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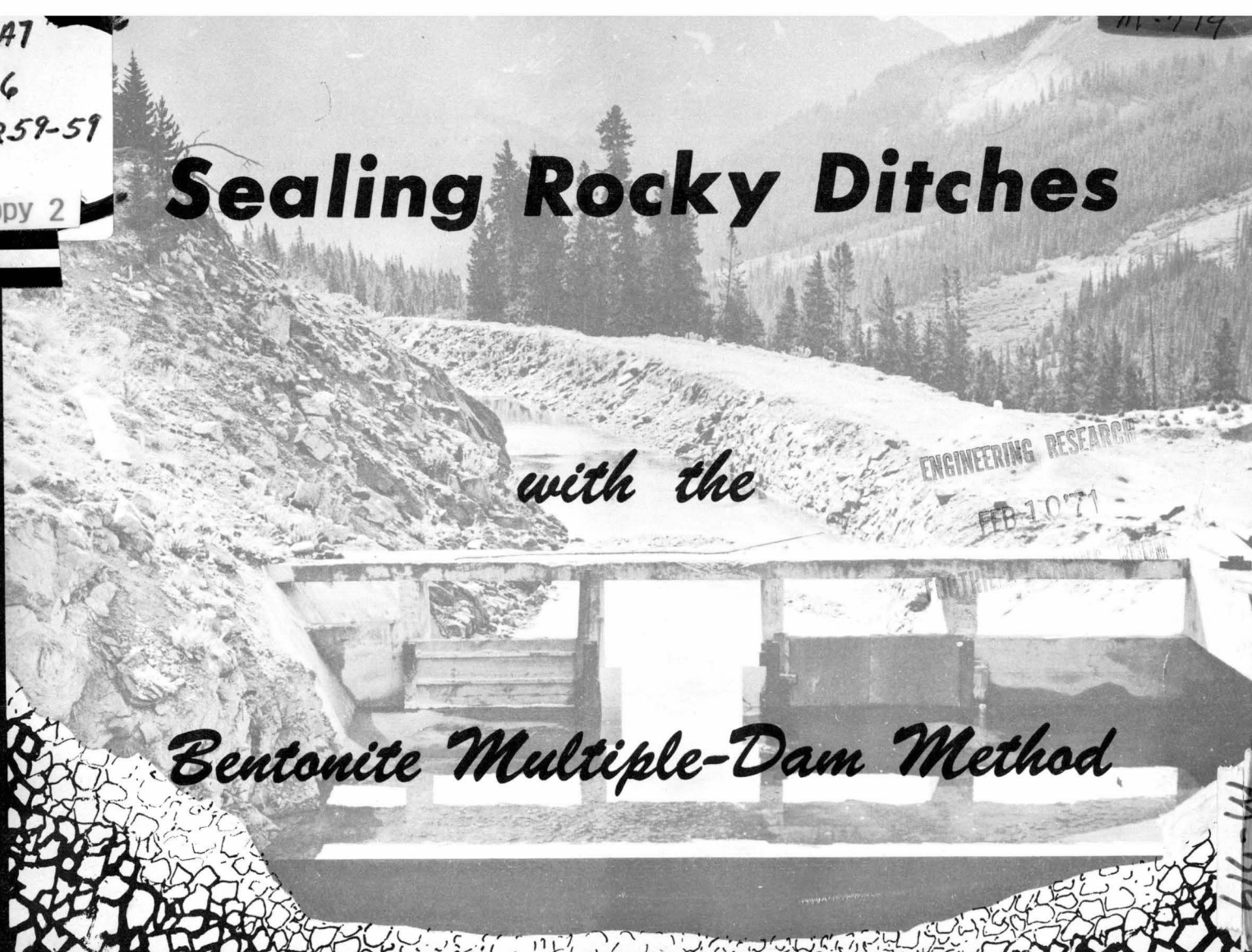
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Sealing Rocky Ditches

with the

Bentonite Multiple-Dam Method

ENGINEERING RESEARCH
FEB 10 1971



The bentonite multiple-dam method was developed near Aspen, Colorado, in the transmountain diversion system of the Twin Lakes Reservoir and Canal Company. This work was supervised by Wallace A. Doe, general manager and engineer, with the assistance of R. D. Dirmeyer, project leader of canal sealing investigations at Colorado State University.

