U.S. Department of Transporation

Federal Aviation Administration

Memorandum

Subject: **INFORMATION:** Engineering Brief No.62 Polymer Composite Micro-Overlay for Fuel-Resistant Wearing Surfaces

Date: December 20, 2002

From: Manager, Airport Engineering Division, AAS-100

Reply to Attn. of:

To: All Regions
Attn: Manager, Airports Division

Engineering Brief No. 62 provides information and guidance on using polymer composite micro-overlays to provide a fuel-resistant wearing surface for use on general aviation aircraft parking aprons.

The information in the brief is not to be construed as general approval by the Office of Airport Safety and Standards. The FAA considers the use of this brief on any Airport Improvement Program, or Passenger Facility Charge-funded project a modification to standards that requires approval at the FAA Headquarters level.

When this brief is used, this office requests notification and a note to the project files that Engineering Brief No. 62, "Polymer Composite Micro-Overlay for Fuel-Resistant Wearing Surfaces" was incorporated into the project specifications.

/signed/

Rick Marinelli

Attachment

ENGINEERING BRIEF NO. 62

POLYMER COMPOSITE MICRO-OVERLAY FOR FUEL- RESISTANT WEARING SURFACES

October 2002

A. GENERAL

Polymer composite micro-overlay (PCMO) technology is an application of polymer concretes over paving surfaces, especially asphalt. PCMOs are polymer-modified concretes containing latex or dry polymer, Portland cement (or other types of hydraulic cements), proprietary additives (pozzolans, plasticizers, air-entraining agents, etc.), and aggregate that are placed similar to asphalt and coal tar slurries. The thickness can range from 2 to 6mm (1/16 to 1/4 inch), depending on aggregate size and number of applications (lifts). PCMOs can have different physical and chemical-resistant properties, depending on the formulations used. They can also be pigmented to increase conspicuity for visual reference.

1. The PCMO product described in this report is E-Krete™ TOL 3000. It appears to be a viable surface-sealing product; however, several areas require additional investigation prior to its acceptance as a standard paving material. These include:

    a. Performance under various climatic conditions (i.e., freeze-thaw cycles) and upon exposure to a variety of aviation fluids and fuels;

    b. Material specifications;

    c. Mix design;

    d. Selection and standardization of laboratory tests for material evaluation, mix design, and acceptance testing;

    e. Development of a rapid quality control test for field verification of proper mixing and formulation;

    f. Skid resistance;

    g. Use of commercial slurry paving equipment for applying PCMO;

    h. Use of proprietary materials; and

    i. Propensity for surface cracking and crack repair protocol.

2. Based on laboratory and field performance tests conducted by the U.S. Army Engineer Research and Development Center since 1998, it appears that the TOL 3000 PCMO has an application for airport apron pavements. The manufacturer proposes PCMO as an alternative to asphalt slurry seals for surface sealing or

coal tar-based slurries for imparting fuel resistance to asphalt parking aprons. There may also be some benefit where tire scuff action during routine turning and braking operations causes surface abrasion and deterioration. *The manufacturer, however, does not recommend PCMO for application to an existing grooved pavement*. The manufacturer can design PCMO to yield highly skid-resistant surfaces, depending on the aggregate type and size (similar to an asphalt slurry seal). If properly placed, PCMO can also yield a "broomed" surface similar to a concrete pavement.

3. PCMO may be specified for use on apron pavements on a case-by-case basis. When this process is specified in a project, the engineer must furnish an economic analysis (as recommended in Appendix 1 of Advisory Circular 150/5320-6D, Airport Pavement Design and Evaluation), as well as evidence to show that equal or better performance can be achieved with PCMO than with conventional methods, commensurate with any increase in costs. For fuel-resistant surfaces, the manufacturer recommends two applications. Unless informed otherwise, the engineer at each location must monitor the area of application and provide an evaluation to the respective FAA Regional Office of the overall PCMO performance at the first anniversary of application.

4. According to a recent engineering evaluation of E-Krete surface treatment, the material provides numerous benefits, including reduced costs and superior performance when compared to a coal tar seal. Based on these results, it has been determined that further field trials of PCMO on asphalt-surfaced airfield pavements are both warranted and in the public interest.

