



TX Active[®] Photocatalytic Cements

TX Arca[®] for self-cleaning concrete
TX Aria[®] for self-cleaning and de-polluting concrete

1. PRODUCT NAME

TX Active Photocatalytic Cements
TX Arca
TX Aria

2. MANUFACTURER

ESSROC Italcementi Group

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www.essroc.com

Essroc is a leading North American cement producer with over 6.5 million metric tons of annual capacity. With headquarters in Nazareth, Pennsylvania, Essroc operates production facilities strategically located throughout the United States, Canada, and Puerto Rico.

Essroc is a member of the Italcementi Group, which is the fifth largest cement producer in the world. Based out of Bergamo, Italy, the Italcementi Group is a global leader in cement, building materials, chemical admixtures, related technologies and research.

www.italcementigroup.com

3. PRODUCT DESCRIPTION

The use of TX Active Photocatalytic Cements will lead to cleaner buildings and cleaner air. Concrete produced with TX Active will exhibit certain properties depending on the formulation used:

- **TX Arca** - Self-cleaning
 - Concrete will resist most organic and inorganic pollutants that gather on the surface causing discoloration.

- **TX Aria** - Self-cleaning and Pollution Reducing
 - In addition to the cleaning effect, this product will also remove significant amounts of environmental pollutants deemed harmful to human health.



The research and development of the TX Active photocatalytic technology began nearly a decade ago, in response to a market need to construct the precast panels for the Dives in Misericordia Church in Rome. The church, constructed in 2001 to celebrate the new millennium and designed by Richard Meier, needed to maintain its brilliant white appearance long after initial installation.

Potentially, any product containing a cementitious material as its base could be manufactured with TX Active cements. Concrete uses include:

- Precast and architectural precast panels
- Cast-in-place – pavements, road surfacing, sidewalks, and other types of concrete.
- Portland cement based plaster/stucco for finish coat applications.
- Manufactured concrete products – interlocking concrete pavers, concrete masonry units, roof tiles, architectural products, and cement based tiles.
- Cement based restoration products.

4. PRODUCT COMPOSITION

In the United States, Gray or White Portland Cement Type I, II, and III complying with ASTM C 150 with the addition of proprietary particles of titanium dioxide (TiO₂) specifically engineered for use in the manufacture of concrete and concrete products.

In Canada, Gray or White Portland Cement Type GU, MS, MH, and HE complying with CSA A3001 with the addition of proprietary particles of titanium dioxide (TiO₂) specifically engineered for use in the manufacture of concrete and concrete products.

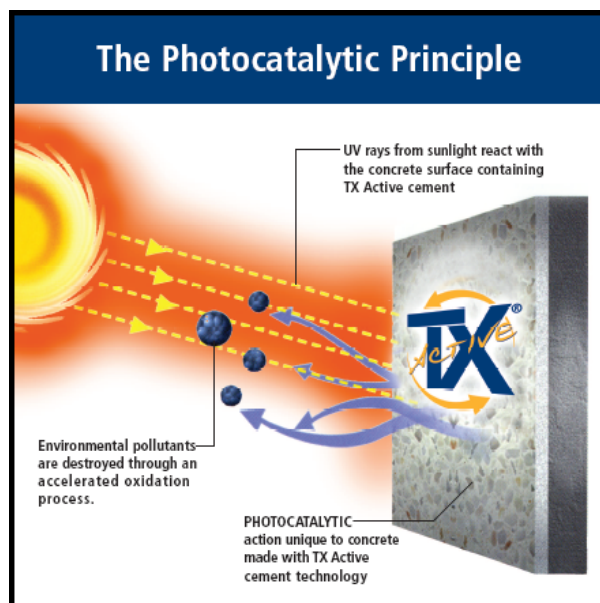
TiO₂ is primarily used as a white pigment in production of paints, varnishes, and plastics. It is also used in many white or colored products, such as: foods, cosmetics, UV skin protection products, fibers, rubber products, and more. TiO₂ pigments are inert, do not react with other materials, and are non-flammable and non-toxic. The addition of this material into cement is proprietary patented technology and will not be shared in this document.

