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Sealing Leaking Ponds

Excessive seepage in ponds is generally due either to a poor site--that is, one in which the soils in the impounded area are too permeable to hold water--to improperly constructed levees or dams, or to physical damage caused by tree roots, burrowing rodents, or other factors. Selecting a poor site is often the result of inadequate preliminary site investigations and is, therefore, an avoidable situation. You can avoid improper construction just as you can avoid the establishment of trees and shrubs that develop root systems that undermine the dam.

In places where a satisfactory site is not available, the need for water may be sufficient to justify using the site. If so, the original pond design must include plans for reducing seepage by sealing the pond bottom. In some places, excessive removal of topsoil during construction, usually to provide material for the embankment, exposes highly pervious materials such as sand, gravel, or rock containing cracks, crevices, or channels. This is usually avoided by carefully selecting the source of embankment material.

To prevent excessive seepage, reduce the permeability of the soil to a point at which losses are insignificant or at least tolerable. The method depends largely on the proportions of coarse-grained sand and gravel and of fine-grained clay and silt in the soil.

Whatever the reason your pond loses water, it is important to remember two major considerations. First, once the pond is constructed, correcting these problems can be costly! Second, if the seep or leak is confined to a small area, you are much more likely to be successful in solving the problem with one of the following methods.

Compaction

Some pond areas can be made relatively impervious by compaction if the material has different particle sizes--small gravel or coarse sand to fine sand--and enough clay (usually 10 percent or more) and silt to effect a seal. **This is the least expensive method of those presented in this publication.** Compaction, however, is limited to these specific soil conditions and by the depth of water to be impounded.

The procedure is simple. Clear the pond area of all trees and other vegetation. Fill all stump holes, crevices, and similar areas with impervious material. Scarify the soil to a depth of 8 to 10 inches with a disk, rototiller, pulverizer, or similar equipment. Remove all rocks and tree roots. Roll the loosened soil under optimum moisture conditions to a dense, tight layer with four to six passes of a sheepsfoot roller.

Make the compacted seal no less than 8 inches thick to impound areas where the depth is 10 feet or less. Since seepage losses vary directly with the depth of water impounded over an area, increase the thickness of the compacted seal proportionately if the depth of water impounded **exceeds** 10 feet. Compact the soils in two or more layers, with each layer not exceeding 8 inches in that section of the pond where the water depth exceeds 10 feet. Remove and stockpile the top layer or layers while the bottom layer is being compacted.

Clay Blankets

Pond areas containing high percentages of coarse-grained soils but lacking enough clay to prevent excessive seepage often can be sealed by blanketing. Blanket the upstream slope of the embankment and the entire area over which water is to be impounded. Make the blanket consist of a well-graded material containing at least 20 percent clay. You can usually obtain material for the blanket from a borrow area close enough to the pond to permit hauling at a reasonable cost.

Thickness of the blanket depends on the depth of the water to be impounded. The minimum thickness is 12 inches for all depths of water up to 10 feet. Increase this thickness by 2 inches for each foot of water more than 10 feet.

Remove all trees and other vegetation. Fill all holes and crevices before hauling earth material from the borrow area to the pond site in tractor-pulled wheeled scrapers or similar equipment. Spread the material uniformly over the area in layers 6 to 8 inches thick. Compact each layer thoroughly, under optimum moisture conditions, by four to six passes of a sheepsfoot roller before placing the next layer.

Protect clay blankets against cracking that results from drying and against rupture caused by freezing and thawing. Spread a cover of gravel 12 to 18 inches thick over the blanket below the anticipated high water level. Use rock riprap or other suitable material to protect areas where the water flow into the pond is concentrated.

Bentonite

Adding bentonite is another method of reducing seepage in soils containing high percentage of coarse-grained particles and not enough clay. Bentonite is a fine-textured colloidal clay. When wet, it absorbs several times its own weight of water and, at complete saturation, swells to as much as 8 to 20 times its original volume. Mixed in the correct proportions with well-graded coarse-grained material, thoroughly compacted, and then saturated, the particles of bentonite swell until they fill the pores to the point the mixture is nearly impervious to water. Upon drying, however, bentonite shrinks to its original volume resulting in cracks; **therefore, sealing with bentonite is usually not recommended for ponds in which the water level is expected to fluctuate widely.** A laboratory analysis of soil particle size distribution is required to decide the rate of application.

Before selecting this method of sealing a pond, find the nearest source of bentonite and investigate freight rates. If the source is far from the pond site, the cost may prohibit the use of bentonite.

As with other methods, clear all vegetation from the area to be sealed. Fill all holes or crevices, and use suitable fill material to cover and compact areas of exposed gravel.

The soil moisture level in the area to be treated is important. Investigate it before applying bentonite. You need an optimum, medium to low, moisture level for good compaction. If the area is too wet, postpone sealing until moisture conditions are satisfactory. If it is too dry, add water by sprinkling.

Spread the bentonite carefully and uniformly over the area to be treated at the rate determined by the laboratory analysis. This rate is usually 1 to 3 pounds per square foot area. Thoroughly mix the bentonite with the surface soil to a depth of at least 6 inches. A rototiller is best for this operation but you can use a disk or similar piece of equipment; then compact the area with four to six passes of a sheepsfoot roller.