Similar work has been done by the Fremont Irrigation Company of Pinedale, Wyoming, supervised by C. C. Feltner. Information on this work was furnished by M. A. McNamee, Agricultural Engineer, Wyoming Agricultural Extension Service.

The field of low-cost canal sealing with clay sediments has been under study at Colorado State University since 1953. This research is sponsored by the Colorado Agricultural Experiment Station and the Colorado State University Research Foundation in cooperation with other organizations, including the U. S. Agricultural Research Service and many irrigation districts and private companies.

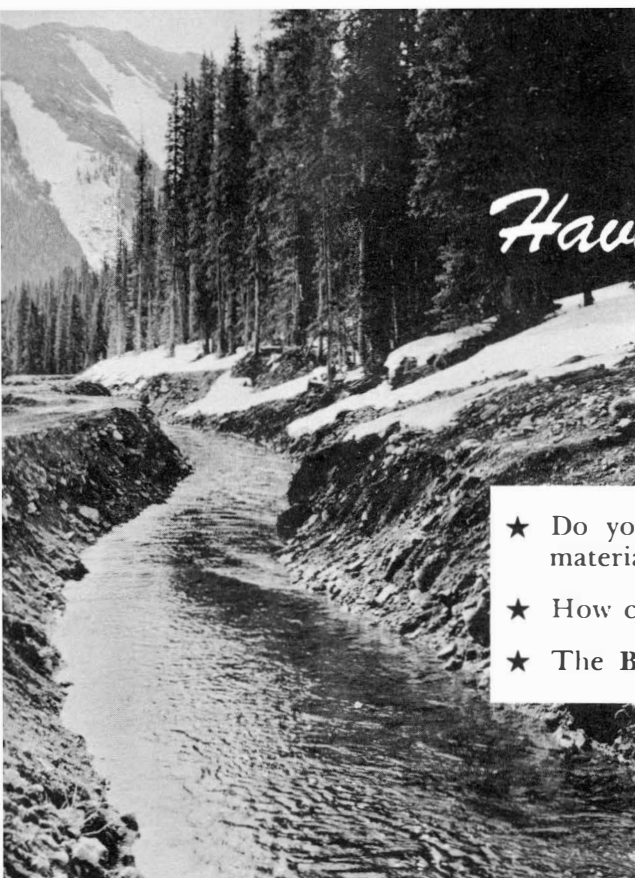
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Written and illustrated by R. T. Shen, Assistant Research Engineer, Civil Engineering Department, Colorado State University, Fort Collins.



Have a High Seepage Loss?

- ★ Do you have a ditch or canal through fractured-rock and gravelly materials? Does it lose a lot of water and cause seep damage?
- ★ How can you stop this seepage at a cost you can afford?
- ★ The **Bentonite Multiple-Dam Method** may be your answer!

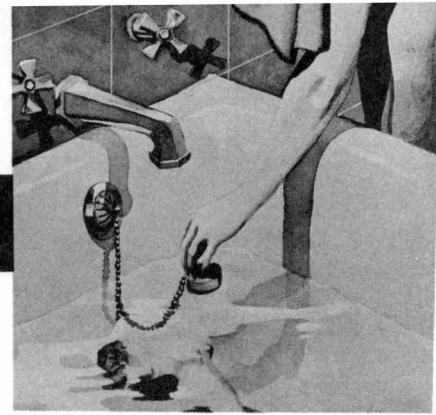
With this method:

- You can stop the water loss!
- You can dry the water-logged land!
- You can do this work at a low cost!

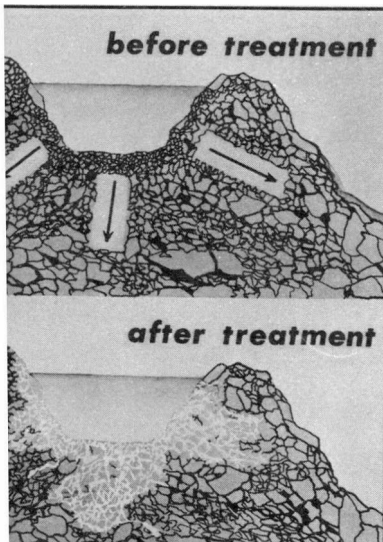


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How it Works



- ★ Bentonite is a clay material; it does not allow water to pass. When mixed with bridging materials, it can plug a hole just like the rubber stopper in your bath-tub.
- ★ In the **bentonite multiple-dam method** you build dams with a mixture of bentonite and bridging materials. When the flow overtops a dam, you help to break up the dam into a lumpy slurry. This will flow into the leaky holes and plug them.