5. SELF-CLEANING AND DEPOLLUTING

Photocatalysis –

A natural phenomenon in which a substance, the photocatalytic principle, utilizes light to alter the speed of a chemical reaction. By taking advantage of the energy of light, the principle will accelerate the formation of strong oxidizing reagents which will result in the decomposition of organic and inorganic pollutants. These pollutants are responsible for gathering on the surface of concrete causing discoloration, as well as, many health related issues.

Photocatalysis is an accelerator of an oxidation process that already exists in nature. It promotes faster decomposition of pollutants and prevents them from accumulating.



- **Self-Cleaning:** Compounds diminished or eliminated by the use of TX Active photocatalytic cements include:
 - Soot, grime, and organic particulates
 - Mold, mildew, fungus, and their spores
 - Algae, bacteria, and allergens
 - Tobacco smoke and stains

- **De-polluting:** In addition to self-cleaning, surfaces containing TX Active photocatalytic cements decrease many of the pollutants deemed harmful to human health and the environment. TX Aria has been proven to reduce:
 - Nitrogen Oxides (NOx) – major component in the formation of acid rain, ground level ozone (smog), certain toxic chemicals, and water quality deterioration.
 - Sulfur Oxides (SOx) – component to acid rain and the formation of many harmful sulfates and other products.
 - Volatile Organic Compounds (VOC's) – such as benzene and toluene.
 - Ammonia – NH₃.
 - Carbon Monoxide.
 - Organic chlorides, aldehydes, polycondensated aromatics, among others.

6. PRODUCT LIMITATIONS

There are no regulatory barriers to acceptance. TX Active products meet all industry standards for Portland cement.

Due to the entire photocatalytic process being dependent on the sun's ultra-violet light, TX Active is not recommended for interior applications unless sufficient light with the appropriate wavelength is administered.

Concrete produced with TX Active cement cannot be labeled graffiti proof. Many paints are UV resistant blocking the sunlight to start the photocatalytic reaction. For the same reason, sealers or other coatings that may block the sun's UV light should not be used.

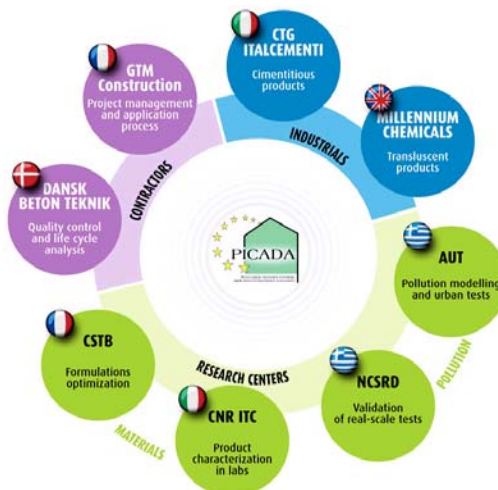
Essroc reserves the right to limit the use of TX Active cements to projects that meet its quality control requirements. Due to the proprietary nature of the product it is imperative that Essroc remain informed and involved in all project applications.

Observing normal occupational health guidelines dealing with the handling of ordinary Portland cement and cement based products are believed to be sufficient to protect workers against exposure. See Material Safety and Data Sheet (MSDS).

Most of the chemical components formed by the photocatalytic process are benign. However, by-products of certain chemical reactions may include calcium nitrates, carbonates, and sulfates, which are mostly simple salts washed away by rain. These resultant products are a much smaller quantity and pose a lower threat to the environment than that caused by the original compounds.

7. TECHNICAL DATA

In early 2001 the PICADA, **Photocatalytic Innovative Covering Applications for De-pollution Assessment**, project was formed in Europe. This 4 ½ year long research study consisted of a consortium of independent research laboratories, universities, contractors, and manufacturers to assess and validate the de-pollution effect of the photocatalytic cements.

