MEMORANDUM

TO: POLY-PAVEMENT APPLICATION ENGINEERS AND APPLICATION ASSOCIATES

FROM: ECO-POLYMERS, TECHNICAL DIRECTOR

DATE: MARCH 4, 1996

SUBJECT: SUMMARY OF DEPARTMENT OF DEFENSE TECHNICAL REPORT ON THE PERFORMANCE OF SOIL STABILIZING POLYMERS AND OTHER MATERIALS USED UNDER TRAFFIC AND NON-TRAFFIC CONDITIONS AND IN DESERT, TROPIC AND TEMPERATE CLIMATIC CONDITIONS.

In September 1993, U.S. Army Corps of Engineers' researchers completed a second study for the Department of Defense. The second study expanded a prior (1972-1974) evaluation and comparison of the performance and cost effectiveness of soil amendment materials for traffic area and non-traffic area soil stabilization. The second study compared the performance of new materials with DCA-1295. DCA-1295 is the polymer material that was developed by the DOD under contract after the first study failed to identify a single material that met the military's performance specifications. Three hundred and fifteen materials were evaluated in the first study, the majority of which were water based polymer emulsions.

Thirty-two materials were evaluated in the second study. Eleven of the thirty-two materials, were water based polymer emulsions. The other materials were not polymers (See study excerpts). The Army developed criteria for evaluating the performance of each material under conditions of non-traffic and traffic, rain, wind, jet fuel spills, and ultra-violet rays. ECO-Polymers submitted one custom formulated polymer soil stabilizer/solidifier for evaluation called Sand/Dirt Glue. (Poly-Pavement's equivalent)

The results of the studies can be summarized this way. ECO's Soil Polymer met or exceeded all of the DOD's performance criteria for traffic and non-traffic applications. None of the other soil polymers met a single one of the DOD's performance criteria for traffic or non-traffic applications. Sand/Dirt Glue was the only material, polymer or non-polymer, to pass all of the DOD field tests under both traffic and non-traffic conditions. Sand/Dirt Glue was the only material that met all DOD performance criteria for all three desert, temperate, and tropic climates. Sand/Dirt Glue was the only material that met DOD cost reduction criteria. In short, ECO-Polymers out-performed every material in existence, including DCA-1295, as evaluated by Department of Defense performance criteria. Please review the Army's recommendations for Sand/Dirt Glue highlighted in the excerpts.

The most important and most condemning fact determined about all other so-called polymer soil stabilizers is that they don't work in soil applications. Not one of 200 or more other so-called polymer soil stabilizers met a single one of the DOD performance requirements for traffic or non-traffic applications.

ECO's polymer soil stabilizers and polymer soil solidifiers are the absolute best available for all soil stabilization applications; whether vehicle traffic, foot traffic or no traffic; in tropical, desert or temperate climates. In addition, our polymers cost less to apply than all other non polymer materials. There is no known equivalent. This is now a matter of public record. You may read the record for yourself. A complete copy of the U.S. Army Corps of Engineers' 72-page study is available on request.

Technical Report GL-93-25
September 1993

US Army Corps
of Engineers
Waterways Experiment
Station VICKSBURG, MISSISSIPPI

Evaluation of Methods for Controlling Dust

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Prepared for Headquarters, U.S. Army Corps of Engineers

1 Introduction

Problem

Controlling dust on military operational areas involve unique challenges. The Army must be provided effective, efficient means of suppressing dust on airfields, helipads, cantonment areas, roads, and tank trails where the presence of dust is detrimental to military operations. When helicopters operate in dusty environments, their rotary blades and engines must be replaced after only one-third to one-half of their normal life due to the erosion of surfaces caused by airborne soil particles. Dust clouds around military installations provide the enemy with easily recognizable signatures of strategic operations and impair visibility of both airborne and ground personnel. In addition, safety and health hazards, as well as low morale result from continuous exposure of personnel to extreme dust conditions.

Dust control materials used in mission areas must be capable of being applied to operational areas by Army engineer troops, indigenous personnel under engineer supervision, or by contract personnel responsible for area maintenance.

