# EVALUATION OF DYNAMIC FRICTION AND SURFACE TEXTURE OF E-KRETE® MICRO-OVERLAY MATERIAL

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**August, 2008**

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## DISCLAIMER

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## 1. BACKGROUND

PolyCon Manufacturing, Inc. (hereinafter referred to as PolyCon) developed a micro-overlay product named E-Krete® in 1996. The E-Krete® is a water-based polymer latex composite coating containing aggregate. The product is designed to provide a friction and wearing surface that is resistant to abrasion and fuel.

The E-Krete® product was first evaluated at the U.S. Army Engineer Research and Development Center (ERDC) from June 1998 through November 2000. The study focused on the application of the E-Krete® product on airfield pavements. The evaluation included a laboratory study and field demonstrations. The laboratory study consisted of evaluations of the E-Krete® material's resistance to fuels, deicing chemicals, freeze-thaw, and abrasion. The field demonstrations included installations of E-Krete® at ERDC and seven airfields around the country. The study estimated that the service life of E-Krete® would be approximately 10 years in areas with light traffic. The E-Krete® product exhibited good fuel and weathering resistance (*1*).

Recently, there has been a growing interest in sound pavement preservation strategies that not only reduce life cycle costs but also result in better overall road conditions under heavy highway traffic. Desired improvements relate to pavement-tire friction for added safety, tire-pavement interaction for reducing the traffic noise level near the roadside, and solar reflectivity of the surface for reducing urban heat island (UHI) effects in urban areas. However, the information about the durability, friction, noise and surface reflectivity characteristics of the E-Krete® product under heavy traffic is not readily available; thus, this study is initiated to provide this information.

## 2. OBJECTIVE

The overall objective of this study is to investigate the use of the E-Krete® product as a pavement surface using a laboratory study and accelerated pavement testing facility. This study focuses on the performance of friction, noise, and solar reflectivity characteristics of the E-Krete® product under heavy traffic over time. This project is divided into two phases. Phase I includes a laboratory testing program. Phase II is a field study at the NCAT Pavement Test Track. A set of objectives is defined below for each phase.

The objective of Phase I was to:

- Evaluate the friction and surface texture characteristics of an E-Krete® treated surface by comparing these characteristics with those of a new hot-mix asphalt (HMA) surface before and after they were polished using the three wheel polishing device (TWPD); and
- Estimate the friction and surface texture characteristics of the E-Krete® treated surface in the field based on laboratory testing results.

The objectives of Phase II are to:

- Evaluate the performance of the E-Krete® product as a friction and wearing surface through a field study at the NCAT Pavement Test Track;
- Evaluate the tire-pavement interface noise and solar reflectivity properties of an E-Krete® treated surface; and

- Incorporate any needed modifications and/or additional information to the findings in Phase I.

Phase I of this study has been completed; results of Phase I are presented in this report.

## 3. LABORATORY TESTING

This section describes testing conducted in the NCAT laboratory in Phase I to compare the friction and surface texture characteristics of an E-Krete® treated surface with those of a new HMA surface before and after they were polished using the TWPD.

### 3.1 Preparation of Testing Slabs

Two slabs—508 mm (20 in.) by 508 mm (20 in.) and approximately 50 mm (2 in.) thick—were compacted to 7 ± 1% air voids in the laboratory using a kneading slab compactor. The HMA material used for preparing these slabs was sampled during the construction of the NCAT test track in 2006. The mix had a nominal maximum aggregate size (NMAS) of 9.5 mm. This mix has been used as a wearing course and tested at the test track.

After the two slabs were prepared, the surface of one slab was treated with the E-Krete® material. Figure 1 shows the application of the E-Krete® product on this slab in the laboratory. As recommend by PolyCon, the E-Krete® treated surface was cured for several days before testing.

**FIGURE 1 Application of E-Krete® product on HMA slab in laboratory.**

### 3.2 Testing of Two Slabs

The two slabs—one with the E-Krete® surface and the other with a new HMA surface—were then polished using the TWPD in the laboratory, as shown in Figure 2. The TWPD polished the surfaces of two slabs in a wet condition with a tire inflation pressure of 345 kPa (50 psi), an applied load of 52.5 kg (105 lbs) and at a speed of 40 rpm. This loading configuration has been used in several studies, including an ongoing study sponsored by the Federal Highway Administration (FHWA). Polishing of the two slabs was applied up to 132,000 cycles with dynamic friction tester (DFT), circular texture meter (CTM), and wear depth measurements conducted at predetermined intervals of 0, 500, 1000, 2000, 4000, 8000, 16000, 32000, 64000, and 132000 cycles. The surfaces of these slabs were dried prior to CTM tests at each testing interval. Figures 3 and 4 show the DFT and CTM units used in this study, respectively. The DFT test was conducted according to ASTM E 1911, and the CTM test was performed in compliance with ASTM E 2157.

**FIGURE 2 Polishing E-Krete® surface using TWPD in laboratory.**

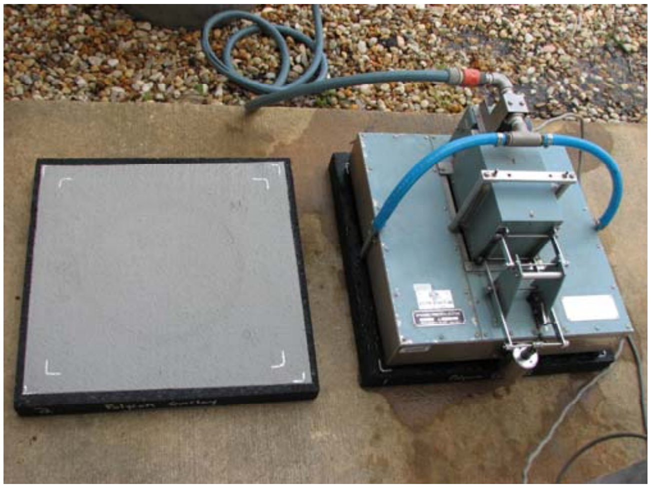

**FIGURE 3 Dynamic Friction Tester on HMA next to E-Krete® surface.**

**FIGURE 4 Circular Texture Meter on E-Krete® surface next to HMA.**

## 4. TEST RESULTS AND ANALYSIS

### 4.1 DFT Results

Detailed results of the DFT tests are presented in Tables A.1 and A.2 in Appendix A. Figures 5 and 6 summarize the DFT friction results at various speeds from zero to 80 km/h (0 to 50 mph) over 132,000 polishing cycles. For both slabs, the friction number did not change significantly after 64,000 polishing cycles. The DFT friction results at speeds other than 0 km/h (0 mph) exhibited an initial spike in friction very soon after the onset of polishing associated with removal of binder and mastic film from the surfaces of the control and E-Krete® slabs, respectively.

