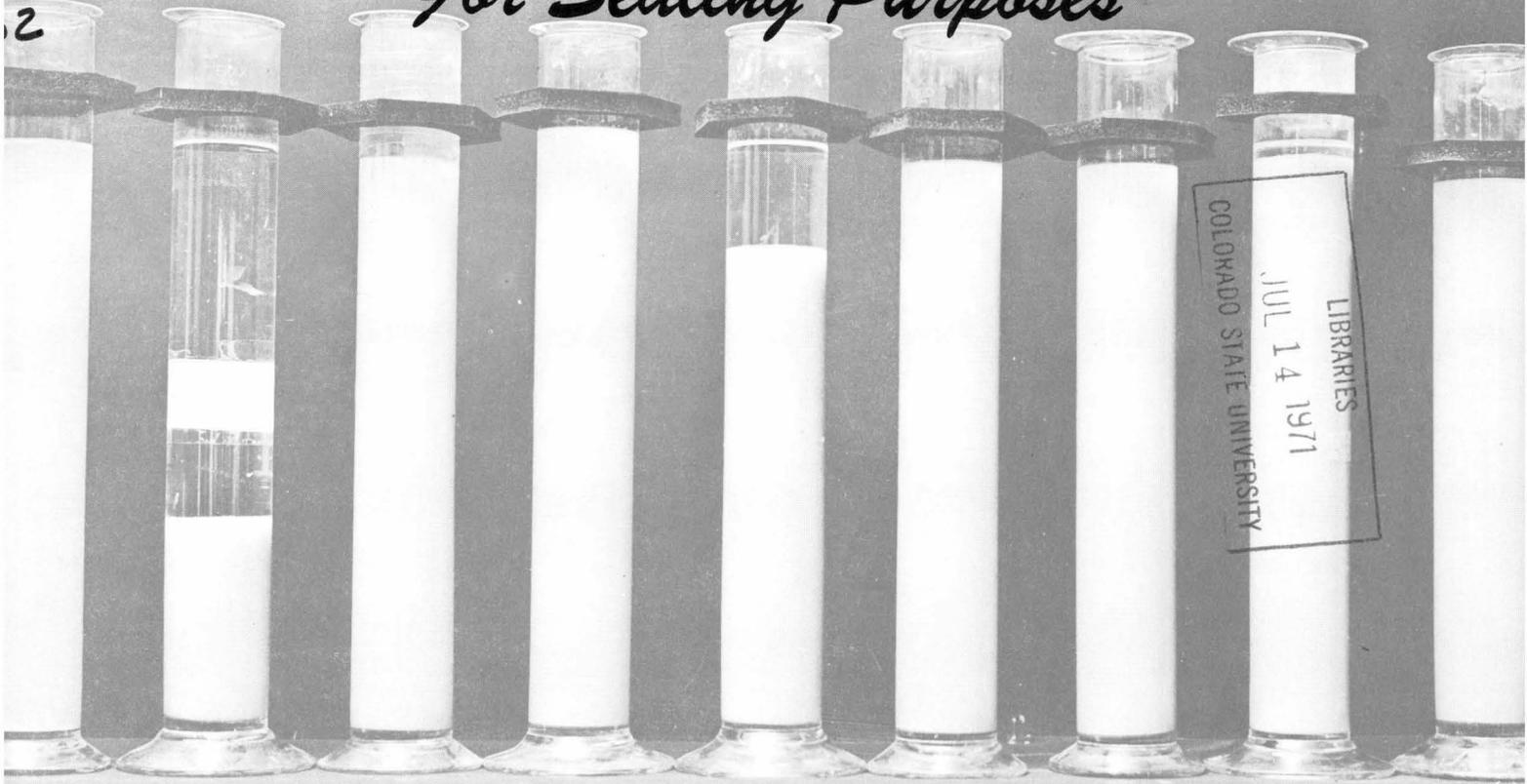


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Testing Bentonite *For Sealing Purposes*

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This circular has been written under the supervision of R. D. Dirmeyer, Jr., project leader, Sediment Sealing Investigations, Colorado State University. Research in the field of low-cost sealing with clay sediments 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.

This circular is published and distributed in cooperation with the Wyoming Agricultural Extension Service through M. A. McNamee, Agricultural Engineer.

