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FIELD STUDY OF EROSION CONTROL AGENTS IN COLORADO

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The recent attention to ecology has led to many changes in road construction. One change has been in the emphasis on roadside planting for erosion control and highway beautification. In Colorado, many roads are being constructed with steep side slopes in both cuts and fills. These slopes are prone to both water and wind erosion, so it is important that vegetation be planted quickly to hold the topsoil in place. This not only makes the highway seem less of an incursion on the scenery, but also aids in the maintenance of roads, preventing culverts from being stopped up and aiding the drainage systems in working properly to prevent hazardous conditions to the people using the highway.

On I 70 west of Denver a series of cuts and fills which, because of their steep slopes, had to be hydroseeded. The first seeding did not result in a good stand because the seed was either blown or washed away This site was chosen to try out 4 of the most promising commercial products, previously laboratory tested in Manhattan, Kansas, for preventing erosion. The objective was to find out the effectiveness of these agents in holding the soil in place while the seed was germinating so that natural erosion control would be achieved.

As well as erosion control, cost of the products and ease and cost of application were considered. When two products do the job, obviously, the cheaper will be used. The 4 types of erosion control agents chosen for the field test sections were: 1) Coherex, a liquid petroleum

resin-in-water emulsion, 2) Wicaloid Latex, a liquid carboxylated styrene-butadiene latex, 3) Terra-Tack, a granular, vegetable colloid protein, and 4) Elvanol 50-42, a powder, polyvinyl alcohol. These products were applied at the manufacturer's recommended rates. Cost of these products is given in Table 1 of the Appendix.

All of the test sections were hydroseeded a few hours prior to the the application of the erosion agents with the seed mixture shown in Table 2 of the Appendix. The erosion control agents were applied with the same Hydroseed sprayer (Bowie Hydro-Seeder - 2300 gallon capacity).

Pictures were taken both prior and during application of the agents on June 14 and 15, on July 11, then again in October. The sections were inspected visually in the interim.

DESCRIPTION OF THE TEST SECTIONS

Section 1 is approximately a 1:1 fill slope of about 1.2 acres. It was sprayed with Coherex (162 gallons of Coherex in 800 gallons of water). Some trouble was encountered with the product because it foamed over the top of the tank. Finally, the tank agitators were disconnected, the foam was allowed to settle for an hour, all the liquid that would come out was sprayed on the slope, then the tank, still full of foam, was washed down with 600 gallons of water and the mixture sprayed on the slope. Coverage was fairly even so the entire slope was used for the test.

The original picture, Figure 1 (pictures of Section 1) shows very little growth on this section in the beginning

Part of this section was disturbed when some drain pipe was installed These parts (the dark color in 2nd picture) were eliminated from the test.

Figure 1 Test Section 1 (Coherex)

Mid June before seeding and spraying
No plant growth and no erosion protection

Mid July plant growth starting
Some protection for the soil

October about 65% plant coverage fair
soil protection and if there is good
self reseeding good coverage next spring.

The final picture shows approximately 65% plant coverage of the slope, enough to prevent some erosion, but not totally effective.

On June 14, Section 2 was seeded, and then sprayed with Wicaloid. (Fifty-five gallons of Wicaloid in 725 gallons of water were used on this 1.2 acre cut with the 1:1 slope.) The Wicaloid mixed well and was sprayed on the slope with good coverage of the middle and lower part. The sprayer could not reach the top of the slope, so only the middle and lower portion of the section was used for the test.