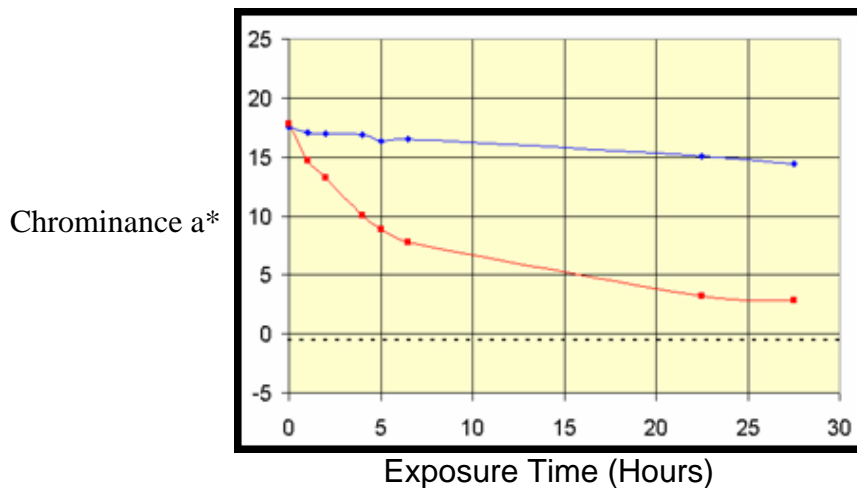


Through state-of-the-art laboratory tests, pollution abatement models, and on-site field assessments, PICADA showed that concrete produced with TX Active cement is efficient in destroying atmospheric pollutants.

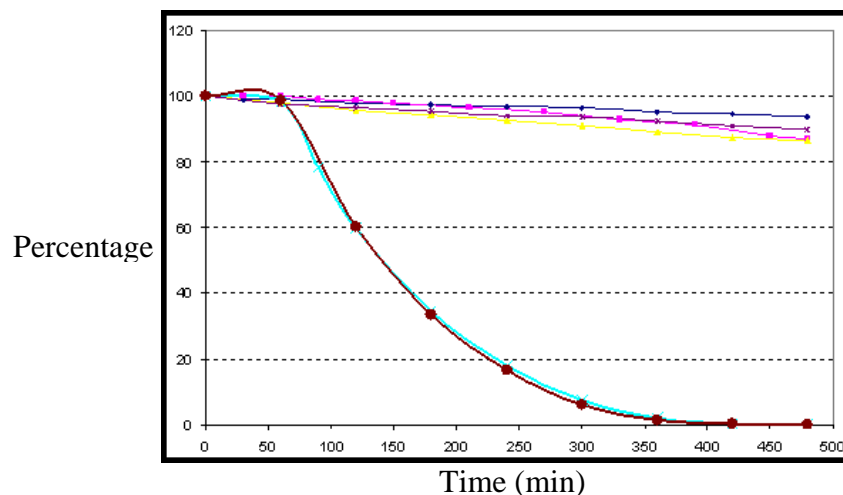
A compilation of the studies and projects associated with the PICADA project can be found by contacting ESSROC or on-line at www.picada-project.com.

In addition, PICADA developed testing procedures used to measure the performance of concrete products produced with photocatalytic cements.

- Self-Cleaning Test – after the initial reference color is determined by a standard L*a*b* colorimeter measuring device, a rhodamine dye is painted over the surface of a concrete panel/piece that is produced with photocatalytic cement. The concrete panel is subjected to 24 hours of ultra-violet light with the correct power and wavelength. Subsequent colorimeter readings are taken periodically. Below is a graph that represents a common result.



- De-pollution Test - Effectiveness against nitrogen oxides (NOx) is assessed in a chamber of known volume into which NOx is first blown and then diluted with air to achieve a preset concentration of pollutant, typically 200ppb. The chamber contains a UV lamp, the light source, and a test specimen of known surface area produced with photocatalytic cement. The amount of time is determined that will eliminate all of the pollutant. Below is a graph that represents a common result.



8. ENGINEERING PROPERTIES

If using the appropriate industry guidelines, the quality of concrete in both the plastic and hardened state should not be jeopardized with the use of TX Active. Slump, air content, unit weight, set-time, workability, permeability, flexural strength, and compressive strength should yield similar results.

