

An Assessment of Polymer Gel Waterproofing

By David Campbell, RWC, AIA, GRP

Whether you are an architect, an engineer, or another design professional, you are only as good as the items you have hanging from your tool belt; namely, the products you specify that are made available by innovative companies and individuals. Sixty years ago, only two or three products were typically used for below-ground waterproofing. Today, there are easily over 100. One such waterproofing product of note is generically referred to as polymer gel. I have more than 35 years of experience in waterproofing failure investigation and design, and I have specified polymer gel on numerous projects over the last 12 of those years—in my opinion, no single product offers the same level of performance as polymer gel-type waterproofing. Polymer gel can be used in both positive-side as well as blind-side (preapplied) applications. However, because I have specified polymer gel only twice in a vertical blind-side application, the following assessment will be limited to positive-side applications only.

WHAT IS POLYMER GEL WATERPROOFING?

Polymer gel waterproofing is a system comprising two components: a hot, fluid-applied, black “goo” with a protection sheet embedded into it (Fig. 1). The “goo” is a polymer-modified synthetic rubber, which never fully cures

and remains in a semifluid state its entire life. The protection sheet is a high-density polyethylene sheet with a fleece face on one side, which mechanically bonds to the polymer gel component. This sheet offers both reinforcing and protection to the semifluid polymer gel. Spraying of the polymer gel component is preferred to reduce application time (Fig. 2 and 3); however, the component can also be rolled on. In either case, the material must be heated to approximately 180°F (82°C) in a specially

designed mobile kettle purchased or rented from the manufacturer. The product is heated only to improve flowability; heating is not for reasons of chemical alteration, as in the case of some other waterproofing products.

Currently, there are two manufacturers in the United States offering their own version of the same basic system. Both products are very similar in formulation and demonstrate comparable performance.

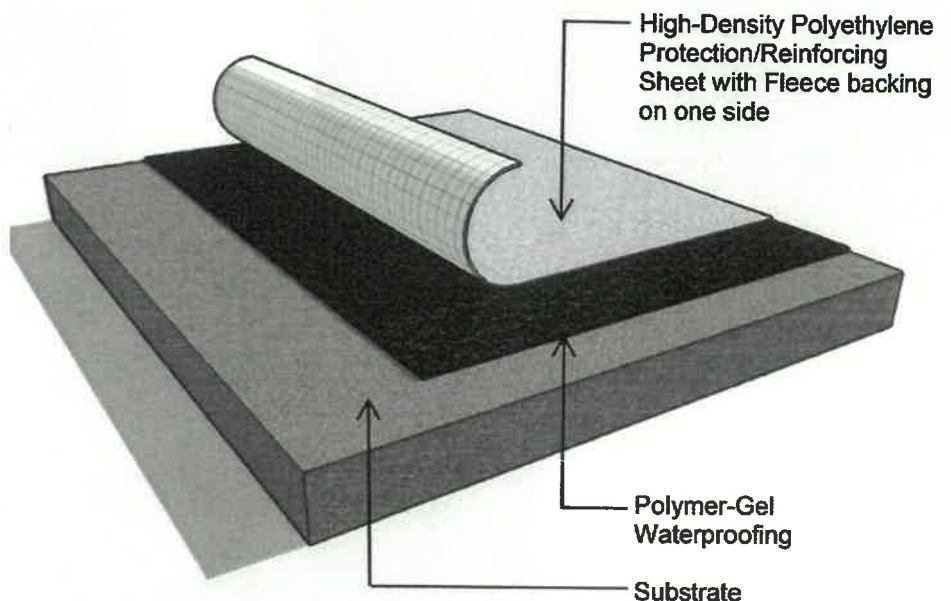


Figure 1. Polymer gel waterproofing system.

BENEFITS

Excellent Adhesion to the Substrates

One of the most noteworthy characteristics of polymer gel is its tenacious and permanent adhesion to a wide variety of substrates. This is of paramount importance in below-grade waterproofing. Because below-grade waterproofing should be designed to perform for the life of the building, and because some breaches may occur during such extended time frames, it is critical that “leak localization” characteristics be built into the waterproofing design. Leak localization is achieved when the waterproofing is fully and permanently adhered to the substrate, thereby preventing the water from migrating between the waterproofing and the substrate (Fig. 4).

