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Pre-cured Silicone Sealant Advantages

All photos courtesy Seallex Inc.

by Jason Bakus

Over the years, many different types of liquid-applied sealants have been used in the construction industry. These ‘wet’ sealants—such as acrylic, polyurethane, polysulfide, silicone, and siliconized polyurethane—have been employed in a wide variety of sealing applications, including expansion joints, curtain walls (CWs), and window perimeter seals. While these wet sealants have a successful history, pre-cured joint sealants are becoming more popular due to certain inherent advantages.

Pre-cured joint sealants are produced by extruding material (similar to a wet sealant), which is then allowed to cure to a rubbery, elastomeric product in a

controlled manufacturing environment. These products are packaged in cured form (often rolls) instead of the liquid form packaging typical of standard wet sealants (e.g. tubes, pails). They are attached to the substrate via a thin, adhesive layer of wet sealant applied on the outer edges, which leaves the non-bonded middle to act as the area for expansion and contraction.

Several basic types of pre-cured joint sealants are available, ranging from extruded polyurethane and polysulfide to silicone rubber extrusions. While each type offers unique chemical and physical characteristics, silicone pre-cured joint sealants have been the most commonly used type in construction applications for several reasons. For example, due to

their molecular structures and high bond energies, silicones have excellent aging characteristics and resistance to ultraviolet (UV) light and weathering. This is in contrast to organic materials such as polyurethanes and polysulfides, which are prone to UV degradation and, as such, have a much shorter effective life span. Since silicones do not degrade when exposed to the elements, it is possible for the material to be produced very thin—2 mm (0.08 in.) suffices for most applications.

A tale of two silicones

Thin pre-cured joint sealant minimizes expansion and contraction forces on the substrate and creates the more pleasing appearance of a flat profile. Additionally, the movement capability for silicone pre-cured joint sealant can be as high as +200 percent and -75 percent—significantly more substantial than any wet sealant. The combination of this high movement capability and thin material enables the pre-cured silicone sealant to easily handle multi-directional movement. Additional advantages include a wide operational temperature range and better resistance to color fading. For these reasons, silicone is used about 95 percent of the time—according to one manufacturer—despite some problems with dirt pick-up and non-paintability.

There are two primary types of pre-cured silicone joint sealant available for construction applications:

1. High-consistency silicone rubber (HCR).
2. Ultra low-modulus, room-temperature vulcanized (RTV) extrusions.

Both products exhibit distinctive physical properties that make them ideally suited for many construction applications. HCR was developed with a high compression set for compression seals, which have been successfully employed for European expansion joints for more than 30 years. RTV silicone extrusions, on the other hand, have a much lower compression set and a considerably lower modulus of elasticity. This results in greater flexibility and extremely high movement capability. Additionally, the RTV silicone extrusions on the market today generally offer better tear resistance and tear propagation resistance than HCR extrusions.

Resistance to tear propagation is a very important characteristic, as it can keep a small hole in the material from developing into a major product failure. Unlike HCR extrusions, RTV will not tear completely when the material is punctured and exposed to a high movement condition. Although RTV cannot be molded into three-dimensional shapes like HCR, it can be extruded with

notches to allow the material to be bent into these forms when necessary.

While there are advantages to both types of pre-formed silicone joint sealant, RTV silicone pre-cured joint sealants are the most widely used in the market today, and thus the remainder of this article focuses on this material.

Pre-cured application advantages

Over the past decade, pre-cured silicone sealants have been used mainly for renovation and remedial construction applications. When repairing a failed traditional sealant joint, there is no need to remove the old product, as is the case when using wet sealant. Installation is easy—the pre-cured sealant is simply applied over the old joint using a thin layer of silicone sealant adhesive on each side of the pre-cured extrusion. The pre-cured sealant is then pressed into place to ensure intimate contact with the adhesive (which is pushed against the substrate). Often, this is accomplished using a roller or a hard flat object, such as a piece of extruded polystyrene (XPS). Once the pre-cured sealant has been pressed into place, any excess adhesive is removed and the installation is complete.

Using pre-cured silicone can mean lower labor costs and quicker project completion, as several labor-intensive steps are removed from the process. For example, the old sealant does not need to be cut out when using pre-cured silicone sealant (which, in turn, means the substrate need not be mechanically abraded to ensure complete removal of the old sealant) and tooling is unnecessary after installation.

Pre-cured silicone sealants are especially useful for repairing failed sealant joints in sensitive substrates such as exterior insulation and finish systems (EIFS) and natural stone. With these types of soft building materials, removal of the old sealant can damage the substrate and ruins the joint integrity. In fact, many EIFS manufacturers recommend the use of pre-cured silicone sealant when repairing sealant joints. Additionally, since the old sealant and substrate are not disturbed during application, pre-cured silicone sealants are also beneficial in applications where the old sealant and/or substrate may contain hazardous materials, such as asbestos or polychlorinated biphenyls (PCBs).

