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New Product Performance Evaluation Under Simulated Rain (Part II)

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CONWED Corporation

Report of Tests

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INTRODUCTION

In January, 1990 a report bearing the same title as this report was prepared and submitted to CONWED Corporation. It contained results from tests performed on experimental erosion control blankets that CONWED was developing. This report provides similar test results of additional new materials.

MATERIALS AND METHODS

Description of Testing Facility

Rainfall simulator. The rainfall simulator is a drip–type device in which raindrops are formed by water emitting from the ends of small diameter brass tubes. The rate of flow is controlled by admitting water into a manifold chamber through fixed orifice plates under constant hydraulic pressure. Five separate inlet orifices are used in each chamber or simulator module. The ratios of the areas of the orifices are 1:2:4:8:16. By controlling the flow to each orifice with an electrically operated solenoid valve, it is possible to vary flow in on–off increments with 31 steps. Outlet from the chambers or modules is through equally spaced brass tubes. Each module is a 24–inch square enclosed box about 1–inch deep and oriented so that the ends of the tubes or needles form a horizontal plane to let the water drip vertically toward a tilting flume. Each module has 672 needles spaced on a 1–inch triangular grid pattern.

The rainfall simulator consists of 100 modules spaced and supported to make a continuous simulator 20 feet square. Each module has separate controls so that a spatially moving storm with time–changing intensities can be simulated. The 500 switches are manually operated or can be controlled by a programmed computer if desired.

Raindrop sizes and velocities of impact are representative of those of typical high intensity storms. The spatial distribution of rain is essentially uniform, and the control of application rates is within the accuracy requirement of most experiments.

Testing flume. The square test flume measures 20 feet on each side and can be tilted at any angle up to approximately 43 degrees. The rainfall simulator is supported over the flume so that rain falls directly onto the test plots.

Approximately 1 foot depth of soil is supported in the testing flume by a metal grating covered with filter cloth through which water can drain. For the CONWED tests, the flume was divided into six test plots, each measuring 2 feet by 19.5 feet. There were three sets of two plots each, and the sets were separated from each other and from the side walls by 2–foot wide walkways. The rainfall simulator was arranged so that rain fell on the plots and not on the walkways. Runoff from each test plot was collected in a plastic container and weighed. The water was decanted off, and the soil was dried and weighed to determine amounts of soil and water leaving each plot per unit of time.

Products Included in Tests

The following products were included in the tests:

- 90# CONWED woodfiber mat without netting
- 60# CONWED woodfiber mat without netting

TESTING PROCEDURE

Plot Preparation

Each of the six test plots was filled and compacted with a sandy loam soil having the following approximate composition: total sand = 63 percent; total silt = 24 percent; total clay = 13 percent; and total organic matter = 1.41 percent. After each test run, the top layer of soil and mulch on each plot was removed and discarded to the depth that erosion had occurred. New soil was added to replace the soil that had been removed, then each plot was cultivated with a garden tiller to a depth of approximately 6 inches. The soil was then raked smooth and uniformly compacted with a lawn roller filled with water in preparation for the next application of test product.

After the plots were prepared and the various mats to be tested were installed, the test flume was tilted to the desired slope in preparation for the rain application.

The 60# mats were tested on a 4:1 (25 percent) slope and the 90# mats on a 2:1 (50 percent) slope.

Rainfall Application

When the plots were tilted to the desired slope, they were covered with a plastic sheet. The rainfall simulator was turned on at full capacity to purge the air from the system. (During this purging, the rain fell onto the plastic and ran into a drain without wetting the plots.) When the purging was complete, the rainfall was adjusted to the desired rate and allowed to stabilize. The plastic sheet was then quickly removed so the rain fell directly onto the plots, and the time clock was started.

Total time was recorded from the instant the rain began falling onto the plots until failure of a mat or slope occurred. As each failure occurred, or the catchment was filled, rainfall to that plot was stopped so no additional soil would be lost.

On the 4:1 slope, rain was applied at 4 inches per hour for approximately 42 minutes and was then increased to 6 inches per hour until the end of the test. On the 2:1 slope, rain was applied at the rate of 8 inches per hour for 40 minutes.

Runoff Measurement

All of the sediment and water leaving each plot during a test were collected in large plastic containers and weighed. After the sediment had settled, the water was decanted from the containers and the soil was dried and weighed.

RESULTS AND DISCUSSION

Photographic Results

A narrated VHS video and color prints were made of each test run; they included close up shots of each plot after rainfall ceased. These are already in the possession of the Fibers Division of CONWED and are considered to be a significant part of this final report.

Numerical and Graphic Results

Data for these test runs are contained in Table 1. Figures 1 is a graphical representation of Table 1 data.

Discussion

Two replications were made of each product test on each of two different slopes, but only one run each of bare soil. During the 8–inch per hour rainfall on a 2:1 slope, one of the 90# product test plots failed due to a mud slide, so all data for that plot were lost. Data remain for the following:

- Two replications of test of 60# material on 4:1 slope
- Single run of test on bare soil on 4:1 slope
- Single run of test of 90# material on 2:1 slope
- Single run of test on bare soil on 2:1 slope