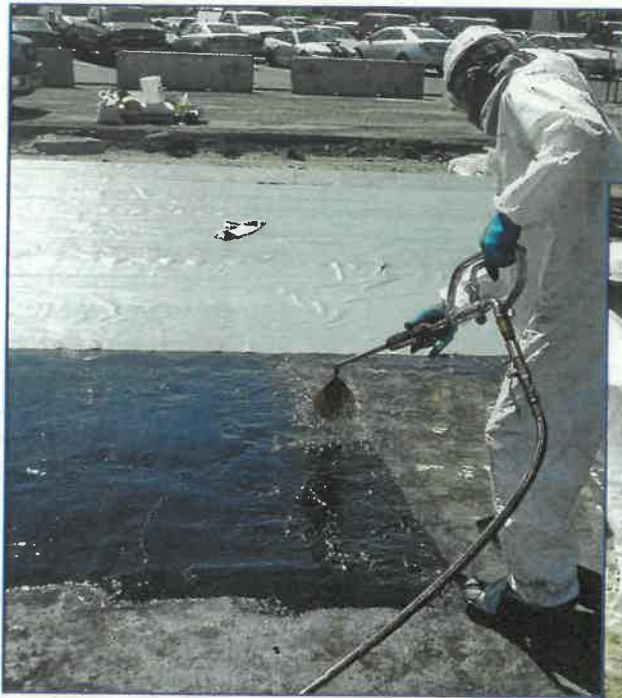
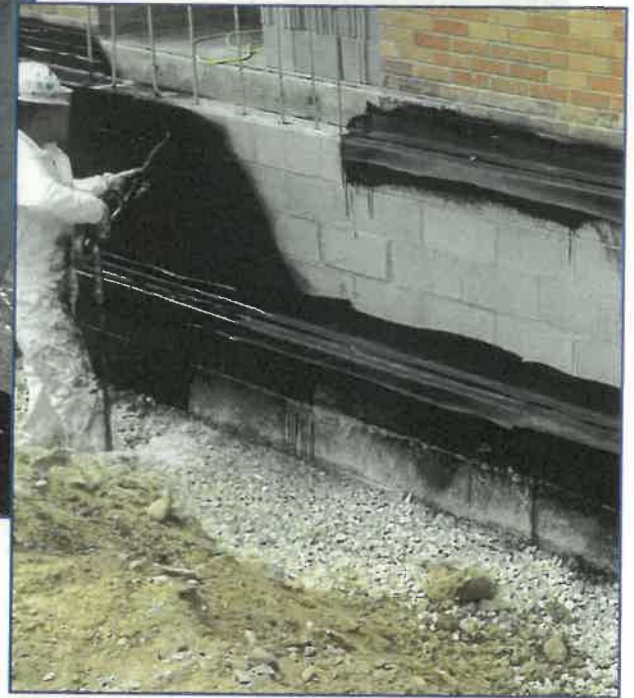


Figure 2. An example of horizontal spray application of polymer-gel waterproofing system.

Figure 3. Vertical spray application of polymer-gel waterproofing system.



EXECUTIVE SUMMARY

The benefits of the polymer gel waterproofing system are as follows:

- Polymer gel offers excellent adhesion to the substrates.
- Polymer gel has a high level of elasticity.
- Polymer gel is self-healing/self-gasketing.
- The hydrostatic pressure resistance is high.
- Polymer gel systems can be applied to “green” concrete or other existing substrates that have a higher than optimum moisture content.
- Polymer gel is seamless.
- The composite system meets Class A vapor barrier standards.
- Polymer gel systems have been used for more than three decades.
- Polymer gel resists sagging on vertical applications.
- No primer is needed.
- Polymer gel is compatible with other products.
- The application time is short.
- Polymer gel is unaffected by most groundwater contaminants.
- Polymer gel can be applied during winter months.
- Polymer gel can be exposed to light traffic immediately after application.
- Polymer gels have little odor and a VOC quantity of less than 1%.

