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**Pavement Technology, Inc.**

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## A.R.A.-1 Ti<sup>®</sup> pollution-reducing polymerized rejuvenating seal

Formulated from the same maltene fractions that vitalize asphalt binders, A.R.A.-1 Ti<sup>®</sup> rejuvenating seal revitalizes aging asphalt while leaving behind a self-cleaning surface that removes nitrogen oxides (NOx), volatile organic compounds and other pollutants introduced into the atmosphere through vehicular exhaust. The air-purifying surface perpetually regenerates itself throughout the life of the pavement, contributing to compliance with U.S. EPA's stringent new National Ambient Air Quality Standard (NAAQS). The ideal solution for government agencies dealing with reduced budgets, deteriorating infrastructures and pollution concerns.

### Markets

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

### Compatible Substrates

- For newly constructed asphalt pavement, A.R.A.-1 Ti rejuvenating seal improves durability by replacing volatile components lost to the heat of production, providing an in-depth seal to reduce permeability.
- For older asphalt pavement, A.R.A.-1 Ti rejuvenating seal reverses the effects of UV, weathering and water intrusion by reintroducing volatile components deep into the asphalt to restore ductility and flexibility.

### Benefits

- Penetrates deeply to protect against air and water – not a topical coating
- Provides a self-cleaning, self-regenerating, air-purifying surface that removes nitrogen oxides (NOx) volatile organic compounds (VOCs) and other airborne pollutants from the atmosphere for the life of the structure
- Prevents stripping and raveling of the aggregate

- Reduces long-term pavement maintenance costs by extending the life of new and existing asphalt pavements:
- Increases the durability of the top portion of new asphalt pavements
- Improves the ductility and flexibility of the top portion of aging asphalt pavements
- Will not obliterate striping and other markings
- Supports NAAQS compliance

### How It Works

A.R.A.-1Ti emulsion uses Maltene Replacement Technology to restore the reactive components that asphalt pavements lose due to hot-plant operations and the aging process. The emulsion delivers photocatalytic TiO<sub>2</sub> deep into the asphalt surface, leaving behind a photocatalytic surface layer that removes NOx, volatile organic compounds (VOCs) and other airborne pollutants from the atmosphere for the life of the pavement. As weather and traffic wear the surface layers of pavements, deeper layers of TiO<sub>2</sub> are exposed at the surface in a self-generating process of 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 4 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 20 minute period. Contractor shall apply various test strips ranging in length from 100-150 ft. using different rates, noting the time it takes for total absorption to occur without surface residues remaining.

### Application Method

A.R.A.-1 Ti rejuvenating seal must be applied by an approved applicator using a computerized distributor truck cleaned of all other materials to prevent contamination.

Apply uniformly to all surfaces. Where grades / elevations are prone to excessive runoff, multiple applications may be required; successive applications must be made as soon as complete penetration of previous applications has occurred.

A light application of dry sand or rock dust shall be applied to all treated pavement after absorption and prior to reopening to traffic; if spills or misapplication occur, a heavier application may be required. The sand or rock dust should be removed within 24 hours.

### Application Rate

- 2:1 dilution  
For new asphalt, recommended rate between 0.04 and 0.08 gallons per square yard (GSY)
- For old asphalt, recommended rate up to 0.15 GSY

### Other Considerations

Treated sections must be closed and free from traffic until A.R.A.-1 Ti treatment with subsequent sand or rock dust application is complete. Traffic control shall be conducted in compliance with all local, state and federal requirements.

### 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.

(continued)

## Specifications/Testing

Property	Test Method	Requirements
<b>Air Pollution Reduction</b>		
Titanium dioxide (TiO <sub>2</sub> )		3.0%
<b>Emulsion</b>		
Residue, %w <sup>1</sup>	ASTM D-244 (Mod)	Min. 55, Max. 60
Miscibility <sup>2</sup>	ASTM D-244 (Mod)	No Coagulation
Particle Charge	ASTM D-244	Positive
<b>Residue from Distillation</b>		
Flash Point, COC °C	ASTM D-92	Min. 196
Viscosity @ 60°C, cSt	ASTM D-445	Min. 100, Max. 200
Asphaltenes, %w	ASTM D-2006-70	Max. 1.0
Maltene Distribution Ratio (PC+A <sub>1</sub> ) / (S+A <sub>2</sub> ) <sup>3</sup>	ASTM D-2006-70	Min. 0.3, Max. 0.6
PC/S Ratio <sup>4</sup>	ASTM D-2006-70	Min. 0.5
Saturated Hydrocarbons	ASTM D-2006-70	Min. 21, Max. 28
Percent Light Transmittance <sup>5</sup>	D&D Emulsions	Max. 30
<b>Polymer</b>		
Charge	Positive	0.5%
<b>Property</b>		<b>Description</b>
Monomer Ratio, Butadiene/Styrene		76/24
Solids Content, %w		63
Coagulum on 80 mesh screen (max. %w)		0.1
Mooney Viscosity of Polymer (ML 4 @ 212°F) min.		100
PH of Polymer		5.0

- ASTM D-244 Evaporation Test for percent of residue is calculated by heating 50 gram sample to 149°C (300°F) until foaming ceases, then cooling immediately.
- Test procedure identical with ASTM D-244 except that .02 Normal Calcium Chloride solution shall be used in place of distilled water.

- PC = Polar compounds; A<sub>1</sub> = First Acidifins; A<sub>2</sub> = Second Acidifins; S = Saturated Hydrocarbons
- Chemical composition by ASTM D-2006-70
- Light Transmittance minimum of 30 without the complete test method shown.

## Specifications/Testing<sup>1</sup>

The Texas A&M Transportation Institute, using samples of A.R.A.-1 Ti rejuvenating seal, studied the application of this Ti-enhanced emulsion to asphalt 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 A.R.A.-1 Ti compounds at five different application rates as indicated in the chart below. The NOx reduction efficiency of A.R.A.-1 Ti rejuvenating seal ranged from 48.26 to 61.12 percent; the effectiveness of the treatment was not linear. The NOx reduction efficiency of the control sample was negligible.

### NOx Reduction Efficiency

Compound	Control Sample	0.16 kg/m <sup>2</sup>	0.21 kg/m <sup>2</sup>	0.26 kg/m <sup>2</sup>	0.31 kg/m <sup>2</sup>	0.36 kg/m <sup>2</sup>
A.R.A.-1 Ti	4.12	52.78	58.61	61.12	53.44	48.26

<sup>1</sup> Laboratory Investigation of the Effect of TiO<sub>2</sub> Topical Treatments on Asphalt Specimens (Phase I) - Texas A&M Transportation Institute, September 2018.

## 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 8,899,871 B2



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