Figures 7 through 11 compare the DFT friction number from 0 km/h (0 mph) through 80 km/h (50 mph). The DFT friction numbers measured at 0 km/h (0 mph) for the E-Krete® slab were higher than that of the control slab. At other speeds, the E-Krete® slab had lower DFT friction values prior to approximately 64,000 polishing cycles but exhibited higher DFT friction numbers beyond the 64,000 polishing cycle. The results showed that the friction characteristics of the E-Krete® surface increased after the initial polishing and were stable throughout the laboratory testing. In general, the E-Krete® surface performed as well as the control surface in terms of friction under the laboratory testing conditions.

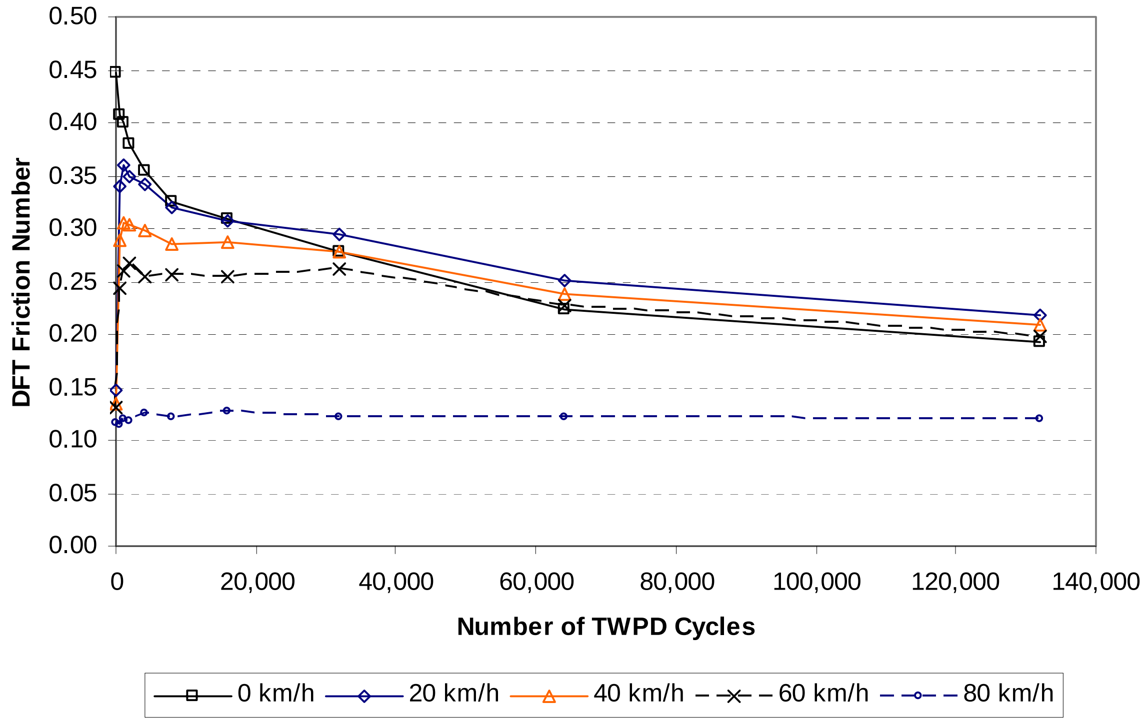


**FIGURE 5 DFT results for control slab.**

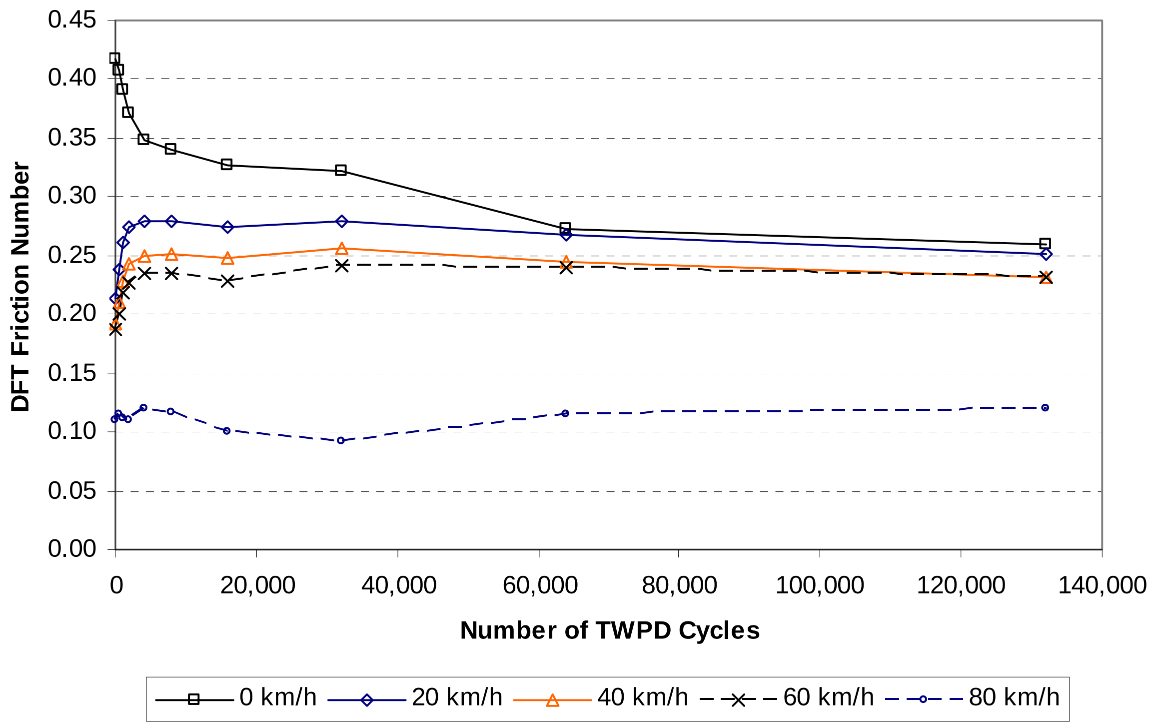


**FIGURE 6 DFT results for E-Krete® slab.**

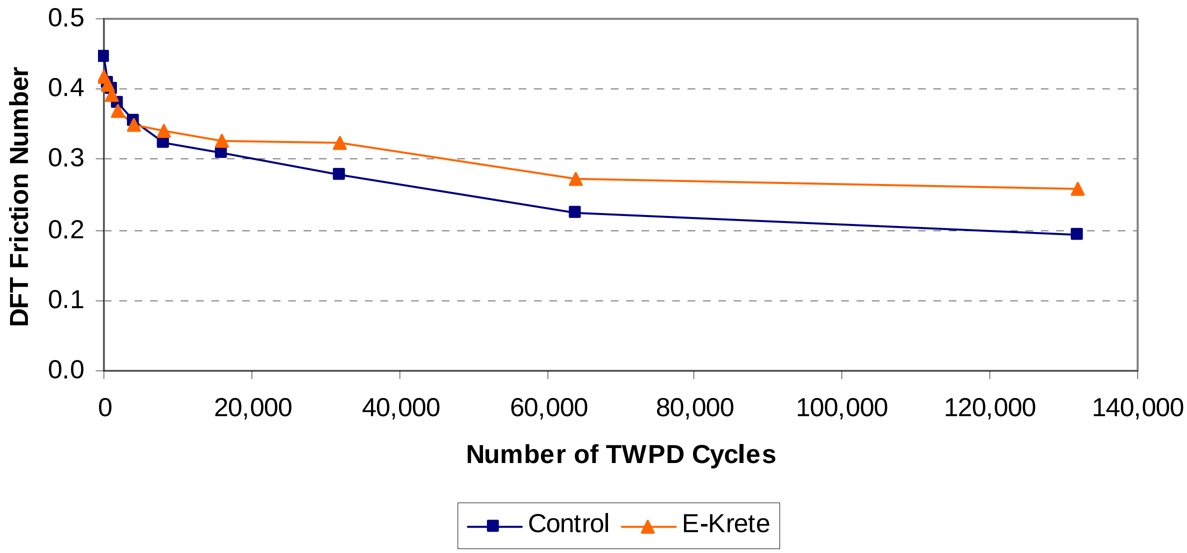


**FIGURE 7 DFT results for control and E-Krete® slabs measured at 0 km/h (0mph).**

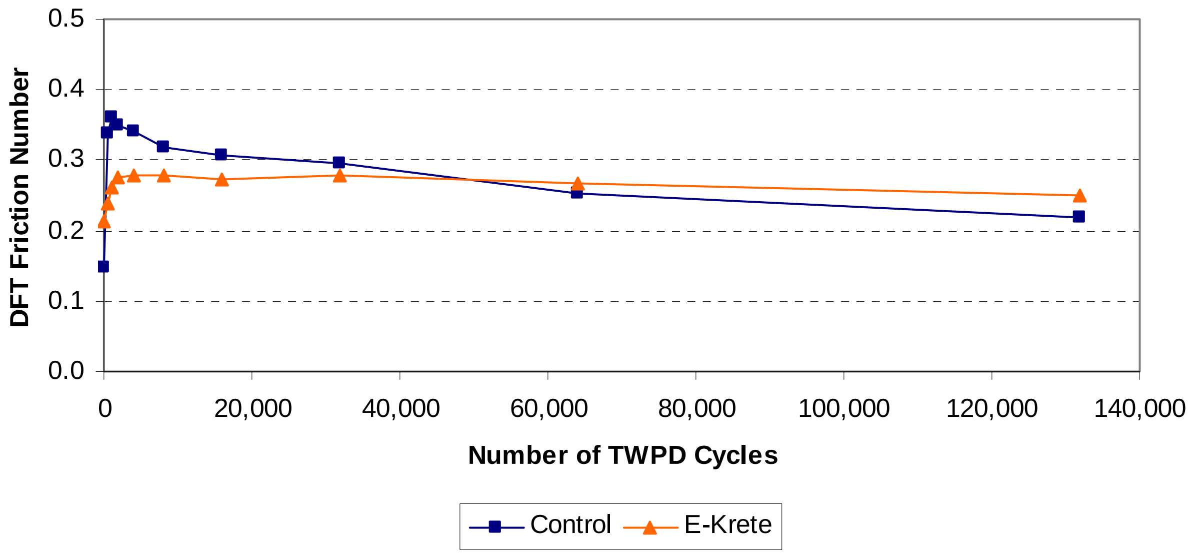


**FIGURE 8 DFT results for control and E-Krete® slabs measured at 20 km/h (12 mph).**

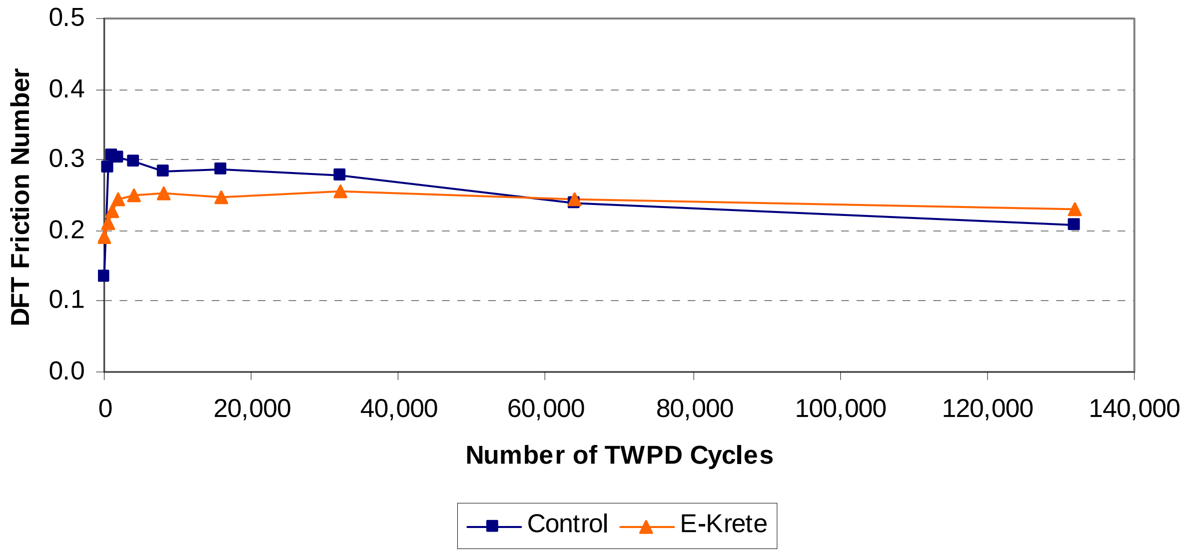