History

Since 1946, research by the Corps of Engineers on dust control materials had been conducted as a companion activity to a more comprehensive military soil stabilization program. The primary consideration was given to materials that, when blended with soils to a relatively shallow depth and then compacted, would provide a dust free and waterproof soil layer.

The emphasis of the dust control program shifted in late 1964 towards materials that could be applied to soil surfaces by spraying rather than admixing. Subsequent field tests of three proprietary materials, a petroleum resin emulsion, a concrete curing compound, and a special cutback asphalt (Peneprime), were conducted in conjunction with landing mat and membrane studies at various military installations. Of the three materials tested, the special cutback asphalt was found to be the most effective and was

recommended for use in the Southeast Asia (SEA) theater of operations until a more effective material could be developed.

In January 1966, WES was requested by the U.S. Army Corps of Engineers (CE), to undertake a program for developing dust control materials for use at military bases but primarily for use in SEA.

The U.S. Army Engineer Waterways Experiment Station (WES) began the dust control program by placing emphasis on the elimination of dust at peripheral (nontraffic) areas of expedient airfields and heliports. Guidelines were established for performance requirements and physical characteristics of a dust control material, and these guidelines were used as the basis for the Department of the Army Approved Qualitative Material Requirement (QMR) for Dust Control Material, dated 1 August 1966 (revised 10 May 1971).

During a conference at WES on 24 January 1966, 45 representatives of 25 industries were informed of the directive from CE and were requested to submit research proposals for new dust control materials as well as information on products already available. Subsequently, contracts were negotiated with various research organizations, and the testing phase of the program was begun.

The initial phase of testing consisted of laboratory tests in which controlled weather conditions were used to determine the suitability of a material for use in a tropical environment. Upon successful completion of the laboratory tests, a material was scheduled for traffic and downwash blast tests. Once a material passed all phases of testing at WES and was considered to show promise as an effective dust control agent, production quantities were procured for field testing at several military installations.

A total of 315 materials were received during the course of the investigation. Forty-nine of the materials processed through the laboratory screening tests were examined further, and 18 were selected for testing in the field. These tests involved the better asphalt products, a natural rubber latex, and several emulsions, one of which was DCA-1295.

DCA-1295, a polyvinyl acetate (PVA) contract-developed material, was selected as having the greatest potential for meeting the requirements for a military dust control material. Engineer tests/expanded service tests of DCA-1295 and fiberglass scrim were initiated in 1972 by the U.S. Army Armor and Engineer Board and the U.S. Army Test and Evaluation Command to determine if these materials would satisfy requirements contained in the QMR for dust control material. The tests were completed in 1974 and DCA-1295 and the fiberglass scrim were placed in the Army Supply System.

Purpose

The purpose of this investigation was to develop and/or identify and evaluate new materials that have become available since the SEA related effort of the late 1960's and early 1970's that will provide the Department of Defense with effective means of suppressing dust in mission areas. The goal was to develop new materials that would effectively control dust while reducing equipment, manpower, and logistical requirements by 30 percent as stated in the Army Science and Technology Master Plan, STO: V.J.3. Lines of Communication (LOC)-Construction Materials and Methods.

Scope

Dust control materials were applied to prepared soil specimens and tested under controlled laboratory conditions to determine their performance when subjected to simulated field conditions. Selected materials were applied to field test sections and evaluated to determine their performance when trafficked by military vehicles.

2 Laboratory Study

Two separate laboratory studies were conducted. The initial study was conducted to evaluate materials that would be effective in a desert climate and the second study was conducted approximately one year later to evaluate materials that would control dust in tropic and temperate climates. During both studies, the performances of the dust control materials were compared to the performance of CSS-1, an emulsified asphalt, that had been used successfully during Desert Shield/Desert Storm.

Private industry was notified of WES' interest in dust control products by two advertisements published in the Commerce Business Daily. The first advertisement was published in November 1990; it was concerned with controlling dust in desert climates. The second advertisement was published in December 1992; it was concerned with controlling dust in tropic and temperate climates. Both advertisements stated that the products must be effective in suppressing dust on airfields, helipads, cantonment areas, roads, or tank trails where the presence of dust is detrimental to military operations.

