GUIDE TO USING SEALANTS

Whether undertaking a new build or refurbishment project, sealant joints are rarely given the attention and budget they require. This is surprising considering the array of tasks that sealants are used for.

Traditional constructions use mass walls and drainage channels to absorb and shed water before it reaches their inner surfaces. Modern constructions, however, utilise lightweight masonry wall, rainscreen, render, and curtain wall systems, which rely heavily on sealant joints, to provide air and weather seals whilst accommodating building movements such as thermal expansion, settlement, creep, sway, differential slab edge deflections, etc.

It is common for these joints to frequently suffer from poor design and/or installation. To preserve their effectiveness, sealant joints have to be maintained and periodically replaced.

If a failure occurs in a sealant joint, it can affect the performance of the building envelope, the structure and internal finishes and furnishings. Special attention must be given to the design and specification of concealed joints, as these will be far more difficult to access for repair or replacement.

Taking the time to ensure that good quality products are selected and installed correctly is repaid many times during the life of the building by the reduction in costs associated with the damage caused by failed sealants and of frequent remediation works.

The majority of modern sealants are composed of an elastomeric compound, for flexibility, together with a filler product. Sealants are usually polymers - these pliable compounds allow gaps to be bridged and the sealant to resist a degree of movement, if required.

There are many different sealant products available, each designed for a different application, including structural applications e.g. for structural glazing, or bonding façade elements together.

THE DIFFERENT TYPES OF SEALANTS AND THEIR PROPERTIES

In construction, the seven most common types of sealants are:

Water based Latex

Popular for residential use because of the ease of application and ability to adhere to most substrates. These can be painted on and are suitable for situations where gaps / voids are very small and movement is minimal. Latex is prone to shrinkage and can pull away from the substrate, creating gaps and allowing water to penetrate.

ACRYLIC

These are UV stable, making them suitable for exterior applications, and are not prone to shrinkage. However, acrylics can be difficult to apply and cannot accommodate significant movement.

BUTYL

Adheres well to a broad variety of substrates but can be hard to apply due to their stringier consistency. They have poor resistance to abrasion and struggle to accommodate movements that introduce shearing forces. They are not suitable for demanding building applications.

POLYSULFIDE

Excellent flexibility even at low temperatures with little shrinkage or UV degradation, and can be used for underwater applications. Polysulfides are more expensive than similar sealants and have a tendency to have higher levels of volatile organic compounds (VOC). Though, a life expectancy of 10 to 20 years does compensate for the price somewhat.

SILICONE

Silicone sealants have excellent thermal resistance, good dynamic movement capability and good adhesion. However, they can be easily vandalised and tend to collect dirt. For certain substrates (such as stone), staining may also be an issue, in some cases making the use of primers a necessity. As weather proofing and air sealing applications, silicones can be used structurally e.g. for bonding glass or metal to frames. Silicones are generally the most expensive sealants, but quality silicones have very good durability performance.

POLYISOBUTYLENES

These have similar properties to natural rubber but with improved durability, good resistance to chemical attack, and have very low permeability. These are commonly used as the primary seal for insulating glazing units (IGU) as they are capable of resisting the transmission of vapour and gases. The products are normally factory applied, rather than site applied.

POLYURETHANE

Polyurethane adhere well to the majority of different surfaces with little substrate preparation, and are generally the go-to choice for contractors. They have excellent resilience to abrasion and shear forces as well as having strong adhesion and movement capability.

No singular sealant type is universally superior or inferior to another. Some are simply better at certain applications than others are due to their innate physical and chemical properties.

SEALANT PROPERTIES

When making a choice on sealant, it's important to consider the properties that most impact the area of the build you will be using the sealant for. The following are the key properties of sealant for evaluation on your build.

CONSISTENCY

Pourable sealants have a fluid consistency and are generally used in horizontal joints, and can be self-levelling. Non-sag sealants are thicker and do not run, even on vertical joints.

DURABILITY

A sealants expected lifecycle under ideal conditions is unlikely to be the same as the actual lifespan; this is especially true if the sealant was misapplied to the surface or is incompatible with the substrate it is applied to. Speaking generally, silicones have the longest service life (around 20 years or more). Some acrylics and butyls last little more than 5 years.

HARDNESS

A harder sealant is more resistant to damage. However, as hardness increases the flexibility decreases.

EXPOSURE

Resistance High performance sealants continue to perform well and remain flexible in the sun, temperature extremes and moisture.

MOVEMENT CAPABILITY

Movement capability is shown as a percentage of the joint width e.g. a sealant with ±10 percent movement capability in a 25-mm joint can stretch to 28 mm or contract to 23 mm and still recover without failing.

MODULUS

Modulus is an abbreviation of modulus of elasticity. Low-modulus sealants usually have high movement capability and vice versa, although it's important to note that this isn't always the case. Low-modulus sealants are often used with delicate substrates. High-modulus sealants are often used in static and non-moving joints. Medium-modulus sealants are general purpose products and balance stress at the surface the sealant is adhering to and the stiffness of the sealant.

ADHESION

How well a sealant will adhere to the construction material is an essential factor to consider. Test methods (e.g. ASTM C794 Standard Test Methods of Adhesion-in-Peel of Elastomeric Joint Sealants) evaluate the adhesion of elastomeric sealants. Manufacturers also provide adhesion data for various substrates.

STAINING

The components within sealants can leach into porous substrates (such as natural stone) and may leave a visible stain. You must ensure sealants are tested on an unobtrusive area before putting into use, even if the sealant claims to be non-staining.