**FIGURE 9 DFT results for control and E-Krete® slabs measured at 40 km/h (25 mph).**

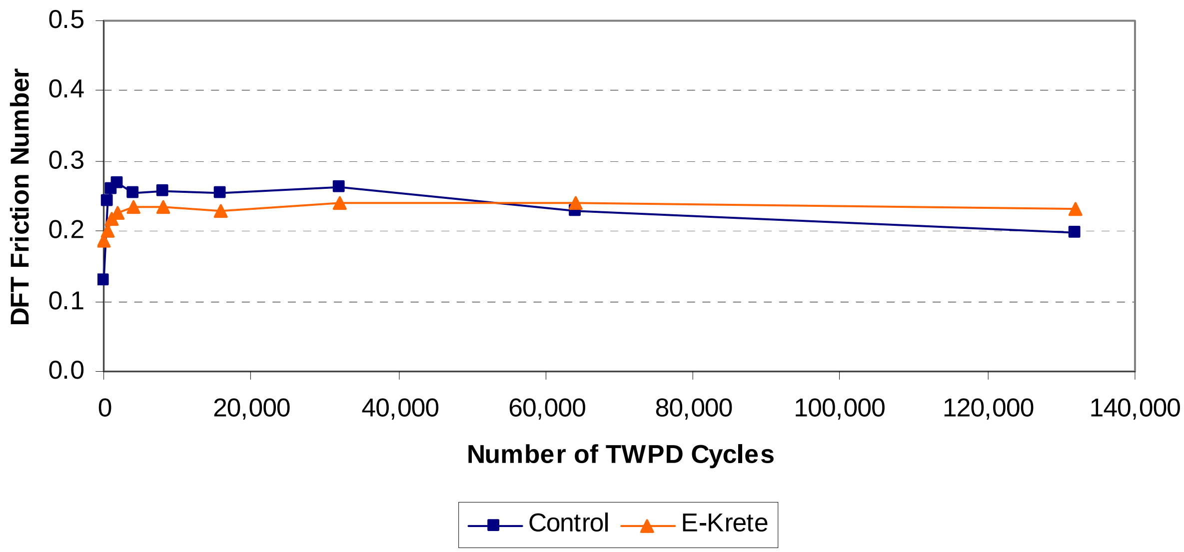


**FIGURE 10 DFT results for control and E-Krete® slabs measured at 60 km/h (37 mph).**

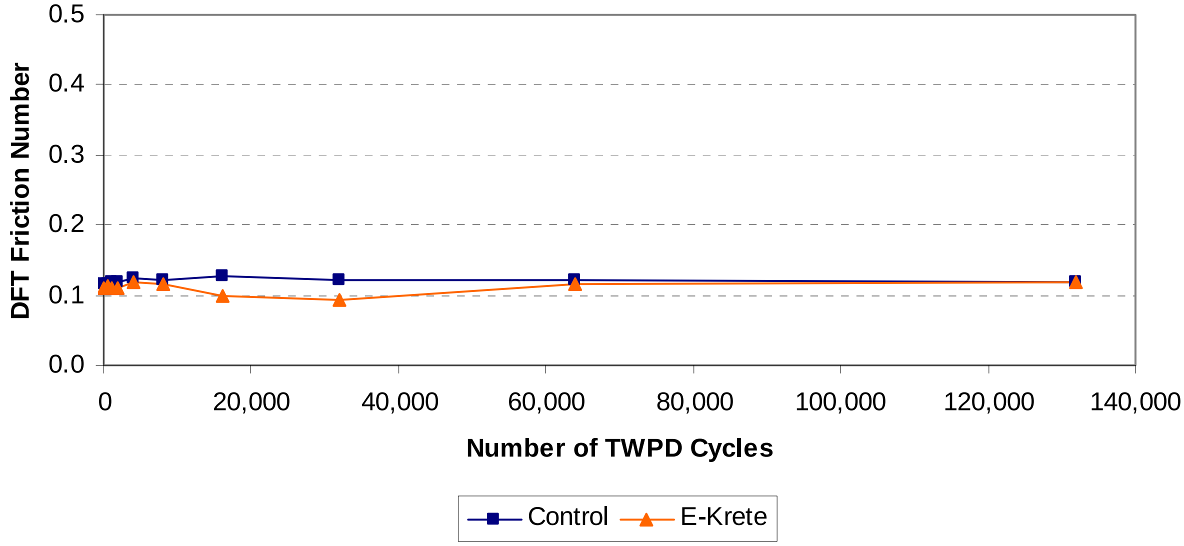


**FIGURE 11 DFT results for control and E-Krete® slabs measured at 80 km/h (50 mph).**

### 4.2 CTM Texture Results

Detailed results of the CTM tests are shown in Tables A.3 and A.4 in Appendix A. Figure 12 summarizes the surface texture (expressed as the mean profile depth) measurements for both slabs. The surfaces of the two slabs exhibited similar texture measurements after 64,000 polishing cycles.

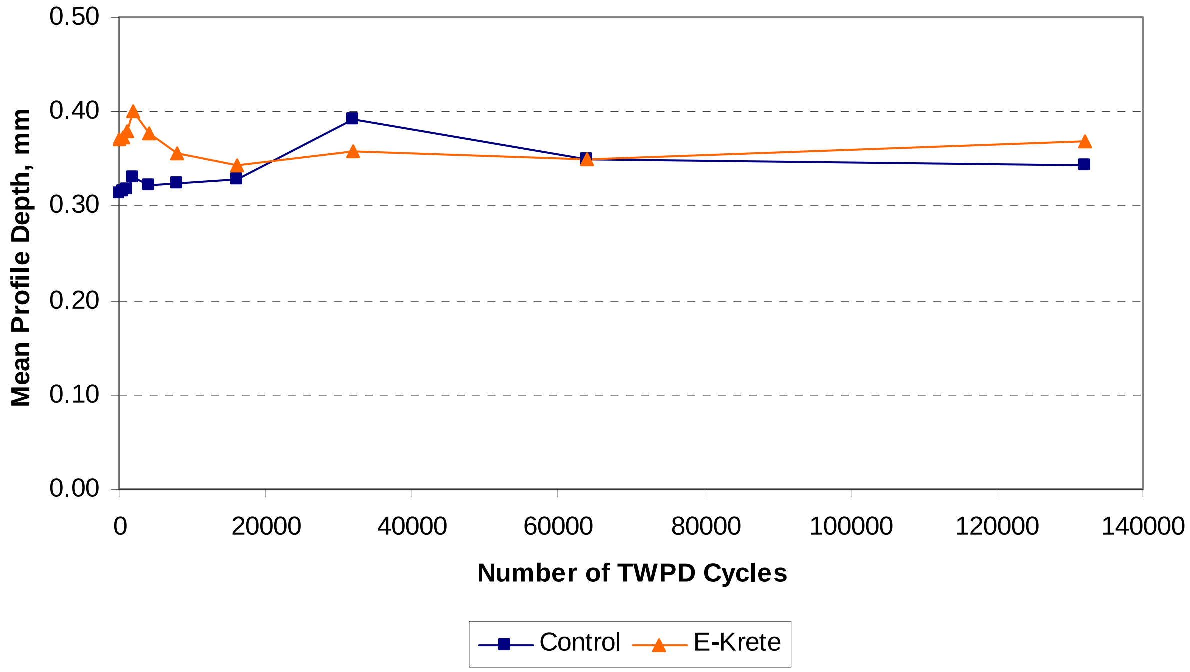


**FIGURE 12 CTM results for control and E-Krete® slabs.**

### 4.3 International Friction Index

The International Friction Index (IFI) parameter $F_{60}$ is the estimated coefficient of friction at 60 km/h (37 mph), which is related to the macrotexture and microtexture of the surfacing. The IFI parameter $F_{60}$ can be estimated based on both the DFT and CTM results using Equation 1 (ASTM E 1960-03).

$$F_{60} = 0.081 + 0.732 \times DFT_{20} \times e^{\frac{-40}{14.2+89.7MPD}} \quad (1)$$

where:

- $F_{60}$ = International Friction Index
- $DFT_{20}$ = Friction number obtained at 20 km/h using the DFT
- $MPD$ = Mean profile depth obtained from CTM

Detailed results of the calculated IFI parameter $F_{60}$ are shown in Table A.5 in Appendix A. Figure 13 compares the IFI parameter $F_{60}$ of the surfaces of the control and E-Krete® slabs. The surface of the control slab had a higher $F_{60}$ prior to the 45,000 polishing cycle, but the $F_{60}$ of the slab surfaces converged after 45,000 polishing cycles. The $F_{60}$ of the control slab surface exhibited an initial spike very soon after the onset of polishing associated with removal of asphalt binder film from the surface, and it stabilized after 64,000 polishing cycles. For the E-Krete® treated surface, the $F_{60}$ increased after the onset of polishing and stabilized quickly after 2,000 polishing cycles. In summary, the $F_{60}$ of both surfaces increased after the onset of polishing. In the laboratory testing conditions, the $F_{60}$ of the control surface was higher than that of the E-Krete® treated surface, but they were similar after 64,000 polishing cycles.