B. PURPOSE

This engineering brief provides guidance on using an innovative polymer composite micro-overlay seal coat for fuel-resistant apron pavement surfaces. The U.S. Army Engineer Research and Development Center and the manufacturer collaborated to provide the attached specification.

C. DEFINITION

PCMOs are proprietary polymer-modified concretes containing latex polymer, Portland cement (or other types of hydraulic cements), proprietary additives, and aggregate. The material described in this engineering brief is E-Krete™ TOL 3000; Polycon, Inc, of Madison, MS, manufactures it. This brief is not intended to be exclusive of other products; however, sufficient test and project data must still be provided to demonstrate a minimum level of performance set by the Office of Airport Safety and Standards, the FAA Regional Airports Office, and the consulting engineer.

D. **BACKGROUND**

1. Polycon, Inc. manufactures and constructs non-petroleum and non-coal tar-containing water-based polymer composite pavement coatings. The company designs the E-Krete™ products to provide a wearing surface that is durable, abrasion-resistant, and fuel-resistant for sealing pavement surfaces. E-Krete is applied using a flooding/squeegee/brush technique. The contractor may apply a surface sealer (either solvent or water-based) to the E-Krete to enhance the fuel/oil/chemical resistance in areas where an additional level of protection is warranted (such as aircraft parking areas or fueling areas).

2. The laboratory testing performed by the U.S. Army Engineer and Research Development Center indicated that the kerosene (ASTM D2939) and abrasion resistance (ASTM D3910) of the TOL 3000 product exceeds that of a typical unmodified coal tar emulsion. Testing of TOL 3000 with kerosene, hydraulic fluid, and synthetic jet turbine fluid indicates that softening occurs with jet turbine fluid. However, testers noticed no adverse effects from either kerosene or hydraulic fluid in 96-hour exposure tests at 25°C (77°F). Other fluids/chemical have not been tested. The laboratory data and field data indicate that TOL 3000 is durable and resistant to weathering.

3. Overall, the TOL 3000 product appears to be a viable alternative to coal tar fuel-resistant sealer and asphalt slurry seal.

4. After satisfactory performance of the TOL 3000 in the laboratory, DoD conducted field trials. A test section was placed at the U.S. Army Engineering Research and Development Center in August 1998, and then at seven more locations around the country in October and November 1998: Norfolk Naval Station (Norfolk, VA), MacDill AFB (Tampa, FL), Tyndall AFB (Panama City, FL), Forbes Field (Topeka, KS), McConnell AFB (Wichita, KS), North Island NAS (San Diego, CA), and Edwards AFB (Barstow, CA). Thus far, the field demonstrations have been successful, with performance at or above expectations at all sites; however, this is based on only 2 to 3 years of testing with TOL 3000. The testers did observe that aviation fluids might have an effect. At McConnell AFB, they found that softening of the TOL 3000 product occurred when it came into contact with synthetic jet turbine fluid (MIL SPEC 7808K AM1 Grade 3 Synthetic Turbine Engine Fluid) at elevated temperatures. They observed a similar phenomenon at MacDill AFB, but the exact source of the fluid at this location is not known. The fluid was discharged from a KC-135 tanker and is suspected to be a synthetic jet turbine lubricating fluid. Both observations, however, may be highly unusual. As of November 2001, the TOL 3000 product had demonstrated generally good durability.

5. Frictional properties may be degraded. Incorporating a larger size aggregate into the mix design can increase the frictional resistance of TOL 3000. However, caution is required. The manufacturer does not recommend broadcast spreading of aggregate onto the TOL 3000 surface due to the potential for foreign object damage/debris (FOD).

E. **AREAS OF USE**

Engineers may specify PCMO for use on apron pavements as an alternative to coal tar and asphalt slurry seals on a case-by-case basis. The Office of Airport Safety and Standards must approve each project.

Please note: The sole FAA experience with this material, as of April 2002, has exhibited some cracking within one year. The extent and severity of cracking is presently characterized as "hairline" and appears to be located above longitudinal construction joints in the underlying pavement. There is no known crack repair method.