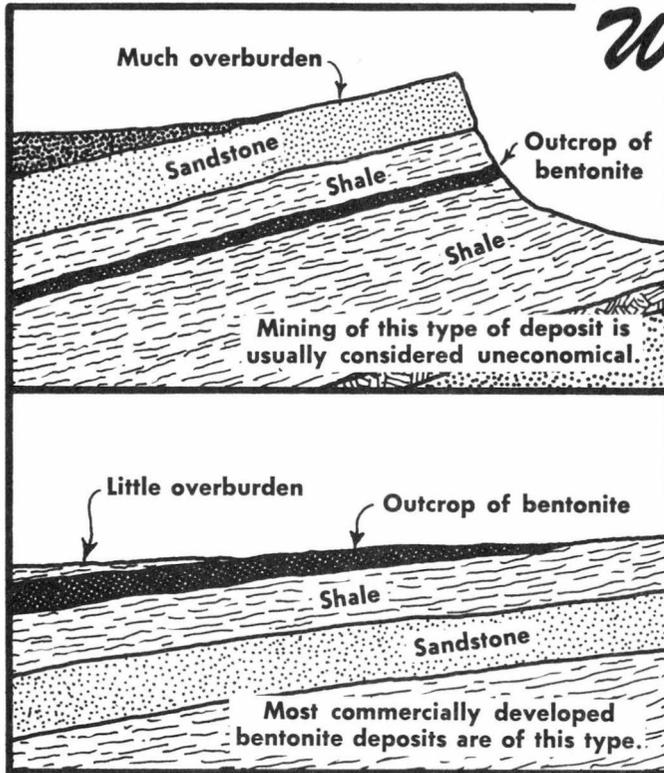
Laramie, Wyoming
August 1959

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

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The University of Wyoming and the U. S. Department of Agriculture cooperating. Agricultural Extension Service, G. H. Starr, Director, Laramie, Wyoming. Printed and distributed in furtherance of Acts of May 8 and June 30, 1914.

What is Bentonite?



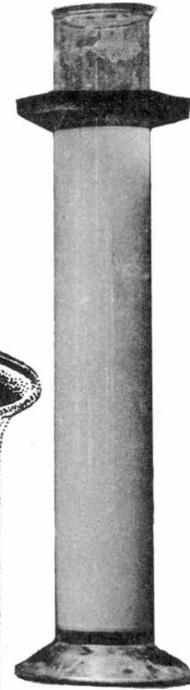
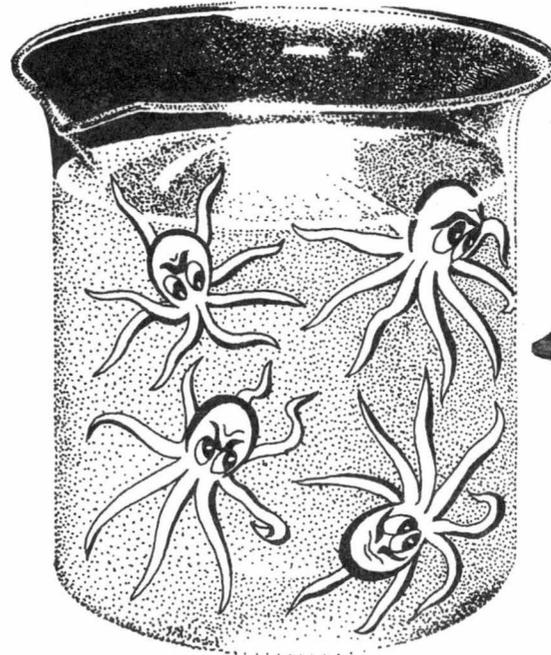
- ★ Bentonite is a special kind of clay that absorbs water and swells. It is usually a decomposed volcanic ash.
- ★ Bentonite occurs in yellow, green, grey and red layers of varying thickness and clay content. It is found in western United States and many other parts of the world.
- ★ There are many types of bentonite; each is used for specific purposes. For example: bentonite for drilling mud (petroleum industry) is often quite different from the type used in foundry sands.
- ★ Bentonite deposits are classified by test-drilling and laboratory analysis before being mined.