The polymer gel waterproofing system has the following limitations:

- It can only be applied by certified applicators.
- It requires hot-melt equipment.
- The material cost is high.
- Polymer gel can migrate into existing cracks and joints.
- Polymer gel systems are extremely messy to install.

This paper describes the benefits and limitations of the polymer gel waterproofing system in greater detail.

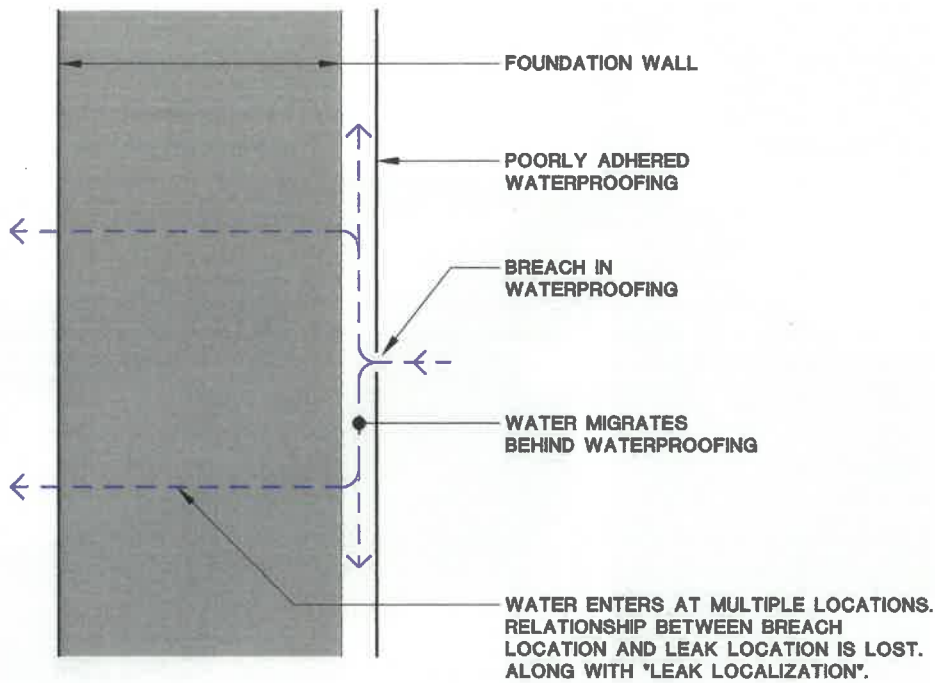


Figure 4. Full adhesion to substrate is essential for good leak localization.

This makes inexpensive localized repairs possible as an alternative to complete waterproofing replacement.

High Level of Elasticity

Another characteristic unique to polymer gel is its high level of elasticity and elongation (Fig. 5). This characteristic enables the product to respond well to the dynamics of the building without being damaged in the process and without losing its watertight integrity. In addition, this elasticity prevents the installed product from being displaced by temporary "point" loads during construction prior to subsequent overburden installation. Examples of such point loads are foot traffic, wheelbarrows, barrels, and other nonmotorized wheeled loads.

If a point load pushes down on the protection sheet and "squeezes" the polymer gel in displacement fashion, the polymer gel then returns to its original location once the point load is removed. The gel does this because of its adhesion to the substrate and the protection sheet and because of its elasticity, which, according to one of the manufacturers, is 394% when measured using ASTM C1135, *Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealants*.¹

Self-Healing/Self-Gasketing

Since the polymer gel component never fully cures and remains in a semifluid state throughout its entire life, it closes in around breaches and heals itself even under hydrostatic conditions, which I have observed firsthand in

the field. Self-healing is an important characteristic when you consider how often installed waterproofing is inadvertently damaged or punctured by subsequent trades before the final overburden is installed. In addition, polymer gel will self-gasket at intentional penetrations (for example, at fasteners), which are sometimes unavoidable to secure subsequent materials.

High Hydrostatic Pressure Resistance

The American Concrete Institute² defines waterproofing as the treatment of a surface or structure to resist the passage of water under hydrostatic pressure, whereas damp-proofing is defined as the treatment of a surface or structure to resist the passage of water in the absence of hydrostatic pressure. The difference between these two types of products is determined by hydrostatic pressure resistance and can be tested and measured.

