A B S T R A C T

REPORT ON

COLORADO SEDIMENT LINING INSTALLATIONS

1954 TO 1956

by

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ABSTRACT

During the past three years Colorado A and M College -- through its Research Foundation and Civil Engineering Department -- has cooperated with individual irrigators and irrigation groups in the trial installations of bentonite sediment linings in Colorado ditches and canals. This report summarizes the experimental work accomplished during the 1954, 1955 and 1956 irrigation seasons in this Colorado phase of the project program.

Realizing that conditions widely vary from one canal to another, the general objective of this work has been to make small trials in a wide range of canal conditions. These trial installations have served admirably to delineate more clearly the problems involved in the installation and evaluation of bentonite sediment linings.

Experience gained from the following installations (see attached location map) is briefly outlined in this report:

1. North Poudre Lateral No. 4.
2. North Poudre Lateral No. 3.
3. Little Cache Ditch.
4. Bijou Land Company Ditch.
5. Harry Miller Farm Ditch.
6. Farmers' Irrigating Company Ditch.
7. Coors Experimental Farm Ditch.
8. George Weaver Ranch Ditch.
9. Christian Lateral.

10. Trinchera Ranch Ditch.

11. Twin Lakes West Portal Connection Canal.

A summary of pertinent data for each of the above installations is presented in Table I.

Funds for a detailed evaluation of each of these installations have not been available, however, some conclusions -- especially in regard to future work -- can be made:

1. The bentonite sediment lining method shows great promise as a truly low-cost canal sealing method. Even with initial procedures -- which we now know could be significantly improved -- the value of water saved in the first season has, in some instances, been several times greater than the experimental costs.

2. Several methods of dispersing the bentonite into the sedimenting charge of ditch water have been used. In the Colorado work, a jetting method with compressed air was used in most of the installations. At best this is a make-shift and relatively slow mixing method, but it does have the advantage of an air compressor being the only required equipment. The multiple jet mixers do a much better job, but the latter equipment was not available for the Colorado work.

3. Where possible, a ponding method of sedimenting has been used. The milky water was ponded-up in the pervious reaches of canal and then was allowed to seep away. This

is the preferred method; however, where ponding was not feasible, the bentonite was added to the flowing water for a short interval -- in an application method quite similar to the way weed killer chemicals are sometimes applied.

4. Ditch cleaning operations with equipment, such as a V-ditcher, that essentially simply re-shapes the ditch does not seem to injure the sealing produced by sedimenting. Actually, in instances where a heavy filter cake of bentonite has formed during the sedimenting, a V-ditcher type of cleaning helps to mix the bentonite into the pervious soils. In one instance involving a dune sand material, the combination of sedimenting followed by V-ditching produced a stabilizing effect in addition to the expected sealing. If major cleaning with a dragline is indicated, this obviously should be completed before sedimenting.

5. If maximum benefit from trial installations is to be realized -- both to the individual cooperator involved and to the irrigation industry in general -- ample funds for complete evaluation studies must be developed. Since the Colorado work was almost completely self-financed by each cooperator, money for complete evaluation studies was not available. Since a large part of the experimental costs are already being borne by the water users, it seems

that a strong justification can be made for Federal and State participation in the program. Some progress in this regard has already been made -- but additional public support is needed to make headway against the strong organized competition for the limited Federal and State research funds.

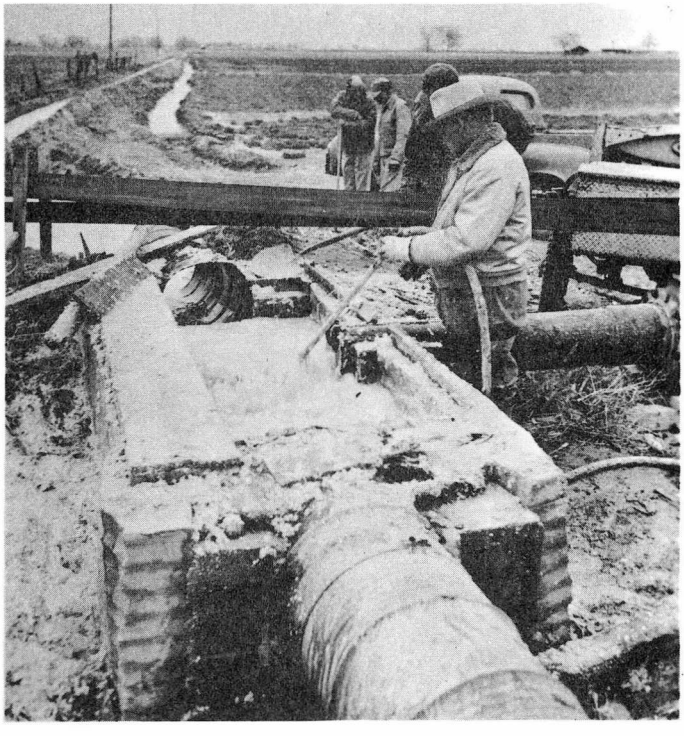

Fig. 1 Air jetting into a small continuous flow using the stilling basin of the pump as a mixing pool.

Fig. 2 Metal 9-in. Parshall flume used to determine inflow. Note small flow of bentonite slurry.

