Tephra® NP

CR Minerals offers Tephra® NP as one of several grades of amorphous aluminum silicate to serve the construction and oil and gas industries as a natural pozzolan or Supplementary Cementitious Material (SCM).

Naturally Pure and Environmentally Sound

Tephra® NP is calcined by Mother Nature and does not contain the heavy metal content of fly ash or the carbon footprint of calcined pozzolans such as Metakaolin or Expanded Shale/Clay. Molten lava, flash frozen upon explosive ejection from the volcanic vent, instantly became 'pulvis puteolanus' or pozzolana, a natural pozzolan, the key ingredient in Roman concrete. Concretes using natural pozzolan have proven to last thousands of years

Historical Effectiveness and Proven Durability

While much of our modern concrete infrastructure crumbles around us, ancient concrete relics of the Roman Empire stand as somber witnesses to the engineering prowess of the Empire's engineers. Their secret—and the origin of the term "pozzolan"—was fine-grained volcanic material they first sourced from Pozzuoli, in Italy. When mixed with lime (still the key component of Portland cement today) and aggregate, the magma based pozzolanic concrete hardened into the most enduring man-made construction material ever designed. The Pantheon, the Coliseum, the Aqueducts and other Roman engineered concrete structures have withstood over two millennia of earthquakes, elements, wars, as well as the relentless passage of time.

Efflorescence discolors the surface of many concrete structures and internal self-destruction is promulgated by deleterious chemical forces inherit to modern cement and concrete. Natural pozzolans not only mitigate such chemical forces, but improve the strength and abrasion resistance of concrete, creating an ageless and durable construction material.

While fly ash works as a replacement pozzolan, the original pozzolan, natural Tephra based material, remains the superior choice. CR Minerals pozzolans are the same as the natural, sustainable pozzolans used by the Romans —carefully refined—resulting in a pozzolan that greatly enhances concrete chemistry and that performs consistently, pour after pour. CR Minerals pozzolans should be part of the toolbox of any engineer interested in designing strong, durable concrete.

Pozzolan Benefits

Tested, Proven, and Certified

CR Minerals' Tephra® NP has been tested, proven and certified as a natural pozzolan in accordance with ASTM C618N. This certification means that Tephra® NP is among the most effective products available to protect concrete from the deleterious effects of chemical attack, and significantly enhances compressive strengths.

Enhances Compressive Strength

The pozzolanic reaction between Tephra® NP and calcium hydroxide begins only after the C3S and C2S in the cement begins to hydrate, thereby releasing calcium hydroxide as a by-product. At the early stage of curing, due to slower (but more effective) reactions created by the pozzolan, compressive strengths will be lower than reference OPC initially. Over time however, the natural pozzolan continues to react with the calcium hydroxide produced by cement hydration and increases the compressive strength by producing additional, densifying C-S-H. Sometime between 28 - 40 curing days, the CR Minerals pozzolan/OPC mixture begins to exceed reference OPC in compressive strength. After 56 days, strengths may exceed reference OPC by 20% or more. The pozzolanic reaction continues until there is no free calcium hydroxide available in the concrete mass. As a result, long term compressive strengths may exceed the reference OPC by up to 30% or more, depending on mix design.

Mitigates Alkali Silica Reaction (ASR)

CR Minerals' natural pozzolan is crushed to a fine particle size resulting in dramatically increased reactive surface area. Thus, the natural pozzolan will readily react with calcium hydroxide as it becomes available, and thereby traps the liquid phase alkali inside the densified cement paste. The consumption of deleterious calcium hydroxide, the densified paste and the resultant alleviation of capillary action virtually eliminates both alkali-silica reactions and efflorescence. By densifying the cement paste and removing calcium hydroxide as a potentially deleterious agent in the concrete, the prospect of ASR is severely mitigated.

Reduces Permeability

The leaching of calcium hydroxide produced by the hydration of Portland cement can be a significant contributor to internal porosity in all Portland cement-based mixtures. Tephra® NP will effectively reduce concrete permeability by reacting with the calcium hydroxide to form stabilizing and strength enhancing C-S-H. The amount of "water of convenience" used to make the concrete workable during the pouring process creates permeable voids in the hardened mass. Additional porosity and efflorescence are created as the calcium hydroxide migrates to the surface.

Reduces Heat of Hydration
Experiments show that replacing 15-25% Portland cement (OPC) with a Tephra NP can reduce the expansion and heat of hydration by as much as 40%. Less heat is produced when natural pozzolan reacts with the available calcium hydroxide. Natural pozzolan not only decreases the overall heat generated by cement hydration, it also delays the time of peak temperature. The 'heat of hydration' of a natural pozzolan– OPC cement mixture is extended longer and lower to form a much more moderate curve than the 'heat of hydration' curve for OPC itself.

Resists Chloride Attack
Concrete deterioration caused by the penetration of chloride occurs when chloride ions react with calcium. The expansion of hydrated calcium oxy-chloride enlarges micro-cracks and further increases permeability, which in turn causes even greater chloride penetration and related damage from freeze-thaw cycles. The Tephra® NP will significantly reduce the permeability and porosity of the concrete, thus mitigating the effect of chloride attack.

Resists Sulfate Attack
CR Minerals' natural pozzolans consume excess calcium hydroxide in the concrete pore solution, thus removing the opportunity for it to react with sulfates and cause destructive expansion

Protects Steel Reinforcement
As the preceding data indicates, concrete made with a natural pozzolan and Portland Cement mixture can protect steel reinforcement by creating a matrix so densely packed that chloride infused liquids and/or gases cannot penetrate to cause the steel to corrode

Shipping and Availability

CR Minerals' Tephra® NP is manufactured and distributed out of our state-of-the-art facility conveniently located in Pueblo, Colorado. Tephra® NP is available for purchase in bulk pneumatic, super sack and rail.

Technical Information Summary

Bulk Density: 48-50 lbs/ft^3
Specific Gravity: 2.39-2.45
Passing 325 mesh screen: 90%+
Water demand: 97~101% of cement control

Physical Properties of CR Minerals' Tephra® NP (Natural Pozzolan)

Grade	Description	Bulk Density (lbs/ft^3)	Specific Gravity
Tephra® NP	Amorphous Aluminum Silicate (Gray)	48	2.39-2.45
Tephra® WP	Amorphous Aluminum Silicate (White)	48	2.33-2.34

Low Density/High Surface Area Advantage
CR Minerals' natural pozzolans have an average specific gravity of 2.4 g/cc. Most other pozzolan products have higher specific gravity, some up to 2.6 g/cc. CRM pozzolan also has a larger surface area than most fly ashes, thus greatly improving pozzolanic reactivity, thereby improving set times and enhancing early strength. This means that less CR Minerals' pozzolan, by weight, is needed to achieve greater benefit compared to fly ash pozzolans.

Applications for CR Minerals' Natural Pozzolans
CR Minerals' pozzolans have a wide range of application, including:

- Precast Concrete
- Glass Fiber Reinforced Concrete Panels (GFRC)
- Stone Veneer
- Mass Concrete
- Architectural Concrete
- Industrial & Infrastructure
- Oil Well Cementing
- Ready Mix Concrete
- Lightweight Concrete
- Decorative Concrete
- Type IP Cements

Any concrete that needs to be strong and durable will benefit from the addition of natural pozzolan to the mix design.

Additional Information at www.CRMinerals.com
To place an order or obtain additional information, please contact CR Minerals at 719-239-7869.