Both available polymer gel product systems exhibit very high hydrostatic pressure resistance and are therefore both categorized as waterproofing, and not

damp-proofing, products. However, because they use similar but different ASTM testing methods, one cannot readily compare the two products by that particular characteristic.

Can Be Applied to "Green" Concrete

Due in part to its extraordinary adhesion characteristics, polymer gel can be applied to "green" concrete, which has cured for only three days after placement. In contrast, most other hot fluid-applied or self-adhering waterproofing products can require substrate cure times as long as 28 days. Cutting up to 25 days out of a construction schedule can be of great benefit to a contractor and building owner.

In addition, polymer gel will adhere to existing substrates that have a higher than optimum moisture content, such as an old existing building foundation that has never been waterproofed. As with any substrate to receive waterproofing, moisture testing should be conducted before any waterproofing product is applied. Such testing should conform to the minimal requirements of the particular manufacturer. However, the drying-out time of the substrate that is required for polymer gel waterproofing will be shorter than it would be for most other waterproofing products.

Seamlessness

The polymer gel component of this system is fluid applied and therefore forms a monolithic,



Figure 5. This photo demonstrates the high elasticity of polymer gel.

or seamless, barrier. This is unlike many sheet waterproofing products that require accessory products within the seams, which can have lesser long-term performance than the sheet itself. However, the protection sheet does have seams, which are taped on site to prevent the polymer gel from migrating out of the seam. Each manufacturer provides its own accessory product tape.

Composite System Meets Class A Vapor Barrier Standards

Because the water vapor permeability of the polymer gel system is less than 0.02 perm for both manufacturers' products, the system is categorized as a Class 1 vapor impermeable barrier and meets Class A vapor barrier standards, which require a perm rating of less than or equal to 0.1 perm.³

More than Three Decades of Use

This type of waterproofing has been used for more than 30 years in other countries and for more than 14 years in the United States, on a wide variety of high-profile projects such as the Presidio tunnel in the San Francisco, Calif., area, and the "Big Dig" tunnel in Boston, Mass. Our firm has been specifying polymer gel waterproofing for over 12 years, for such clients as the Minneapolis–St. Paul International Airport, and at various campuses of the Minnesota State University system.

Resists Sagging on Vertical Applications

Because of its ability to adhere to itself as well as to the substrate, polymer gel can be built-up in lifts on vertical surfaces to as much as 160 mil (4 mm) before it starts to sag. Both manufacturers recommend an applied thickness of between 90 and 120 mil (2.3 and 3 mm); therefore, sagging is never an issue.

No Need for Primer

Polymer gel can be applied directly to any approved substrate, including concrete that has not fully cured, without a primer, which reduces time and cost. One reason that primer is not needed is the product's previously discussed adhesion characteristics.

Compatibility with Other Products

It is not unusual for a newly applied waterproofing product to be incompatible with an older existing waterproofing product, making tie-ins difficult. Usually, an intermediary material that is compatible with both the old and new products must be introduced. This use of an intermediary increases costs and lengthens schedules, and it can compromise the water-

tightness integrity and create warranty issues.

However, an intermediary material may not be needed when applying polymer gel because the gel is compatible with, and will adhere to, virtually any existing waterproofing product, including rubberized asphalt, built-up asphalt, coal tar pitch, butyl rubber, and polyvinyl chloride, to name just a few. Nevertheless, it is always a good idea to verify issues of compatibility with the polymer gel system manufacturer.

Short Application Time

Both polymer gel systems can be either spray-applied or applied with a roller. When the system is spray-applied, the application time is considerably shorter than with most other waterproofing systems. The short application time is due in part to the elimination of a primer and the fact that the polymer gel system's reinforcing doubles as the protection sheet. It has been this author's experience that, all other factors being equal, the polymer gel system can be installed in half the time of reinforced hot-rubberized asphalt waterproofing.

Unaffected by Most Groundwater Contaminants

No matter how many redeeming characteristics a specified waterproofing may have on the day it is applied, the product becomes worthless junk over time if it is not 100% compatible with existing groundwater contaminants. No one waterproofing product is compatible with all possible groundwater contaminants; however, I know of no other product that is as unaffected over long periods of time by a wider variety of potential contaminants.

