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PlusTi™
Smog Eating Roads
A Better Way to Get There

**Pavement Technology, Inc.** 800-333-6309 www.pavetechinc.com

# Ti-intro CME® pollution-reducing penetrant

**The PlusTi™ family of smog-eating road penetrants includes the all-purpose Ti-intro CME® pollution-reducing penetrant for asphalt and concrete pavements. This all-purpose cationic molecular emulsion is titanium dioxide ($TiO_2$) in a carrier liquid that delivers titanium dioxide to the surface and upper matrix of the structure. PlusTi all-purpose pollution-reducing penetrant uniformly distributes $TiO_2$ throughout the pavement's upper matrix area in a process known as distributive embedding. Once delivered by the selective penetrant, the $TiO_2$ catalytic material creates an electrochemical reaction that reduces atmospheric vehicle exhaust gas by removing nitrogen oxides (NOx), volatile organic compounds (VOCs), and other pollutants generated by automotive, bus and truck traffic.**

**The liquid carrier is a cationic aqueous emulsion with a proven track record for effectively transporting various chemicals into a pavement matrix. Pavements treated with Ti-intro CME penetrant inhibit the degradation of air quality surrounding America's roadways.**


PlusTi Ti-intro CME penetrant application

## The Vehicular Pollution Challenge

Detrimental gas emissions, such as nitrogen oxides (NOx) and sulfur oxides (SOx), are formed during the vehicle combustion process. Diesel vehicle emissions introduce one of those oxides (nitrogen dioxide ($NO_2$), into the environment, increasing ozone concentrations. As the ozone concentrates, the percentage of nitrogen oxides undergoing oxidization also increases, resulting in an increasingly higher percentage of $NO_2$ in the atmosphere.

Research has identified a clear association between serious environmental issues, such as photochemical smog and acid rain, and NOx. The ratio of $NO_2$ to NOx has been increasing over the years due to increasing traffic and a corresponding increase in ozone concentrations. U.S. Environmental Protection Agency (EPA) technical data shows more than 50 percent of atmospheric NOx is emitted from mobile sources.

Several approaches, including photo catalysis, have been studied as methods for counter-acting NOx emissions. Photo catalysis is the acceleration of a photo-reaction (light absorbing) in the presence of a catalyst. A semiconductor activated by Ultraviolet (UV) light with wavelengths less than 380 nm creates hydroxyl radicals and superoxides. This irradiation can naturally decompose the organic pollutants, such as NOx.

$TiO_2$ has been used as a photo catalyst for several reasons. First, $TiO_2$ fulfills the requirements for effective photo activity under solar radiation. Secondly, $TiO_2$ has a solid oxidizing strength at ambient conditions. The band gap of the solid state enables $TiO_2$ to be beneficial in the UV section of the spectrum. Finally, $TiO_2$ is chemically inert, physically stable, non-toxic and super hydrophilic.

## Markets

- DOTs
- Urban/Suburban Municipalities, Counties, Gated Communities
- Airports
- Bridges
- Parking Lots
- Highway Shoulders

## Compatible Substrates

- For newly constructed asphalt pavements where traffic is restricted on closed construction sites, **PlusTi** all-purpose penetrant provides cost-effective air pollution remediation on clean, receptive surfaces.
- For existing pavements, **PlusTi** all-purpose penetrant provides retrofitted air pollution remediation without the need for expensive resurfacing or reconstruction.

*(continued)*

## Benefits

- Penetrates approximately 1/8 inch into the pavement matrix
- Not a topical coating, so impervious to traffic wear
- Captures and removes up to 60% of toxic airborne vehicular emissions
- Creates a quick-drying super-hydrophilic surface
- Provides a self-cleaning, self-regenerating, air-purifying surface that removes NOx, VOCs, and other airborne pollutants from the atmosphere
- Will not obliterate striping and other markings
- Supports NAAQS compliance

## How It Works

The **P**lus**Ti** all-purpose Ti-intro CME penetrant delivers photocatalytic $TiO_2$ deep into the asphalt surface, leaving behind a photocatalytic surface layer that removes NOx, VOCs, and other airborne pollutants from the atmosphere. As weather and traffic wear the surface layers of pavement deeper layers of $TiO_2$ are exposed at the surface in a self generating process of continued air purification.

## How to Apply

### Temperature

Apply only when ambient temperature is expected to remain at or above 40°F during application and for the next 12 hours.

### Surface Preparation

Surface must be dry with no threat of rain within 2 hours of application.

Field testing shall be performed prior to application to determine the maximum amount of material that the pavement can absorb within a 10 minute period. Contractor shall apply various test strips ranging in length from 25-50 ft. using different rates, noting the time it takes for total absorption without surface residues remaining. In no case shall the application rate exceed 0.08 gallons per square yard.

### Application Method

**P**lus**Ti** all-purpose penetrant must be applied by an approved applicator using computerized application equipment for accuracy, cleaned of all other materials to prevent contamination. Apply uniformly to all surfaces. Where grades or super elevations are prone to excessive runoff, multiple applications may be required; successive applications must be made as soon as complete penetration of previous application has occurred.

If spills or misapplication occur, application of sand or rock dust may be required as a blotting medium, and should be removed prior to resuming traffic.

## Limited Warranty

Pavement Technology, Inc. (PTI) warrants its products to be of the highest quality. Refund of purchase price or replacement of product shall constitute the limit of PTI's liability. PTI makes no other warranties, express or implied, with respect to the products or any service and disclaims all other warranties, including any warranty of merchantability and fitness for particular purpose. This limited warranty may not be modified by reps of PTI, its distributors or dealers.

## Specifications/Testing[1]

**Table 1.7 $TiO_2$ Impact on Skid Resistance and Hydrophilic Implications**

| Location / Rate gsy | Pre-Application | Post 20 Minutes | Post 24 Hours |
|---|---|---|---|
| Alicante Drive EB / 0.03 | 58 | 61 | 61 |
| Alicante Drive WB / 0.06 | 59 | 64 | 64 |
| Indian Trail WB / 0.03 | 42 | 43 | 45 |
| Indian Trail WB / 0.06 | 42 | 51 | 51 |

Source: International Cybernetics, Charlotte County (FL) March 2019

### $NO_X$ Reduction Efficiency

| Compound | Control Sample | 0.16 kg/m2 | 0.21 kg/m2 | 0.26 kg/m2 | 0.31 kg/m2 | 0.36 kg/m2 |
|---|---|---|---|---|---|---|
| Ti-intro CME | 4.12 | 48.19 | 52.33 | 54.78 | 58.41 | 53.27 |

1 The Texas A&M Transportation Institute, using samples of Ti-intro CME penetrant, studied the application of titanium dioxide ($TiO_2$) to pavement surfaces to impart air pollution remediation properties. The test program on specimens yielded data to assess the effects of the application rate and the carrier on the effectiveness of the photo catalytic reaction. To understand the proper application rate for asphalt specimens, the NOx removal efficiency was measured with Ti-intro CME compounds at five different application rates as indicated in the chart below. The NOx reduction efficiency of Ti-intro CME ranged from 48.19 to 58.41 percent; the effectiveness of the treatment was not linear. The NOx reduction efficiency of the control sample was negligible .

## Safety Guidelines

Contractors shall follow all stipulated application requirements.

## Manufacturer

D&D Emulsions, Inc., Mansfield, OH

## National Distributor

Pavement Technology, Inc., Westlake, OH

Patents: US 9,493,378 B2 and US 8,899,871 B2

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