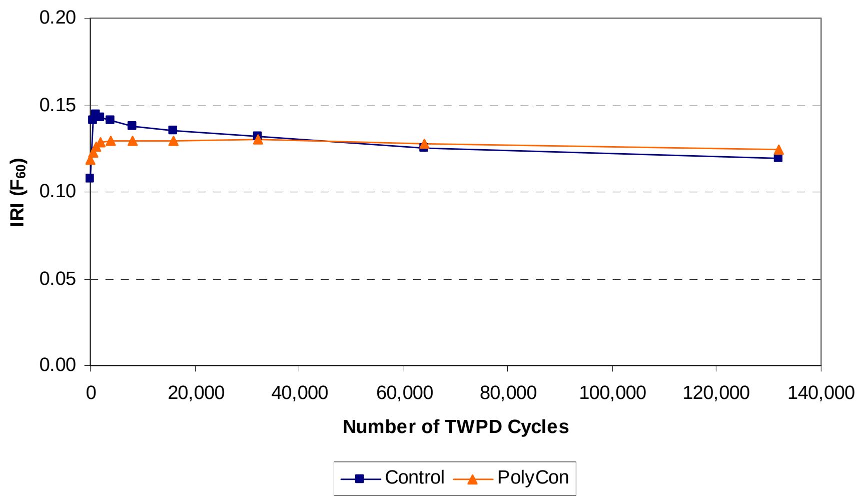


**FIGURE 13 IFI Parameter $F_{60}$ for control and E-Krete® slabs.**

### 4.4 Discussion

State agencies often measure the pavement surface skid resistance using a locked wheel skid trailer at 64 km/h (40 mph) with ribbed tires (SN(40)R) or smooth tires (SN(40)S). The standard procedure for the locked wheel skid trailer is described in detail in the ASTM E 274. In this study, it was desirable to estimate the skid number for the surfaces of both slabs using the DFT and CTM results. There are predictive equations proposed by Kasawneh and Liang (*2*) for estimating the SN(40)R based on the DFT and CTM results measured in the field. The research team tried to use these equations to estimate the SN(40)R of the two surfaces based on the DFT and CTM results; however, the estimated skid numbers for both of the surfaces were very low (in the 20s range). In addition, the estimated skid numbers for the control slab were much lower than the measured skid numbers of the same mix from field performance at the test track. At the time of this report, the SN(40)R for the control mix at the test track was 44.8. This test section was built in 2006 and has been subjected to in excess of eight million 18-kip equivalent single axle loads (ESALs). These differences may have been observed because the predictive equations were developed in field testing conditions that were very different from the laboratory testing conducted in this study.

Since terminal DFT and CTM measurements of both slabs were very similar at various speeds, except for 0 km/h (0 mph), it is estimated that the friction and wearing characteristics of the E-Krete® treated surface would be similar to that of the control surface. Figure 14 shows both slabs after all polishing cycles were completed in the laboratory. The E-Krete® treated surface showed little wear and seemed to be durable after 132,000 laboratory polishing cycles.

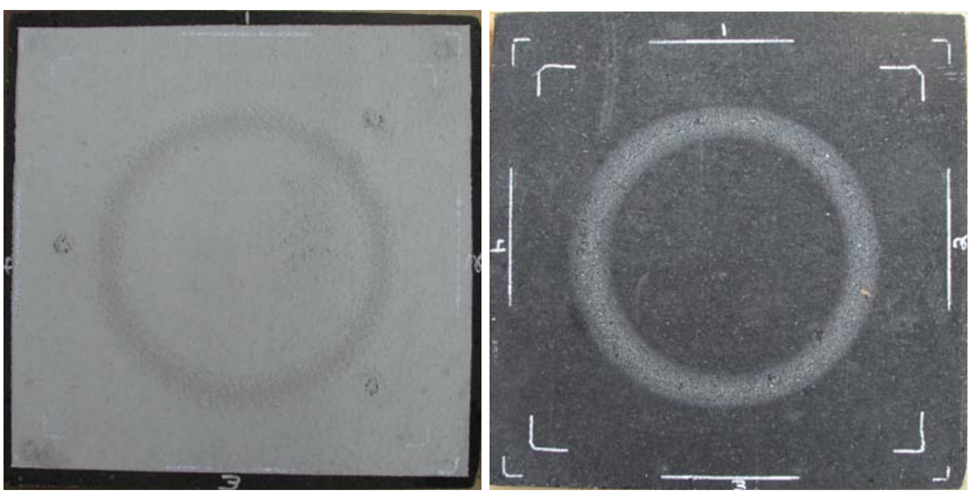

**FIGURE 14 Control and E-Krete® slabs after 132,000 polishing cycles.**

## 5. CONCLUSIONS AND RECOMMENDATIONS

This study evaluated the friction and surface texture characteristics of the E-Krete treated surface in the laboratory and estimated the performance of this surface in the field using the laboratory results. Based on the results of this effort, the following observations and conclusions are offered:

- The DFT friction results of both slabs measured at speeds other than 0 km/h (0 mph) exhibited an initial spike in friction very soon after the onset of polishing associated with removal of binder and mastic film from the surfaces, respectively.
- The DFT friction number of the E-Krete® surface increased after the initial polishing and then stabilized throughout the laboratory testing.
- The E-Krete® surface performed as well as the control surface in terms of friction under the laboratory testing conditions.
- The surfaces of the two slabs exhibited similar texture measurements after 64,000 polishing cycles.
- Since the DFT and CTM measurements of both slabs were very similar at various speeds, it was felt that the performance of the E-Krete® treated surface would be similar to that of the control surface in terms of friction. At the time of this report, the SN(40)R for the control mix at the test track was 44.8. This test section was built in 2006 and has carried in excess of eight million ESALs.
- The E-Krete® treated surface showed little wear and seemed to be durable after 132,000 laboratory polishing cycles. This observation agreed with the previous ERDC study in which the E-Krete® product exhibited good wear resistance (*1*).