F. **USE OF ALTERNATE BIDS**

Field offices will strongly encourage sponsors to use alternate bid items, as noted in FAA Order 5100.38B, Airport Improvement Program Handbook dated May 31, 2002, Chapter 9, Procurement and Contract Requirements, paragraph 914. "Alternate Bids" for issuance of the Invitation for Bids (IFB) in order to identify the cost factors involved in the procurement process. The amount of Federal participation will depend on the manner in which the alternate bids are addressed in the IFB. If, in the IFB, the sponsor has not reserved the right to accept the low bid in either alternate or has not established an objective standard to be applied in making the award, the sponsor may award to the low bidder or the higher alternate bid if local policy allows; but the Federal participation will be based on the lowest responsive alternate bid.

ENGINEERING BRIEF NUMBER 62

POLYMER COMPOSITE MICRO-OVERLAY FOR FUEL- RESISTANT WEARING SURFACES

DESCRIPTION

This process shall consist of at least one application of a polymer concrete emulsion seal coat, with mineral aggregate, applied on an existing, previously prepared bituminous surface, in accordance with the specifications for the apron area shown on the plans or as designated by the engineer. The material is intended for use as a fuel-resistant asphalt pavement sealer on an apron surface. Note that for fuel resistance, the manufacturer recommends two applications.

MATERIALS

The materials described here are specific to the E-Krete™ TOL 3000 PCMO, and are designed to establish a minimum level for quality and quality control; however, we do not intend these requirements to exclude other materials. If another PCMO product is to be used, the engineer should develop specific criteria for that product. For all products, Material Safety Data Sheets (MSDS) must be made available upon request, and certification sheets that do not reveal proprietary information shall be made available to the consulting engineer verifying the composition of each separate material employed in the PCMO. For TOL 3000, this requires certificate of analyses (COA) for the polymer emulsion, aggregate, and cement/aggregate dry blend verifying that the materials meet the requirements, as outlined in Sections 2.1 thru 2.5. The COAs should be traceable to the batch/lot of materials received from the supplier of polymer emulsion and cement/aggregate mix. Batch/lot identification must be clearly marked on all packaging and traceable to a specific COA for that particular batch. Upon request, all COAs and batch/lot identifications must be made available to the consulting engineer, and must include all required information listed in Sections 2.1 thru 2.5, including allowable tolerances.

1. AGGREGATE: The aggregate will be either a natural or manufactured angular aggregate composed of clean, hard, durable, uncoated particles, free from lumps of clay and all organic matter. The aggregate must meet the criteria outlined in ASTM C33 and follow the gradation shown in Table 1, when tested in accordance with ASTM C144.

TABLE 1. GRADATION OF AGGREGATES

Sieve Size, US (metric)	Percentage By Weight, Passing Sieves	Allowable Tolerance, Percent
No. 8 (4.72 mm)	95 - 100	± 2
No. 16 (2.36 mm)	70 - 100	± 2
No. 30 (1.18 mm)	40 - 75	± 2
No. 50 (0.85 mm)	10 - 35	± 2
No. 100 (0.60 mm)	2 - 15	± 1
No. 200 (0.40 mm)	0 - 5	± 1

2. POLYMER EMULSION: The polymer emulsion is of proprietary design, according to the requirements of E-Krete™ TOL 3000. However, the solids content must be between 46.5 and 47.5 percent by weight of total liquid, and viscosity latex between 5 and 55 centipoises when measured at 25°C (77°F). Water content must not exceed 52% by weight of total latex liquid.

   Polymer emulsion is typically supplied in 5-gallon buckets. The allowable tolerance for the amount of polymer emulsion in each bucket is 5 ± 0.08 gallons or 44.1 ± 0.7 lbs. (20.0 ± 0.32 kg).

3. CEMENT: Cement for E-Krete™ must conform to the specifications of ASTM C150 for Type I Portland Cement.

4. WATER: The water used in mixing must be potable and free from harmful soluble salts. The temperature of the water added during mixing must be at least 10°C (50°F) and not above 32°C (90°F). The pH of the water added during mixing must conform to the requirements of the E-Krete™ manufacturer.

5. CEMENT/AGGREGATE DRY BLEND: The cement/aggregate dry blend used for TOL 3000 must conform to the specifications outlined in ASTM C387 for a Type M mortar. Cement content must be 33 ± 1.0 percent by weight of total dry mix and aggregate content must be 67 ± 1.0 percent by weight of total dry mix. The cement/aggregate dry blend comes prepackaged in 60 lb. (27.2 kg) bags. Weight tolerance is 60 ± 0.5 lbs. (27.2 ± 0.25kg) for each bag.