Materials Tested

Thirty-two products were evaluated during this investigation. These products included latexes, emulsions, acids, lignosulfonates, polyurethanes, chlorides, and molasses. Table 1 lists each material and its assigned laboratory number, the name and address of the supplier, the supplier's designation, and a general description of the product. When the products were submitted, the supplier included the mission area(s) where they would be effective and directions for applying them. The mission areas included nontrafficked areas where all traffic (including foot traffic) could be controlled, helicopter landing pads, wheeled-vehicle roadways, and tracked-vehicle roadways. Most of the products listed in the table were assigned a numeric/alpha laboratory number. This indicates that the supplier recommended more than one use for the product, or more than one application rate was recommended. The first 24 products were evaluated for use in desert climates. The products identified with underlined laboratory numbers were evaluated for use in tropic and temperate climates.

Table 1
Identification of Dust Control Materials for Laboratory Evaluation Tests

WES Lab No.	Supplier and Address	Supplier Designation	General Description
1A 1B	Albright Seed Company, Inc.	Sentinel	Hydrophilic colloid
2A 2B	Amtrade, Inc.	Petro D-Dust	Methyl lardate
3A 3B	Bartlett Services, Inc.	Polymeric Barrier System	Acrylic latex
4A 4B	Benetech, Inc.	Dust Tamer	Aqueous acrylic emulsion
4C 4D	Benetech, Inc.	Benebind	Tall oil pitch emulsion
5A 5B 5C	Brown Industrial Process Corp	BIPCO 282	Acrylic copolymer
6	C.S.S. Technology, Inc.	EN-1	Sulfuric acid
7A 7B	Cellulose Resources Corp	Fiber Pro	Cellulose

Table 1 (Continued)

WES Lab No.	Supplier and Address	Supplier Designation	General Description
8A 8B 8C	DeWitt Company	Polybilt 4178	Polymer
9A 9B 9C	Dustpro	Lignosite Road Binder	Calcium lignosulfonate
10A 10B	Earth Systems International,Inc.	Soil Master WRI	Acrylic copolymer emulsion
11	Earth Systems International, Inc.	Soil Master WRII A&B	Vinyl acetate
12A 12B	Energy Systems Associates, Inc.	Sandstill	Petroleum hydrocarbon emulsion
13	Energy Systems Associates, Inc.	Sandstill Instaperve	Petroleum hydrocarbon emulsion
14A * 14B 14C 14D	Executive Resource Associates, Inc. Suite 813, One Crystal Park 2011 Crystal Drive Arlington, VA 22202	Sand Glue *	Polymer

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In 1990, Executive Resource Associates, Inc was a Distributor for ECO Polymers. ECO-Polymers developed the product which at the time was called ECO-CF Soil Binder and was later named PolyPavement. ECO-CF Soil Binder was submitted to USACE as Dirt Glue/Sand Glue. There is a product that recently entered the market called "Dirt Glue". Please note that "Dirt Glue", the product that is currently in the market is not the same "Dirt Glue" named in the USACE study. PolyPavement is "Dirt Glue/Sand Glue named in this study.

Table 1 (Continued)

WES Lab No.	Supplier and Address	Supplier Designation	General Description
15	Erosion Control Systems, Inc.	Verdyol Dust Binder	Sodium lignosulfonate
16A 16B	Green Mountain, Inc.	Mountain Grout	Hydrophobic polyurethane
17	R/M Sciences Inc.	US Formula 1202	Sulfuric acid
18A 18B	Soil Stabilization Products Co.	Road Oyl	Pitch and resin emulsion
19A 19B	Weather Tect, Inc.	Weather Tect	Acrylic copolymer
20A 20B	Ergon Asphalts & Emulsions, Inc.	CSS-1	Asphalt emulsion
21A 21B 21C	Future Way Enviro Technologies,Inc.	Endurasoil 200 Endurasoil 100 Endurasoil 300	Gilsonite resin and tall oil pitch
22	Gustafson, Incorporated	Magna-Coat	Polymer

Table 1 (Concluded)

