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EROSION CONTROL AT THE ARES FACILITY KIRTLAND AIR FORCE BASE, NEW MEXICO

by

C. R. Styron III

June 1972

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Conducted by U. S. Army Engineer Waterways Experiment Station
Soils and Pavements Laboratory
Vicksburg, Mississippi

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13. ABSTRACT

This report describes application of a dust-control system, DCA-1295 reinforced with fiberglass, for erosion control. Application conditions were unusual in several ways. A soil sterilant was used prior to application of the DCA-1295/fiberglass system after it was ascertained that the sterilant would be compatible with the dust-control materials. A soil sterilant was deemed necessary because the most common type of vegetation in this area, tumbleweed, is ineffective in controlling erosion. Vegetative growth occurring after the dust-control materials had been placed would have destroyed the system. Most of the area to be treated was on slopes ranging from 1V on 4H to 1V on 2H. Vehicular traffic (e.g. that of distributor vehicles) was not possible in the area; therefore, all materials were applied using hand-held hoses. Most of the 1V on 4H slopes were covered by cables and wire mesh; therefore, short glass fibers were used for reinforcing on these slopes. The remaining area, though steeper, was relatively uncluttered, and fiberglass scrim was used for reinforcing. Because persistent high winds made placement of the fiberglass fabric impossible, a portion of the project area was sprayed with DCA-1295 and left unreinforced until more favorable wind conditions would allow Sandia Base personnel to place the reinforcing and secure it in place. Based on the results obtained in this investigation, the following conclusions are believed warranted: (a) the soil sterilant used (Hyvar X) is compatible with fiberglass and DCA-1295; (b) use of the stabilization system discussed herein at the specified design rates will control erosion; (c) chopped glass is easier to apply on steep slopes than the scrim, mainly due to the weight of the packages (30 versus 230 lb); and (d) cutter guns, considered unsuitable for large projects, are ideal for special jobs such as the ARES project where small areas can be covered in a reasonable time.

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Details of illustrations in this document may be better studied on microfiche

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ARMY-MRC VICKSBURG, MISS.

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FOREWORD

The project reported herein was conducted by the U. S. Army Engineer Waterways Experiment Station (WES). The project was requested and authorized by the Defense Atomic Support Agency (now the Defense Nuclear Agency) in a letter and 2d indorsement thereto from the Facilities Engineer, Sandia Base, Albuquerque, New Mexico, subject: "Soil Stabilization (ARES)," dated March 1971. (Sandia Base became a part of Kirtland AFB effective 1 July 1971.)

The project was performed during the period 18-29 May 1971 under the general supervision of Messrs. J. P. Sale, Chief, and R. G. Ahlvin, Assistant Chief, of the Soils and Pavements Laboratory, and W. L. McInnis, Chief, Expedient Surfaces Branch. The Stabilization Section, under the supervision of Mr. Royce C. Eaves, was given primary responsibility for recommending and placing suitable erosion-control materials. Mr. Eaves visited the site and recommended the materials to be used. The WES field crew that placed the materials was supervised by Mr. C. R. Styron III. This report was prepared by Mr. Styron.

COL Ernest D. Peixotto, CE, was Director of the WES during the conduct of this study and the preparation of this report. Mr. F. R. Brown was Technical Director.

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CONVERSION FACTORS, BRITISH TO METRIC UNITS OF MEASUREMENT

British units of measurement used in this report can be converted to metric units as follows:

Multiply	By	To Obtain
inches	2.54	centimeters
feet	0.3048	meters
yards	0.9144	meters
square feet	0.092903	square meters
square yards	0.836127	square meters
acres	4046.856	square meters
gallons (U. S. liquid)	3.785412	cubic decimeters
ounces	28.3495	grams
pounds	0.45359237	kilograms
pounds per square inch	0.6894757	newtons per square centimeter
ounces per square yard	0.03390574	kilograms per square meter
miles per hour	1.609344	kilometers per hour
knots	1.852	kilometers per hour
cubic feet per minute	0.0283168	cubic meters per minute

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SUMMARY

This report describes application of a dust-control system, DCA-1295 reinforced with fiberglass, for erosion control. Application conditions were unusual in several ways.

A soil sterilant was used prior to application of the DCA-1295/fiberglass system after it was ascertained that the sterilant would be compatible with the dust-control materials. A soil sterilant was deemed necessary because the most common type of vegetation in this area, tumbleweed, is ineffective in controlling erosion. Vegetative growth occurring after the dust-control materials had been placed would have destroyed the system.

Most of the area to be treated was on slopes ranging from 1V on 4H to 1V on 2H. Vehicular traffic (e.g. that of distributor vehicles) was not possible in the area; therefore, all materials were applied using hand-held hoses. Most of the 1V on 4H slopes were covered by cables and wire mesh; therefore, short glass fibers were used for reinforcing on these slopes. The remaining area, though steeper, was relatively uncluttered, and fiberglass scrim was used for reinforcing. Because persistent high winds made placement of the fiberglass fabric impossible, a portion of the project area was sprayed with DCA-1295 and left unreinforced until more favorable wind conditions would allow Sandia Base personnel to place the reinforcing and secure it in place.

Based on the results obtained in this investigation, the following conclusions are believed warranted:

a. The soil sterilant used (Hyvar X) is compatible with fiberglass and DCA-1295.

b. Use of the stabilization system discussed herein at the specified design rates will control erosion.

c. Chopped glass is easier to apply on steep slopes than the scrim, mainly due to the weight of the packages (30 versus 230 lb).

d. Cutter guns, considered unsuitable for large projects, are ideal for special jobs such as the ARES project where small areas can be covered in a reasonable time.

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EROSION CONTROL AT THE ARES FACILITY, KIRTLAND AIR FORCE BASE, NEW MEXICO

PART I: INTRODUCTION

1. On 17 September 1970, representatives of Sandia Base,* Albuquerque, N. Mex., contacted the U. S. Army Engineer Waterways Experiment Station (WES) and described an erosion problem at the Advanced Research Electromagnetic Pulse Simulator Facility (ARES) at Sandia Base.

2. The erosion problem consisted of soil eroding and washing into the ARES test area. During construction of the facility, the soil had been treated with a very dilute solution of a polyvinyl acetate (PVA), but this treatment had deteriorated to the point that it was no longer effective. The main vegetation in this area is tumbleweed, which breaks off near the ground in autumn and is blown about by the wind, proving to be a nuisance rather than an aid in providing soil stabilization.

3. Based on observations made by a WES representative during a visit to the site, it was suggested that the soil could be stabilized by the application of fiberglass and PVA, which would form a composite film and protect the soil from the forces of wind and water. The representative also recommended that a soil sterilant be used to keep vegetation from growing through the film and destroying the film's windproof and waterproof integrity. WES agreed to furnish an engineer to provide technical assistance.

4. Later, because the coordinated application of these research materials was still in the development stage and due to the short time remaining to work in this area (a major maintenance program was under way and full-time operation of this facility was scheduled to resume 15 June 1971), Sandia Base requested that the WES perform the work after the site was prepared by a local construction company. WES representatives were to be responsible for treating the entire area with a

* Sandia Base became a part of Kirtland AFB effective 1 July 1971.

soil sterilant to prevent vegetation growth, covering the area with fiberglass reinforcing, and applying the PVA to form a composite film with the fiberglass.

5. The proposed project was of interest to WES for the following reasons:

a. The job required the application of a soil sterilant. One of the design requirements of the dust-control material was that "materials formulation(s), if required, shall incorporate insecticide, fungicide, or turf control additives to prevent surface irregularities damaging to dust control." Prior to this project, no such additives had been employed.

b. Approximately 98 percent of the area to be protected was on slopes with a minimum configuration of 1V on 4H. The maximum slopes treated prior to this project were lesser slopes that are associated with airport runway shoulders. In addition to the extreme slopes, wire mesh and cables along the ground precluded any vehicular traffic; application of all materials would have to be made by hand.

c. The project presented an opportunity to demonstrate the effectiveness of research materials under conditions that, while somewhat different from those considered in their development, were conditions for which the recommended materials were considered to be uniquely qualified.

PART II: DESCRIPTIONS OF MATERIALS

Soil Sterilant

6. Hyvar X, the soil sterilant suggested by Sandia Base for use in this project, is produced commercially by E. I. Du Pont De Nemours and Company, Inc. Hyvar X, a nonselective herbicide, had been used sucessfully to destroy vegetation at Sandia Base, and an adequate quantity was already on hand. This material is received as a powder that is mixed with water at the rate of 1 oz* per gallon of water. To adequately treat an area of interest, Hyvar X should be applied at a rate of 16 lb of powder per acre. Because dust from the powder and mist from the sprayed solution are harmful to humans, chemical respirators and goggles were used during application.

DCA-1295

7. DCA-1295 is a PVA liquid developed for the Department of the Army by the Union Carbide Corporation under Contract No. DACA39-70-C-0011. DCA-1295 is a white, milky liquid normally diluted at a rate of three parts concentrate to one part water for spraying purposes. In this report, rates of application (e.g., 4 lb/sq yd) indicate the amount of the as-supplied liquid employed. As supplied, the concentrate weighs 9.2 lb/gal and contains approximately 57 percent solids.

