

# Geopolymer Mortar Solutions

## Background

Dating back to the earliest historical uses of cementitious formulations as building materials, society has looked for ways to use the wide variety of available raw materials to improve the physical properties of the final products.

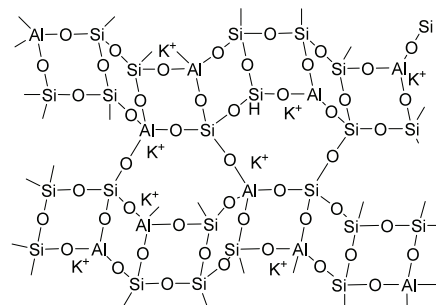
Evidence of the inclusion of volcanic materials such as volcanic ashes by the ancient Greeks dates back to at least 500-400 BC. As early as the 1920s, cement formulators have employed refined industrial by-products such as fly ash, metal slag and processed silicas, collectively referred to as pozzolans, as fillers and aggregates in standard cements. Today, almost all cement formulations contain some percentage of these natural or man-made by-products.

It has long been known that these pozzolans undergo chemical reactions with standard cement materials that improve properties, such as compressive strength, and bind materials like calcium hydroxide,  $\text{Ca}(\text{OH})_2$ , enhancing the resistance to chemical corrosion.

## The Discovery of Geopolymers

In the early 1970s a French scientist, Joseph Davidovits, discovered that under the right set of conditions these components could fully react with one another to form an extended polymeric network primarily made of Aluminosilicate bonds (Al-O-Si). He coined the term geopolymer to refer to this new class of materials.

Since that time, engineers and scientists around the world have worked to develop commercially viable geopolymer solutions for a wide variety of industrial applications. Milliken Infrastructure Solutions, LLC has developed a state-of-the-art geopolymer mortar - GeoSpray® - that exploits the physical and chemical advantages of geopolymeric materials in a form that is easy to use and employ in the field.



An example theoretical chemical structure of an Aluminosilicate geopolymer

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## Not A Plastic

When you see the term **geopolymer** for the first time, many people immediately assume the material will be a plastic like HDPE or Polyester. While it is true plastics are polymers, not all polymers are plastics. So, instead of thinking of the materials you find in plastic bottles or food storage containers you should picture a material that behaves like cement.

## The Best of Cement

GeoSpray geopolymer mortar has the look and feel of most standard cements. The geopolymer powder containing pozzolans is mixed directly with water to form a mortar just like standard cement materials. GeoSpray mortar has been specially formulated for centrifugal casting of large diameter pipes, but processability and workability are similar to what you might expect from a cement mortar.

One can think of GeoSpray mortar as an advanced cement. Compressive, tensile and flexural properties of GeoSpray mortar have been engineered to meet or exceed those you would expect from a standard cement formulation.

## Chemistry of Stone

The major advantage of a geopolymer over typical cement mortars is that a geopolymer has the chemistry of an engineered stone. The Aluminosilicate network that forms the chemical structure of GeoSpray mortar is similar to the chemical structure found in natural stone, such as zeolites or quartz.

This stone-like chemistry is different than the hydration chemistry that is present in standard portland and calcium aluminate cements, and creates a distinct advantage in chemical resistance. Additionally, unlike standard cement mortar, GeoSpray mortar continues to react with itself for decades, building additional strength and enhancing its service life expectancy.



GeoSpray is a geopolymer - but not a Plastic



GeoSpray mortar has the look and feel of standard cement mortars when it is begin processed and applied



GeoSpray mortar has the chemical structure like a natural stone, giving it benefits that traditional cement materials cannot deliver