# EVALUATION OF E-KRETE AND RESURF II IV FOR CONCRETE SPALL REPAIR

STATE STUDY NO. 139

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CONDUCTED BY
RESEARCH DIVISION
MISSISSIPPI DEPARTMENT OF TRANSPORTATION

IN COOPERATION WITH
FEDERAL HIGHWAY ADMINISTRATION
U.S. DEPARTMENT OF TRANSPORTATION

September, 2000

**Technical Report Documentation Page**

| 1.Report No. | 2. Government Accession No. | 3. Recipient's Catalog No. |
|---|---|---|
| FHWA/MS-DOT-RD-00-139 | | |

| 4. Title and Subtitle | 5. Report Date |
|---|---|
| Evaluation of E-Krete and RESURF II IV for Concrete Spall Repair | September 2000 |
| | 6. Performing Organization Code |

| 7. Author(s) | 8. Performing Organization Report No. |
|---|---|
| Stephen K. Johnson | MS-DOT-RD-00-139 |

| 9. Performing Organization Name and Address | 10. Work Unit No. (TRAIS) |
|---|---|
| Mississippi Department of Transportation<br>Research Division<br>P O Box 1850<br>Jackson MS 39215-1850 | 11. Contract or Grant No. |

| 12. Sponsoring Agency Name and Address | 13. Type Report and Period Covered |
|---|---|
| Federal Highway Administration and Mississippi Department of Transportation | Final Report |
| | 14. Sponsoring Agency Code |

15. Supplementary Notes

16. Abstract

This report will focus on two products, E-Krete and RESURF II IV, for their performance in rehabilitating spalled cracks on CRCP (Continuously Reinforced Concrete Pavement). E-Krete is a product manufactured by Polycon, Inc. and , prior to this evaluation, was not on the approved list of products for MDOT (Mississippi Department of Transportation). RESURF II IV, manufactured by Polymer Concrete, Inc., was the only product approved for this type of rehabilitation by the Department. E-Krete has some similar components to that of RESURF II IV. RESURF II IV is a polymer modified concrete while E-Krete is an acrylic and polymer modified concrete mix.

| 17. Key Words | 18. Distribution Statement |
|---|---|
| E-Krete, RESURF II IV, Concrete Spall Repair | Unclassified |

| 19. Security Classif. (of this report) | 20. Security Classif. (of this page) | 21. No. of Pages | 22. Price |
|---|---|---|---|
| Unclassified | Unclassified | 17 | |

**Form DOT F 1700.7 (8-72)**

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**TABLE OF CONTENTS**

## LIST OF FIGURES AND TABLES

## INTRODUCTION

This report will focus on two products, E-Krete and RESURF II IV, for their performance in rehabilitating spalled cracks on CRCP (Continuously Reinforced Concrete Pavement). E-Krete is a product manufactured by Polycon, Inc. and is not on the approved list of products for MDOT (Mississippi Department of Transportation). RESURF II IV, manufactured by Polymer Concrete, Inc., is the only product approved for this type of rehabilitation by the Department. E-Krete has some similar components to that of RESURF II IV. RESURF II IV is a polymer modified concrete while E-Krete is an acrylic and polymer modified concrete mix.

Transverse cracking is an undesirable distress associated with CRCP systems. These cracks are often accompanied by spalling of the cracks. Spalled cracks result in a higher severity of the distress, which consequently becomes more detrimental to the health of the pavement system by opening the system up to environmental factors. The health of a roadway system is also gauged by the quality of the ride. The condition of the ride quality is reduced due to these distresses and causes the traveling public to experience a rougher ride.

In an attempt to preserve a desired condition of CRCP, a patch or fill for the cracks and spalls is needed. Several proprietary filling materials have been evaluated by MDOT in the past, but none with the desired success needed for this type of repair. The material that has been the most successful is the polymer-modified concrete with the trade name RESURF II IV. The RESURF II IV product, even with its moderate success in Mississippi, has not had the desired level of success by MDOT.