COMPOSITION AND APPLICATION

1. COMPOSITION: The TOL 3000 PCMO consists of a polymer emulsion, water, cement, and aggregate in proportions that fall within the ranges shown in Table 2. A "kit" of TOL 3000 refers to 75 gallons of polymer emulsion, 55 sixty-pound bags of cement/aggregate dry blend, and 10 gallons of water. A kit of TOL 3000 yields approximately 4500 feet of coverage (500 yards).

2. JOB MIX FORMULA: The contractor must submit the recommended formulation of water, emulsion, and cement/aggregate dry blend and application rate proposed for use to the engineer at least **[ ]** days prior to the start of operations. The mix design must fall within the range shown in Table 2. The contractor must not produce any seal coat for payment until the engineer has approved a job mix formula. The formulation must pass the fuel-resistance test in Appendix A.

   The job mix formula for each mixture will remain in effect until modified in writing by the engineer. Improper formulations of TOL 3000 PCMO will produce coatings that crack prematurely or do not adhere properly to the pavement surface. The manufacturer recommends a minimum of 5 days for job mix approval.

TABLE 2. JOB MIX FORMULA

Product Type	Polymer Emulsion, gallons (percent by weight of total mix)	Cement/Aggregate Dry Blend, weight in pounds (percent by weight of total mix) [Number of bags of dry mix]	Water, gallons (percent by weight of total mix)[a]	Application Rate [b], weight in pounds/square yard
TOL 3000	75 ± 0.5 (16.0% ± 0.1)	3300 ± 55 (81.9% ± .1.36) [55]	10 ± .25 (2.1% ± 0.05)	0.90 ± 0.1

[a]This may be increased to no more than 15 gallons total to account for evaporative water loss if applied on a hot, windy day (see Item 5.1).

[b]This is an average application rate for many pavement types; the actual application rate may be outside this suggested range, depending on the surface properties of the pavement to be sealed.

3. APPLICATION RATE: The PCMO seal coat must be applied in one or two coats, depending on the application. The application rate and number of applications will match those shown on the project plans. The application rate submitted with the job mix formula shall be verified during placement of the test section; the rate must fall within the limits shown in Table 2. In areas the engineer thinks may be subjected to fuel spillage, a double coat of TOL 3000 may be placed at the same application rate as listed in Table 2.

TEST SECTION

Prior to full production, the contractor will prepare a quantity of mixture in the proportions shown in the approved mix design. The amount of mixture must be sufficient to place a test section a minimum of 250 square yards at the rate specified in the job mix formula. Although the engineer will designate the area to be tested, it must be on a representative section of the pavement to be seal coated. The engineer will determine the actual application rate during placement of the test section, depending on the condition of the pavement surface. From this test section the engineer will verify the adequacy of the mix design and determine the application rate. The contractor must use the same equipment and method of operations on the test section as will be used on the actual area of application. If the test section should prove to be unsatisfactory, the necessary adjustments to the mix composition, application rate, placement operations, and equipment will be made. Additional test sections shall be placed and evaluated, if required. Full production will not begin without the engineer's approval. Acceptable test sections shall be paid for in accordance with Section 3.

* *

The test section affords the contractor and engineer an opportunity to determine the quality of the mixture in place as well as the performance of the equipment. The section must be free of pinholes, air bubbles, inconsistent thickness, lumps, and other visible defects.

The application rate depends on the surface texture. If operational conditions preclude placement of a test section on the pavement to be seal coated, it may be applied on a pavement with similar surface texture.

A minimum of three field fuel-resistance tests (see Appendix B) should be conducted at locations selected by the engineer. All tests should receive a "pass" rating. If they do not, the surface cannot be considered fuel-resistant, and the PCMO should not be used in areas where fuel spillage may occur.

* *

CONSTRUCTION METHODS

1. WEATHER. TOL 3000 must not be applied when the surface is wet or when humidity or impending weather conditions will not allow proper curing. The contractor must only apply the PCMO when the atmospheric or pavement temperature is 55°F (12.7°C) and rising and expected to remain above 55°F (12.7°C) for 24 hours, unless otherwise directed by the engineer. Pavement temperatures should not exceed 120°F (49°C) to limit water loss by evaporation. Ideal conditions for placement are 60° to 90°F (15° to 32°C) and humidity levels between 50 and 60 percent. TOL 3000 should be allowed to cure a minimum of 4 hours, with 24 hours recommended before application of traffic.