8. DCA-1295 has been applied by WES to the periphery of airport runways, taxiways, and heliports; the films that formed after curing (approximately 4 hr) have successfully prevented the generation of dust clouds caused by the airblast of C-130, CH-54, and CH-47 aircraft. The rate of application of DCA-1295 can be varied (usually from 3 to 7 lb/sq yd), depending on the predicted quantity, proximity, and type of traffic in the area.

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* A table of factors for converting British units of measurement to metric units is presented on page ix.

Fiberglass

9. Fiberglass is fine spun filaments of glass made into yarn that can be purchased as woven fabric or as untwisted continuous strands. This inorganic material is impervious to mold, rot, mildew, etc., and is unaffected by ultraviolet rays from the sun. When fiberglass is applied as reinforcement for DCA-1295 film, it significantly reduces thermal expansion and contraction of the film and increases the film strength. Thus, fiberglass increases the design life of the film and reduces maintenance. For this project, two types of fiberglass were employed:

a. Style No. 16-445 from Uniglas Corporation. A plain weave fabric with a 10 x 10 thread count that weighs about 1.6 oz/sq yd and is furnished on 6-ft-wide rolls of 1000 lin yd. It will be referred to herein as fiberglass scrim or scrim (see fig. 1). This particular scrim readily conforms to most ground surface irregularities associated with construction sites.

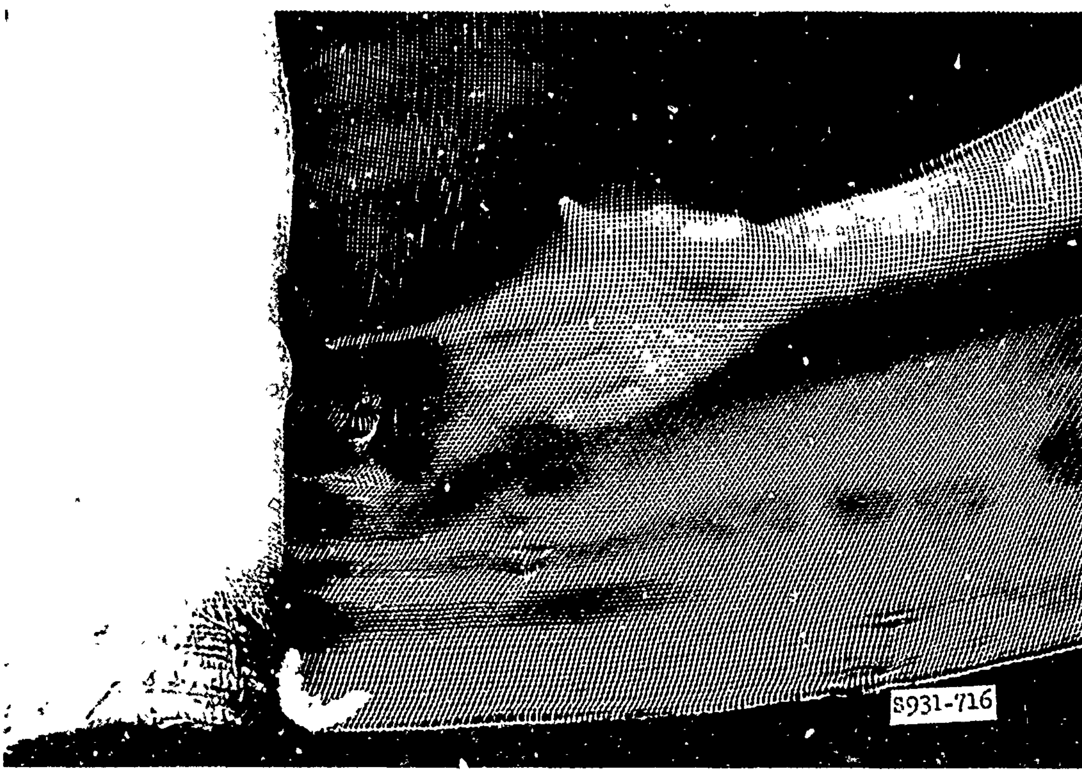

Fig. 1. Uniglas Corporation fiberglass scrim, Style No. 16-445

b. Style Unistrand, type No. 206, from Ferro Corporation. A standard roving package containing 60 untwisted glass fiber strands gathered in parallel and wound into the form of a cylindrical package. The fiberglass strands are chopped at the site and blown onto the ground. This material will be referred to herein as chopped glass (fig. 2). When used as reinforcement for a DCA-1295 film, the chopped glass is excellent both for strength purposes and for conforming to ground surface irregularities; however, an expedient emplacement method does not exist at this time.

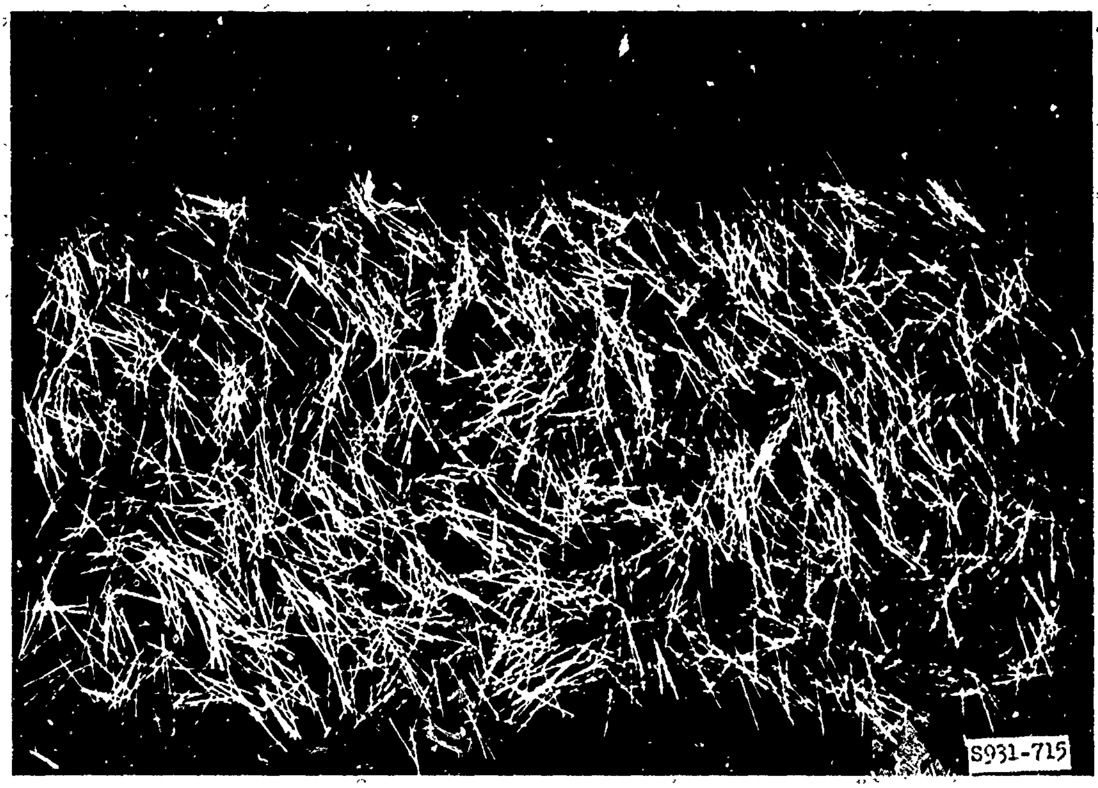

Fig. 2. Chopped particles of Ferro Corporation fiberglass roving (style Unistrand, type No. 206)

PART III: PRELIMINARY TESTING AND INVESTIGATIONS

10. Prior to this project, WES experience with application of dust-control materials on slopes had been minimal. In fact, with one exception, it had been limited to the slight slopes associated with airport runway shoulders. The exception is reported in a previously published WES report* that describes various methods used to stabilize sand mounded as high as 12 ft.

DCA-1295

11. The U. S. Army Materiel Command charged WES with the responsibility for development of dust-control materials with the concurrence of the Office, Chief of Engineers. A series of tests was initiated, and more than 300 items were tested in the WES laboratory.** Approximately 20 percent survived the initial screening tests and were investigated further. DCA-70, an early dust-control candidate, was one of the successful items. DCA-1295 is a significantly improved formulation that is essentially the same as DCA-70 but to which two plasticizers have been added to improve the durability and increase the flexibility of the film on the ground.

12. DCA-1295 has also been processed through the WES traffic tests for dust-control materials and the weathering cycle test for dust-control materials. Descriptions of these tests will be presented in a subsequent WES report.** Results of these tests show that DCA-1295 is the best dust-control material investigated to date.

