DEPARTMENT OF THE ARMY
ENGINEER RESEARCH AND DEVELOPMENT CENTER, CORP OF ENGINEERS
GEOTECHNICAL AND STRUCTURES LABORATORY
WATERWAYS EXPERIMENT STATION, 3909 HALLS FERRY ROAD
VICKSBURG, MISSISSIPPI 39180-8199

January 22, 2001

Mr. Jack Wilson
Chairman
Polycon, Inc.
P.O. Box 2023
Madison, MS 39130

Dear Mr. Wilson:

This letter is to provide you with an update on the joint research project being conducted under a Cooperative Research and Development Agreement between the US Army Engineer Research and Development Center and Polycon, Inc.

Summary

The conditions of the PermaStripe™ and E-Krete™ were generally in excellent condition except in areas where the products were subjected to severe treatment (such n under B-1B aircraft). Adhesion to underlying substrates was strong and skid resistance typically measured at or above common asphalt concrete as measured by the British Pendulum Tester. Reflective cracking was the most noted distress and is a problem with the underlying substrate. Slight failing of the colors of PermaStripe™ was noted. Overall, the Polycon, Inc. products were in excellent condition and performing above expectations in several locations. The products resist weathering very well, prevent raveling from crack faces, and cracking of the materials appears to be controlled by the underlying substrate. Prevention of raveling from crack faces is important for military airfield applications for prevention of FOD (Foreign Object Damage).

Discussion

In 1998, demonstrations of Polycon, Inc. products were placed at eight military sites under the guidance of the US Army Corps of Engineers. These demos were prompted after a range of laboratory tests revealed that Polycon's E-Krete™ product was superior in fuel resistance, abrasion, and weathering resistance compared to common coal-tar based fuel resistance sealer products. The demonstrations were intended to place the Polycon products under a wide range of environmental conditions with heavy aircraft loads and hydraulic fluid spills. The products were often placed on severely cracked and failing surfaces with the intention of yielding some information pertaining to the envelope under which these materials would fail.

In the fall of 2000, all eight demonstration sites were visited to conduct condition surveys, and measure adhesion (ASTM D4541 using the elcometer), and skid resistance (ASTM E303 using the British Pendulum Tester). A brief statement about the experiences at each location follow:

1. US Army Engineer Research and Development Center, Vicksburg, MS — placed on July 1998. Condition - Excellent - receives very little traffic but has been subjected to pivot steers of a 60-ton M-60) tank and diesel fuel spills. Adhesion tests pulled up the underlying asphalt. Skid resistance was in the 60-65 range, the adjacent asphalt (Corps of Engineers Heavy-Duty

Airfield Asphalt Design) measured in the 55-60 range.

2. Tyndall AFB, Panama City, FL - placed in October 1998. A PermaStripe™ stopbar was placed in the Air Force Civil Engineering Service Center (AFCESA). Condition was excellent until a marking crew placed standard road marking paint over the top of the PermaStripe™. An E-Krete™ pad was placed in the fuel station west of the runways. It is subject to heavy military aviation fuel trucks and light-duty pickup trucks. Condition is excellent showing almost no wear or damage from repeated fuel spills and traffic. Base personnel commented on the case of cleaning the E-Krete surface with simple detergent, water, and a broom. Stains from fuel and oil spills were easily removed in this manner. Adhesion was strong, skid resistance was similar to asphalt.

3. MacDill AFB, Tampa, FL - A PermaStripe™ line approximately 40 feet long was placed on Taxiway L. Aircraft traffic only (KC-135 tankers) Condition was excellent (no cracking or wear-evident with reflective beads still intact) with the conventional marking paint (3 years old) on either side of the PermaStripe™ showing significant cracking. Two E-Krete™ sections (each approximately 75 ft by 75 feet) were placed at fuel Pit 25 and were in excellent condition and looked brand new except for some reflective cracks that had propagated up from a severely map-cracked coal-tar surface. It was noted that many of the reflective cracks in the coal-tar layer did not propagate up through the E-Krete™ layer. In several locations, the crack in the coal-tar butted up to the edge but did not reflect through the E-Krete™ layer. Minor staining revealed evidence of fuel spills. Adhesion tests pulled up the underlying coal-tar. Skid resistance was similar to asphalt.