2. EQUIPMENT AND TOOLS. The contractor must furnish all equipment, tools, and machinery necessary for the performance of the work.

   a. Mixers. For batch mixing, the mix tank must have a mechanically powered, full-sweep mixer with sufficient power to move and homogeneously mix the entire contents of the tank. For continuous mixing, the machine shall be capable of accurately delivering a predetermined proportion of cement/aggregate dry blend, water, and polymer emulsion, and of discharging the thoroughly mixed product on a continuous basis. The mixing unit shall be capable of thoroughly blending all ingredients together and discharging the material to the spreader box without segregation.

   b. Spreading Equipment. The TOL 3000 application unit consists of proprietary equipment designed to apply the coating at a precise thickness. The unit has a series of rubber and stainless spring steel blades. The rubber blades have a specific durometer hardness that allows the material to pass underneath without completely wiping the material off the surface of the pavement. The stainless steel blades are notched and separated so that an uneven base will not affect the micro-overlay. A brush feathers the material as it is overlapped on subsequent passes to reduce buildup from overlap. The operator must keep the unit clean, and not allow any TOL 3000 buildup.

c. Calibration. The contractor will furnish all equipment, materials, and labor necessary to calibrate the equipment. The calibration will assure that the unit will produce and apply a mix that conforms to the job mix design and deliver the application rate specified in Table 2. The contractor will make calibrations with the approved job materials prior to applying the seal coat to the pavement and will use this calibration on the test section (see Item 4). The contractor will furnish a copy of the calibration test results to the engineer.

3. PREPARATION OF PAVEMENT SURFACE. The contractor must remove bituminous pavement surfaces softened by petroleum derivatives or that have failed due to any other cause to the full depth of the damage and replace these surfaces with new bituminous concrete similar to that of the existing pavement. Areas of the pavement surface to be treated must be in a firm consolidated condition, and sufficiently cured so there is no concentration of oils on the surface.

A period of a minimum of **[ ]** days must elapse between the placement of a bituminous surface course and the application of the seal coat.

* *

The engineer must specify the time period. In order to ensure adequate adhesion and minimize cracking and curling, the pavement surface must be sufficiently cured prior to application of the seal coat. Experience has shown that approximately 90 days of hot weather (daytime temperatures of 70°F) is needed for adequate curing. To determine if the pavement has cured adequately, the engineer can pour a cup of water on the pavement surface (on a warm day) and observe if any oils appear in the standing water. If oils appear, the surface is not sufficiently cured to accept a seal coat.

* *

4. CLEANING EXISTING SURFACE. Prior to placing TOL 3000, the contractor must ensure the pavement is clean and free from dust, dirt, or other loose foreign matter, grease, oil, or any type of objectionable surface film. When directed by the engineer, the contractor must clean the existing surface with a vacuum sweeper or a combination of wire brushes and a power blower. The manufacturer recommends the vacuum sweeping method.

a. Where vegetation exists in cracks, the contractor must remove the clean cracks to depth of two inches where practical, and then treat them with a concentrated solution of an herbicide approved by the engineer. Cracks shall then be **[ ]**. The contractor must also cure brush areas that have been subjected to fuel or oil spillage to remove any dirt accumulations.

* *

The Engineer must specify the appropriate method of treating cracks. Depending on the frequency and severity of the cracks, this may

include filling or routing and filling with a compatible crack filler, filling with a sand slurry at the time it is applied to the pavement surface, milling, etc. Polycon manufactures a spall repair product, OSR 2000, that the engineer may consider as part of the crack repair process. Polycon recommends as preparation prior to crack filling, routing followed by a thorough cleaning of the crack faces using high-pressure water followed by compressed air to dry.

* *

5. CURING. The contractor must permit the mixture to cure for a minimum of **[ ]** hours after the final application before opening the area to traffic. The area must be sufficiently cured to drive over without damage to the seal coat, and any damage to the uncured mixture due to early traffic will be the responsibility of the contractor to repair. TOL 3000 contains Portland cement, and although an initial set occurs within a few hours that provides enough strength to accept traffic, ultimate strength requires 28 days of cure time.