13. Large-scale field tests of DCA-1295 have been conducted at Ft. Belvoir, Va.; Ft. Bragg, N. C.; Eglin AFB, Fla.; Dyess AFB, Tex.; and Yuma Proving Ground, Ariz. Each site presented a unique situation

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* G. R. Kozan, "Stabilization of Shifting Sand," Miscellaneous Paper No. 4-968, Mar 1968, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

** C. R. Styron III, "Review of Research and Development of Dust-Control Materiel," Miscellaneous Paper (in preparation), U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

of either soil type or weather conditions, and every test was considered successful. The DCA-1295 was tested with and without fiberglass. The fiberglass has proven to be an excellent reinforcement with a potential that has not yet been fully evaluated. Tests of the plain fiberglass were not conducted because the manufacturer supplied a brochure wherein each fiberglass style was described and the physical properties listed along with the particular American Society for Testing and Materials method of determination.

Soil Sterilant

14. Aside from the usual problems associated with working with a toxic material, the immediate problems for this study were (a) determining the compatibility of the dust-control materials with Hyvar X, and (b) disposal of unused quantities of the Hyvar X solution.

15. Six ounces of Hyvar X was used to determine the compatibility of Hyvar X with DCA-1295. A solution of Hyvar X and water was mixed at the recommended ratio of 1 oz of powder per gallon of water, and the following tests were performed:

- a. The solution was sprayed onto soil in a mold at a rate representative of 256 gal/acre (16 lb of Hyvar X per acre) and allowed to dry; then DCA-1295 was added. This duplicated the expected field conditions.
- b. DCA-1295 was added to the mold immediately after spraying the soil with Hyvar X solution before the solution dried.
- c. Finally, in an attempt to preview the worst possible situation, DCA-1295 concentrate was combined with Hyvar X solution instead of water (at a rate of three parts concentrate to one part Hyvar X solution) and placed in a mold.

A control sample was prepared at approximately the same time for comparison purposes.

16. It was concluded, based on visual observation of the films that were formed as described above, that Hyvar X in solution has no effect on DCA-1295.

17. For advice on the remaining problems associated with the

application of Hyvar X, Dr. Wayne Cole, Agronomist, Mississippi State University, was consulted. Dr. Cole stated that the usual precautions associated with the application of soil sterilants, i.e. rubber gloves and chemical respirators, would adequately protect the people handling this material and a 30-minute flush with fresh water would clean the equipment used. Dr. Cole pointed out that constant recirculation is necessary to maintain suspension of Hyvar X in water because Hyvar X will rapidly settle out of solution. He also suggested that a good method of disposing of any excess solution would be to empty the solution into a hole located in the area to be treated and backfill the hole.

PART IV: DESCRIPTIONS OF EQUIPMENT

Soil Sterilant Spray Rig

18. Sandia Base supplied a special spray rig, which consisted of a trailer-mounted pump with a 150-gal-capacity tank, for applying the soil sterilant. A shaft from the pump turned a propeller in the tank, providing constant circulation of the contents of the tank. For application at the recommended rate, a tankful of water required 150 oz (9.375 lb) of Hyvar X; this solution treated a 25,500-sq-ft ground area.

Etnyre Distributor

19. An Etnyre distributor (Model TUC) was used to mix DCA-1295 and dilution water and pump the solution through hoses to the area desired. To spray this material, the distributor pump was modified by installing four grease fittings on the pump at a total cost of approximately $30. The distributor has a capacity of 916 gal. Each load consisted of 11 bbl of DCA-1295 and 200 gal of water and treated 1370 sq yd.

Fiberglass Chopper

20. The fiberglass was chopped at the site by a hand-held, air-activated, Style B210 cutter gun manufactured by Glass Craft of California (fig. 3). WES had two of these fiberglass choppers at the site, and occasionally both were in operation simultaneously. A compressor with a minimum capacity of 15 cfm and a minimum pressure of 90 psi is required to operate the chopper. (The compressor and several other miscellaneous items were supplied by Sandia Base, permitting avoidance of unnecessary transportation expenses.)

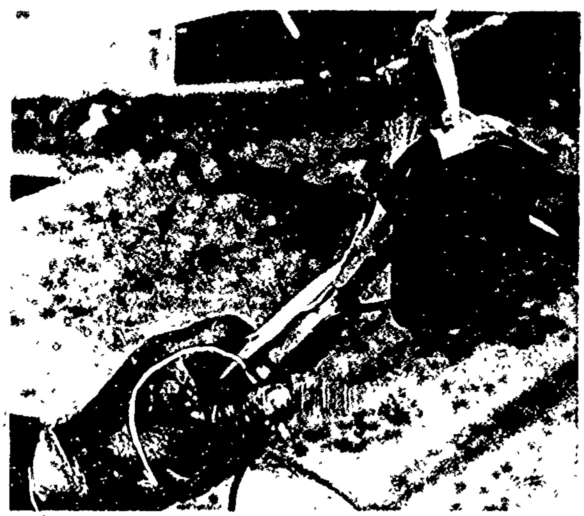


Fig. 3. Hand-held, air-activated cutter gun

Cyclone Seeder

21. Two Cyclone seeders manufactured by the Cyclone Seeder Company, Inc., were used for transporting the Unistrand fiberglass during placement operations. The rolls of fiberglass fit perfectly in the feed tanks of the seeders, making each seeder a handy dispenser.

Hook

22. Two hooks were made from No. 3 reinforcing steel so that, without bending over, a person could hook the wire mesh that covered the ground (see paragraph 5b) and shake the mesh, thus allowing the short glass fibers to fall through. Each shake was effective in clearing an approximately 10-sq-ft area of mesh.

PART V: DESCRIPTION OF PROJECT AREA

23. The ARES facility is located in the central valley region of New Mexico just south of Albuquerque. The native soil is a sandy clay. The area receives an average annual rainfall of 8.5 in., and the humidity averages 30 percent in the summer and 20 percent the rest of the year.

24. Vegetation is sparse and consists mostly of tumbleweed, a coarse weed with spiney branches and small leaves that will apparently grow anywhere in this type environment, i.e., either on flat ground or steep slopes. Tumbleweed, however, does not grow in clusters and each autumn when the plant matures, it breaks off near the ground and is blown about by the wind. Obviously, this type vegetation provides very little protection for the soil. The amount of erosion each year is dependent upon only the force and direction of the wind and rain.

25. The general site layout is shown in plate 1, and a section of the project area showing sparse vegetation cover and state of erosion is shown in photo 1.

26. The entire project area was cleared, grubbed, and graded in order that soil sterilant, DCA-1295, and fiberglass could be applied on an area free of obstructions. The working nucleus of the ARES facility was constructed on ground with a slope of 1V on 4H. Photo 2 shows the east and the west 1V on 4H slopes, respectively, which comprise approximately 66 percent of the project area. The north slope, shown in photo 3 ready for the application of the stabilizing materials, was inclined 1V on 2H and had proved to be the major cause for concern. Soil from the north slope washed into the working area and obstructed operation of the facility. This area had been reshaped very well, but the steepness of the slopes, together with the man-made obstructions, effectively canceled all attempts to compact the surface, as attested to by the footprints and wheel tracks visible in photo 3. About 6 hr was spent trying to better compact the soil by spraying the entire area with water. This procedure is believed to have helped somewhat, but whether or not it was worth the time spent remains a question.

27. Wire mesh, some with 2- by 2-in. grids but most with 4- by 4-in. grids, and wire cables cover the east and west slopes. Views of typical areas on these slopes before and after regrading are shown in photos 4 and 5. Vehicles are not permitted to operate on the wire mesh on the east and west slopes, and the vehicles usually used to dispense the soil stabilizer materials could not traverse the north slope; therefore, all materials had to be applied with hand-held pressure hoses. Four hundred feet of 5/8-in.-diam, high-pressure hose was purchased for this project.

PART VI: APPLICATION OF MATERIALS

28. Usually, water, fiberglass scrim, and DCA-1295 are placed simultaneously by a distributor designed for this special purpose (fig. 4). The prohibition of vehicular traffic at the ARES facility,

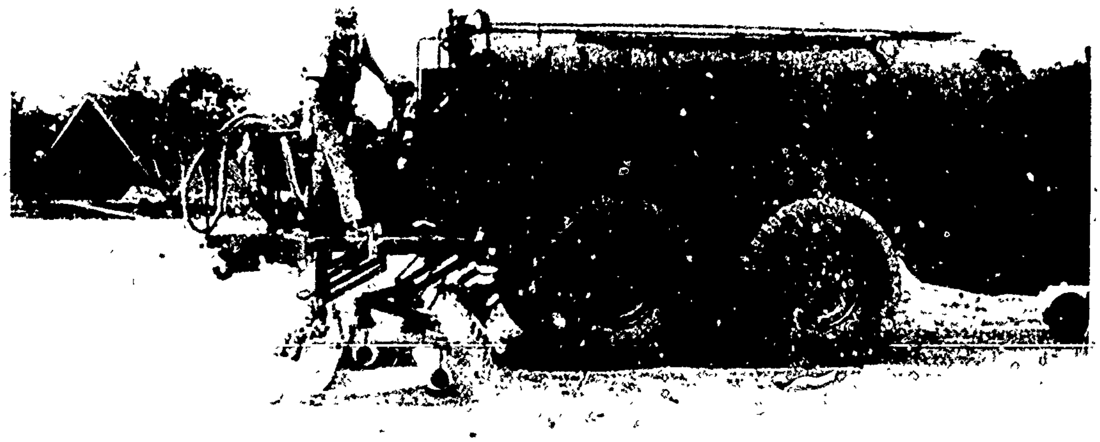


Fig. 4. Distributor usually used to place prewetting water, scrim, and DCA-1295

as well as the steep slopes to be treated, made it necessary to devise means of accomplishing these operations by hand. Small areas were treated successively, and the work was phased for efficient completion in critical time frames.