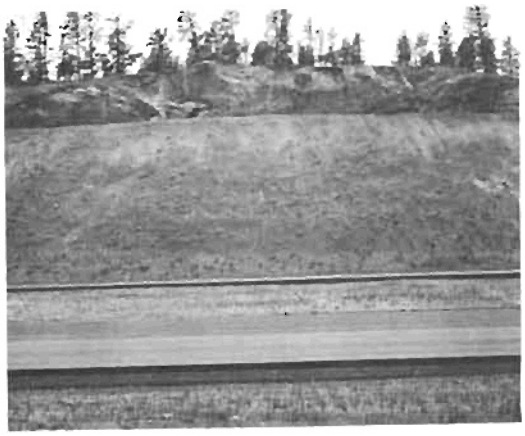
Both visual inspection and the June photograph show that only a few sparse weeds were growing on the slope and that there was no apparent erosion present. The second picture taken July 11, shows that very little new growth has taken place over the 3 week period, but that little erosion has taken place.

Inspections in August and September showed that the growth had started. The final picture shows that there was 40% plant coverage on the slope and that small gullies were forming. This sparse coverage is not preventing the slope topsoil from eroding away.

Section 3 was sprayed with Terra-Tack. (40 lbs. in 2,000 gallons of water.) It is adjacent to Section 2 with about the same size and slope as Section 2. The material went on the slope with little trouble but the sprayer could not reach the very top of the slope so again the middle and lower parts were used for the test.

Terra-Tack performed almost exactly as Wicaloid in Section 2. About 40% of the slope had growth on it and small gullies appeared throughout the test section by October.

Figure 2 Test Section 2 (Wicaloid)



Mid June Sparse Weeds Little Erosion Protection

Mid July a Little Plant Growth Little Erosion Protection

October About 40% Plant Cover Gullys Appearing In Slope

Figure 3 Test Section 3 (Terra-Tack)

Mid June A Few Weeds Formed Very Little Erosion Protection

Mid July

October About 40% Plant Cover Gullies Appearing in Slope

Figure 4 Test Section 4 (Elvanol)

Mid-June Very Little Growth No Erosion Protection

Mid-July Plant Growth Well Underway

October Very Heavy Plant Coverage
Good Natural Erosion Protection

Section 4 was sprayed with Elvanol (100 lbs. in 1,000 gallons of water). It is a fill slope of about 1.2 acres. The agent foamed with the tank agitators turned on, but after they were disconnected, the foam settled out in 5-10 minutes. Only the very bottom of the slope was not well covered.

Section 4 showed the best results of the four sections. As the pictures show in July, the plant growth was well underway and the October photograph shows very good plant coverage.

About 90% plant coverage was achieved, and on close inspection there is no noticeable erosion in this section. The abundant plant growth should prevent future erosion here, thus accomplishing the objective.

LABORATORY STUDIES

In addition to the field test sections on erosion control agents, a simple lab study was also undertaken. For details on materials used see Table 3 of the Appendix. On July 27, 1972 a composite soil was split into seven equal parts of 17.1 pounds each (dry weight). The soil was placed in 18" square pans 1 1/2" deep. 500 ml. of water was added to each and mixed.

Each flat was seeded with a mixture of 50 grams of crested wheat seed and 5 grams of bluegrass seed, followed by 400 lbs/ft^2 of compaction to simulate a hydroseeded slope.

Soil additives were placed in the pans as shown below:

PAN NO.	TARE (LB)	TARE + SOIL (LB)	H_2O ADDED TO SOIL	EROSION CONTROL AGENT
1	2.7	19.8	500 ml	Terra-Tack
2	2.7	19.8	500 ml	Coherex
3	2.7	19.8	500 ml	Elvanol
4	2.7	19.8	500 ml	Erode-X
5	2.7	19.8	500 ml	Wicaloid
6	2.7	19.8	500 ml	3 M
7	2.7	19.8	500 ml	Standard

Rates of application (manufacturer's recommended rates):