## ESTABLISHING ANALYSIS SECTIONS

E-Krete and RESURF II IV will be used to repair cracks and spalls on State Route Highway 25 (SR25) in Rankin County. Three consecutive sections were established for the application of these two products. A two-lane 2500 ft section was established for the E-Krete product followed by a two-lane 500 ft section for the RESURF II IV product. An additional 100 ft section, outside lane only, was established for the RESURF II IV product. This section is located prior to the E-Krete section for the purpose of having some higher severity cracks and spalls to administer the RESURF II IV product. The E-Krete section is between Sta. 585+00 and Sta. 610+00. The RESURF II IV sections are between Sta. 584+00 and Sta. 585+00 and between Sta. 610+00 and Sta. 615+00. The E-Krete section is longer for two reasons. First, the price agreement in the contract negotiated between Polycon, Inc. and the Department allowed for a longer test section. Secondly, a longer section of E-Krete was needed since the Department has never used this product before, except on an undocumented 300 ft section. This 300 ft section was applied on the same roadway several miles from the site of interest in this report and it has existed for approximately one year. The performance of this section will be documented in this report.

Prior to the application of both products, the three sections were established and a distress survey was conducted. Before the distress survey began, MDOT research staff members visited the section sites and documented the types of cracks that existed. A criterion for categorizing the different severity levels of cracks was agreed upon after reviewing the characteristics of the cracking in these sections. The criteria is as follows:

| Criteria Width | Severity |
|---|---|
| 0 to 3 inches | low |
| 3 to 6 inches | medium |
| 6 to 9 inches | high |
| over 9 inches | extreme |

*Note: Ten percent of the length of a crack must be spalled with the criteria widths above to fit into each respective severity category.*

The entirety of each section was surveyed and each distress location and severity was documented. After all the cracks were mapped, the data was entered into a database. The sum of the amount of cracks for each severity was calculated (see tables 1 and 2). For comparative reasons, percentage of cracks relative to each products total section length was observed to ensure that the sections are characteristically the same even though they differ in length. In the RESURF II IV sections, there is an average of 66 cracks per 100 ft. There is an average of 69 cracks per 100 ft for the E-Krete section. This calculation is based on the assumption that all cracks are 12 ft in length, which covers the entire width of the lane. This assumption is validated by the overwhelming number of cracks in both sections that cover the entire width of the lane in which they reside. Also, a comparison of severity proportions of each section was observed (see figure 1). This comparative information shows that the two sections are characteristically the same in distress even though the lengths are different.

**Table 1. Distress Data for RESURF II IV Section**

| Section | No. of Cracks | Length (ft) | Severity |
|---|---|---|---|
| RESURF II IV | 301 | 3614 | Low |
| | 78 | 930 | Med |
| | 15 | 176 | High |
| | 3 | 36 | Extreme |
| Total | 397 | | |

**Table 2. Distress Data for E-Krete Section**

| Section | No. of Cracks | Length (ft) | Severity |
|---|---|---|---|
| E-Krete | 1362 | 16349 | Low |
| | 281 | 3374 | Med |
| | 70 | 834 | High |
| | 3 | 36 | Extreme |
| Total | 1716 | | |