Soil Sterilant

29. The soil sterilant spray rig was delivered to the jobsite equipped with 100 ft of hose and a spray nozzle. At the jobsite, 190 ft of hose was added.

30. The 150-gal tank was filled with water twice and timed while it was emptied; 30 min were required to spray 150 gal. The area to be treated was marked off in tank-load plots (25,500 sq ft). Based on the results of the emptying tests just discussed, it was assumed that an application rate of 851 sq ft/min could be attained. Actually, spraying each plot took longer than 30 min and/or more than one tank load.

A full tank load was mixed prior to spraying each plot to ensure complete coverage with the recommended amount. In all, more than 80 lb of Hyvar X were spread over the 3.55-acre plot (22.5 lb per acre). The east slope was sprayed first, then the west, and finally the north slope (photo 6).

31. During this phase of the project, everyone wore protective clothing, i.e., long-sleeve coveralls, rubber gloves, goggles, and a chemical respirator. The remaining solution in the last tank load was drained into a hole dug in a flat area at the base of the north slope, and the hole was backfilled. No particular difficulties were encountered while applying the soil sterilant.

DCA-1295 and Chopped Fiberglass

32. Experience has indicated the necessity of prewetting the ground to reduce the surface tension of the DCA-1295 (prior to application of a fiberglass-reinforced DCA-1295 system). The established procedure is to spray the area with approximately 0.03 to 0.10 gal of water per square yard, apply the fiberglass to the damp surface, and then quickly apply the DCA-1295. This method of application enables the DCA-1295 to flow evenly over the surface to be treated and prevents the formation of fisheyes.* When this procedure is not practical, the same effect can be achieved by increasing the normal dilution ratio (three parts concentrate to one part water) to two parts concentrate and one part water. The increase can be permitted if runoff of the solution is avoided and if the time of cure is either unaffected or unimportant.

33. For this project, several sections of 4-in.-diam fire hose and a few sections of 2-1/2-in.-diam fire hose were used for prewetting. The 2-1/2-in.-diam hose full of water weighs over 2 lb/ft and the 4-in.-diam hose over 5 lb/ft. Early in the project when the water was

* "Fisheyes" is a word that has been adopted at WES to describe treated areas in which the DCA-1295 has separated and exposed the soil below through small round holes resembling the eyes of fish.

used in an attempt to compact the north slope, the fire hoses were probably the best means of applying water; however, for prewetting water, where the areas of application were smaller, the fire hose proved extremely cumbersome. One person could turn the hose on and spray with it, but an observer was required to direct the spray where it was needed. Leaks in the hose washed the soil away if the hose was left in one place for any length of time. One section of hose ruptured and had to be removed.

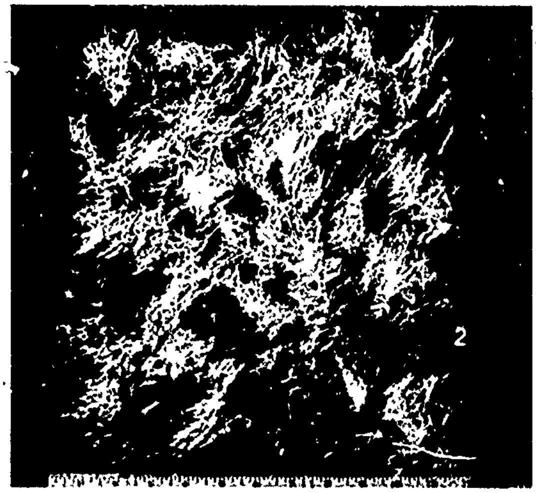
Chopped fiberglass

34. Chopped glass was uniquely suited for application on the east and west slopes of the ARES facility because it was necessary to keep the wire mesh surface of these slopes free of all obstruction. The fiberglass strands were chopped at the site with the cutter gun as shown in photo 7. The fiberglass strands were cut to approximately 1/2-in. lengths and blown about 10 ft from the gun. The cutter required about 8 min to cut up 30 lb (one box) of the Unistrand fiberglass. A typical operation of one of these guns is shown in photo 8, which shows the air hose from the compressed air supply that activates the gun, the wheeled fiberglass dispenser, and the ground wire that prevents the buildup of static electricity. The guns worked very well and required only a periodic change of blades. Placing chopped glass at the design rate of 1/4 lb/sq yd resulted in a placing rate of 15 sq yd per minute.

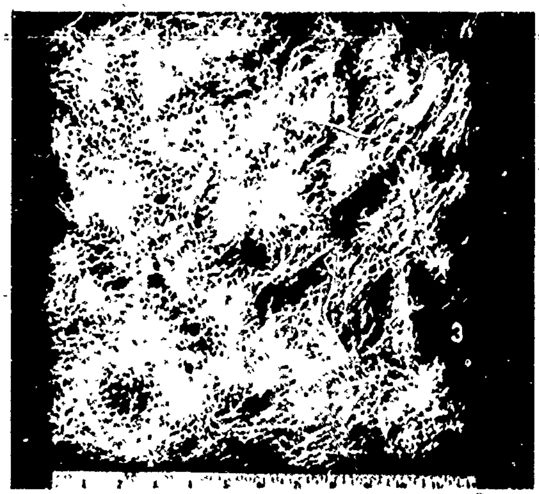
35. The actual rate of application varies with the compressor air pressure and ease with which the continuous fiberglass strand feeds into the chopper; therefore, visual checks must be made over a marked area where the total amount (in pounds) of chopped glass applied is known. The number of these checks can be varied (subject to the engineer's judgment), depending on the experience of the operators, the regularity of the terrain, and weather conditions. Fig. 5 shows the comparative density of glass fibers placed at application rates ranging from 1/8 to 1/2 lb/sq yd. The actual average rate of application was 3.6 oz/sq yd.

36. After an area had been checked, the hooks described previously (paragraph 22) were used to snag a section of wire and shake it.

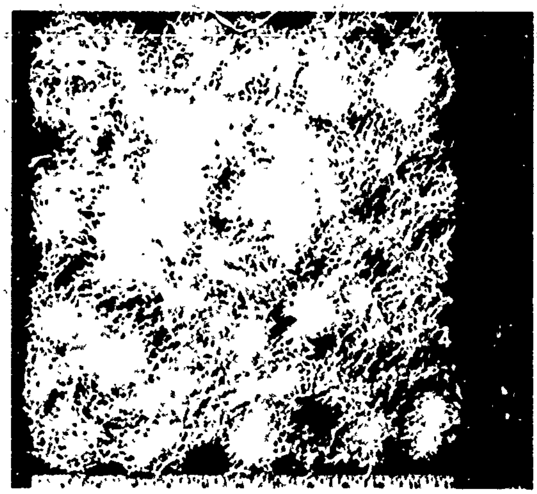
a. 1/8 lb/sq yd



b. 1/4 lb/sq yd



c. 3/8 lb/sq yd



d. 1/2 lb/sq yd

Fig. 5. Chopped fiberglass placed at four rates of application on 1-sq-ft areas

This action caused the chopped glass to fall through to the ground. This segment of the operation went fairly fast, and each shake effectively cleared about a 10-sq-ft area of mesh.

<u>DCA-1295</u>

37. The DCA-1295 solution was hand-sprayed over the chopped glass (photo 9). The rate of application was checked in much the same manner as the rate of fiberglass application. The desired application

rate, in this case 4 lb/sq yd, is used to calculate the number of gallons to be applied per square yard. The density of this material is 9.2 lb per gal, which would indicate 0.435 gal per sq yd, or 1370 sq yd per truckload. Actual average application rate was 4.3 lb/sq yd.

38. An operator and one laborer placing chopped glass and two teams spraying the DCA-1295 over the west slope where the chopped glass has already been placed are shown in photo 10. Close examination of this photograph will reveal the boxes of continuous-strand fiberglass roving positioned on the slope to increase production rates by having material stockpiled in areas close to chopper operations. One box is just to the right of the two men placing the chopped fiberglass. Photo 11 shows a close-up of the chopped fiberglass and DCA-1295 placed in a section covered by 4-in.-grid wire mesh. A broader view of a typical area adjacent to the wire mesh is shown in photo 12.

DCA-1295 and Fiberglass Scrim

39. The north slope (1V on 2H) was very difficult to climb. The surface of the slope was covered with loose soil that earlier thorough wetting had not compacted. Prewetting and working on the slope were impossible; therefore, it was decided that the dilution of the DCA-1295 would be increased as described previously (paragraph 32).