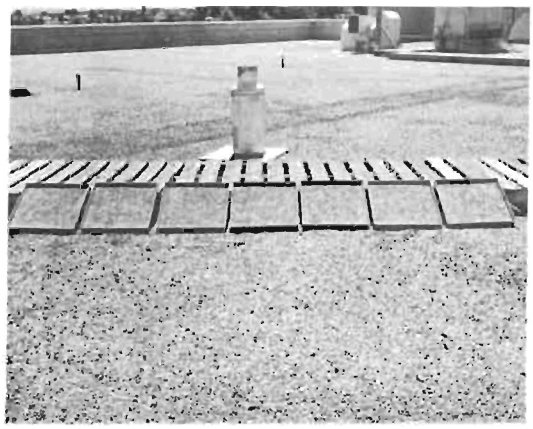
Terra-Tack	0.95 g	and	391 ml. water
Coherex	33.2 ml.	and	132.8 ml. water
Elvanol	2.45 g.	and	196 ml. water
Erode-X	26.3 ml.	and	236.7 ml. water
Wicaloid	13.1 ml.	and	163.75 ml. water
3 M Product	25 ml.	and	250 ml. water

Number 2 (Coherex) only covered about 85% of the pan.

Number 6 (3 M Product) set up in the bottle within ten seconds, so only about half of this material was used.

The pans were placed on the roof of the lab to be exposed to natural weathering and were tilted up at an angle to approximate a 2:1 slope.

Figure 5



Pans on Lab Roof.

These box samples were checked periodically for soil and seed retention. The seed retention was checked, because while the grass was not expected to grow in shallow pans under the hot and dry conditions of the lab roof, the longer the seed was held in place the better chance it had of germinating under field conditions.

On August 4, after approximately 1/2 inch of rain the night before, the boxes were checked and all were doing well in retaining the soil. Rated by visual inspection on a scale of ten, Terra-Tack (#1) was best with 9.8. Coherex (#2) and the 3 M Product (#6) were rated the worst at 9.2. All others were rated at 9.7. In seed retention Terra-Tack (#1) was also rated best at 9.8. Coherex (#2) and the Standard (#7) were rated the lowest at 3.0. The rest were rated as follows: Wicaloid (#5) 9.1; Elvanol (#3) 8.9; Erode-X (#4) 6.8; and the 3 M Product (#6) 5.0.

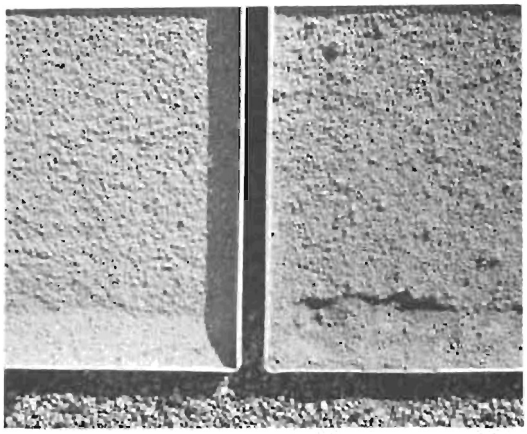
Two weeks later, Erode-X appeared dryer than any of the other samples hinting that it might have been repelling water more than the others.

On August 18, following a storm with heavy rain (3/4") and winds up to 50 mph the samples were again checked. In soil retention, all seemed to be unchanged, but Terra-Tack (#1) had lost most of the seeds it had previously retained. Elvanol (#3) and Wicaloid (#5) were unchanged.

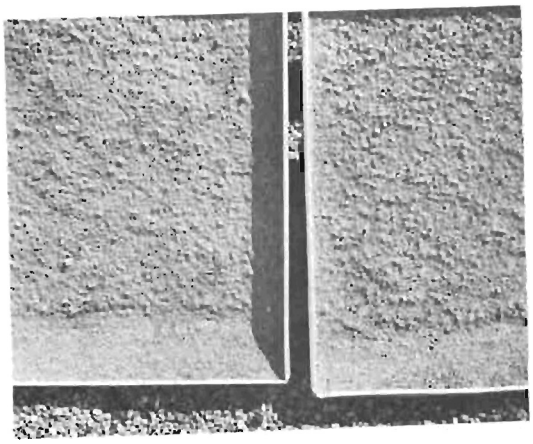
On August 28, all samples were the same in soil retention but Elvanol (#3) was the only sample retaining enough seed to prevent erosion if germination had taken place. Cracking was appearing in all samples except Elvanol (#3) and Erode-X (#4).