The following recommendations are made based on the findings of this study:

- Phase II of this study should be conducted to verify the findings of Phase I and to determine the change in friction and wear characteristics of the E-Krete® treated surface under heavy traffic in the field over time.

## REFERENCES

1. Newman J. K., and J. Shoenberger. *E-Krete Polymer Composite Micro-Overlay for Airfields: Laboratory Results and Field Demonstrations*. Engineer Research and Development Center, U.S. Army Corps of Engineers, Vicksburg, MS, 2003.
2. Khasawneh, M. and R. Liang. Correlation Study Between Locked Wheel Skid Trailer and Dynamic Friction Tester. *Proceedings of the 2008 Annual Meeting of Transportation Research Board*, Washing D.C., 2008.

# Appendix A
# Laboratory Test Results

**TABLE A.1 Dynamic Friction Test Results for Control Slab**

| No. of Polishing Cycles | DFT Speed (km/hr) | Measurement No. | | | | | Avg | Std Dev | COV (%) |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | | |
| 0 | 0 | 0.507 | 0.433 | 0.436 | 0.438 | 0.418 | 0.446 | 0.035 | 7.79 |
| 500 | 0 | 0.437 | 0.415 | 0.427 | 0.382 | 0.378 | 0.408 | 0.027 | 6.52 |
| 1,000 | 0 | 0.430 | 0.411 | 0.409 | 0.372 | 0.374 | 0.399 | 0.025 | 6.34 |
| 2,000 | 0 | 0.384 | 0.406 | 0.367 | 0.392 | 0.352 | 0.380 | 0.021 | 5.56 |
| 4,000 | 0 | 0.383 | 0.348 | 0.347 | 0.352 | 0.344 | 0.355 | 0.016 | 4.52 |
| 8,000 | 0 | 0.324 | 0.324 | 0.328 | 0.318 | 0.332 | 0.325 | 0.005 | 1.60 |
| 16,000 | 0 | 0.318 | 0.307 | 0.314 | 0.314 | 0.291 | 0.309 | 0.011 | 3.47 |
| 32,000 | 0 | 0.293 | 0.273 | 0.278 | 0.266 | 0.283 | 0.279 | 0.010 | 3.67 |
| 64,000 | 0 | 0.233 | 0.219 | 0.221 | 0.222 | 0.223 | 0.224 | 0.005 | 2.44 |
| 132,000 | 0 | 0.190 | 0.196 | 0.188 | 0.195 | 0.192 | 0.192 | 0.003 | 1.74 |
| 0 | 20 | 0.153 | 0.150 | 0.144 | 0.148 | 0.142 | 0.147 | 0.004 | 3.02 |
| 500 | 20 | 0.354 | 0.348 | 0.339 | 0.331 | 0.324 | 0.339 | 0.012 | 3.60 |
| 1,000 | 20 | 0.367 | 0.361 | 0.358 | 0.359 | 0.352 | 0.359 | 0.005 | 1.51 |
| 2,000 | 20 | 0.359 | 0.351 | 0.349 | 0.347 | 0.340 | 0.349 | 0.007 | 1.97 |
| 4,000 | 20 | 0.350 | 0.346 | 0.338 | 0.334 | 0.339 | 0.341 | 0.006 | 1.89 |
| 8,000 | 20 | 0.317 | 0.320 | 0.319 | 0.324 | 0.318 | 0.320 | 0.003 | 0.85 |
| 16,000 | 20 | 0.307 | 0.309 | 0.311 | 0.308 | 0.305 | 0.308 | 0.002 | 0.73 |
| 32,000 | 20 | 0.295 | 0.296 | 0.296 | 0.292 | 0.294 | 0.295 | 0.002 | 0.57 |
| 64,000 | 20 | 0.252 | 0.252 | 0.249 | 0.252 | 0.254 | 0.252 | 0.002 | 0.71 |
| 132,000 | 20 | 0.218 | 0.218 | 0.219 | 0.218 | 0.216 | 0.218 | 0.001 | 0.50 |
| 0 | 40 | 0.137 | 0.134 | 0.132 | 0.137 | 0.130 | 0.134 | 0.003 | 2.30 |
| 500 | 40 | 0.295 | 0.296 | 0.291 | 0.283 | 0.282 | 0.289 | 0.007 | 2.27 |
| 1,000 | 40 | 0.309 | 0.308 | 0.305 | 0.302 | 0.303 | 0.305 | 0.003 | 1.00 |
| 2,000 | 40 | 0.311 | 0.304 | 0.304 | 0.299 | 0.298 | 0.303 | 0.005 | 1.70 |
| 4,000 | 40 | 0.302 | 0.300 | 0.298 | 0.290 | 0.297 | 0.297 | 0.005 | 1.53 |
| 8,000 | 40 | 0.286 | 0.283 | 0.284 | 0.285 | 0.287 | 0.285 | 0.002 | 0.55 |
| 16,000 | 40 | 0.285 | 0.289 | 0.288 | 0.290 | 0.285 | 0.287 | 0.002 | 0.80 |
| 32,000 | 40 | 0.282 | 0.278 | 0.281 | 0.273 | 0.275 | 0.278 | 0.004 | 1.38 |
| 64,000 | 40 | 0.234 | 0.246 | 0.239 | 0.235 | 0.238 | 0.238 | 0.005 | 1.98 |
| 132,000 | 40 | 0.209 | 0.213 | 0.215 | 0.209 | 0.200 | 0.209 | 0.006 | 2.75 |
| 0 | 60 | 0.135 | 0.132 | 0.131 | 0.134 | 0.123 | 0.131 | 0.005 | 3.62 |
| 500 | 60 | 0.260 | 0.251 | 0.246 | 0.231 | 0.232 | 0.244 | 0.012 | 5.11 |
| 1,000 | 60 | 0.268 | 0.260 | 0.261 | 0.254 | 0.259 | 0.260 | 0.005 | 1.93 |
| 2,000 | 60 | 0.267 | 0.260 | 0.271 | 0.270 | 0.267 | 0.267 | 0.004 | 1.61 |
| 4,000 | 60 | 0.258 | 0.245 | 0.259 | 0.257 | 0.256 | 0.255 | 0.006 | 2.24 |
| 8,000 | 60 | 0.250 | 0.260 | 0.255 | 0.252 | 0.264 | 0.256 | 0.006 | 2.25 |
| 16,000 | 60 | 0.255 | 0.256 | 0.258 | 0.256 | 0.252 | 0.255 | 0.002 | 0.86 |
| 32,000 | 60 | 0.263 | 0.262 | 0.263 | 0.261 | 0.260 | 0.262 | 0.001 | 0.50 |
| 64,000 | 60 | 0.227 | 0.230 | 0.221 | 0.229 | 0.231 | 0.228 | 0.004 | 1.75 |
| 132,000 | 60 | 0.199 | 0.198 | 0.199 | 0.199 | 0.199 | 0.199 | 0.000 | 0.22 |
| 0 | 80 | 0.119 | 0.127 | 0.094 | 0.117 | 0.125 | 0.116 | 0.013 | 11.33 |
| 500 | 80 | 0.112 | 0.117 | 0.118 | 0.118 | 0.111 | 0.115 | 0.003 | 2.97 |
| 1,000 | 80 | 0.116 | 0.118 | 0.122 | 0.119 | 0.123 | 0.120 | 0.003 | 2.41 |
| 2,000 | 80 | 0.126 | 0.110 | 0.125 | 0.115 | 0.112 | 0.118 | 0.007 | 6.32 |
| 4,000 | 80 | 0.124 | 0.122 | 0.126 | 0.122 | 0.129 | 0.125 | 0.003 | 2.38 |
| 8,000 | 80 | 0.128 | 0.113 | 0.127 | 0.121 | 0.122 | 0.122 | 0.006 | 4.89 |
| 16,000 | 80 | 0.122 | 0.125 | 0.127 | 0.132 | 0.131 | 0.127 | 0.004 | 3.26 |
| 32,000 | 80 | 0.117 | 0.129 | 0.120 | 0.128 | 0.119 | 0.123 | 0.006 | 4.49 |
| 64,000 | 80 | 0.125 | 0.118 | 0.127 | 0.126 | 0.116 | 0.122 | 0.005 | 4.11 |
| 132,000 | 80 | 0.109 | 0.122 | 0.134 | 0.107 | 0.126 | 0.120 | 0.011 | 9.58 |