Fiberglass scrim

40. A yoke was constructed to enable one person to unroll the fiberglass scrim. The tip of the yoke was grasped by hand and pulled over level areas; however, for the north slope, a rope was tied to the tip of the yoke for raising and lowering. After a few trials of unrolling the scrim in each direction, it was decided to unroll the scrim as the roll was pulled up the hill, but not to allow the roll to unwind as it rolled downhill since the tip of the yoke would occasionally dip down and snag the scrim, causing the fabric to unravel and wrinkle. The scrim was applied at an average rate of 1.6 oz/sq yd.

DCA-1295

41. DCA-1295 solution was sprayed on the scrim at rates that

produced an average application of 4.3 lb/sq yd. Areas in which a concentration of foot traffic was expected, i.e., near the base of guy wires, etc., received a heavier application of DCA-1295 in an effort to prevent damage of the film (photo 13). No runoff of the solution was observed, and good coverage was obtained. Photo 14 shows a partial view of the completed scrim/DCA-1295 system.

Wind Problems

42. The wind proved to be a major obstacle during the entire project. The need for restricting placement of the scrim/DCA-1295 system to periods in which wind velocity is below an established limit is well illustrated in plate 2 where the daily wind velocity is superimposed on a chart representing the accumulative percent of work completed versus days worked at the ARES facility. Actually, the Qualitative Materiel Requirement for Dust-Control Materials excludes application during periods when the wind velocity is greater than 20 knots (23 mph). Since this project was authorized by another agency under a contract bid with a firm deadline for the completion of all work, a determined effort was made to place the materials regardless of the wind.

43. During two days of favorable wind conditions, chopped glass was placed on the east and west slopes by blowing the glass on the prewet surface and following closely with application of DCA-1295 solution.

44. Placement of the scrim fabric was begun on the day of the highest recorded wind velocity. The placement of the scrim should have proceeded faster than an equal coverage with chopped glass; however, the wind was so severe, it lifted a treated section of scrim saturated with DCA-1295 liquid off the slope and ruined it. Occasionally when the wind presents a problem during placement, it is advantageous to head into the wind, but working on the steep slope limited maneuverability and the wind frequently changed directions through an estimated arc of 60 to 80 deg, which effectively prevented use of this alternative.

45. Placement of the scrim was halted on 28 May when the coverage on the north slope was about 90 percent complete. With the

sponsor's approval, the remaining area was treated with DCA-1295 only. The nonreinforced film provided adequate temporary protection, and later, when weather conditions were more favorable, Sandia Base personnel returned, covered the film with chopped glass, and secured it in place with additional DCA-1295 liquid.

Costs

46. Costs associated with the usual method of application, as shown in photo 10, amount to $0.885 per sq yd and are itemized as follows for a coverage level of 26,000 sq yd per 10-hr day and an application rate of 4 lb/sq yd:

Item	Cost
DCA-1295	$19,000
Fiberglass	3,120
Equipment and labor	840

Costs at the ARES facility amounted to $1.31 per sq yd and are itemized as follows for a coverage level of 155,000 sq ft per 8.8 days of 10 hr each:

Item	Cost
DCA-1295	$13,600
Fiberglass	1,700
Equipment and labor	7,203

Costs of quantities remaining on hand for maintenance are not reflected in these figures nor are any prices for a soil sterilant included. The difficult working conditions due to high winds reduced labor efficiency, which is reflected in the unit cost. Thus, hand application of materials increased the cost approximately 48 percent; however, this method of erosion control was the most economical measure considered that would provide the desired results.

PART VII: CONCLUSIONS AND RECOMMENDATIONS

Conclusions

47. Based on the results obtained in this investigation, the following conclusions are believed warranted:

a. The soil sterilant used (Hyvar X) is compatible with fiberglass and DCA-1295.

b. Use of the stabilization system discussed herein at the specified design rates (4 lb/sq yd of DCA-1295 sprayed over fiberglass reinforcement, i.e. either 4 oz/sq yd of chopped glass or 1.6 oz sq/yd of scrim) will control erosion.

c. Proposals for future projects of this type should include weather stipulations, such as limiting applications to periods in which the wind velocity is less than 20 knots.

d. Chopped glass is easier to apply on steep slopes than the scrim, mainly due to the weight of the packages (30 versus 230 lb).

e. Cutter guns, considered unsuitable for large projects, are ideal for special jobs such as the ARES project where small areas can be covered in a reasonable time.

f. When hand application of chopped glass is required in the future, each cutter-gun operator should be furnished a backpack container for the fiberglass strand similar to the one described in Appendix A.

Recommendations

48. Because reinforced DCA-1295 is not a maintenance-free item, the stabilized areas at the ARES facility should be inspected at regular intervals. Repairs should be made where the film has ruptured and water has seeped through a hole in the film and softened or eroded the underlying soil.

49. The following general recommendations are made:

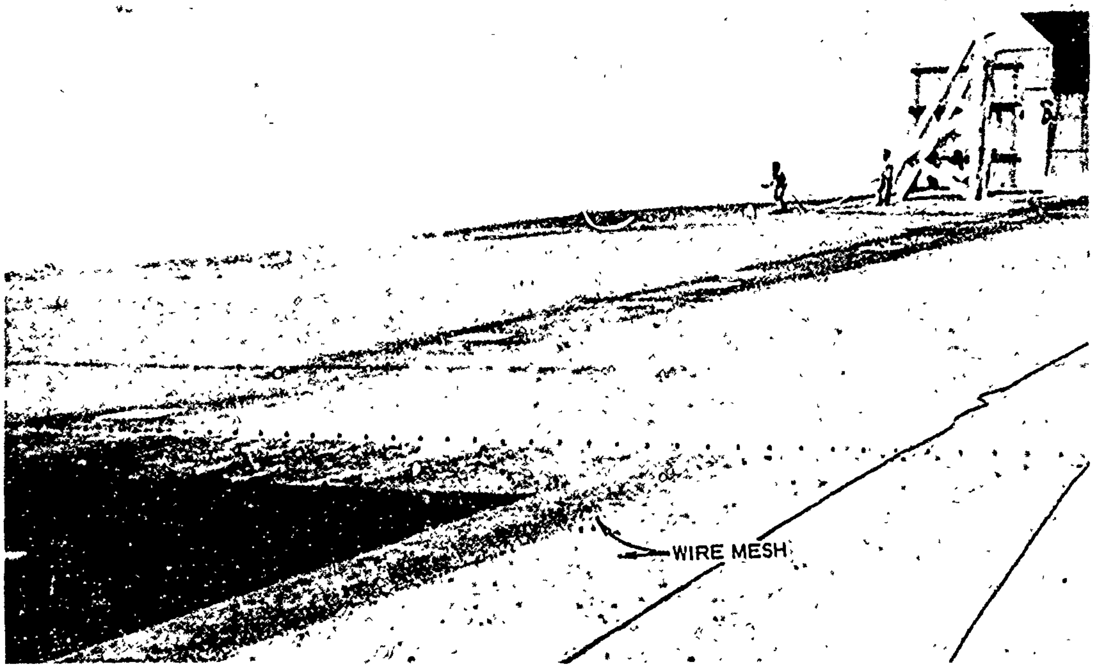
a. Consideration should be given to the use of the reinforced DCA-1295 system, when required, in special problem areas.

b. In certain geographical areas, consideration should be given to use of liquid fertilizer or other vegetative inducements rather than a soil sterilant because the DCA-1295/fiberglass film system does not impede vegetation growth in any way and could be used to stabilize an area until vegetation becomes established.

c. An applicator that constantly agitates soil sterilant solutions should be procured for similar WES projects.

