Industry Insights:

8 Questions to ask your Geopolymer Supplier

When you are deciding on what geopolymer to use for your next project, before you make any final decisions or specifications, ask your supplier the following eight questions to ensure you are getting the qualified, quality product you are expecting.

Any legitimate geopolymer mortar supplier should be able to confidently answer every question with data, research and testing to back up his or her claims. (See below for our answers to these critical questions.)

If you don't see a question you may have, or would like to learn more about GeoSpray geopolymer mortars, visit **infrastructure.milliken.com/geopolymer.**

1. How long has your geopolymer been on the market?

Milliken Infrastructure Solutions, LLC launched the first commercially available geopolymer mortar for sewer and storm water rehabilitation in 2011, called GeoSpray® geopolymer mortar. Since then, "geopolymer" has become a bit of a buzzword in the trenchless industry, and several competitors have introduced so-called "geopolymer" products. Some of these competitors have just rebranded the products they were selling as portland cement mortars once the key aspects of geopolymer chemistry (i.e. chemical resistance, no cold-joints and enhanced structural properties) became widely recognized as advantages in the trenchless industry. No other product can truly claim its use of geopolymer chemistry in the market since 2011.

2. How do you know you are really getting a geopolymer and not just a formulated portland cement?

This is a key question because there is misinformation within the industry about what qualifies as a geopolymer. In strict terms, a geopolymer is a network of mineral-based elements linked with covalent bonds, but that explanation is a hard definition to quantify. Typically, in the trenchless market, geopolymers are aluminosilicates, which have a high percentage of Si-O-Al-O bonds. While there are several detailed techniques that can be used to quantify the chemical composition of a mortar, none are perfect at assuring that the mortar is a geopolymer. The best option currently available is x-ray fluorescence (XRF). XRF can be measured using ASTM C114 and helps determine the actual composition of the material.

Milliken Infrastructure recommends that a geopolymer material formulation must contain at least 70% of raw materials that can react in the correct way (also called pozzolanic material); these raw materials include SiO_2, Al_2O_3, Fe_2O_3 and MgO. If someone asks for a specification of an exact ratio or percentage of chemistry or more exotic testing, he or she is trying to get you to sole source his or her product without knowing it. This XRF test ensures that one of the main components of portland cements—CaO—which can come from other sources as well, is below 30%. This value minimizes the chance that the product is a portland cement mortar with some pozzolanic filler material thrown in claiming to be a geopolymer.

3. How many projects have been completed with your geopolymer material?

Since 2011, more than 160 projects have been completed using GeoSpray geopolymer mortar. This project amount is estimated to be over 8-10 times more than the closest geopolymer competitor. The projects have been completed across the world, including North & South America, Europe, Asia and Australia. In the US, installations have been completed in 30 states. More than 10 contractors have been trained and certified worldwide, including industry leaders IPR and Michels Corporation.

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4. How much pipe has been repaired with your geopolymer material?

Since 2011, more than 90,000 linear ft of large diameter pipe has been structurally repaired with GeoSpray geopolymer mortar, including pipes as small as 24" to greater than 17' in diameter. Combined, this is more than 17 miles of rehabilitation, and GeoSpray mortar projects will easily surpass the 100,000 linear ft mark in mid-2018. This amount of completed linear feet is at least five times more than any other geopolymer lining. In addition, over 5,000 vertical ft of manhole work has been completed along with more than 50,000 square ft of drainage and containment structures.

5. Has your geopolymer been tested in pipe form?

Currently, Milliken Infrastructure's GeoSpray geopolymer mortar is the only spray-on material to be fully tested and validated for structural performance in pipe configurates by third party labs. Two of the most respected civil engineering labs in North America have done extensive tests on pipes repaired with GeoSpray geopolymer mortar. Both the Trenchless Technology Center (TTC) at Louisiana Tech University as well as Dr. Ian Moore's laboratory at Queens University in London, Ontario, have characterized the structural performance of actual pipes rehabilitated with GeoSpray mortar, and full reports of the testing are available to customers interested in understanding the structural performance of GeoSpray mortar. To date, more than 50 pipe samples have been tested and broken, allowing the data to have statistical validation. Testing has also been completed in Asia and additional testing will continue indefinitely.

6. Has your geopolymer design model been verified by pipe testing?

Because GeoSpray geopolymer mortar has been third party tested in both standard physical properties as well as full pipe testing, the design methods are the only spray-applied pipeline methodologies that have been verified to conservatively predict the performance of the material in the field. No other spray-on liner has a design methodology that can be verified with actual pipe performance data. This data can help assure the engineers and asset owners that the design thickness calculated using this validated methodology will stand up to rigorous engineering standards.

7. What is the flex strength of your geopolymer product and why is it important?

The rigorous third party testing conducted in pipe form confirms that the failure mode of cementitious and geopolymer mortars will be longitudinal cracking in the crown of the pipe under excess load. This failure is different from flexible pipes, which can fail by buckling. This longitudinal crack will form when the tensile forces on the interior surface of the pipe exceed the tensile strength of the material, but because this load is applied perpendicular to the tensile face, the critical physical property of the material failure mode is flexural strength or flexural modulus. Of all the spray-applied cementitious materials on the market today, GeoSpray geopolymer mortar has the highest third party verified flexural strength of any product, at 1,500 psi. This result means that for any given load configuration, GeoSpray mortar will have the minimum required structural thickness.

8. What test method is used to determine the flexural modulus of your geopolymer?

Not all test methods are created equal. In fact, just because a company says it measures a certain physical property, it doesn't ensure that the company provides the proper conservative engineering value. For flexural strength, there are several methods that suppliers are using to report their values: ASTM C293, ASTM C348 and ASTM C78. Which one is right? Which one is conservative? ASTM C293 and ASTM C348 both use center point loading, which loads the beam from a single central point across a known span, while ASTM C78 loads a beam at two equidistant points across the span or in what is called third-point loading. Third-point loading is more conservative and produces a lower value when the same material is tested, thus ASTM C78 will give you a more conservative value versus ASTM C293 and C348 respectively.

Therefore, all values of flexural strength don't conservatively predict the material behavior in actual loading conditions. Milliken Infrastructure has conducted full scale pipe testing and compared the available engineering models to the values obtained in ASTM C78, a good prediction when calculating thickness. Using less conservative test methods in the same model will under-predict the required design thickness and shouldn't be considered conservative engineering.

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