4. Norfolk Naval Station, Norfolk, VA - placed in October 1998. E-Krete™ area approximately 100ft by 100ft with PermaStripe™ around the aircraft tie-downs. Aircraft traffic only (E-6). Numerous fuel and hydraulic fluid spills had occurred. Condition was excellent with considerable staining and some pooling of hydraulic fluid evident. PermaStripe™ has delaminated in some areas probably due to wicking of pooled hydraulic fluid under the tie-downs. Adhesion tests pulled up the underlying coal-tar. Skid resistance was similar to asphalt.

5. Edwards AFB, CA - Placed in November, 1998. An E-Krete™ area approximately 20 ft by 20 ft was placed in the parking lot of the Civil Engineering office. Condition - Excellent with reflective cracks from the underlying asphalt. Car traffic only. PermaStripe™ markings were placed on Rosemond Ave. on base. "Stop" and "Stop Ahead" markings showed reflective cracks and staining from vehicle tires. Car and truck traffic. Condition-Excellent. Skid resistance was similar to asphalt.

6. North Island NAS, San Diego, CA - Placed in November, 1998. E-Krete™ area is approximately 50 ft by 50 ft with a PermaStripe™ white line around the perimeter and a yellow PermaStripe™ line down the middle. Light-duty aircraft (C-12) use only. Condition-

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Excellent with reflective cracks from the underlying asphalt. Skid resistance was similar to asphalt.

7. Forbes Field, Topeka, KS - Placed in November 1998, two E-Krete™ areas. One are approximately 75ft by 75 ft and the other approximately 20 ft by 20 ft. Both of these were placed on top of a severely failed coal-tar fuel resistant sealer that was delaminating from the asphalt base. Condition - Excellent, however, severe reflection cracking from the coal-tar substrate is evident. Whitening of the E-Krete™ surface adjacent to the cracks has occurred. The third area is a PermaStripe™ "red-carpet" section (a red section outlined in white) approximately 30 ft long by 12 feet wide placed on concrete. Condition - Excellent with reflective cracks, slight color fading apparent, some staining is apparent. Aircraft traffic only, KC-135 tankers. Adhesion tests pulled up the underlying coal-tar. Skid resistance was similar to asphalt. As with the test section at MacDill ATB, many of the reflective cracks do not propagate through the E-Krete™, only the most severe cracks do.

8. McConnell AFB, Wichita, KS - Placed in November, 1998. Three E-Krete™ "pads" approximately 15 ft by 15 ft in diameter. All three were placed on recent concrete about two months old but with substantial hydraulic fluid staining. Areas were pressure washed only before E-Krete™ placement. Condition-Fair. Approximately 15-20% of the E-Krete™ surface has delaminated, with severe staining from hydraulic fluid. Delamination of the E-Krete™ likely occurred from poor adhesion due to existing hydraulic fluid already present on the concrete and proceeded from the joints towards the center of the concrete slab. It appears that using E-Krete™ to resist high temperature and prevent hydraulic fluid ingress into the concrete base is a viable and economical solution to prevent concrete damage under B-1B aircraft. Adhesion and skid testing were not performed. However, it must be noted that this is the most demanding of conditions. The pads are directly underneath the B-1B aircraft APU (auxiliary power unit) exhaust and reach temperatures between 300 and 450°F. A constant drip of hydraulic fluid and water condensate combined with the high temperatures cause concrete to crack and severely spall. At high temperatures, the esters (a chemical component of hydraulic fluids) react with the cement paste, causing a weakening of the concrete. This is exacerbated by the thermal cycling of the concrete and pore pressures due to volatilization of the hydraulic fluid. Typically, concrete slabs under B-1B aircraft are to be replaced every 2-3 years under normal operating conditions

Sincerely,

J. Kent Newman, PhD
Research Physical Scientist
Airfields and Pavements Branch