Photo 1. Typical section in project area. Note the sparse vegetation and evidence of erosion

a. East slope



b. West slope

Photo 2. East and west slopes of project area

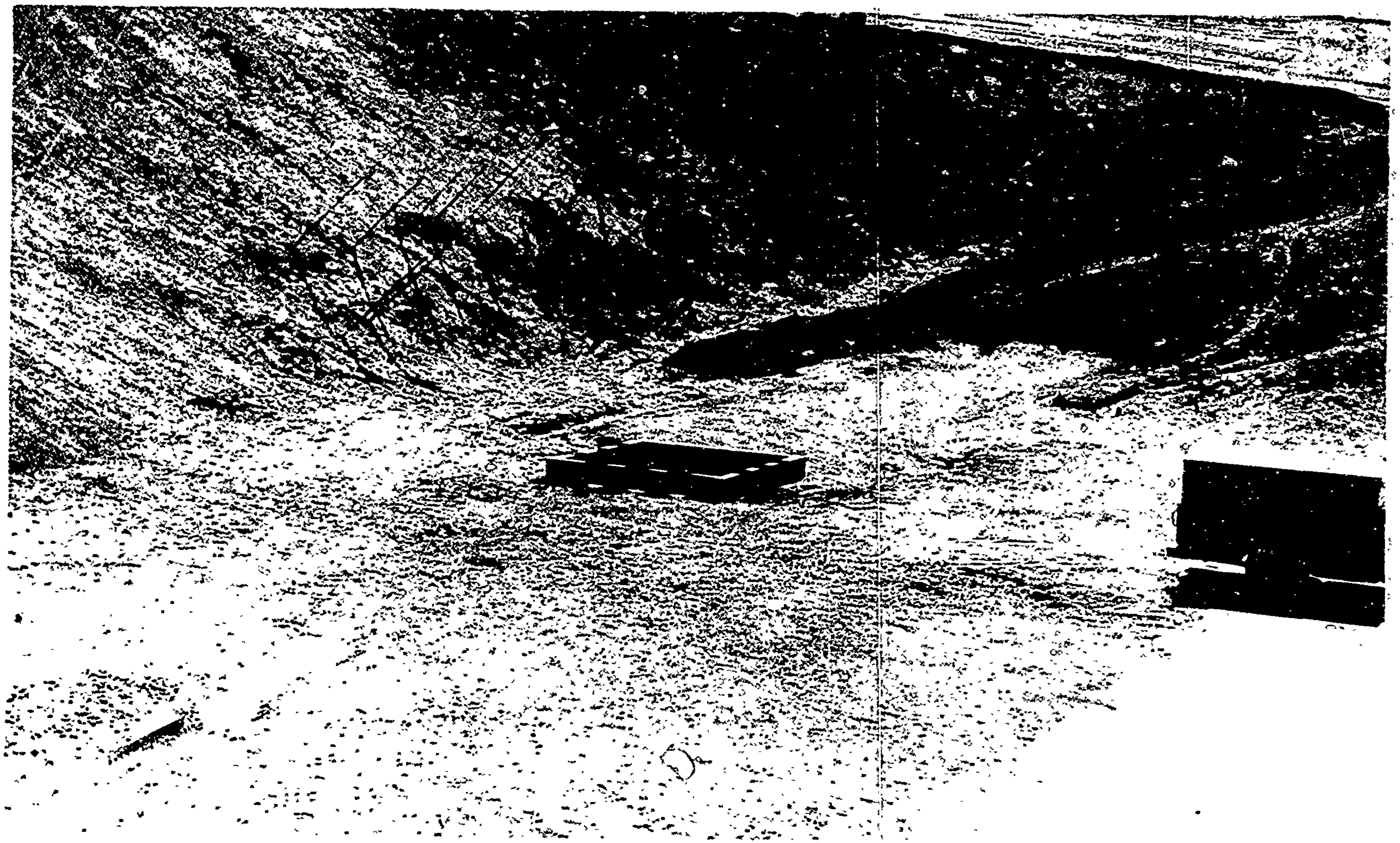
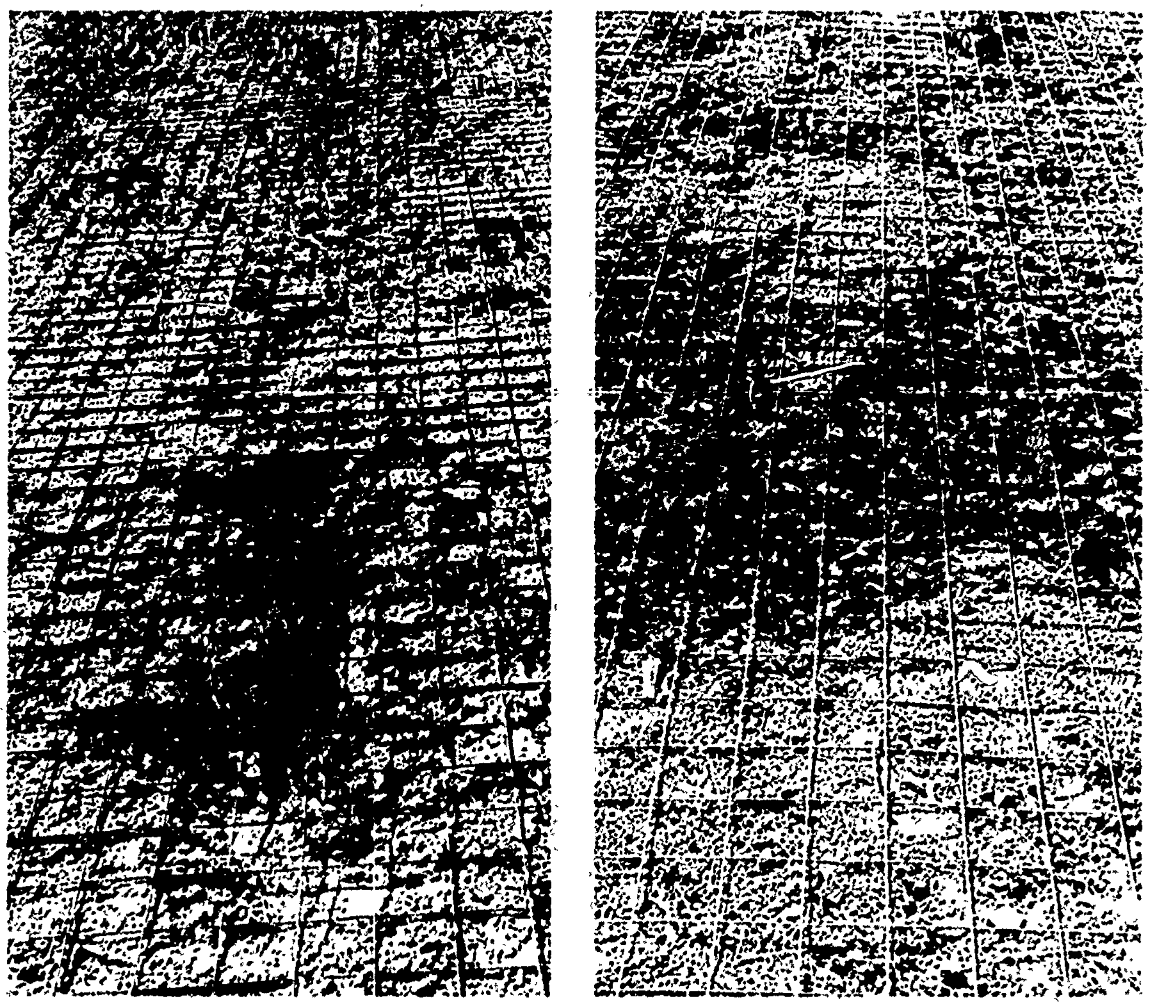


Photo 3. North slope prepared for application of the stabilizing materials



a. Prior to preparation　　　　b. After preparation

Photo 4. Erosion in area of 4- by 4-in. mesh and same area after preparation for application of stabilizing materials

a. Prior to preparation

b. After preparation

Photo 5. Erosion in area adjacent to 4- by 4-in. mesh and same area after preparation for application of stabilizing materials