If considerable time elapses between applying the bentonite and filling the pond, protecting the treated area against drying and cracking may be necessary. A mulch of straw or hay pinned to the surface by the final passes of the sheepsfoot roller gives this protection. Use rock riprap or other suitable material to protect areas where water inflow into the treated area is concentrated.

Chemical Additives

Because of the structure or arrangement of the clay particles, seepage is often excessive in fine-grained soils. If these particles are arranged at random with end-to-plate or end-to-end contacts, they form an open, porous, or honeycombed structure, and the soil is said to be aggregated. Applying small amounts of certain chemicals to these porous aggregates may result in collapse of the open structure and rearrangement of the clay particles. This dispersed structure reduces soil permeability. The chemicals used are called dispersing agents.

The soils in the pond area need to contain more than 50 percent fine-grained material (silt and clay) and at least 15 percent clay for chemical treatment to be effective. Chemical treatment is not effective in coarse-grained soils.

Although many soluble salts are dispersing agents, sodium polyphosphates and sodium chloride (common salt) are most commonly used. Of the sodium polyphosphates, tetrasodium pyrophosphate and sodium tripolyphosphate are most effective. You can also use a technical grade soda ash (99 to 100 percent sodium carbonate). Sodium polyphosphates are usually applied at a rate of 0.05 to 0.10 pound per square foot and sodium chloride at a rate of 0.20 to 0.33 pound per square foot. Soda ash is applied at a rate of 0.10 to 0.20 pound per square foot. A laboratory analysis of the soil in the pond area is essential to determine which dispersing agent will be most effective and to determine the rate at which to apply it.

Mix the dispersing agent with the surface soil and then compact it to form a blanket. Thickness of the blanket depends on the depth of water to be impounded. For water less than 8 feet deep, the blanket should be at least 6 inches thick. For greater depths, it should be 12 inches thick, treated in two 6-inch lifts.

The soil-moisture level in the area to be treated needs to be near the optimum level for good compaction. If the soil is too wet, postpone treatment. Polyphosphates release water from soil, and the material may become too wet to handle. If the soil is too dry, add water by sprinkling or wait for a light rainfall.

Clear all vegetation and trash from the area to be treated. Cover rock outcrops and other exposed areas of highly permeable material with 2 to 3 feet of fine-grained material. Thoroughly compact this material. In cavernous limestone areas, the success or failure of the seal may depend on the thickness and compaction of this initial blanket.

Apply the dispersing agent uniformly over the pond area at a rate determined by laboratory analysis. You can apply the agent with a seeder, drill, fertilizer, spreader, or by hand broadcasting. The dispersant should be finely granular, with at least 95 percent passing a No. 30 sieve and less than 5 percent passing a No. 100 sieve.

Thoroughly mix the dispersing agent into each 6-inch layer to be treated. You can use a disk, rototiller, pulverizer, or similar equipment. Operating the mixing equipment in two directions produces best results. Thoroughly compact each chemically treated layer with four to six passes of a sheepsfoot roller.

Protect the treated blanket against puncturing by livestock. Cover the area near the high-water line with a 12- to 18-inch blanket of gravel or other suitable material to protect it against erosion. Use riprap or other suitable material on areas where inflow into the pond is concentrated.

Waterproofed Linings

Using waterproofed linings is another method of reducing excessive seepage in ponds with coarse-grained and fine-grained soils. Polyethylene, vinyl, butyl-rubber membranes, and

asphalt-sealed fabric liners are gaining wide acceptance as linings for ponds because they virtually eliminate seepage if properly installed.

Thin films of these materials are structurally weak, but if not broken or punctured, they are almost completely watertight. Black polyethylene films are less expensive and have better aging properties than vinyl. Vinyl, on the other hand, is more resistant to impact damage and is readily seamed and patched with a solvent cement. Polyethylene can be joined or patched with a special cement.

All plastic membranes need to have a cover of earth or earth and gravel not less than 6 inches thick to protect against punctures. Butyl-rubber membranes need not be covered except in areas traveled by livestock. In these areas, use a minimum of 9 inches on all types of flexible membranes. Make the bottom 3 inches of cover no coarser than silty sand.

Clear the pond area of all undesired vegetation; fill all holes and remove roots, sharp stones, or other objects that might puncture the film. If the material is stony or of very coarse texture, cover it with a cushion layer of fine-textured material before placing the lining.

Some plants may penetrate the vinyl and polyethylene films. If nutgrass, johnsongrass, quackgrass, and other plants with high potential for liner penetration are present, sterilizing the subgrade is desirable, especially the side slopes. Several good chemical sterilizers are available commercially. Sterilization is not required for covered butyl-rubber linings 20 to 30 mils thick.

Lay the linings in sections or strips, allowing a 6-inch overlap for seaming. Make the vinyl and butyl-rubber linings smooth but slack. Polyethylene should have up to 10 percent slack. Be extremely careful to avoid punctures. Anchor the top of the lining by burying it in a trench dug completely around the pond at or above the normal water level. Make the anchor trench 8 to 10 inches deep and about 12 inches wide.

Summary

In most cases, you can avoid leaking ponds by wise site selection and proper maintenance. In some instances, however, leaks and seeps can develop. If the leak or seep is severe, correction is warranted, and usually will be costly.

It is a good idea to prevent trees and shrubs from becoming established on levees and dams. Take action to remove burrowing animals such as muskrats and beavers and nutria as soon as you notice them.

If maintenance activity does fail, however, one of the corrective measures described in this publication might prove useful.

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