Wet-applied sealant bridge joints have been traditionally used for butt-joint applications where the joint depth cannot achieve the required 6.4-mm (0.25-in.) bond area to the substrate—a common situation in leaky aluminum window systems. These wet-applied



Pre-cured room-temperature vulcanized (RTV) silicone sealants have been used to repair severe water-intrusion problems in aluminum window systems with numerous metal-to-metal joints. With the correct finish specification, the sealant should not be noticeable.

sealant bridge joints are difficult to install and it is nearly impossible for them to achieve a consistent, uniform joint. The pre-cured sealant can provide a more aesthetically pleasing solution—the industry standard thickness for a wet sealant bridge joint is 6 mm (0.24 in.), while pre-cured silicone is typically produced at 2 mm (0.08 in.).

Due to the thin sealant adhesive layer required to attach the pre-cured sealant to the building substrate, the adhesive cures rapidly and joint deformation is minimized. This is particularly evident when comparing a pre-cured silicone sealant adhesive's cure time of several hours to the several weeks sometimes needed for a 6-mm thick wet sealant bridge joint. Indeed, this discrepancy

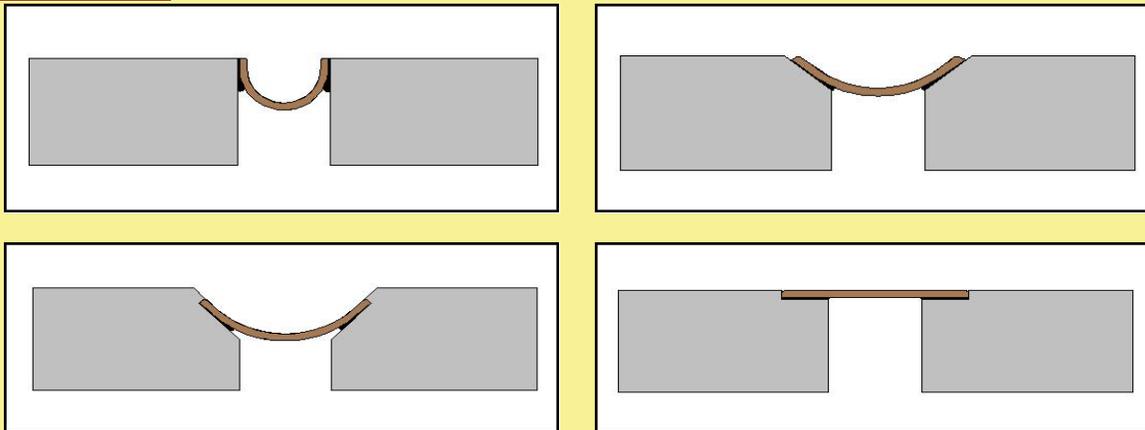
in cure time frequently causes wet sealant joints to develop ripples or folds as the joint expands and contracts before a complete cure is reached. In addition to an unpleasant aesthetic appearance, this can damage the integrity of the joint.

Pre-cured sealants can also be advantageous when the joint width is not sufficient to handle the joint movement. This frequently happens in buildings lacking an adequate number of expansion joints on the exterior substrate, which causes the joints to expand and contract beyond the movement capability of even the highest movement wet sealant. In this case, pre-cured silicone joint sealant can be used because the material can handle the extreme movement in these types of joints. An additional example of this phenomenon is in window perimeters where the opening does not leave adequate space around the window for a working sealant joint.

Frequently, the window in a building does not exactly match the size specified. This can easily result in an opening without the required gap for a properly sized wet sealant joint. Since the sealant adhesive is only used on the material's edges, the pre-cured silicone system creates its own artificial joint width to handle the movement experienced by the substrate. Combined with its high movement capability, this property allows the pre-cured silicone to provide an effective seal.

As previously mentioned, aluminum window systems are one area pre-cured silicone sealants have been used to repair serious water intrusion problems. Since most aluminum window systems contain numerous metal-to-metal joints (and other potential areas for

Figure 1



While pre-cured silicone sealant is traditionally considered less appealing in appearance than its wet counterpart products, innovative designs are changing this perception, allowing for a potential increase in new construction projects. Clockwise from the upper left: The U-joint configuration, the concave bridge joint, the recessed bridge joint, and the recessed concave bridge joint.

leaks), when these system begin to fail it can be very difficult to seal leaks with traditional wet sealant. Pre-cured silicone sealant can be applied over the leaking areas in these systems and may not be noticeable when specifying a color matching the finish.