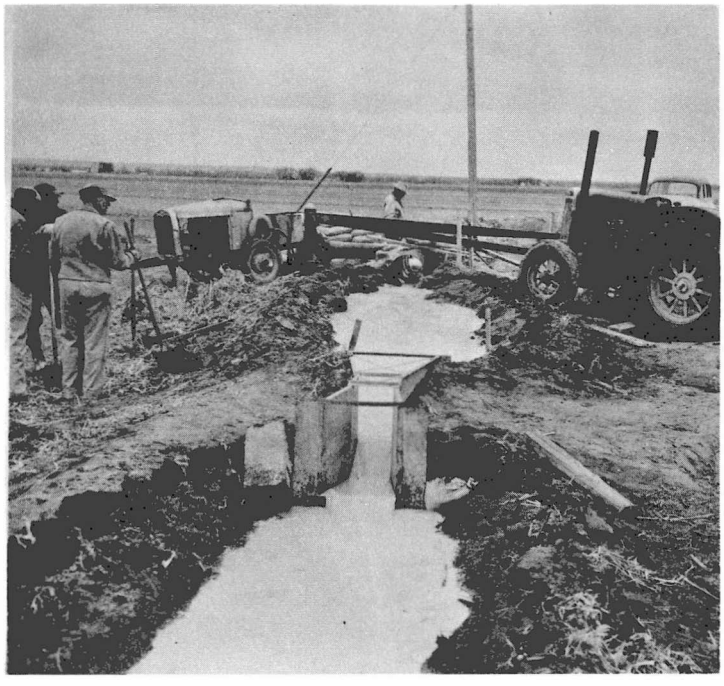

Fig. 3 Multiple jet type mixer -- capacity up to 6 tons per hour.

SUMMARY OF COLORADO SEDIMENT LINING INSTALLATIONS

Installation	Dominant soils Flow capacity Length of reach	Construction period Mixing method Sedimenting method	Amt of bent. Total cost Cost/mile	Water saved Cost/AF Eval. method	Remarks
North Poudre No. 4 Lat. near Wellington, Colo.	Sand with clay layers 3 cfs, 1 mile	Intermittent 1954-5 Comp. air jetting Full flow	10 tons $300 $300	120 AF in 1955 $2.50 Inflow-outflow	Mainly for mix tests. Loss reduced from original of 50% to 7%.
North Poudre No. 3 Lat. near Wellington, Colo.	Sand to clayey 6 cfs 1.75 miles	9-13 to 9-24-55 Comp. air jetting Full flow	4 tons $125 $71.50	30 AF in 1956 $4.25 Inflow-outflow	Mainly for mix tests. Loss reduced from original of 10% to 5%.
Little Cache Ditch near Fort Collins, Colo.	Sand with clay layers 3 cfs, 1.25 mi.	Intermittent 1954 Mixco prop. type Full flow	2 tons $60 $48	60 AF in 1955 $1.00 Inflow-outflow	Mainly for mix tests. Loss reduced from original of 43% to 19%.
Bijou Land Farm Ditch near Fort Morgan, Colo.	Sand 5 cfs 0.4 mile	4-27 to 4-29-56 Comp. air jetting Ponding	2 tons $125 $312	Not available Inflow-outflow and ponding	Bad erosion problem. Sealing action did not last. Initial savings at least 0.77 cfs.
Harry Miller Farm Ditch at Atwood, Colo.	Sand 2.25 cfs 1,000 ft	4-3 to 4-5-56 and 6-27-56, Comp. air jetting, Ponding	3 tons $185 $975	42 AF in 1st season $4.50 Inflow-outflow	Extra bentonite used to stabilize the banks.
Farmers' Irrigating Ditch near Loveland, Colo.	Silty clay 25 cfs 0.5 mile	5-18 to 5-21-56 Comp. air jetting Ponding	3.75 tons $150 $300	126 AF in 1st season $1.19 Comb. inflow-ponding	Primarily sedimented to save land. Results not yet available.
Coors Exper. Farm Ditch near Center, Colo.	Sand gravel 6 cfs 0.5 mile	5-24 to 5-26-56 Comp. air jetting Ponding	6 tons $200 $400	Final results not available Inflow-outflow	Loss reduced by 380 gpm in a flow of 2640 gpm.
Weaver Ranch Ditch near Red Feather Lakes, Colo.	Gravel 2 cfs 2,000 ft	6-5-56 Comp. air jetting Ponding	2/3 ton $35 $92.50	No water measurement performed	Primarily a seepage problem in high country. Visible results are very satisfactory to the rancher.
Christian Lateral near Loveland, Colo.	Silty clay 3 cfs 0.5 mile	6-20 to 6-21-56 Comp. air jetting Ponding	2 tons $85 $170	14.4 AF in 1st season $5.90 Inflow-outflow	Primarily sedimented to save land. Small ditch and small loss make cost of water saved quite high.
Ted Zimbelman Farm Ditch near Keensburg, Colo.	Sand 2.5 cfs 0.5 mile	7-10 to 7-12-56 Comp. air jetting Ponding	1.5 tons $95 $190	21 AF in 1st season $4.50 Inflow-outflow	Mixing too slow to get adequate amount of bentonite in the ditch.
Trinchera Ranch Ditch near Fort Garland, Colo.	Sand 9 cfs 1 mile	7-25 to 7-26-56 Comp. air jetting Full flow	8 tons Bent. and comp. donated	Results not complete Inflow-outflow	Outside factors made results very difficult to analyze.