VCAS™ White Pozzolans

Custom-engineered, high performance, pozzolanic mineral additives for use in white cement, mortar, and concrete products

www.vitrominerals.com

How VCAS Works: Environmental Benefits

VCAS Pozzolans are derived from a post-industrial stream of by-product reinforcement fiberglass that is ground into a white powder finer than 325 mesh. VCAS feedstocks are unique compared to 95% of recycled glass in that the alkali content ($Na_2O + K_2O$) of VCAS is about 15-times lower than post-consumer sources of glass such as windows and bottles. VCAS powders are designed to replace about 25% of the cement powders used to make concrete. The VCAS can then be treated as another form of cement powder in your mix design calculations.

When water is added to cement, calcium silicate hydrate (CSH) is formed as the main binder, together with 20-25% of lime (aka calcium hydroxide) as a non-cementitious by-product. The lime is dispersed in the concrete both in solid form and dissolved in the cement fluids. As the fluids come to the surface, the water evaporates, leaving behind a deposit of whitish lime, which quickly reacts with atmospheric CO_2 to create a calcium carbonate-rich scale on the concrete surface. Since the calcium carbonate scale is white, the efflorescence phenomena is most pronounced on darker colored parts. In addition to staining adjacent concrete, stone, windows, or brickwork, over time the efflorescence will greatly diminish the color intensity of color pigmented parts. Furthermore, the lime remaining in the interior of the concrete part is a weak spot in the concrete matrix, and the source of more efflorescence as the outdoor exposed concrete goes through wet and dry cycles.

VCAS Pozzolan powders are finer than cement and are also dispersed throughout the concrete matrix in both solid and dissolved forms. Under proper concrete placement conditions of low water/cement ratios and moderate temperatures, the VCAS and lime readily react to form more cement binder (CSH), with the added advantage that the new CSH forms within the pore structure of the concrete, reducing porosity and absorption, and strengthening the concrete. As the reaction takes place, more lime and VCAS go into solution, with the process taking place rapidly over the first 4-5 weeks, and then continuing more slowly for years until the pore structure of the concrete is effectively filled and the remaining lime is locked in place. A detailed discussion of the reactions taking place and the changes in physical properties of the concrete can be found in downloadable form on our website <www.vitrominerals.com>.

All silicate glasses, regardless of chemical composition, will undergo a pozzolanic reaction. However, high alkali glasses derived from windows or beverage containers have significant negative consequences for concrete: they generate large amounts of soluble sodium compounds that deposit efflorescence in great quantities on the surface of the concrete part; and they create a highly alkaline environment within the concrete which promotes deleterious alkali-silica reactions with certain aggregates and other delayed reactions that can destroy the concrete parts quite quickly. Similarly, high sodium and sulfate contents in some fly ashes deposit a sodium sulfate scale that can be highly deleterious. Sulfides in blast furnace slag may cause the concrete part to turn blue-green for an extended period of time. VCAS white pozzolans contain less than 1/15th of the alkalis found in post-consumer glass; they contain no sulfides or carbon; and they are as white as white cement. Since VCAS has about the same water demand as cement powders, adding VCAS to the mix design is quite seamless.

If you are making a concrete part without VCAS (the control) and decide to substitute VCAS for 25% of your cement powders, you will note the following general phenomena (subject to differences in mix design, curing practices, and cement vendor):

- The water to cement ratio remains essentially unchanged, and dosage of admixtures will not materially change.
- SCC concretes will have better flow (rheology) due to the added cohesiveness of the VCAS particles.

- VCAS reduces surface imperfections of precast parts due to the pozzolanic reaction with the lime that works its way to the surface during the placement and curing process.
- Colors will be more intense and will remain brighter with time due to the lime being locked up.
- Depending on the curing conditions and grade of VCAS used, strengths will be 85-90% of the control at 3 days; reaching 100% of the control within 7-21 days; and could be 120-150% of the control after 56 days.
- Because VCAS has a specific gravity about 17% lower than cement, your parts will be 3-4 % lighter.

Achieving LEED Points with Concrete

VCAS is a certified 100% post industrial recycled product that will contribute points to the U.S. Green Building Council's **L**eadership in **E**nergy and **E**nvironmental **D**esign (LEED) certification for building sustainable structures.

Concrete is a superior material for building sustainable structures. It is durable, uses local materials, has high heat reflectivity (especially white concrete), and uses thermal mass to help energy efficiency. In the LEED-NC protocol, concrete can contribute in whole or in part to 25 of the total 69 points available for LEED certification. 26 points are the minimum required. VCAS makes concrete greener as described below.

VCAS has a Positive Impact on the Environment

VCAS also brings significant environmental benefits to the concrete operation. For a concrete producer normally buying 1,000 tons of cement per year, at a nominal 25% replacement level, the operation will purchase 250 tons of the recycled VCAS to replace 250 tons of manufactured cement powder. This will have the following reduced impact on the environment:

- Reduce CO_2 emissions by 250 tons per year, equivalent to taking 41 midsized cars driving 12,000 miles per year off the road permanently.
- Create landfill space now occupied by VCAS for 250 tons garbage, enough space for 312 households generating 1,600 pounds landfill waste each.
- Conserve 375 tons of limestone, sand, gypsum, and clay being mined to manufacture the 250 tons of cement you have removed from your mix design.
- Save 875-million Btu's per year needed to make the cement, enough to provide heat and electricity for nine full sized homes for a year.
- The white color of VCAS contributes to the wider use of sustainable and durable white concrete with high refectivity for higher energy efficiency, as well as improved safety (e.g., in highway median barriers, tunnel linings, etc).

Use of the post-industrial VCAS in your mix design will result in stronger more durable parts, more intense colors and a genuine reduced carbon footprint (carbon credits).

Vitro Minerals technical staff will advise on mix designs and run on site trials with lab testing where appropriate. Five pound samples are free upon request, and technical details of the VCAS can be downloaded from our website at www.vitrominerals.com.

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