VOC CONTENT

Any emission of Volatile Organic Compounds (VOC) from products needs to be understood. The majority of sealant manufactures have developed them with low levels of VOC. Solvent based sealants generally have a higher level of respiratory irritants and environmental toxins and these should be avoided. However, VOC content varies widely by product.

EASE OF APPLICATION

A sealants curing and tooling (ease of getting a smooth surface of correct/required geometry) characteristics are important when it comes to judging a sealants ease of application. Note that some cure quickly while there are others which are specifically designed to remain uncured.

COST

As with most construction products, cheaper doesn't mean better. Higher cost products come with a higher performance. Replacing failed sealants is almost always more expensive than selecting the correct sealant in the first place. However, buy wisely and concentrate efforts on matching the performance requirements.

CAUSES OF SEALANT FAILURE

POORLY DESIGNED JOINTS

Poorly designed joints are the most common cause of joint failure. If a sealant joint is properly designed it should have a 2:1 width-to-depth ratio, which is the configuration which allows the joint to accommodate movement most effectively. Manufacturers of sealant provide maximum and minimum dimensions.

INAPPROPRIATE SELECTION

Not allowing for sufficient building movement can cause even correctly proportioned joints to fail. Sites subject to vandalism, water and weather conditions demand sealant with superior abrasion resistance. High-heeled shoes are known to be a particular bane for sealant and are notorious for puncturing it. Sealants have been designed to withstand vandalism - these are harder materials and tend not to accommodate much movement.

SUBSTRATE COMPATIBILITY

Substrate compatibility is very important. Some products can leach chemicals, causing staining of porous materials (such as Brick, masonry, stone) or, in some cases, degrading them.

If a sealant is stronger than the substrate it can cause cracks and spalls as the sealant dissipates forces to the weaker materials. This particular phenomenon is common within exterior insulation and finish systems (EIFS / ETICS).

If the substrates have existing coatings this can also cause problems - fully removing these coatings is advised. Alternatively undertaking an adhesion test and finding a sealant which is compatible with the existing product will be necessary. Note: many surface sealers are transparent and on existing buildings it is important to always conduct a field adhesion test before starting work.

IMPROPER APPLICATION

Sealant failures are very often due to poor surface preparation. The thorough cleaning and priming of a joints surfaces prior to application is of primary importance; manufacturer's recommendations for preparing the substrate should always be followed. The use of dirty rags, incorrect or contaminated solvent, lint or even residue from existing sealants are just some of the ways a sealant joint can be compromised.

Some sealant types require surface primers to be applied to the substrate prior to the application of the sealant. These are designed ensure the correct adhesion is achieved and/or to prevent the sealant from diffusing into the substrate and bind with the dirt particles remaining on the surface.

WEATHER CONDITIONS

On the day of application, weather conditions must be correct. An ideal sealant installation temperature would be at the median of the design range. This means that the product retains its flexibility, the ability to elongate or compress and to accommodate future fluctuations in temperature.

The viscosity of the sealant will also vary with the ambient temperature. Hot temperatures may cause the sealant to sag and cold temperatures may make it too thick to tool properly.

High levels of humidity, frost, dew or general dampness can also lead to failure as the majority of sealants will not adhere to a surface unless it is dry.

THREE-SIDED ADHESION

Three-sided adhesion must be prevented, and this can be done by utilising a backer rod or release tape. Three-sided adhesion will prevent sealants from moving freely resulting in adhesive or cohesive failure (or sometimes, both).

Poor or sloppy tooling can result in voids, gaps and irregular sealant thickness which can cause stresses to act unevenly along the joint. Sealant should follow the curve of the backing rod, ideally with a concave tooled outer surface, so that is resembles an hourglass in a cross-section.

Other things you should try and avoid are:

- Making use of sealant which has reached or gone past its shelf life
- Storing sealant in a location which is subject to extreme temperatures
- Mixing multicomponent sealant incorrectly
- Applying irregular pressure and flow with the sealant gun.

A team member should be tasked with quality control on site so as to ensure installation meets the manufacturer's warranty requirements for testing and inspection.

REVERSION

Some organic based sealants, especially those derived from polyurethanes, have a potential for reversion failure in which the revert to an uncured or gummy state in response to moisture or UV light exposure.

Modern sealants do not suffer from this, but older sealants on existing buildings may suffer from this.

IMPRECISE SPECIFICATION

Careless specification of sealant products and unclear drawings or documents can leave the installation open to guesswork, which of course has a high potential for failure.

PERFORMANCE TESTING

Site conditions do vary and it's a good idea to test the products onsite whenever possible, using peel tests to check adhesion on multiple test areas. This is especially important for older buildings. Testing at a laboratory can provide more in depth and detailed information than site testing, but should not substituted for site testing. In the lab it's possible for conditions (such as movement, stresses, temperature, cure times, product, etc) to be varied to recreate many different scenarios.

SEALANT SUCCESS

Sealant joints demand care and attention if the building envelope is to perform like it's meant to. A good point of reference would be ASTM C1193, Standard Guide for Use of Joint Sealants, which gives an in-depth set of information on joint design and sealant installation.

SEALANT JOINT REPLACEMENT

Sealants have a limited lifespan and that means that, regardless of how well you install them in the first place, they'll eventually need to be replaced. When replacing sealants always utilise the experience of a sealant manufacturer.

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