**TABLE A.2 Dynamic Friction Test Results for E-Krete® Slab**

| No. of Polishing Cycles | DFT Speed (km/hr) | Measurement No. | | | | | Avg | Std Dev | COV (%) |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | | | |
| 0 | 0 | 0.417 | 0.399 | 0.423 | 0.406 | 0.443 | 0.418 | 0.017 | 4.07 |
| 500 | 0 | 0.421 | 0.437 | 0.426 | 0.373 | 0.381 | 0.408 | 0.029 | 7.03 |
| 1,000 | 0 | 0.439 | 0.414 | 0.354 | 0.334 | 0.417 | 0.392 | 0.045 | 11.51 |
| 2,000 | 0 | 0.435 | 0.338 | 0.377 | 0.382 | 0.321 | 0.371 | 0.044 | 11.95 |
| 4,000 | 0 | 0.312 | 0.383 | 0.359 | 0.359 | 0.330 | 0.349 | 0.028 | 7.97 |
| 8,000 | 0 | 0.334 | 0.369 | 0.359 | 0.321 | 0.318 | 0.340 | 0.023 | 6.71 |
| 16,000 | 0 | 0.304 | 0.351 | | | | 0.328 | 0.033 | 10.15 |
| 32,000 | 0 | 0.382 | 0.312 | 0.348 | 0.369 | 0.334 | 0.349 | 0.028 | 7.96 |
| 64,000 | 0 | 0.258 | 0.243 | 0.287 | 0.254 | 0.324 | 0.273 | 0.033 | 11.98 |
| 132,000 | 0 | 0.258 | 0.267 | 0.239 | 0.218 | 0.314 | 0.259 | 0.036 | 13.87 |
| 0 | 20 | 0.209 | 0.214 | 0.216 | 0.216 | 0.216 | 0.214 | 0.003 | 1.42 |
| 500 | 20 | 0.248 | 0.241 | 0.233 | 0.234 | 0.237 | 0.239 | 0.006 | 2.56 |
| 1,000 | 20 | 0.266 | 0.266 | 0.256 | 0.256 | 0.261 | 0.261 | 0.005 | 1.92 |
| 2,000 | 20 | 0.294 | 0.274 | 0.271 | 0.270 | 0.266 | 0.275 | 0.011 | 4.00 |
| 4,000 | 20 | 0.285 | 0.282 | 0.279 | 0.277 | 0.271 | 0.279 | 0.005 | 1.90 |
| 8,000 | 20 | 0.289 | 0.284 | 0.277 | 0.272 | 0.270 | 0.278 | 0.008 | 2.88 |
| 16,000 | 20 | 0.278 | 0.270 | | | | 0.274 | 0.006 | 2.06 |
| 32,000 | 20 | 0.285 | 0.284 | 0.284 | 0.277 | 0.268 | 0.280 | 0.007 | 2.59 |
| 64,000 | 20 | 0.275 | 0.266 | 0.269 | 0.265 | 0.260 | 0.267 | 0.006 | 2.07 |
| 132,000 | 20 | 0.253 | 0.254 | 0.253 | 0.247 | 0.248 | 0.251 | 0.003 | 1.29 |
| 0 | 40 | 0.189 | 0.192 | 0.193 | 0.192 | 0.191 | 0.191 | 0.002 | 0.79 |
| 500 | 40 | 0.220 | 0.212 | 0.203 | 0.205 | 0.207 | 0.209 | 0.007 | 3.25 |
| 1,000 | 40 | 0.239 | 0.231 | 0.224 | 0.221 | 0.227 | 0.228 | 0.007 | 3.06 |
| 2,000 | 40 | 0.258 | 0.243 | 0.239 | 0.239 | 0.237 | 0.243 | 0.009 | 3.52 |
| 4,000 | 40 | 0.252 | 0.252 | 0.250 | 0.249 | 0.243 | 0.249 | 0.004 | 1.49 |
| 8,000 | 40 | 0.258 | 0.256 | 0.252 | 0.248 | 0.245 | 0.252 | 0.005 | 2.15 |
| 16,000 | 40 | 0.250 | 0.245 | | | | 0.248 | 0.004 | 1.43 |
| 32,000 | 40 | 0.260 | 0.261 | 0.259 | 0.256 | 0.245 | 0.256 | 0.007 | 2.55 |
| 64,000 | 40 | 0.252 | 0.243 | 0.246 | 0.241 | 0.239 | 0.244 | 0.005 | 2.08 |
| 132,000 | 40 | 0.234 | 0.238 | 0.234 | 0.226 | 0.226 | 0.232 | 0.005 | 2.32 |
| 0 | 60 | 0.186 | 0.188 | 0.188 | 0.187 | 0.185 | 0.187 | 0.001 | 0.70 |
| 500 | 60 | 0.208 | 0.201 | 0.195 | 0.195 | 0.200 | 0.200 | 0.005 | 2.68 |
| 1,000 | 60 | 0.229 | 0.221 | 0.215 | 0.209 | 0.215 | 0.218 | 0.008 | 3.47 |
| 2,000 | 60 | 0.246 | 0.223 | 0.221 | 0.222 | 0.221 | 0.227 | 0.011 | 4.80 |
| 4,000 | 60 | 0.235 | 0.242 | 0.239 | 0.234 | 0.227 | 0.235 | 0.006 | 2.41 |
| 8,000 | 60 | 0.243 | 0.239 | 0.235 | 0.230 | 0.229 | 0.235 | 0.006 | 2.52 |
| 16,000 | 60 | 0.225 | 0.232 | | | | 0.229 | 0.005 | 2.17 |
| 32,000 | 60 | 0.241 | 0.243 | 0.247 | 0.247 | 0.227 | 0.241 | 0.008 | 3.42 |
| 64,000 | 60 | 0.249 | 0.240 | 0.238 | 0.234 | 0.238 | 0.240 | 0.006 | 2.33 |
| 132,000 | 60 | 0.245 | 0.222 | 0.241 | 0.226 | 0.224 | 0.232 | 0.011 | 4.58 |
| 0 | 80 | 0.109 | 0.112 | 0.112 | 0.108 | 0.109 | 0.110 | 0.002 | 1.70 |
| 500 | 80 | 0.115 | 0.117 | 0.111 | 0.115 | 0.114 | 0.114 | 0.002 | 1.92 |
| 1,000 | 80 | 0.113 | 0.112 | 0.109 | 0.108 | 0.114 | 0.111 | 0.003 | 2.33 |
| 2,000 | 80 | 0.122 | 0.104 | 0.094 | 0.125 | 0.105 | 0.110 | 0.013 | 11.91 |
| 4,000 | 80 | 0.119 | 0.120 | 0.123 | 0.115 | 0.120 | 0.119 | 0.003 | 2.41 |
| 8,000 | 80 | 0.120 | 0.120 | 0.113 | 0.112 | 0.121 | 0.117 | 0.004 | 3.69 |
| 16,000 | 80 | 0.098 | 0.101 | | | | 0.100 | 0.002 | 2.13 |
| 32,000 | 80 | 0.116 | 0.114 | 0.000 | 0.123 | 0.107 | 0.092 | 0.052 | 56.24 |
| 64,000 | 80 | 0.117 | 0.115 | 0.114 | 0.113 | 0.117 | 0.115 | 0.002 | 1.55 |
| 132,000 | 80 | 0.115 | 0.121 | 0.125 | 0.122 | 0.114 | 0.119 | 0.005 | 3.96 |