- ★ The bridging materials prevent the bentonite from seeping through the bigger holes. They can be easy-to-obtain materials such as
 - Wet sawdust
 - Natural silt
 - Coarse clay



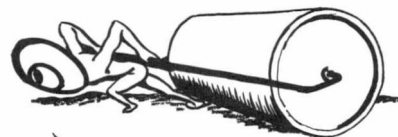
Keep in Shape !

★ Good results come from good preparation. You should put your canal into good shape first.

- Remove bushes and trees



- Provide a bank road



- Clean and shape the ditch



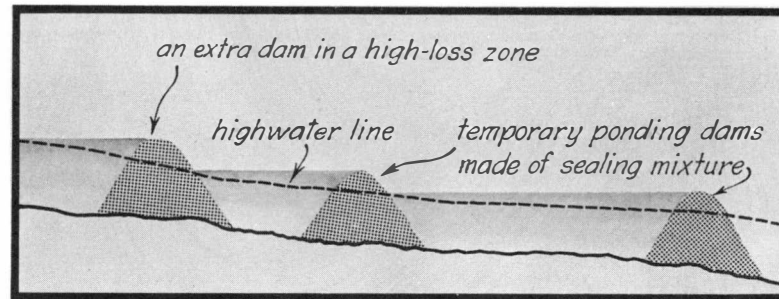
Now is the time to start the repairs your ditch so badly needs, even if only a little is accomplished at a time!



Plan Your Job!



- ★ Survey your ditch section and calculate the dams needed for ponding above the highwater line. Survey along the whole section. Locate the obvious seepage springs fed from the ditch and plan extra dams in these high-loss zones.
- ★ Compute the amounts of bentonite and coarse material needed for the dams and for blanketing high-loss areas in the canal.



- ★ You should plan to use 30 percent or more high-quality bentonite in the sealing mixture. The rest can be some locally available materials suitable for blending with bentonite and coarse enough to plug the large leaks.
- ★ Check to see if you are using at least one pound of high-quality bentonite per square foot of wetted area.

Follow These Steps



Spread a blanket (4 to 6 inches) of the sealing mixture in the suspected high-loss zones, especially the upper bank area.



Build the dams as planned with the bentonite sealing mixture. Release a small flow of water into the first pond.



As the flow overtops the dam, break up the dam as fast as you can. Make a lumpy slurry that will plug up holes of all sizes in the ditch.



Repeat this operation for each dam. Be sure to use a small flow so that you can move on to the next dam in time.

Don't forget!

Follow the slurry from pond to pond. Be ready to shovel additional sealing mixture into the obvious high-loss areas.



A Good Example

Where A good installation has been made by the Twin Lakes Reservoir and Canal Company in the Connection Canal near Aspen, Colorado.

What This canal is 7,800 feet long. It runs through a very rocky bed in fractured granite with loose talus. Its capacity is 350 second-feet. It was losing all flows under 10 second-feet.

How After some pilot explorations, the multiple-dam method was adopted. The sealing mixture contained one-third Wyoming high-swell bentonite, one-third Colorado low-swell bentonite, and one-third wet sawdust.

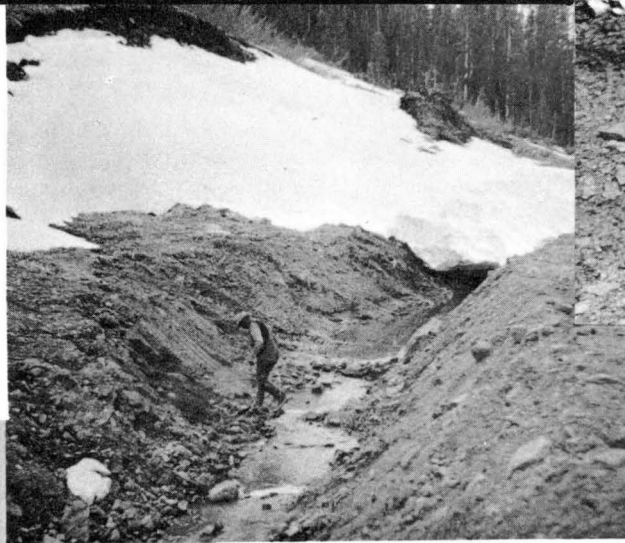
When The work was done in the summer of 1956 and, so far, there has been only a slight deterioration in effectiveness.

