Criteria for Sealant

Cold Weather Applications

When the SWR Institute Applicator staff indicated their desire to have us write about criteria for cold weather sealant applications, a myriad of scenarios came to mind.

By Jerome (Jerry) Klosowski and Dave Kimball

The Meaning of Cold Weather

Winter in Florida, winter in Arizona, winter in New York and winter in Minnesota all mean different things. However, there are some things that these locations have in common. In winter all joints in typical commercial buildings will be at their largest dimensions because all the substrates will be contracted to their smallest dimensions. If you install sealant on a very cold day, on a side not facing the sun, the joint will be at its widest. The joint will only compress from that time on; all joint movement will be in compression, relative to the original installed dimension. Because the sealant is in compression you can get mottled-looking joints or you can get loafed-looking joints.

If the sealant you choose can't really withstand all the movement as advertised, you will have a problem. The reason is that most sealants are sold as +/- 25 percent or +/- 50 percent joint movement sealants, but in reality cannot take that much movement on the job. If a product has been validated by SWR Institute it has handled the advertised movement in the lab, after it was freshly cured. SWR Institute-validated products generally work on the job when installing them during normal weather conditions. However, realize that on extreme-temperature days, you will see part of the joint movement in extension and part in compression. Thus they will not stand up to the full-advertised movement in a given direction, and everybody winds up pretty happy when the temperatures are not at their extremes.

A good practice when installing sealants at extreme temperature limits is to choose a sealant with higher-

than-needed movement ability and there will be a greater chance of success. A better idea is to not install on the coldest day of the year and use a sealant with higher-than-needed joint movement ability (theoretically).

The simple lesson from all the above: On really cold days, install joints on the sunny side of a building. The joints will be warmer there, not as wide, and thus the sealant will not be stressed so much in the summers that are to come. Save the north side sealing jobs until the weather breaks from the actual extreme limits. It is good relative to joint movement and keeps workers happy as well, regardless of whether you are in Miami or Minneapolis.

Another thing to note about winter sealing is that joint movement is rather extreme relative to movement during cure. Movement during the cure is always detrimental to joint sealants and the sealant's ability to handle movement repeatedly. Good, +/- 50 percent sealants can have the ability to handle joint movement decreased to +/- 35 percent or even +/- 25 percent movement. Imagine the substrate is aluminum with high thermal expansion and contraction. Sealant installed in the heart of winter on the cold side of the building can have a movement during cure of 14 percent to 0 percent and back again and repeated each day as it cures. That could impair the sealant so that it is now only capable of 25 percent movement or even 20 percent movement.

An alternative is the use of a precured silicone strip, which is not much affected by movement during cure. First, the silicone sealant used to adhere the strip to the substrate is a relatively thin layer so it will cure much faster than a traditional bead of sealant. Second, the extreme movement capability of some silicone strips will place very little stress on the curing sealant (adhesive) layer. Third, as mentioned earlier, when used in cold conditions most of the eventual movement is going to be in compression, so the stress on the curing sealant (adhesive) will generally be very low, the precured strip just bends a little. And fourth, since the pre-cured silicone strip is pre-cured, there is no degradation of its properties, even if there is movement while the silicone (adhesive) layer is curing.

An example of a loafed joint.

So there is a series of lessons here. The first lesson is to seal whenever possible on the sunny side in the winter. The second lesson is to use sealants rated and validated by SWR Institute as +/- 35 percent or +/- 40 percent or +/- 50 percent in joints expected to move only 25 percent. The third lesson is that more extreme joint movement is seen in winter, and the movement with cure will cut any and every sealant's joint movement ability. Some conditions might dictate the use of a precured sealant and all will require special planning. This is true for all geographic locations.

Geographic Location

Winter temperatures in South Florida rarely get below freezing but there is a chance of heavy dew so the usual rule applies – make sure the joint is dry. Water from winter rain is handled just like rain at any other time of year – make sure the joint is dry. Now getting to North Florida and other Southern states there are days of frost and freezing and sometimes snow – again, make sure the joint is dry. That is not easy with porous surfaces since evaporation rates in the cold are very slow. This happens to all sites as you head North except you have more cold days and even lower temperatures, thus drying the joint in the cold temperatures is a long process.

One aspect of drying the joint is porous versus nonporous. Everything said thus far is really in relation to porous joints. Moisture gets in and is difficult to dry. Nonporous joints are quite easy to prepare but be careful the frost doesn't reappear. A common technique for drying nonporous joints is to wipe them dry with a water miscible solvent like acetone or 90 percent isopropyl alcohol. This technique was even used in Detroit in January when a structural glazing job was done very successfully by wiping the aluminum and glass with acetone just before sealing.

