

# Sealants Go Hybrid

## New technology opens up a world of opportunity for contractors and building owners

By Ta-Min Feng and Steve Milano

**F**ew industries have been harder hit than the construction industry in today's economic climate. Dollars are tighter than ever and to complicate matters further, the movement toward environmentally friendly products is growing stronger daily. Lifecycle costing and VOC content are being discussed on a regular basis. Can sealant manufacturers using innovative chemistries respond to these issues?

In a world dominated by the demand for long life products, higher costing silicone sealants have received significant attention and are being used in more and more construction applications. That being said, new sealant technology has been and is being developed to address the limitations associated

with lower costing polyurethanes. This innovation, known as hybrid urethanes, can be formulated to have ultra-low VOC content or be solvent-free, capable of providing excellent UV and color stability, exhibit tenacious adhesion to metals and other difficult substrates and provide the ability to be painted, all while being more affordable than most silicone sealants.

These features translate into longer-term high performance (i.e., longer warranties) and greater aesthetic appeal as compared to standard urethanes. This means easier application for the contractor, reduction in callbacks and attractive price points that enable profits to be maximized while ensuring customer satisfaction.

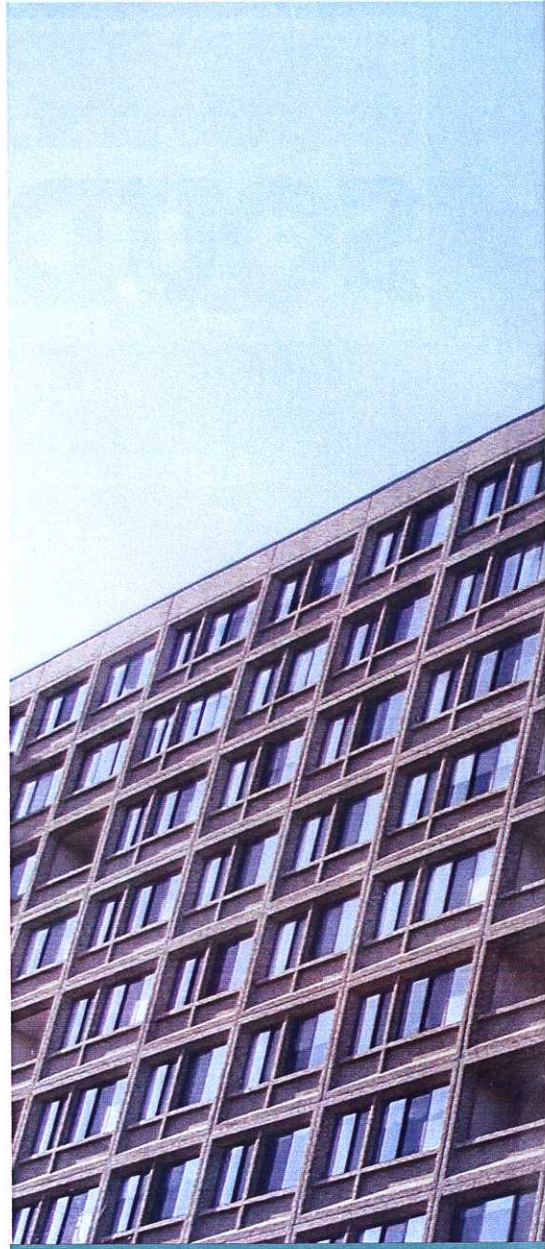
### Not All Hybrids Created Equal

Combining two or more species, materials or technologies to achieve a particular objective – also known as hybridization – is not a new concept. In fact, this theory has been practiced for

several decades. A modern day example of this is the hybrid car. A hybrid car is a vehicle that uses both an electric battery and a conventional internal combustion engine for power. The car was designed with these two different technologies to achieve superior gas mileage. Not only do these hybrid vehicles feature a sizeable improvement in fuel efficiency, but they are also less polluting.

As with everything, not all hybrids are created equal. As demand for hybrid sealants continues to grow and as more applications are identified, hybrid technology continues to evolve.

Hybrid sealants are a combination of a silicone sealant and an organic sealant, such as polyurethane. A typical hybrid sealant is a silane-terminated polyurethane sealant. Silane-terminated







## CONDO OWNER GIVES HYBRID A TRY

Regency Park is a mid-rise condominium building in the upscale community of Brookline, Mass. The building's façade consists of exposed aggregate concrete panels. The existing polyurethane sealant in the expansion joints between the panels and around the window perimeters was in need of restoration.

The owner, The Trustees of Regency Park, wanted a sealant material that could provide a longer service life than what was in place. To install a silicone in these joints, the existing sealant would have to be completely removed and the joints mechanically ground. The existing polyurethane sealant had gotten in the voids of the aggregate, and the only way to completely remove the existing sealant would be to grind it out. Grinding meant the joints would become wider, which was not acceptable to the owners. It would also be very noisy, dusty, costly and time-consuming. Obviously, all of these factors would be extremely unappealing to the occupants. A polyurethane sealant could be used and applied directly to the joints without grinding, but the service life of the sealant would not be as long.