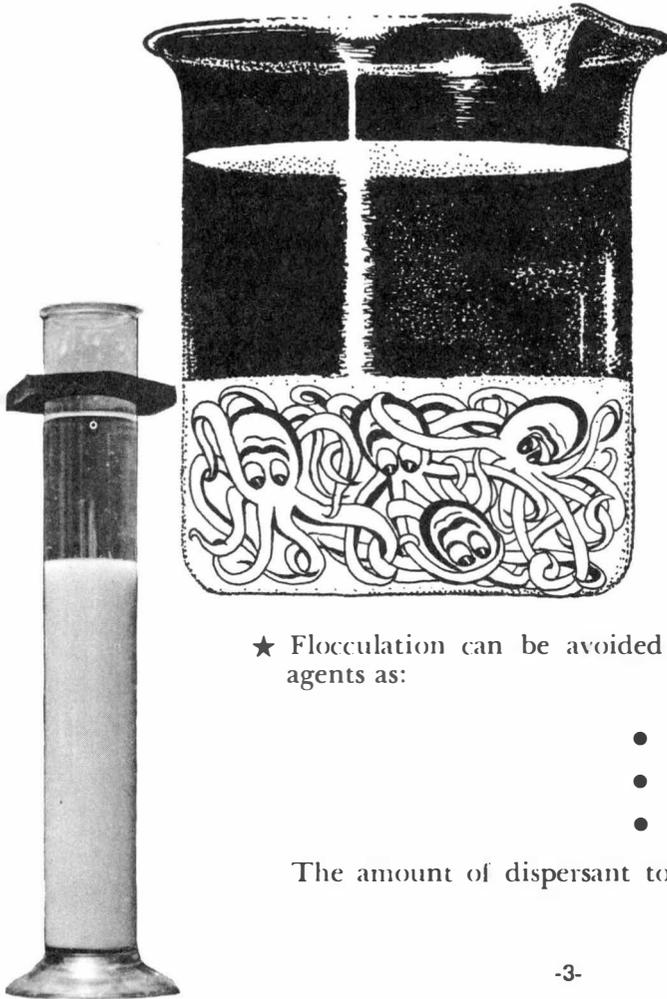
Mining and processing bentonite involve complex techniques. Get some expert advice before you decide to mine a deposit.

High-Swell Bentonite

- ★ The commercial “drilling mud” type bentonite swells 8 to 12 times its own dry volume when soaked in water. It contains a high percentage of colloidal-sized particles (less than 0.0001 cm. in diameter).
- ★ You will find it hard to mix in water, especially the finely-ground, powdered variety.
- ★ When a high-swell bentonite is thoroughly mixed in soft water, the colloidal particles repel each other and stay suspended in the water. The mixture will remain milky from top to bottom almost indefinitely.

This is called dispersion





★ When hard water is used in the mixture a chemical conversion takes place. The bentonite particles tend to bunch together and settle out. A layer of clear water without bentonite is left at the top.

This is called flocculation

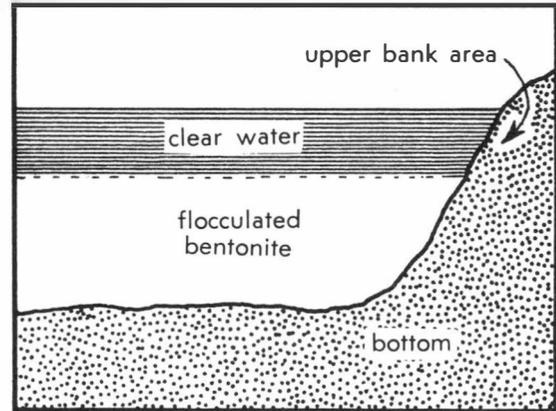
★ Flocculation can be avoided by adding to the water such dispersing agents as:

- Tetrasodium pyrophosphate
- Sodium tripolyphosphate
- Sodium hexametaphosphate

The amount of dispersant to use is determined by trial mix tests. -

Low-Swell Bentonite

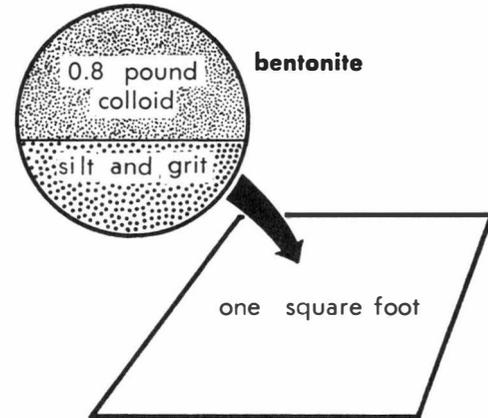
- ★ Many bentonites swell less than 8 times their own dry volume when soaked in water. This low swell is due to either the chemical make-up or the low percentage of colloidal-sized particles, or a combination of both.
- ★ You can mix low-swell bentonite in water more easily than high-swell bentonite. However, even in pure water, low-swell bentonite tends to flocculate. In some sealing jobs this may leave the upper bank area untreated.
- ★ Flocculation of low-swell bentonite can be avoided by adding dispersing agents, but usually this is not economically practical. It is better to let the bentonite flocculate but offset the disadvantages from flocculation by modifying your procedure.