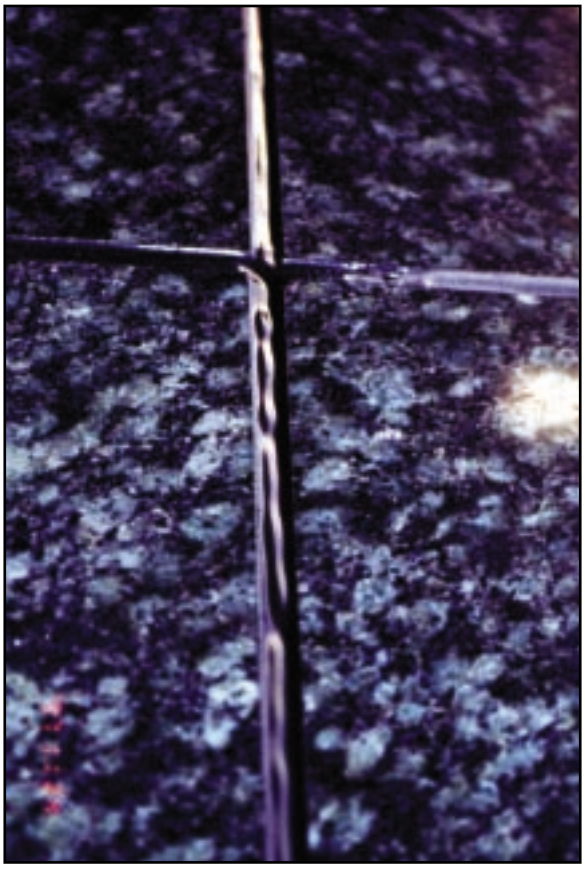
Chemistry of Curing

The above statements take care of the mechanics of sealing in the winter climates but there is yet the chemistry to consider. Some sealants cure very, very slowly in cold temperatures and even slower as temperatures continue to fall. Some sealants cannot be extruded when the sealants are cold. Consider the latter situation first. Some sealants, including most of the non-silicones, get very stiff and have to be heated to get them to extrude. That is not so difficult to achieve – there are many special ovens available for heating sealants on the job.

The chemistry of the slow cure is more difficult to handle. One problem with a slow cure in the cold is the movement with cure. As stated earlier, sealants that move while curing have lesser performance than those that are

Here are the basics of cold weather sealing: joint movement is extreme, it is difficult to dry the joint, it is more difficult to extrude the sealant, it is more difficult to obtain adhesion and the sealant will have lesser performance relative to movement.

tested by ASTM and verified by SWR Institute. The more they move during the cure, the more damage is done. Thus, sealants that cure very slowly in the cold typically have lesser performance. These movements produce flaws and fatigue, aspects of poor performance. There is yet adhesion to be considered. Oftentimes with many sealants on many surfaces the adhesion is much poorer with sealants cured at low and very low temperatures than the adhesion obtained at normal or elevated temperatures. One needs to have the manufacturer detail how to gain adhesion in the cold. Perhaps priming when the sealant normally doesn't need priming will be recommended.



Movement during curing.

The adhesion aspects of many sealants in the cold and the more repeated and more dramatic movement with cure in the cold, makes several manufacturers suggest their sealants should not be installed at temperatures below 40 degrees or below 32 degrees. The manufacturer's recommendations are very important because if ignored, the applicator generally takes on an unwanted liability. We cannot be totally negative because some jobs have been done very successfully in the extreme cold. Take for example a job on the North Slope of Alaska, done in the winter. It was done with a low modulus silicone and it took months to cure but the movement was low during this time and the joint was successful. It kept the weather out the first winter and has worked well ever since.

Here are the basics of cold weather sealing: joint movement is extreme, it is difficult to dry the joint, it is more difficult to extrude the sealant, it is more difficult to obtain adhesion and the sealant will have lesser performance relative to movement. Winter sealing can be done with some sealants and with some substrates if there is adequate attention to details. The good aspect of winter sealing is that the winter and the difficulties only last for six months in the Northern states and less in the others.

Jerome (Jerry) Klosowski is president of Klosowski Scientific Inc., responsible for contract research in adhesion, sealants and silicone chemistry; Chief chemist for Engineering Diagnostics, responsible for building forensics; and Scientist Emeritus for Dow Corning (from which he retired as Senior Scientist). He is a lifetime member of SWR Institute, author of Sealants in Construction published by Marcel Dekker, editor of two books, editor of four encyclopedia chapters, his writing has been featured in more than 60 publications and he has many awards in the sealant industry, including FASTM and the Adhesives Age Award. He is an architect of the SWR Institute Validation program and the Seminar program.

Dave Kimball has 25 years at Dow Corning Corporation and has spent the past 15 years in sealants. He spent eight years in Sealants Manufacturing primarily in Quality and Technology Development. Kimball moved to Northern California as technical service specialist for Construction Products in the Western Region. He is currently Senior Technical Service Specialist working out of Midland, Mich. Kimball has been an SWR Institute member for the past eight years, but most active in the past two.