WES Lab No.	Supplier and Address	Supplier Designation	General Description
23	Brown Industrial Process Corp.	BIPCO 33	Alcohol/petroleum solvents/polyamide resin
24	P Q Corporation	Sodium Silicate	Silicic acid, sodium salt
25	Cargill Solerchem Resources	Dust-Off	Magnesium chloride
26	Weather Tect, Inc.	Weather Tect MSS	Acrylic copolymer
27	Earth Systems International, Inc.	Soil Master WR	Acrylic copolymer emulsion
28	RDE, Inc.	Molex	Condensed molasses
29A 29B 29C	Ashland Chemical Company	Liquidow Dowflake Dowflake	Calcium chloride Calcium chloride

4 Conclusions and Recommendations

Conclusions

Conclusions based on the results of laboratory and field tests conducted during this investigation are as follows:

a. The laboratory tests conducted to simulate field conditions such as rainfall, sun light, heat, POL spillage, wind, and the airblasts from C-130 aircraft and UH-1 helicopters provided an effective and economical procedure for comparing the performances of the dust control products.

b. In most cases the results of the laboratory tests provided an accurate indication of product performance in the field. But, sometimes this was not true. For instance, Benebind scored 100 points when it was evaluated in the laboratory for use on helipads located in a desert climate, and it appeared to be an ideal product for use on roadways and nontrafficked areas also. Therefore, it was selected for field evaluation on all three areas at YPG. Due to this product's poor performance in the field, it was considered failed after the first cycle of tests were completed.

c. Laboratory test results indicated five products recommended for use in desert environments on nontrafficked areas should be considered for field testing at YPG, and three products should be considered for use in tropic and temperate climates.

d. Laboratory test results indicated thirteen products should be considered for further evaluation on roadway test sites at YPG, and seven products should be considered for use in tropic and temperate climates.

e. Laboratory test results indicated seven products should be considered for further evaluation on helicopter test items at YPG, and four products should be considered for use in tropic and temperate climates.

f. Sandstill and Sand Glue performed the best of the four products applied to nontrafficked areas at YPG.

g. Four products, Sand Glue, Road Oyl, Lignosite Road Binder, and Sandstill, withstood the M927 truck traffic conducted on the roadway test site at YPG.

h. None of the products withstood the M2 Bradley traffic.

i. Sand Glue and Lignosite Road Binder treated helipad test items withstood the UH-1 helicopter traffic.

j. The CSS-1 emulsified asphalt was as effective on the wheeled-vehicle roadway test section and helipad test item as any of the products tested.

k. Dirt Glue should be the most effective dust control product of those evaluated for use on nontrafficked areas located in tropic or temperate climates.

l. Lignosite Road Binder, Dirt Glue, Road Oyl, and CSS-1 should be effective on wheeled-vehicle roadways located in tropic and temperate climates.

m. None of the products evaluated will be effective on tracked-vehicle roadways.

n. Lignosite Road Binder, Dirt Glue, and CSS-1 should be effective on helipads located in tropic and temperate climates.

o. The logistic requirements for Lignosite Road Binder, Sandstill, Sand Glue/Dirt Glue, Road Cyl are generally more than 30 percent less than the requirements for similar products currently in the system.

p. The manpower and equipment requirements for Sand Glue/Dirt Glue are less than those for DCA-1295.

q. The manpower and equipment requirements for Lignosite Road Binder are essentially the same as the requirements for lime or portland cement.

Recommendations

It is recommended that TM 5-830-3, "Dust Control for Roads, Airfields, and Adjacent Areas" be revised to include the following dust control products and respective areas of application applied at the rates listed in the text of this report.

a. Sandstill and Sand Glue will control dust on nontrafficked areas located in desert climates.

b. Sand Glue, Road Oyl, Lignosite Road Binder, and Sandstill will control dust on wheeled-vehicle roadways located in desert climates.

c. Sand Glue and Lignosite Road Binder will control dust on helipads located in desert climates.

d. Dirt Glue will control dust on nontrafficked areas located in tropic and temperate climates.

e. Lignosite Road Binder, Dirt Glue, and Road Oyl will control dust on wheeled-vehicle roadways located in tropic and temperate climates.

f. Lignosite Road Binder and Dirt Glue will control dust on helipads located in tropic and temperate climates.