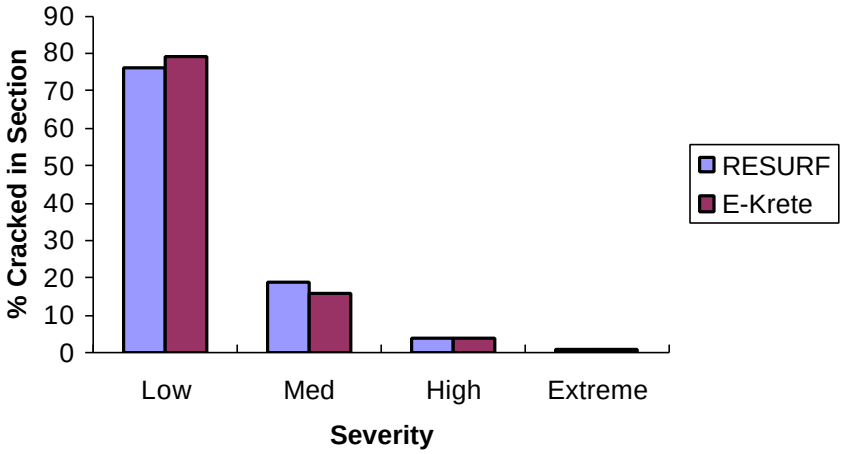


**Figure 1. Percentage of cracks quantified by severity.**

## E-KRETE APPLICATION

The E-Krete section, Sta. 585+00 to Sta. 610+00, was addressed first. The product application began on May 1, 2000 and ended on May 15, 2000. The actual number of days on the job was eight with weekends and rain delays accounting for the rest of the time period. One lane, at a time, was addressed while the other lane remained open for the traveling public. Since the E-Krete product requires an approximate two-hour curing period, the application of E-Krete had to stop at 1:00 p.m. in order to cure and to allow traffic back in the lane by 3:00 p.m.

The application process began with some minor preparations to the existing distresses. After establishing traffic control, all the cracks and spalls are checked for loose debris. A jackhammer and sledgehammer was used to break away the loose particles or potential loose particles from the spalls (see figure 2). The jackhammer was used on the first day to prepare only the most severe spalls. After these severe spalls were prepared, the sledgehammer was sufficient in prepping the remaining spalls. The loose debris is then removed from the entire roadway surface with compressed air (see figure 3).

**Figure 2. Removal of potential loose debris.**

**Figure 3. Compressed air for cleaning surface.**

When the surface was free of loose debris, the acrylic and polymer modified concrete was mixed. The mixing consists of combining a liquid solution, cementitious dry mix and some aggregate into a mortar mixer (see figure 4). The liquid solution contains the proprietor's additives for hardening and bonding while the dry mix is basically the dry cement. Some aggregates are added for skid resistance and other material properties. After thoroughly mixing, the E-Krete remains in the mixer rotating at a slow rate. This prevents the mix from prematurely hardening. The mix should not remain in mixer for over two hours according to the proprietor.

**Figure 4. Mixing the E-Krete.**

The next step in the E-Krete application process for cracks and spalls is to apply some of the liquid solution with a narrow paint roller (see figure 5). The proprietor claims this improves the bonding of the mix to the existing concrete surface. The liquid is applied only several minutes before the spalled cracks are filled with the mix or the liquid will dry and actually make a weaker bond between the mix and the existing surface. The mix is now applied to the distresses with an applicator designed by Polycon, Inc. (see figure 6 and figure 7). The main components of the applicator are a reservoir, two compressed air tanks and a squeegee mounted on a mobile frame. The compressed air operates a lever and valve system for controlling the amount of mix dispensed from the reservoir to the surface of the pavement. The squeegee allows for a smooth surface after manually pushing the applicator across the distressed area. As previously stated, one lane at a time was addressed for traffic purposes. Therefore, the mix was applied to a 12 ft distress (one lane width) at a time. When the end of the spalled crack was reached, the excess was scooped with a square-nosed shovel and placed back into the reservoir on the applicator (see figure 8). After a brief period of curing time for the mix, a flat hoe is used to scrap the surface of the mix as seen in figure 9. This allows for a smooth and uniform surface of the pavement. A considerable amount of loose debris is created from the scrapping process. The final step was to blow off the loose debris with compressed air.