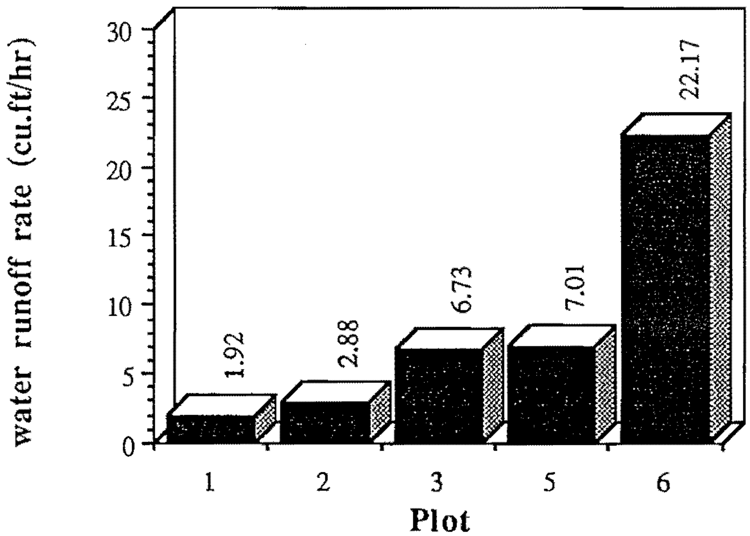
With so few data, these tests by themselves are not definitive, but are indicative only. However, the primary purpose of the client in having the tests run was to enable them to compare results of the tests on these new materials with results obtained from previously tested materials under similar conditions of slope, soil, and rainfall.

Both the 60# and the 90# materials appear to be very effective in decreasing erosion caused by rainfall. During the first part of a rainstorm, they retain most of the water and bleed it slowly into the soil profile beneath. If the soil becomes saturated due to high moisture content before a storm, or due to a prolonged storm, a slide may occur as it did in plot No. 4. The higher the clay content of the soil, the sooner such a condition may be attained. However, the chance of having a rainstorm of such high intensity for a long period of time is extremely remote.

After the runs were completed, the mats were removed, pictures were taken, and a 60# mat was reinstalled in plot No. 2 and stapled at the top end only. The flume was tilted to a 2:1 slope, and rain was applied to plot No. 2 at a rate of 8 inches per hour for 10 minutes and then shut down. There was a small amount of gullying beneath the mat, but the mat was still intact. Additional details of this and other runs are presented in the video and the colored prints.

Table 1. Test data for water runoff and soil erosion.

Plot	Product	collection time (hr)	water vol. (cu.ft.)	soil weight (lb)	water runoff rate (cu.ft/hr)	soil erosion rate (lb/hr)
1	60# CONWED mat	1.217	2.34	0.30	1.92	0.25
2	60# CONWED mat	1.217	3.51	0.20	2.88	0.16
3	Bare soil control 1	1.217	8.19	51.20	6.73	42.08
4	90# CONWED mat	0.633	n/a	n/a	n/a	n/a
5	90# CONWED mat	0.667	4.67	1.20	7.01	1.80
6	Bare soil control 2	0.667	14.78	156.20	22.17	234.30



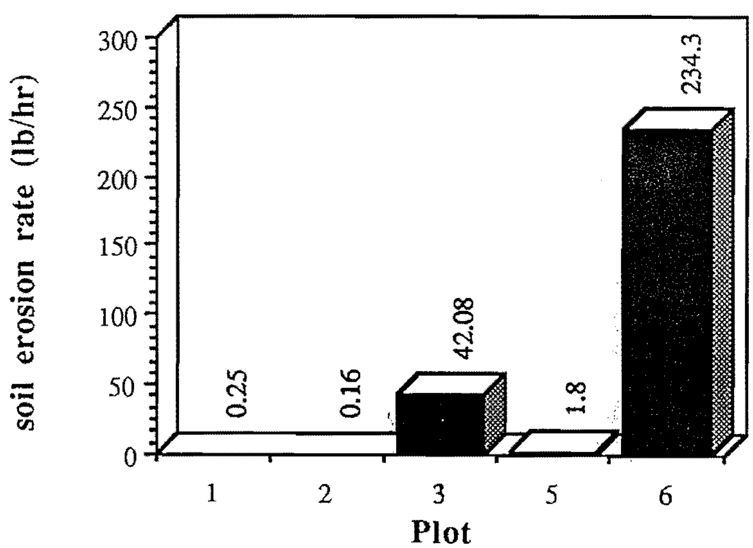


Figure 1. Graphical representation of data in Table 1.

SUMMARY AND CONCLUSIONS

Based on data collected in the foregoing tests, as well as observations made and impressions received during performance of the tests, the following general summary statements and conclusions are presented:

1. The performance of erosion control products herein described was for a particular set of soil, slope, and rainfall conditions and may be expected to be different if any or all of these conditions are changed. Additional replications of the tests under the same conditions may alter the results as well.

2. Both materials are effective in preventing or decreasing erosion by enabling more water to infiltrate and less to flow downslope; however, during rainstorms of high intensity and long duration, this product characteristic may result in failure of the slope, caused by soil saturation, unless the soil has exceptionally good drainage.

3. It appears that a netting to hold the blankets in place is not necessary, unless perhaps they were subjected to high–velocity winds before rain had fallen to adhere the fibers to the soil.

4. It appears that the 60# material will provide adequate protection against soil erosion under heavy, prolonged rainstorms on moderate to steep slopes under all but, perhaps, very extreme conditions. In most instances, the 90# material might be an overkill, as well as an unnecessary expense.

5. Both products performed extremely well in preventing soil particles from moving downslope on the plots.

Policy Notice

The University has requested that the following be included in all test reports:

> *It is understood that the production of this report and contents thereof does not constitute an endorsement by the University of any of the products tested. The client shall not use the University's name for advertising purposes, and shall not publish statements pertaining to University research or test findings about such products except statements specifically approved in writing by the University.*