Which Bentonite to Use

- ★ For sealing silty to sandy materials, the high-swell bentonite is commonly used. For sealing gravelly to rocky materials, the high-swell bentonite can be used, but only in combination with coarser materials which act as bridging agents.
- ★ Low-swell bentonite can be used for sealing any material provided you take the following precautions:

- If your bentonite has a low colloidal content, you should use enough so that there is at least 0.8 pound of colloidal material per square foot of area to be sealed.
- If your bentonite flocculates, you should modify your procedure to take care of the upper bank area.



Refer to "Sealing Sandy Ditches with the Bentonite Dispersion Method" and "Sealing Rocky Ditches with the Bentonite Multiple-Dam Method."

Simple Field Tests

If you consider using a bentonite for sealing purposes, here are some tests you can make outside the laboratory.

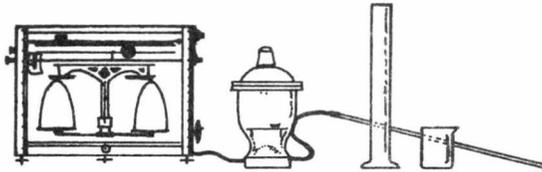
★ **Look at your deposit**—An outcrop of bentonite dries and cracks into a loose and fluffy material but is soft and gummy when wet.

★ **Taste the bentonite**—Put some of the powder in your mouth. The highly colloidal bentonite is smooth and has little sand or grittiness.

★ **Soaking test**—Place one-half inch of bentonite (ground to less than $\frac{1}{8}$ -inch size) in a glass jar. Fill the jar with soft water without disturbing the bentonite surface. It takes weeks for water to soak into a high-swell bentonite, but much shorter time into a low-swell bentonite.

★ **Swelling test**—Sprinkle a known volume of bentonite very gradually into a jar of water. Compare its increase in volume with that of a granular commercial high-swell bentonite. A high-swell bentonite increases more than 8 times its own volume.





Laboratory Tests

- ★ If you have a bentonite that may be suitable for your sealing job, you should send out samples for laboratory testing. Your samples should truly represent your deposit. Sampling is not a simple matter. It pays to get a specialist to do this work for you.
- ★ Two laboratory tests are used to determine the particle-size distribution of a bentonite:
 - The grit content test
 - The colloidal yield test
- ★ The grit content is the percentage of particles (by oven-dry weight) greater than 44-micron size. This is determined by washing a dispersed sample (usually 20 gm.) through a U. S. No. 325 sieve and weighing the portion retained.
- ★ The colloidal yield is the percentage of particles (by oven-dry weight) that can stay in suspension for at least 24 hours in a standard liter-cylinder at a one percent concentration. This is determined by siphoning off the well dispersed colloidal portion and weighing the decanted non-colloidal portion.

For sealing silty and sandy materials, use a bentonite with less than 7% grit content and more than 70% colloidal yield. For sealing gravelly and rocky materials the grit content can be as high as 40% and the colloidal yield as low as 50%.

In Summary

- 1** Before you decide to mine bentonite, get some advice from qualified geologists and engineers to find out whether it is worth mining.
- 2** High-swell bentonite, with less than 7% grit content and more than 70% colloidal yield, is commercially available. It is used to seal silty to sandy material by the dispersion method.
- 3** Low-swell bentonite, with less than 40% grit content and more than 50% colloidal yield, is usually not developed commercially. It can be used to seal gravelly to rocky material.
- 4** Low-swell bentonite can also be used in sealing sandy material provided the disadvantages from flocculation and/or low colloidal content are overcome.
- 5** High and low-swell bentonites can be blended together according to the needs of a sealing job.

Any Questions ?

Q. 1. How do I use trial mix tests to determine the amount of dispersant to add?

Ans. Dissolve various amounts of dispersant in samples of your water. Mix in bentonite to make a 1% suspension in each case (10 gm. in 1000 ml. of water). After 24 hours you can determine the minimum concentration of dispersant required to prevent flocculation, usually in the range of 1 to 10% by weight of the bentonite.

Q. 2. Where can I obtain the dispersants you have described?

Ans. You can buy them from chemical supply houses. In small quantities, sodium hexametaphosphate can be obtained from your grocer's; it is commercially known as "Calgon."

Q. 3. What is the "barrels yield" test?

Ans. This test is used in the drilling mud industry. A bentonite of over 70 barrels yield is usually a high-swell bentonite.