**Figure 5. Preparation of cracks with liquid hardener.**

**Figure 6. Front view of E-Krete applicator.**

**Figure 7. Rear view of E-Krete applicator.**

**Figure 8. Removal of excess E-Krete.**

**Figure 9. Scrapping off excess of partially cured E-Krete.**

## RESURF II IV APPLICATION

On June 27, 2000, American Field Service Corp. Constructors began the rehabilitation of the spalled cracks in the RESURF II IV section. The two-lane 500 ft section, Sta. 610+00 to Sta. 615+00, was addressed first and took two eight hours days to complete. The RESURF II IV application was basically a three-step process. The three steps consisted of 1) preparation of the distressed area 2) mixing the RESURF II IV and 3) applying the mix to the distressed area. First, the cracks must be cleaned of all debris before administering the product. This is accomplished with a sandblasting procedure (see figure 10). This is part of the standard operational procedure suggested by RESURF II IV proprietors. Prepping and cleaning the distressed area is more crucial to the success of this product. Second, the RESURF II IV product requires the mixing of a liquid solution and a dry mix. The liquid contains a resin and polymer solution that has to be activated with a catalyst substance to initiate the necessary chemical reaction (see figure 11). The dry mix consists of plastic pellets and small rock aggregates. The two components of the mix are placed in a wheelbarrow and mixed with a shovel until a level of consistency is obtained (see figure 12). Finally, the mix is ready to be applied to the distressed area. As with the E-Krete product, some of the liquid solution is applied to the distressed area before filling the spalls with the mix (see figure 13). The mix is then placed into the spalls with a shovel and troweled flush with the surface of the CRCP (see figure 14). The RESURF II IV mix is then allowed to cure for several hours depending on the weather conditions.

On July 13, 2000, the one-lane 100 ft section was addressed with the RESURF II IV product. The same application procedure was administered for this section. The application and curing time took about eight hours.

**Figure 10. Sandblasting the spalled cracks.**

**Figure 11. Mixing catalyst with liquid solution.**

**Figure 12. Mixing RESURF II IV components in wheelbarrow.**

**Figure 13. Applying liquid solution to spalled crack.**

**Figure 14. Filling spalled cracks with mix.**

## SUMMARY AND CONCLUSION

First, some construction or application differences between RESURF II IV and E-Krete should be noted. The E-Krete application requires less preparation of the existing CRCP surface. Even though a jackhammer was utilized on the most severe distresses, the preparation time was much shorter than having to thoroughly sandblast each spalled crack. The bonding of the E-Krete mix to the existing distressed surface required only the large loose debris to be removed before applying the mix. According to the proprietor, only a sledgehammer was needed to dislodge loose or potential loose portions of concrete in the spalled areas. Compressed air can then be used to remove the debris from the spalls. RESURF II IV, on the other hand, requires a higher degree of preparation to the spalls before application. In the past, to retain the necessary bond to hold the product to the existing surface, the distressed area must be thoroughly cleaned. Sandblasting the entire distressed area to be rehabilitated was utilized in this project. Lack of workability is another limitation of the RESURF II IV. The RESURF II IV uses two types of aggregates in its mix, plastic pellets and very small rock aggregate. The mix appears lumpy making it difficult to achieve a surface texture comparable to the existing CRCP surface. The aggregate and pellet sizes make it impossible for the RESURF II IV product to penetrate the smaller spalls. There was not even an attempt to apply the RESURF II IV mix to a crack without any spalling. The mix is too coarse to penetrate anything smaller than approximately one half inch in width. The only application process used on this particular project was to shovel the RESURF II IV out of a wheelbarrow directly onto selected distressed areas and finished with a hand trowel. On the other hand, E-Krete is mixed with aggregates in the cement mix that allows for a consistency close to that of a mortar mix. It can be and was applied to the entire crack across the width of the lane. It not only filled the spalls that existed in the cracks, but penetrated and sealed the crack itself. The squeegee process used in the application process of the E-Krete provided a surface texture flush and consistent with the surface of the CRCP.

The main benefit needed from these products is the ability to bond and remain bonded to the existing CRCP material. In the past, RESURF II IV has shown some inability to remain bonded causing the material to dislodge from the spalls. The E-Krete that was placed approximately one year earlier on a 300 ft section of SR25 is still bonded to the spalled cracks. At this point, September 2000, both products are bonded and intact in the spalled cracks on the test sections of this report. Based on the results to date, MDOT has placed E-Krete on its approved list of materials for concrete spall repair.