Customizing considerations

Aside from remedial work over failed sealant in expansion joints, butt joint applications, undersized expansion and window perimeter joints, and leaking aluminum window systems, pre-cured silicone sealants are used successfully in many other applications, including:

- roofing and parapet seals;
- CW seals;
- skylights;
- HVAC system seals; and
- fillet beads for showers and bathtubs.

As pre-cured silicone sealants have become more accepted by the construction industry, manufacturers have made an effort to continually improve and expand their product line. Additionally, most companies offer custom colors, widths, and surface textures, designed to match the appearance of EIFS and other surfaces. As previously mentioned, custom designed materials can be produced with one or more notches in the extrusion, allowing the pre-cured silicone sealant to follow complex bends on a building in applications such as inside/outside corners, parapet caps, and window mullions. Although RTV silicone pre-cured sealant

cannot be produced in true three-dimensional shapes, the same effect can be achieved using these custom-notched materials.

Potential for new construction projects

Pre-cured silicone sealants have been successfully used in renovation and remedial construction applications for many years and are becoming accepted as a viable alternative to removing failed sealant. As they become further established in the construction industry, it is expected changes in basic joint design will take advantage of their benefits in new construction.

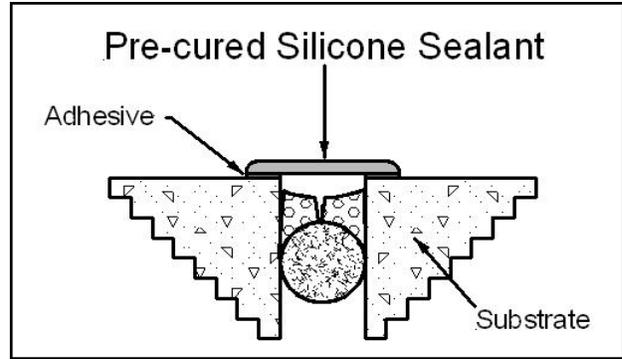
Historically, the main drawback for using pre-cured sealants in new construction has been the aesthetic look of the joint. The perception was—and still is, in some cases—new construction joints looked more appealing when wet sealant is used, rather than pre-cured sealant. However, there are several different designs for new construction applications to provide an aesthetically pleasing joint. Examples of these include recessed bridge joint, concave bridge joint, recessed concave bridge joint, and U-joint configurations (Figure 1). Many of these recessed and specialty joints are ideal for substrates where the joint areas can be produced with angles and recesses, such as precast concrete and EIFS.

One particular area where pre-cured silicone sealant is ideal is tilt-up concrete, as this type of construction can have joints inconsistent in width, depth, or plane. This makes the flexibility and multi-directional movement capability of pre-cured silicone sealant

especially valuable. In many areas, 45-degree angles are formed into the joints, making them perfect candidates for the concave bridge joint. Even in areas where angles are not formed in the panels, a U-joint or traditional bridge joint application can work very well. Finally, the quick cure of the thin adhesive layer and simple installation procedure associated with pre-cured silicone sealant allows the project to proceed quickly—often an important feature for tilt-up construction.

Another major advantage of using pre-cured silicone sealant in new construction is the need for fewer expansion joints. Again, the high movement capability of pre-cured silicone sealant means fewer expansion joints are required to handle the movement associated with the expansion and contraction of building substrates. This results in lower waterproofing costs and fewer disruptions in the appearance of the building envelope.

Finally, the use of pre-cured silicone sealant can result in a more energy-efficient building. The majority of structures have numerous leaks, most of which are in the joint areas. Due to these leaks, buildings need to be pressurized, resulting in higher heating and cooling costs throughout the year. Virtually any leak area in a building can be sealed using pre-cured silicone sealant. Once sealed, the air required to keep a building pressurized is drastically reduced, which can result in lower heating and cooling costs.



In renovation applications, the pre-cured sealant is simply applied over the old joint using a thin layer of silicone adhesive on each side of the extrusion. The material is then pressed into place with a roller, ensuring contact with the adhesive, which, in turn, is pushed against the substrate. Once the pre-cured sealant has been pressed into place, any excess adhesive is removed and the installation is complete.

As leaders in the construction industry begin to realize the impact cost savings and product performance can make in a wide variety of applications (for both new construction and renovation projects), it is expected the market share for pre-cured silicone sealant will continue to grow. The scope and magnitude of the material's use greatly depends upon collaboration between contractors, specifiers, architects, consultants, and manufacturers. ▼

Additional Information

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Abstract

Liquid-applied sealants are used in various sealing applications ranging from expansion joints to curtain walls and windows. Now, pre-cured joint sealants are becoming more popular due to certain advantages,

including the potential to speed up installation and lower labor costs. This article focuses on room-temperature vulcanized (RTV) silicone, discussing its advantages, limitations, and detailing considerations.