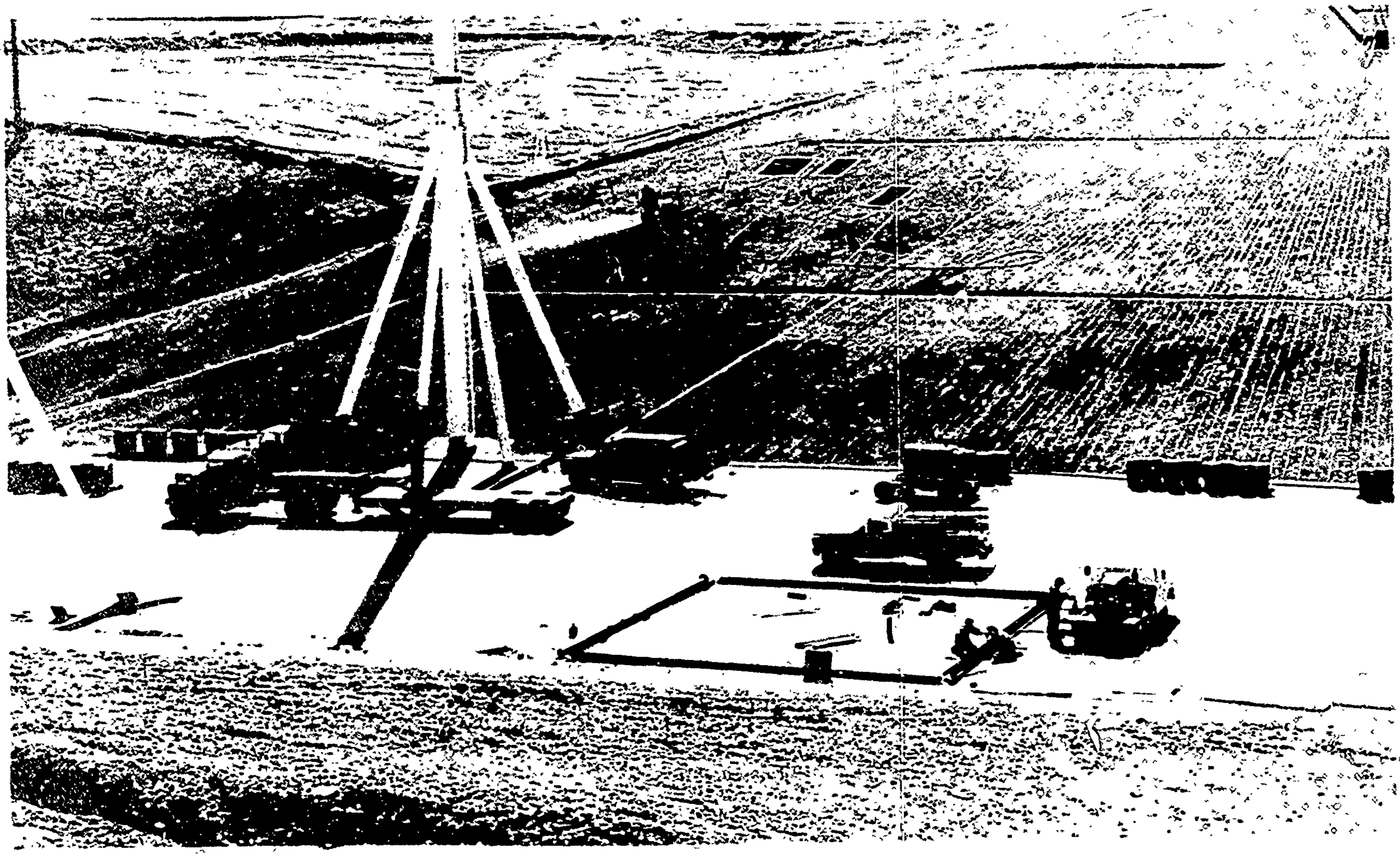


Photo 6. Application of the soil sterilant

Photo 7. Hand-held, air-activated cutter gun in operation

Photo 8. Typical operation showing cutter gun, dispenser, and crew

Photo 9. Application of DCA-1295 on an area covered with chopped glass

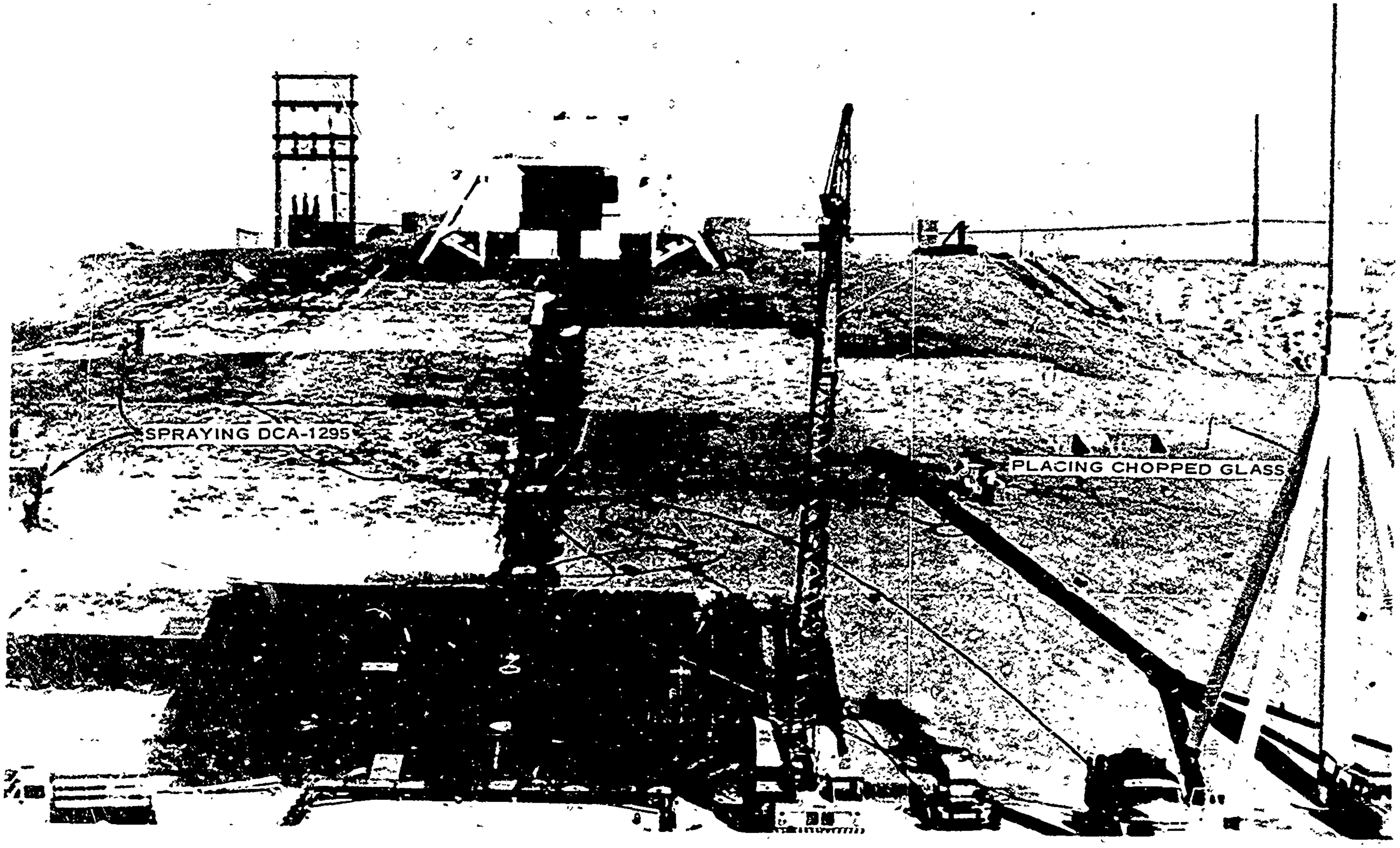


Photo 10. Placing chopped glass and spraying DCA-1295 on west slope

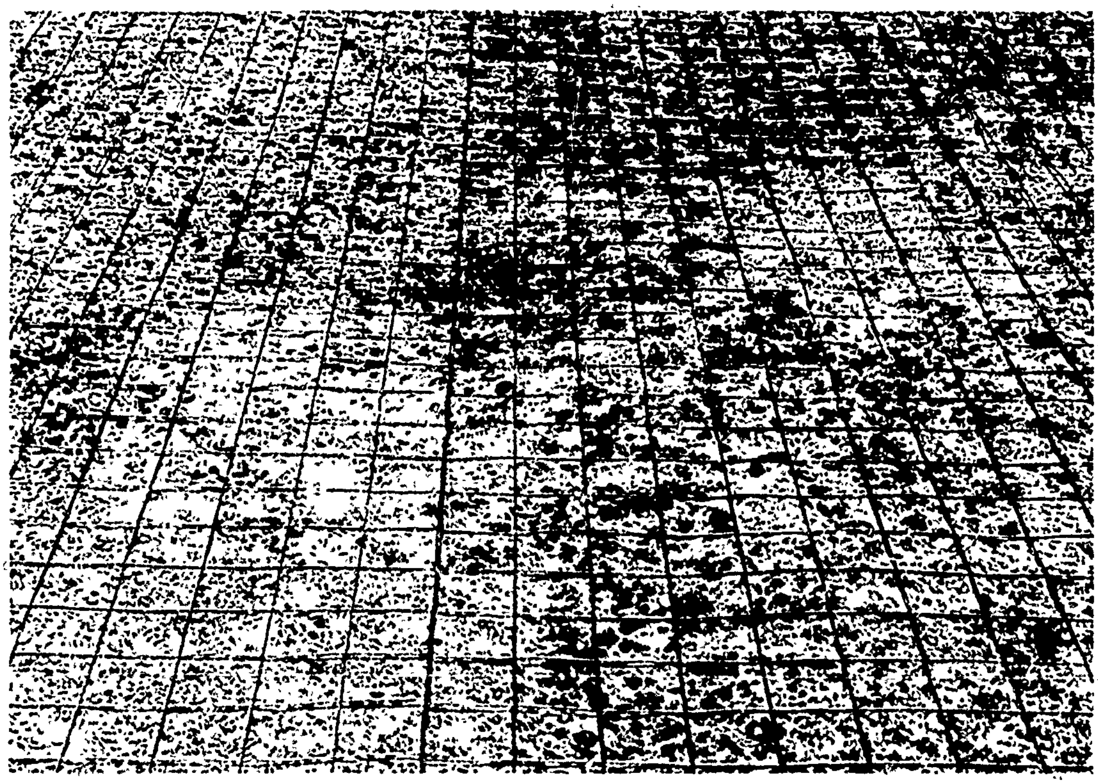
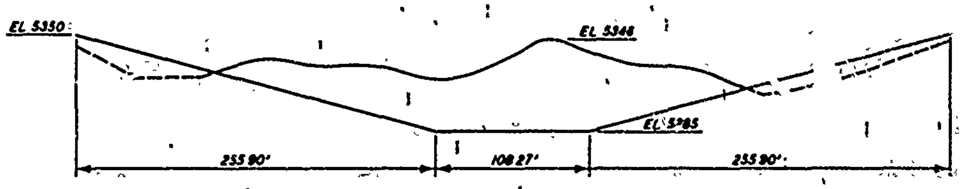