On September 8, all samples were still holding but some sloughing in the boxes was appearing in Terra-Tack (#1), 3 M Product (#6) and Standard (#7).

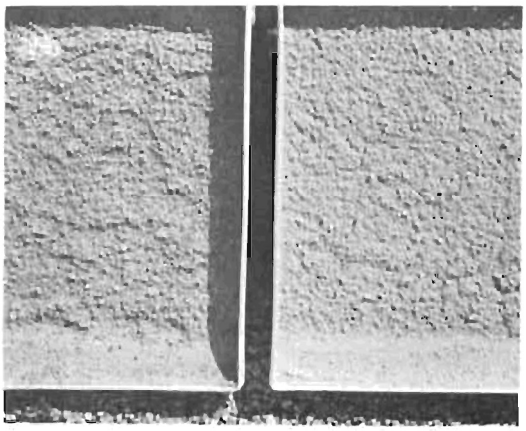
Figure 6
Pans In October



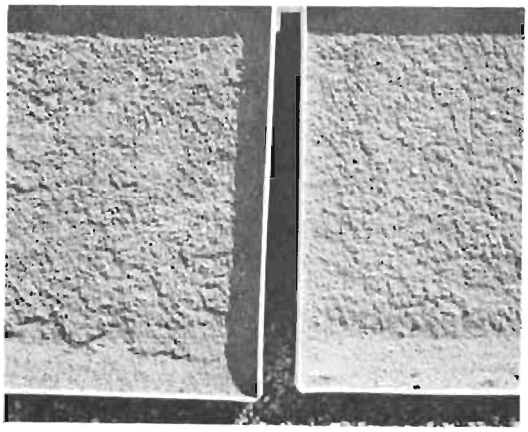
#1 #3



#2 #4



#4 #7



#5 #6

On October 10, it was decided to final out this project. Visual inspection (see Figure 6) showed that Terra-Tack (#1), 3 M Product (#6), and the Standard (#7) had some of the fine silt and clay removed and some sand was protruding from the surface; Coherex (#2) seems to have this same appearance to a lesser degree. Elvanol (#3) and Wicaloid (#5) appear to have the worst problem with soil sloughing at the bottom of the pan. This is probably caused by water forming a pool in the lower corner of the pan. None of the samples had enough seeds remaining to affect natural erosion control.

After the visual inspection, the pans were removed from the roof, dried, and weighed to determine soil loss.

Following are the results.

Pan No.	Tare	Tare & Soil (lbs)	Soil Loss (lbs)	Product
1	2.7	19.1	0.7	Terra-Tack
2	2.7	19.0	0.8	Coherex
3	2.7	19.2	0.6	Elvanol
4	2.7	19.0	0.8	Erode-X
5	2.7	19.3	0.5	Wicaloid
6	2.7	19.0	0.8	3 M
7	2.7	19.0	0.8	Standard

CONCLUSIONS

In field test sections only Section 4 produced the desired results, although Section 1 has little erosion and the plants may reseed themselves, so that by the middle of next spring it may also have sufficient plant cover to prevent erosion.

The agents on Sections 2 and 3 did not prevent erosion and these sections may present problems this spring. One reason that these products did not perform as well as the other two is that both of these test sections are on cut slopes. Cut slopes in the mountains are generally very hard under the four inches of topsoil added to them. This material does not absorb and hold as much water as the loose rocky fill slopes, so the plants do not get as much water or as deep rooted as they can on a fill slope. Also a cut slope can have runoff water drain from the ground above onto the cut slope, while the water above the fill slope is usually caught by the road and drained off via curbs into culverts and lined ditches.

