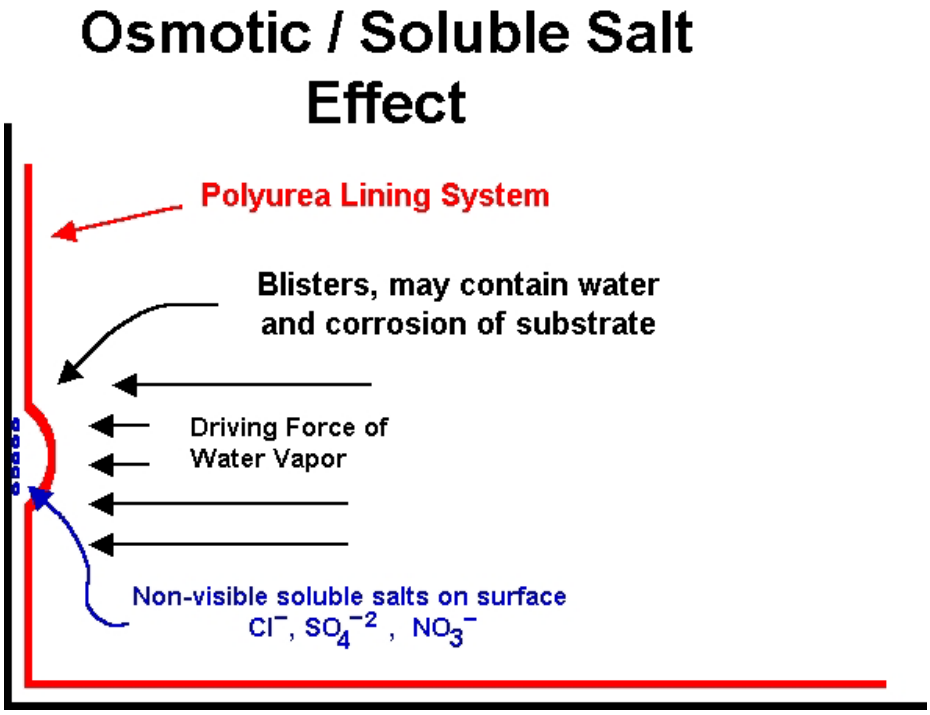
Example of Cold Wall Effect Blistering in a Steel Tank

Primeaux Associates LLC
161 Forest Drive
Elgin, Texas 78621
1-512-285-4870 FAX 1-512-281-4933
Polyurea@flash.net

Studies indicate that lining systems with the lowest permeability (perm rating) are more resistant to Cold Wall Effect than systems with higher permeability. Compared to many systems, polyurea spray elastomers have a very low perm rate but not as low as the flake or carbon filled vinyl esters on the market.

The phenomenon of Cold Wall Effect occurs more often on un-insulated steel tanks rather than concrete because the concrete acts as insulator (but it **CAN** still happen!). Open top tanks are less vulnerable. Cold wall effect can also occur where a cold liquid is inside and the exterior is very warm

The presence of soluble salts on the substrate act as a hydrophilic point and will actually "pull" moisture vapor through the coating / lining system. This then will create a corrosion cell resulting in the blister formation and disbondment of the polyurea coating / lining system. Inspection of the blister may show the contents of water as well as gas generated from the corrosion cell.



Testing:

There is no real field testing that can be used to test for cold wall effect. A safe rule of thumb would be to avoid a thermal gradient of no more than 10% for un-insulated steel tanks. There is testing however for soluble salt contamination on a substrate. This should be verified and the following substrate surface soluble salt content should be used:

Primeaux Associates LLC
161 Forest Drive
Elgin, Texas 78621
1-512-285-4870 FAX 1-512-281-4933
Polyurea@flash.net

Soluble salts must be removed to an acceptable level for the coating / lining application. These contaminants are directly related to osmotic blistering of the coating system and subsequent delamination. In general, the following soluble salt levels are noted:

chloride (Cl^-) level should be < 5 µg/cm^2
sulfate (SO_4^{-2}) level should be < 10 µg/cm^2
nitrate (NO_3^-) level should be < 10 µg/cm^2
(of which the above combined combination of all three should not exceed a total of 20 µg/cm^2)

Note:

- Similar blistering can occur from the same phenomenon in other structures where a polyurea spray elastomer system would be applied on the cold side of a cavity wall if the opposing side of the wall were subject to warm, humid air. (Example: clean rooms, food processing facilities, etc.)
- A good barrier coating / lining system should have good electrical barrier properties; i.e. "insulative" - Electrical Impedance Spectroscopy

Solutions:

- Check for soluble salt content, remove as required;
- Insulate steel tanks and check the gradient for adequacy;
- Verify insulation and vapor barrier in cavity walls;
- When in doubt, avoid the application!

References:

General Guidelines: Polyurea Elastomeric Coating / Lining Systems, Polyurea Development Association publication, December 2002.

Munger, Charles G., **Corrosion Prevention by Protective Coatings**, Second Edition. National Association of Corrosion Engineers, 1999.

"Salts 101 – An Overview", CHLOR*RID® International Inc., Chandler, AZ.

Mitschke, Howard, "Effects of Chloride Contamination on the Performance of Tank and Vessel Linings", ***Journal of Protective Coatings and Linings***, March 2000, pp 49 – 56.

ISO 15235 (latest revision), "Preparation of Steel Substrates Before Application of Paints and Related Products – Collected Information on the Effect of Levels of Water-Soluble Salt Contamination" Geneva, Switzerland: ISO.

Primeaux Associates LLC
161 Forest Drive
Elgin, Texas 78621
1-512-285-4870 FAX 1-512-281-4933
Polyurea@flash.net

NAVFAC Requirements for Allowable Soluble Salts, Naval Facilities Engineering Command (NAVFAC), Washington Naval Yard, Washington, DC 20376.

Soltz, G.C., "The Effects of Substrate Contaminants on the Life of Epoxy Coatings Submerged in Sea Water," National Shipbuilding Research Program (NSRP) Report, TASK No. 3-84-2, March, 1991.

SSPC-TU 4 (latest revision), "Field Methods for Retrieval and Analysis of Soluble Salts on Substrates," Society for Protective Coatings, Pittsburgh, PA.

Kirk, Mike, "Old Wall Effect Causes Blistered Coating", ***Materials Performance***, June 2005, pp 38 – 19.