Photo 11. Chopped glass and DCA-1295 in wire mesh area

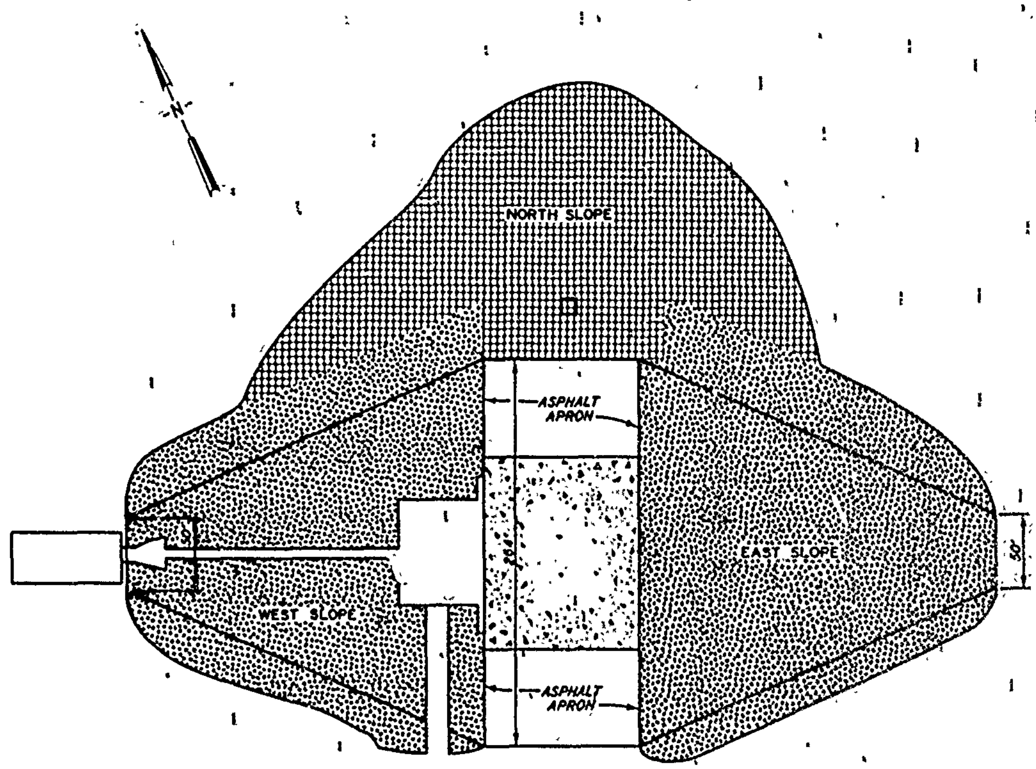
Photo 12. Chopped glass and DCA-1295 in area adjacent to wire mesh

Photo 13. Area around guy wire base that received a heavier application of DCA-1295 due to expected occasional foot traffic

Photo 14. Partial view of the area treated with fiberglass scrim and DCA-1295



PROFILE



PLAN

LEGEND

- CONCRETE PAD
- AREA TO RECEIVE CHOPPED GLASS
- AREA TO RECEIVE FIBERGLASS SCRIM

NOTE: BOTH AREAS TO RECEIVE SOIL STERILANT AND DCA 1295.

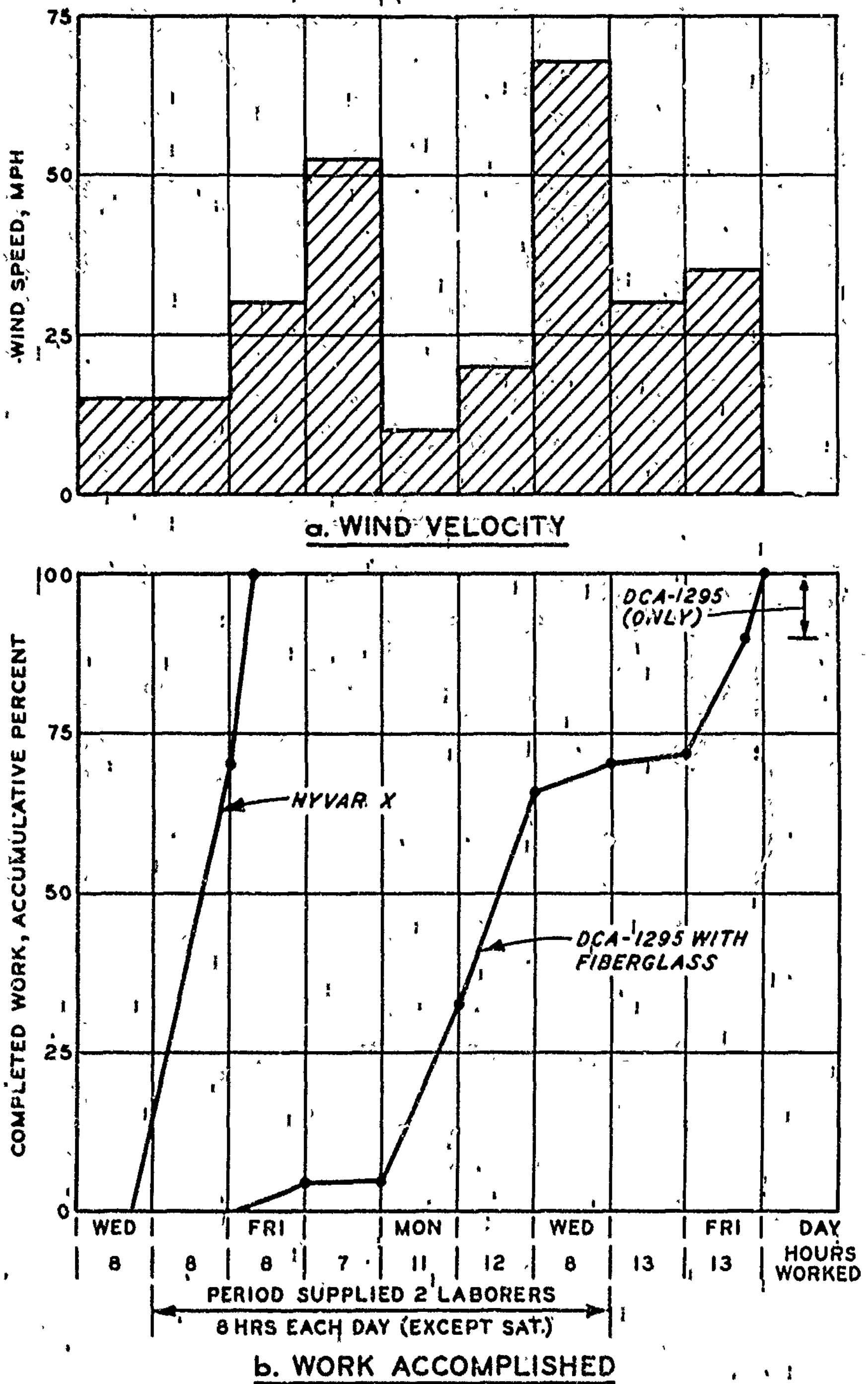
SCALE IN FEET

50 0 50 100

ADVANCED RESEARCH EMP SIMULATION FACILITY (ARES)

SITE LAYOUT

EROSION CONTROL



EFFECT OF WIND VELOCITY ON WORK ACCOMPLISHED

PLATE 2

APPENDIX A: USE OF BACKPACK TO CARRY FIBERGLASS FOR CUTTER GUN

1. The suggestion below was submitted by Mr. William E. Fry, Facilities Engineer, Sandia Base, regarding the use of a back pack to carry fiberglass for the cutter gun discussed in the main text.

2. Mr. Fry contends that the adoption of his suggestion will save time and materials, improve methods, and simplify work.

3. The actual suggestion, as submitted, is as follows:

> Suggest the U. S. Army Engineers, Waterway Experiment Station, P. O. Box 631, Vicksburg, Mississippi 39180 adopt the use of a back pack to be carried by the fiberglass chopper operator when applying the chopped glass fibers to soil that is to be stabilized. The present method is to have one man follow behind the chopper operator carrying the ball of fiberglass roving or pushing a two-wheeled cart that transports the ball. The back pack can be rigged using a 5-gallon paint bucket strapped to the back pack at an angle so that the ribbon of fiberglass roving will pull out of the ball smoothly. A piece of garden hose, about 4 feet long, tied to the top and side of the back pack to keep the glass ribbon from rubbing against the chopper operator should be used. This method will prevent tangling of the ribbon and will allow the operator to proceed uninterrupted.
>
> Under the present method, there is tangling when the ball of continuous strand ribbon is reduced to a thickness of approximately one inch and is subsequently wasted. Under the suggested method, there is no waste. This was evidenced by the suggestor when actually applying six balls of fiberglass on 8 and 9 June 71. Under the suggested method, the second man would not be needed, provided a small air hose 3/8 I.D. and 5/8 O.D. is used.