**TABLE A.3 Circular Texture Meter Test Results for Control Slab**

| No. of Polishing Cycles | Measurement No. | | | | | | | | Avg | Std Dev | COV (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | | |
| 0 | 0.32 | 0.31 | 0.31 | 0.32 | 0.31 | 0.31 | 0.32 | 0.31 | 0.31 | 0.01 | 1.65 |
| 500 | 0.31 | 0.32 | 0.31 | 0.32 | 0.32 | 0.31 | 0.32 | 0.31 | 0.32 | 0.01 | 1.70 |
| 1000 | 0.38 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.32 | 0.02 | 7.76 |
| 2000 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.34 | 0.33 | 0.33 | 0.33 | 0.00 | 1.07 |
| 4000 | 0.34 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.01 | 2.19 |
| 8000 | 0.32 | 0.32 | 0.33 | 0.33 | 0.33 | 0.32 | 0.32 | 0.32 | 0.32 | 0.01 | 1.60 |
| 16000 | 0.33 | 0.32 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.00 | 1.08 |
| 32000 | 0.39 | 0.40 | 0.39 | 0.41 | 0.39 | 0.39 | 0.39 | 0.38 | 0.39 | 0.01 | 2.26 |
| 64000 | 0.34 | 0.35 | 0.35 | 0.35 | 0.36 | 0.35 | 0.35 | 0.35 | 0.35 | 0.01 | 1.53 |
| 132000 | 0.34 | 0.35 | 0.35 | 0.34 | 0.35 | 0.34 | 0.34 | 0.34 | 0.34 | 0.01 | 1.51 |

**TABLE A.4 Circular Texture Meter Test Results for E-Krete® Slab**

| No. of Polishing Cycles | Measurement No. | | | | | | | | Avg | Std Dev | COV (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | | |
| 0 | 0.36 | 0.37 | 0.38 | 0.35 | 0.38 | 0.38 | 0.36 | 0.38 | 0.37 | 0.01 | 3.23 |
| 500 | 0.35 | 0.38 | 0.38 | 0.37 | 0.37 | 0.37 | 0.38 | 0.38 | 0.37 | 0.01 | 2.78 |
| 1000 | 0.38 | 0.38 | 0.38 | 0.38 | 0.39 | 0.37 | 0.38 | 0.37 | 0.38 | 0.01 | 1.69 |
| 2000 | 0.40 | 0.40 | 0.39 | 0.41 | 0.41 | 0.40 | 0.40 | 0.39 | 0.40 | 0.01 | 1.89 |
| 4000 | 0.36 | 0.38 | 0.38 | 0.37 | 0.38 | 0.38 | 0.39 | 0.38 | 0.38 | 0.01 | 2.35 |
| 8000 | 0.35 | 0.37 | 0.36 | 0.35 | 0.35 | 0.36 | 0.35 | 0.36 | 0.36 | 0.01 | 2.09 |
| 16000 | 0.36 | 0.33 | 0.35 | 0.34 | 0.35 | 0.33 | 0.35 | 0.34 | 0.34 | 0.01 | 3.09 |
| 32000 | 0.34 | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 | 0.37 | 0.36 | 0.36 | 0.01 | 2.33 |
| 64000 | 0.35 | 0.35 | 0.34 | 0.35 | 0.35 | 0.36 | 0.34 | 0.35 | 0.35 | 0.01 | 1.84 |
| 132000 | 0.36 | 0.37 | 0.40 | 0.37 | 0.36 | 0.36 | 0.37 | 0.36 | 0.37 | 0.01 | 3.68 |

**TABLE A.5 IFI Parameter $F_{60}$ for Control and E-Krete® Slabs**

| No. of Polishing Cycles | Control Slab | | | E-Krete Treated Surface Slab | | |
|---|---|---|---|---|---|---|
| | DFT20 Avg | CTM Avg | F60 | DFT20 Avg | CTM Avg | F60 |
| 0 | 0.147 | 0.31 | 0.123 | 0.214 | 0.37 | 0.148 |
| 500 | 0.339 | 0.32 | 0.178 | 0.239 | 0.37 | 0.156 |
| 1,000 | 0.359 | 0.32 | 0.184 | 0.261 | 0.38 | 0.164 |
| 2,000 | 0.349 | 0.33 | 0.184 | 0.275 | 0.40 | 0.172 |
| 4,000 | 0.341 | 0.32 | 0.180 | 0.279 | 0.38 | 0.170 |
| 8,000 | 0.320 | 0.32 | 0.174 | 0.278 | 0.36 | 0.167 |
| 16,000 | 0.308 | 0.33 | 0.171 | 0.274 | 0.34 | 0.164 |
| 32,000 | 0.295 | 0.39 | 0.177 | 0.280 | 0.36 | 0.167 |
| 64,000 | 0.252 | 0.35 | 0.158 | 0.267 | 0.35 | 0.162 |
| 132,000 | 0.218 | 0.34 | 0.147 | 0.251 | 0.37 | 0.160 |