How Much A total of 242 tons of bentonite was used at a cost of about 35 cents per square yard of wetted area.

Results:

- A flow of 10 second-feet through the section now loses less than one second-foot.
- Wet roadway below the canal has dried up.
- A small flow can be maintained under snow during the winter. This speeds up snow-clearance work in the spring.

A Job Well Done!



Close-up view of the channel bottom, showing its rocky nature.

A small flow can be maintained under the snow as a result of the bottom seal. This greatly facilitates snow removal in the spring.

Continuous recording gages have been installed to provide flow data for accurate evaluation.



Any Questions ?

Q 1. How good is the bentonite seal?

Ans. It varies with installations. A good job can be done by careful planning and competent installation.

Q 2. How long will the sealing last?

Ans. Given proper maintenance, a good installation will probably last ten years or more. Under unfavorable conditions—such as severe climate and extreme inflow of groundwater into the canal during the snow-melt season—the life of the seal may be shorter. Since the technique was developed only recently, present information on the life of the seal is not complete.

Q 3. Can success be assured for every installation?

Ans. Because of the varied canal bed conditions, not all installations can be successful on the first trial. However, common sense and experience will suggest modifications of procedure necessary to achieve success at a reasonable cost.

Q 4. What proof of success can I anticipate?

Ans. You can find more flow at the lower end of the treated section. If you want to be sure of this, you must set up accurate recording stations and get enough loss information beforehand for later comparison. Your measuring devices must be good in order to obtain reliable evaluation. Of course, the drying up of nearby springs or water-logged land may be a good qualitative proof of success. However, a water-logged area may have more than one source of intake; before deciding to treat your ditch you should analyze the seep problem thoroughly. Otherwise you may be treating the wrong ditch section.

Q 5. What sealing agents are suitable for use?

Ans. Standard tests are used to determine the suitability of high-swell bentonite. The use of bridging materials depends on their availability and the void spaces in the bed material. You will save money if you adapt the method to the convenience of your site.

Q 6. What is the best time of the year for sealing work?

Ans. When the groundwater is at a low stage, the temperature above freezing, and the canal deliveries can be shut off for a few days.

Q 7. Is this method a surface seal?

Ans. No. Surface seals are vulnerable to erosion and puncturing. If you have only a surface seal, it means either the slurry is too lumpy and thick or the bed material is too fine. Try reducing the concentration of the slurry. Also consider the **bentonite dispersion method** as described in a separate booklet.

Q 8. Can this method be used in a sandy ditch?

Ans. If this method is used in a sandy ditch, it should at least be combined with the **bentonite dispersion method** as described in a separate booklet. Where the ditch bed ranges from sandy or gravelly, a combination of the two methods will be most profitable.

Q 9. Can bentonite take the place of other types of lining such as concrete?

Ans. Bentonite can produce sealing only. Other types of lining may bring other benefits in addition to sealing, benefits such as reduced cross-sectional area and decreased maintenance costs. If you can afford an expensive lining like concrete you need not consider using bentonite.

Want to Know More ?

★ Other publications on the use of bentonite for sealing purposes:

- Sealing Sandy Ditches With the Bentonite Dispersion Method—Circular 202-A
- Mixing Bentonite for Sealing Purposes—Circular 204-A
- Testing Bentonite for Sealing Purposes—Circular 205-A
- Sealing Farm Ponds and Reservoirs With Bentonite—Circular 206-A

★ For additional information, get in touch with your county agricultural agent or write to:

**Project Leader
Canal Sealing Investigations
Colorado State University Research Foundation
Fort Collins, Colorado**

or

**Irrigation Specialist
Colorado State University Extension Service
Fort Collins, Colorado**