According to both manufacturers, the polymer gel system is compatible with the following common contaminants, among others:

- Gasoline
- Jet fuel
- Most other hydrocarbons
- Ethylene glycol
- Hydrochloric acid
- Propane gas
- Nitric acid (up to 50%)
- Salicylic acid
- Sulfuric acid (up to 50%)

In addition, there are over 100 other chemicals that do not adversely affect the polymer gel system by virtue of the high-density polyethylene protection sheet.

Can Be Applied During Winter Months

Because polymer gel can be applied in air temperatures and to substrate temperatures as

low as 0°F (-17.8°C), more construction scheduling flexibility is possible. When the temperature is below freezing, the spray hoses are usually wrapped with heating cables designed for such use.

Can Be Immediately Exposed to Light Traffic

Because the sprayed polymer gel is covered with the protection sheet immediately after the gel is applied, the installed product can be subjected to light foot and wheeled traffic right away, without waiting for curing or drying.

Little Odor and Low VOC Quantities

Both of the available polymer gel products have a volatile organic compound (VOC) quantity of less than 1%. VOCs are organic chemicals that have a high vapor pressure at room temperature. High vapor pressure correlates with a low boiling point, which relates to the number of molecules in the surrounding air; therefore, the lower the VOC percentage is, the lower the odor will be.

LIMITATIONS

Can Only Be Applied by Certified Applicators

General contractors often consider the requirement that all product applicators be certified with training by the manufacturer to be a limitation because the certification requirements can limit the number of subcontractor bids, especially if there is only one such applicator in the project market area, and that can make it difficult to stay competitive.


However, such certification requirements can also help ensure that the application is properly performed. In addition, certification requirements ensure that the manufacturer is aware of the project and can therefore offer manufacturer inspections during application.

Requires Hot-Melt Equipment

The equipment needed to spray the polymer gel is a specialized tow-behind melter, which is either rented or purchased by the certified applicator from the manufacturer. This equipment is expensive to purchase, and that can be a deterrent to waterproofing contractors who want to expand the list of products that they can apply.

Even though both manufacturers allow the certified applicator to heat the product in a bucket using a handheld torch and then roll the product in place, it is more cost effective to purchase the melter and spray-apply the product, unless the application area is very small.



for all waterproofing applications, and this is true of polymer gel as well. However, in my opinion, the many unique characteristics of polymer gel, such as its tenacious adhesion and self-healing characteristics, to name just two, set it apart from all other types of waterproofing products in many ways. Therefore, design professionals and contractors should consider polymer gel systems when a long-term, high-performing waterproofing product is required. 

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design experience. He also taught a course on the Building Envelope and Waterproofing at the University of Minnesota for nine years. He has received numerous awards for his work in failure investigation and design and received The Richard M. Horowitz Award from IIBEC. He also provides expert testimony in litigation cases.

Figure 6. Polymer-gel migrating down through improperly predetailed substrate joint.

High Material Cost

Compared to other high-end waterproofing products currently on the market, the material cost of polymer gel is relatively high, as one might expect for such a highly effective and unique product. However, the money saved by the short application time tends to offset the higher material cost, resulting in a competitive installed cost per square foot.

Can Migrate into Existing Cracks and Joints

Because polymer gel never fully cures and instead remains somewhat flowable its entire life, it will tend to migrate down into cracks and joints that are not properly prepared. **Figure 6** shows what can happen if a precast concrete keyway joint with partially degraded mortar is not properly sealed or pre-detailed before the

polymer gel system is fully applied. This phenomenon not only creates a mess in the space below but can also compromise the watertight effectiveness of the polymer gel membrane.

Extremely Messy Installation

Because this product adheres tenaciously to virtually anything and is black in color, it is easy to imagine how messy it can be for applicators to install. Typically, members of the field crew wear white synthetic jumpsuits, which are disposed of at the end of every day. Sometimes, hand tools must also be discarded.

CONCLUSION

My 35 years of experience in waterproofing-related failure investigations and design has taught me that no one product is suitable