In the box experiment only Elvanol (#3), Wicaloid (#5), and Terra-Tack (#1) performed any better than the standard. Here the seed retention has to be taken into account. In the field, the seed would germinate in 2-3 weeks and so those that retained the seed (Terra-Tack, Elvanol, Wicaloid) should be preferred over those that did not. After heavy rain and strong wind, by August 28, only Elvanol (#3) retained enough seed to promote vegetation sufficient to prevent erosion. The 3 M product (#6) should probably be eliminated from the test because it was not properly applied, and some reservation should be used in judging Coherex (#2).

The experiments indicated that under ordinary circumstances erosion control agents are not effective enough to outweigh their cost. The two sections on cut slopes did not show very promising results, and as stated earlier, the two fill sections were protected from water erosion by the drainage system of the road so they might have done just as well without the erosion agents.

Under severe wind conditions however, where seeds cannot be drilled, into the slopes, some type of agent might be used to hold the seed and soil in place for the 30-40 days necessary for vegetation to get started. Another example where an erosion control agent might be considered is in an area like eastern Colorado. These areas have frequent strong winds and highly wind erodible soil. Here an agent might be used to hold the seed and soil so that natural erosion protection could be obtained easier. Several of these products demonstrated the ability to hold the seed and soil well enough to obtain plant germination so that natural soil protection could be accomplished in windy areas.

APPENDIX
TABLE 1

Material	Chemical Composition	Manufacturer	Recommended Rate/Acre	Dillution Ratio	Material Cost/Acre	
					Exp. Cost	Est. Bulk Rate
Coherex	Liquid, petroleum resin-in-water emulsion	Golden Bear Oil	170 gal./acre	1:4	$52.80	$34.60
Wicaloid	Liquid, carboxylated styrene-butadiene latex	Wica Chemicals	67 gal./acre	1:12.5	$63.80	$14.40
Terra-Tack	Granular, vegetable colloid protein	Grass Growers Inc.	40 lbs./acre	1:400	$80.00	$72.00
Elvanol 50-42	Powder, polyvinyl alcohol	E. I. duPont deNemours & Co.	104 lbs./acre	1:80	$68.00	$ 8.20

APPENDIX
TABLE 2

Seed Used To Plant Slopes In Erosion Control Project

Lot No.	Mixture Kind and Variety	Pure	Germ	Origin
366	Crested Wheatgrass, Fairway	17.05	92	Colorado
SB111	Intermediate Wheatgrass	10.62	93	Kansas
DR137	Western Wheatgrass	21.30	87	Montana
4960	Pubescent Wheatgrass	10.72	91	Colorado
090	Smooth Brome, Lincoln	10.40	87	Kansas
112	White (Dutch) Clover	6.97	96	Idaho
9-1-27A	Perennial Rye Grass	19.81	93	Oregon

Crop .39 Inert 2.55 Weed .19 Tested 3-72

Noxious Weeds None

Rabbit Ears Brand - Supplied by Arkansas Valley Seeds, Inc., Rocky Ford, Colorado

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TABLE 3

Material	Chemical Composition	Manufacturer	Recommended Rate/Acre	Dillution Ratio	Estimated Cost/Acre
Coherex	Liquid, petroleum resin-in-water emulsion	Golden Bear Oil	170 gal./acre	1:4	$ 34.60
Wicaloid	Liquid, carboxylated styrene-butadiene latex	Wica Chemicals	67 gal./acre	1:12.5	$ 14.40
Terra-Tack	Granular, vegetable colloid protein	Grass Growers Inc.	40 lbs./acre	1:400	$ 72.00
Elvanol 50-42	Powder, polyvinyl alcohol	E. I. duPont deNemours & Co.	104 lbs./acre	1:80	$ 8.20
Erode-X	Liquid, emulsion	Malter International	120 gal./acre	1:9	--
3 M Product	Liquid, elastomeric polymer	Minn. Mining and Manufacturing	75-230 gal./acre	Varies	$560.00