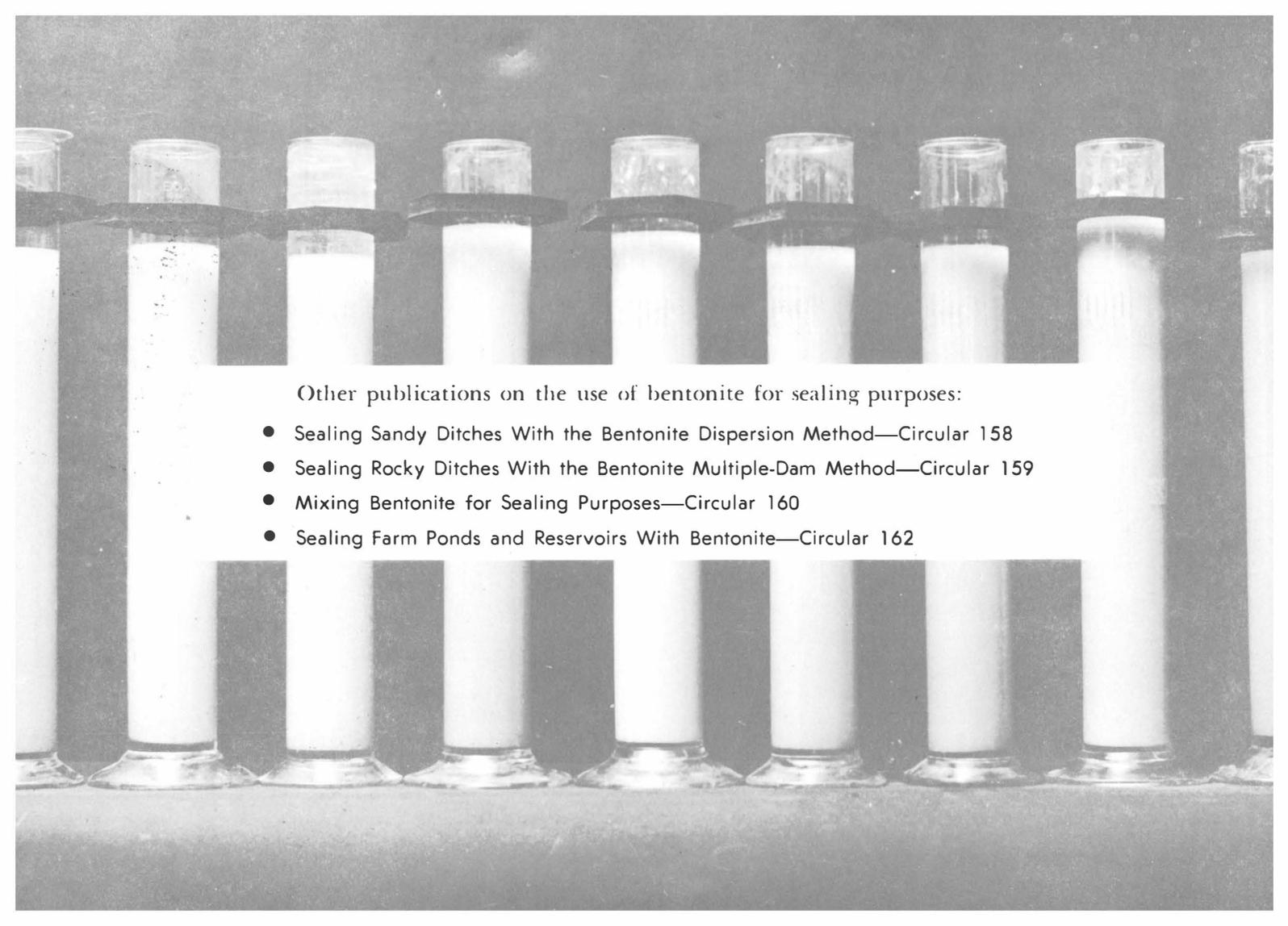
Q. 4. Where can I obtain more detailed instructions on the laboratory tests?

Ans. You can write for a pamphlet by R. T. Shen entitled "Evaluation procedures for sediment material for canal lining," Colorado State University, Civil Engineering Department, CER 58RTS4, January 1958.

Q. 5. Where can I obtain more information on other tests for bentonite?

Ans. You may refer to: "Bentonite with test methods and results of tests of Wyoming bentonite," by H. G. Fisk, University of Wyoming, Natural Resources Research Institute, Bul. No. 2, August 1946.

★ For additional information get in touch with your county agricultural agent or write to the Extension Agricultural Engineer, University of Wyoming, Laramie, Wyoming.



Other publications on the use of bentonite for sealing purposes:

- Sealing Sandy Ditches With the Bentonite Dispersion Method—Circular 158
- Sealing Rocky Ditches With the Bentonite Multiple-Dam Method—Circular 159
- Mixing Bentonite for Sealing Purposes—Circular 160
- Sealing Farm Ponds and Reservoirs With Bentonite—Circular 162