Not so long ago, the contractor and the owner would have had to make a choice between the polyurethane or silicone. Kenrick Restoration chose instead a polyurethane hybrid sealant formulated with a silane end-capped polymer technology. A polyurethane-based sealant, it will adhere to most common substrates (including existing polyurethane sealant), but with the silane end-capped polymer technology, it also has the weathering characteristics including outstanding UV protection and color stability of a silicone.

polyurethanes have received increased attention over the last several years. These termination agents replace the isocyanate cross-link mechanism with a silane cross-link mechanism that enables systems to be formulated offering a good balance of physical properties and application-oriented benefits. A broad range of additives can be incorporated into the hybrid systems that cannot be used in isocyanate systems.

Depending on the formulation developed, viscosity, UV stability, shelf life, color stability and the ability to minimize yellowing will result in a change of the product. Usually hybrids require an extra step during processing which can affect manufacturing costs, but some manufacturers have developed proprietary formulations in-house and have created processes to manufacture

hybrid sealants that are extremely cost effective and that provide the best performance available.

### Varied "recipes" provide significantly varied performance

Ongoing development of proprietary silane endcappers has resulted in better control over properties such as UV resistance and color stability as compared to other polyurethane sealants. The amount and type of ingredients in a formulation that chemically degrades upon exposure to sunlight will determine this performance aspect of the sealant. The best example of this is white sealants. Some formulations will be significantly better at minimizing yellowing properties. Yellowing is a function of what ingredients are used in the system. Proper ingredients selection prevents yellowing, the cracking and

**Project:** Regency Park

**Location:** Brookline, Mass.

**Owner:** The Trustees of Regency Park Condominium

**Restoration Contractor:** Kenrick Restoration

**Tremco Sales Rep.:** Kevin Rooney

**Products:** Dymonic® FC and illmod 600

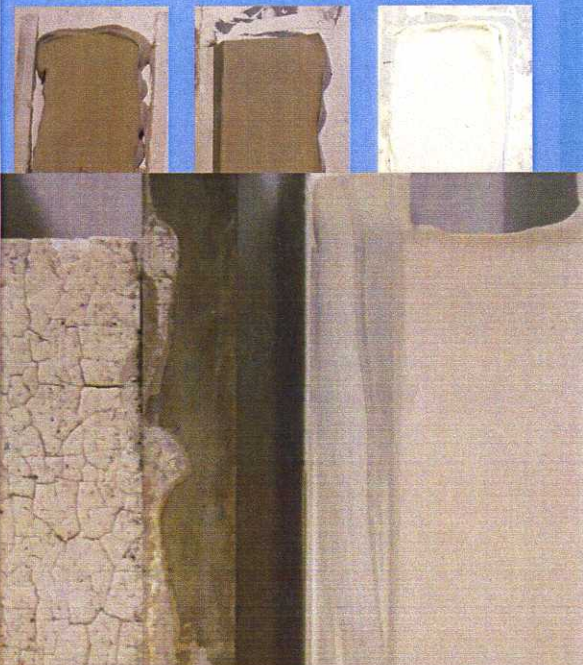


## 2000 hrs Xenon Arc Test (ASTM C793)

Polyurethane  
Product A

Polyurethane  
Product B

Dymonic® FC  
Polyurethane Hybrid



(Top) When you compare two of the leading polyurethane brands to a leading polyurethane hybrid brand, all of which were originally the color white, the hybrid brand remained white, while the others yellowed after 2000 hours of exposure to Xenon Arc Testing (ASTM C793), an accelerated weathering machine. This amount of exposure is equivalent to one year of exposure to sunlight.

(Bottom) This picture shows the difference in weatherability between a typical polyurethane sealant and a polyurethane hybrid sealant after they were both exposed to Xenon Arc Testing (ASTM C793), an accelerated weathering machine, for 2000 hours. Left: Polyurethane Right: Polyurethane Hybrid

chalking and provides a "greener," more environmentally friendly product.

Another advantage of using silane-curing mechanisms is they allow the addition of adhesion promoters to ensure an aggressive bond to even the most difficult substrates. To top off the benefits, these formulations can allow virtually immediate paintability. While these additives and the additional processing required for hybrid sealants add cost versus traditional polyurethane sealants, the added performance gained generally doubles the life of the hybrid sealant over standard urethane sealants.

### Just the right ratios

The selected ratios of ingredients in hybrid polymers will determine the hybrid sealant viscosity or gunnability. Depending on the particular ratio, physical properties such as modulus, flexibility and strength will also be affected. Hybrid sealant formulations can be low modulus while maintaining ease of work and toolability. In addition, the ratio will affect a sealant's ability to withstand significant thermal movement and the resulting expansion and contraction of building joints. Movement for products currently on the market range from +25/-25 to +100/-50.

### What's next?

Hybrids are providing a new world where it is no longer necessary to compromise when it comes to performance or cost. Due to their formulation flexibility, modifications may be made to adapt to a variety of applications or performance requirements. Additionally, renewable and recyclable materials may be used in these formulations. Standard polyols may soon be replaced by soybean-based and castor oil.

Chemistry-based innovations will continue to affect the construction industry, and sealants will be a significant contributor. An important key in their development, however, will be their ability to interact, overlap or adjoin other components within the building structure...for the long term. Components cannot be evaluated in isolation. Manufacturers that offer a broad range of products throughout the building envelope and that can evaluate jobsite challenges while recommending proper product selection based on long-term performance and compatibility testing will provide the critical bridge between success and failure in the long run.

### About the Authors

Ta-Min Feng is associate R&D Fellow and Steve Milano is senior research chemist with Tremco.

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