In general, concrete containing TX Active cements should be used in accordance with standards that apply to ordinary Portland cement concrete and accepted industry practices.

Mixture designs, chemical and mineral admixtures, and finishing techniques must be verified for compatibility with TX Active cements by Essroc. Essroc will work with potential users to develop and test mixtures for specific applications.

9. ENVIRONMENTAL BENEFITS / USGBC LEED CREDITS

The website www.concretethinker.com has detailed information from the **Portland Cement Association (PCA)** about the environmental benefits of using concrete in construction and the possible **Leadership in Environmental and Energy Design (LEED)** credits attainable.

Using concrete manufactured with TX Active cements further enhances the ability of concrete in obtaining LEED Green Building certification. Enhancements include reduction of pollutants, less chemical cleaning, and lower lifecycle maintenance costs. Detailed information on the LEED program and the project certification process is available from the U.S. Green Building Council (USGBC) at www.usgbc.org.

Listed below are some of the areas where the use of photocatalytic cement in concrete may contribute to LEED credits for New Construction and Major Renovations:

➤ **Sustainable Site**

- Heat Island Effect: Non-Roof – As the temperature of urban areas increase, the chemical reactions that produce smog and pollution also increase. The intent of this credit is to use materials that stay cool in sunlight and have a solar reflective index (SRI) of at least 29. Ordinary Portland cement has a SRI of around 35, and new concrete produced with white cement has an SRI of 86. It is likely that concrete produced with TX Active cement will maintain a higher SRI value for a longer period of time.
- Heat Island Effect: Roof – Similar to above, the intent is to reduce heat island effects. Credits can be obtained by using roofing materials with an SRI of at least 78 for low-sloped roofs and 29 for steep sloped roofs. Concrete roof tiles and ballast pavers produced with TX Active would likely qualify.

➤ **Energy and Atmosphere**

- Credits are awarded if energy cost savings can be shown compared to a baseline building meeting specific requirements. Whole-building energy simulations using computer models can show the benefits of concrete's thermal mass, along with the complex interaction between solar reflectance, emissivity, and thermal mass.

➤ **Materials and Resources**

- Regional Materials – This credit supports the use of indigenous materials and reduced transportation distances. The requirement is that materials or products need to be extracted, harvested, or recovered, as well as manufactured, within 500 miles of the project site for a minimum of 10% of the total materials value.
- Concrete will usually qualify since ready-mix and precast plants are generally within 50 miles of a job site and the materials to make concrete are within 500 miles.

➤ **Innovation and Design**

- These points can be applied for if an innovative green design strategy is used that does not fit into the standard LEED point structure or if it goes significantly beyond a credit requirement and demonstrates exceptional environmental performance. Examples may include:
 - Exceptional performance in aged reflectance – due to the self-cleaning benefit, concrete produced with TX Active cements will remain clean and reflective reducing the heat island effect longer.
 - Exceptional performance in air pollution abatement – the use of TX Active cement in concrete will reduce the organic and inorganic substances responsible for air pollution.
 - Durability – the use of TX Active cement will tend to give concrete a longer life without the use of protective coatings.

10. AVAILABILITY AND COST

TX Active cements are currently manufactured and available in the United States directly from Essroc. TX Active cements are available in either white or gray color, produced in 47lbs. bags, 1500lbs. bulk bags, and bulk truckload shipments.

Pricing is available upon request by contacting Essroc directly.

11. MAINTENANCE

Concrete produced with TX Active cements require simpler maintenance at less frequent intervals compared to normal concrete surfaces. Pressure washing and chemical treatments may be replaced by simple washing or by natural rain water cleansing. If an adequate amount of rain water is not present a maintenance washing program may need to be administered.

12. AVAILABLE INFORMATION

- Material Safety and Data Sheets (MSDS)
- Product Brochures
- LEED-NC 2.2 Guide
- Continuing Education Programs
- PICADA Research Reports



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