* *

Although TOL 3000 requires a minimum of 4 hours to reach an initial set, the manufacturer recommends 24 hours before opening the area to traffic, where possible.

* *

6. HANDLING. The contractor must continuously agitate the mixture from the initial mixing until its application on the pavement surface. The contractor must maintain the distributor or applicator, pumps, and all tools in satisfactory working condition.

QUALITY CONTROL

1. CONTRACTOR'S CERTIFICATION. The Contractor must furnish the manufacturer's certification that each consignment of materials shipped to the project meets the requirements of Item 2 for polymer emulsion, aggregate, cement, and cement/aggregate blend. The contractor must deliver the certification to the engineer prior to the beginning of work, but must not interpret the manufacturer's certification for the emulsion as a basis for final acceptance. Any certification received shall be subject to verification by an independent laboratory for materials received for project use as required by the engineer. The contractor shall also furnish a certification demonstrating a minimum of three years of experience in the application of a PCMO.

2. FIELD MIXING. The contractor must monitor each batch of material prepared for placement, and keep written records of the number of bags of dry mix, amount of polymer emulsion and water used for each batch. In addition, the contractor must keep records of air temperature, pavement temperature (as measured by an infrared sensing device), wind velocity (speed and direction), and humidity. The engineer will have access to these records upon request. For each airport feature receiving

PCMO, the engineer will keep a record of which batch was used in a particular location as well as the amount of coverage expressed in square feet per “kit”.

3. INSPECTION. The contractor must have an independent technical consultant on the job site at the beginning of operations. The consultant must have knowledge of the materials, procedures, and equipment described in this specification and will assist the contractor in the proper mixing of the component materials and application of the TOL 3000. The consultant must have a minimum of 3 years experience in the use of PCMO. The consultant must provide documentation of this experience to the engineer prior to the start of operations. The contractor must include the cost of the technical consultant in the bid price.

4. SAMPLING. The engineer will take a random sample of two bags of the dry mix and two gallons of polymer emulsion daily, and place the samples in a glass or plastic container. The engineer must seal the sample bags of dry mix inside a plastic bag or 5-gallon bucket to prevent humidity from damaging the Portland cement in the dry mix. All sample containers must be sealed against contamination and stored by the owner for a period of one year, at room temperature in a place not subject to freezing temperatures. The engineer will conduct a sampling of a random batch without the contractor’s prior knowledge.

5. PROJECT RECORDS. The engineer shall maintain written records of the number of bags of dry mix, amount of polymer emulsion, and water for each batch. In addition, records of air temperature, pavement temperature as measured by an infrared sensing device), wind velocity (speed and direction), and humidity shall be maintained. For each airport feature receiving PCMO, a record of which batch was used in a particular location shall be kept. Records of the amount of coverage expressed in square feet per “kit” shall be maintained.

METHOD OF MEASUREMENT

1. The dry mix (cement/aggregate blend) shall be measured by the ton (kg).

2. The polymer emulsion shall be measured by the gallon (liter).

3. Water shall be measured by the gallon (liter).

BASIS OF PAYMENT

1. The airport will make payment to the contractor at the contract unit price per square yard for the PCMO. These prices will fully compensate the contractor for furnishing all materials; and for all labor, equipment, tools, and incidentals necessary to complete the application process.

TESTING REQUIREMENTS

1. Dry Mix:

   a. ASTM C387, “Standard Specification for Packaged, Dry Combined Materials for Mortar and Concrete”

   b. ASTM C33, “Standard Specification for Concrete Aggregates”

   c. ASTM C144, “Standard Specification for Aggregate for Masonry Mortar”

   d. ASTM C150, “Standard Specification for Portland Cement”

2. PCMO Blend: See Appendix A.

WARRANTY

1. Polycon, Inc., offers a 10-year warranty against wear, delamination caused by improper application, and the breach of the TOL 3000 by fuels and hydraulic fluid. The company also offers a limited 5-year warranty against breach of the TOL 3000 by synthetic jet turbine fluids. These warranties apply only to a properly prepared surface (see Items 5.3 and 5.4) and do not cover reflective cracking from the substrate underlying TOL 3000.

APPENDIX A

LABORATORY FUEL-RESISTANCE TEST

1. Scope:

   a. This method determines the resistance of the PCMO to kerosene. This procedure is found in Section 25 of ASTM D2939, "Standard Test Methods for Emulsified Bitumens Used as Protective Coatings." In order to accommodate PCMO, some slight modifications to the standard method have been made.

2. Apparatus:

   a. Two 6-inch-by-6-inch square 16-gauge sheet metal masks with a 4-inch-by-4-inch square center removed.

   b. One 6-inch-by-6-inch unglazed white ceramic tile with an absorption rate of 10 to 18 percent (determined in accordance with ASTM C67).

   c. Brass ring, 2-inch diameter and 2 inches high.

   d. Kerosene meeting requirements of ASTM D3699.

   e. Silicone rubber sealant or fast-setting epoxy.

3. Procedure:

   a. Immerse the ceramic tile in distilled water for a minimum of ten minutes.

   b. Remove excess water from the tile to produce a damp surface before applying the seal coat.

   c. Using the mask described in 2a, apply one layer of the PCMO blend (as mixed according to Section 3.3). Spread the PCMO even with the top of the mask using a spatula or other straight edge.

   d. Allow the sample to cure for 24 hours at 77 + 2 degrees and 50 + 10 percent relative humidity.

   e. Position a second mask on top of the first mask. Apply a second coat of PCMO emulsion mixture. Spread even with the top of the second mask.

   f. Cure as in step 3d.

   g. After curing, affix the brass ring to the seal coat on the tile with silicone rubber or epoxy. Epoxy often adheres better to the TOL 3000 than silicone.

   h. Fill the brass ring with kerosene. Add a small amount of coloring to the kerosene; asphalt works well for this. The coloring may be necessary to determine if the kerosene breached the PCMO surface.

i. After 24 hours, remove the kerosene from the brass ring, blot dry, and immediately examine the film for softness and loss of adhesion. Immediately after the film is examined, break the tile in half, exposing that part of the tile with the film that was subjected to the kerosene.

j. Evaluate for penetration of kerosene through the sealer and loss of adhesion.

4. Report:

a. Report the results as “pass” or “fail.” Visible evidence of leakage through, or discoloration in, the tile constitutes failure of the test.

5. Criterion:

A "pass" rating in the fuel-resistance test is required.

APPENDIX B

FIELD FUEL-RESISTANCE TEST

1. Scope:

   a. The manufacturer recommends this field method to verify the resistance of the PCMO to aviation fuel. This procedure is adapted from a field test proposed for use with coal tar materials. The engineer has made some slight modifications to the method to accommodate PCMO. This test is best conducted in conditions of little wind and moderate temperatures (around 70° to 75°F or 21° to 24°C).

2. Apparatus:

   a. A 152-mm diameter metal, glass, or PVC pipe at least 76-mm long.

   b. A lid for the pipe.

   c. RTV silicone rubber sealant or fast-setting epoxy for affixing the pipe to the pavement surface.

   d. Silicone rubber sealant or fast-setting epoxy.

   e. A ruler.

3. Procedure:

   a. Locate a clean, flat surface on the pavement to be tested.

   b. Place the pipe on the pavement surface, and seal the edge with silicone or epoxy. Firmly mold the adhesive between the pipe and the surface of the pavement to prevent leakage.

   c. Allow the adhesive to cure for 24 hours.

   d. Pour approximately 1 inch of aviation fuel or kerosene inside the pipe. Record this distance. Place the lid on the tope of the pipe.

   e. After 30 minutes, remove the lid and measure the distance from the tope of the fluid to the top of the pipe. Record this distance.

   f. If seepage occurs between the bottom of the pipe and the pavement surface through the adhesive, the test is invalid and must be repeated in a different location.

4. Report:

   a. Report the distance from the surface of the fluid to the tope of the pipe immediately after placing the fluid and after 30 minutes. Determine the difference between the two readings. If less than 0.2 inches (5mm) of fluid has penetrated the surface, give a “pass” rating. If more than 0.2 inches (5mm) of fluid penetrates the surface, the pavement surface “failed” and may be unacceptable for fuel resistance.

5. Criterion:

   A “pass” rating in the fuel-resistance test is required.