WATER SEALING AND DRAINAGE

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As part of the above heading, two problems come to mind that seem pertinent to the general subject of Turfgrass:

1. Seepage loss from reservoirs and holding ponds.
2. Drainage problems caused by excess water in the soil.

The first problem of seepage loss from ponds, and methods for controlling the seepage loss problem, will be the major topic for this talk. The second problem of drainage will be discussed only indirectly -- and then only from the standpoint of pond seepage and its potential contribution to some drainage problems.

Seepage losses from ponds and reservoirs are most commonly noticed in one of two ways:

1. By the fast rate of fall of the level of water in the pond.
2. By the presence of seep-damaged areas below the pond.

In both cases, factors in addition to seepage loss may be involved. Not counting the water level drop caused by releases for irrigation or other purposes, a drop in pond level is usually the combination of (a) seepage into the underlying soil, (b) evaporation from the pond surface, and (c) transpiration by trees and bushes at the edge of the pond. In general, it can be assumed that:

1. Evaporation and transpiration can account for up to one-inch/24 hours drop in water level in the pond.
2. Seepage losses constitute the remaining part of the drop which can range to as high as five feet/24 hours.

In other words, for a loss of 1-foot/24 hours or greater, the evaporation and transpiration part of the overall loss can be ignored in most cases -- with the entire loss being considered as seepage loss only.

Actually, the rate of fall of the pond level is the best and only dependable method of measuring the rate of seepage loss from a pond. The existence of a seep-damaged area below the pond, may or may not be related to seepage from the pond. Part or all of the water in the seep-damaged area may have come from sources other than pond seepage. Other potential sources include: Return flow from irrigation, springs and precipitation.

CONTROL METHODS

The methods of controlling seepage loss range from the most expensive linings, such as those of concrete and asphalt, to the least expensive ones, including those of clay and the chemical sealants.

In a general way, the lining and sealing methods can be grouped as follows:

1. Paved or hard-surfaced linings.
2. Exposed membrane linings.
3. Conditioned earth linings.
4. Buried membrane linings.
5. Water-borne sealants.

The types listed above, in addition to wide variation in cost, also vary widely in their adaptation and in their total functions. Some of the linings do more than seal or waterproof -- they stabilize slopes, control erosion, or eliminate shoreline weeds. The expected life of the lining and sealing methods also varies widely. All of these factors must enter into the cost considerations. -- initial costs, annual costs and replacement costs should enter into the total cost considerations.

HARD SURFACE LINING

Paved linings may be constructed from a variety of materials, including concrete, asphaltic concrete, brick and rock. Some of these linings are watertight -- some are not unless special bedding materials are used. Costs of these linings usually will be in the range of $2.50 to $20.00/sq. yd.

EXPOSED MEMBRANES

The exposed membranes are usually of the prefabricated type of asphaltic material. Several kinds of laminated materials have been used including:

1. Asphalt and felt similar to roofing paper but much heavier -- ranging in thickness from 1/8 to 1-inch in thickness. Fiber glass and jute have also been used in this manner with asphalt.
2. Butyl rubber is another material that is showing promise as a long-life, durable material for lining purposes.

These materials are reasonably flexible and can, therefore, accomodate to moderate movement of the sub-grade. Puncturing by plants and deterioration from weathering have caused the most trouble in installations with the asphaltic materials. The costs are comparable to those for concrete, or around $2.50 to $4.00/sq. yd., but the prefabricated liner is favored by some because it can be installed with a minimum of equipment with unskilled labor doing the work at odd times.

CONDITIONED EARTH LININGS

Where suitable earth is available near the site of construction, a thick (2 to 3 feet) lining of compacted earth is a cheap and effective means of controlling seepage loss from ponds. In order for this lining to be competitive cost-wise with other linings, heavy equipment for excavating, conveying, and compacting the earth material is necessary. This limits the use of this method,

making it usually infeasible for small ponds.

In some instances, the in-place soils can be sealed by the addition of agents, such as bentonite, sodium chloride (plain salt), sodium carbonate, sodium tripolyphosphate, Portland cement, asphalt emulsion, and a variety of chemicals. This is a most attractive possibility since only a relatively small amount of new material is added to the in-place materials in most instances. The cost range is from less than $.01/sq. yd. to as much as $2.50/sq. yd.

BURIED MEMBRANE LININGS

In this method the waterproof barrier is protected with a cover material. The membrane can be asphalt (not spray or prefab roll), plastic, bentonite, clay or earth. A catalytically-blown asphalt is the most common material that has been used in past installations of buried membrane linings. Both vinyl or polyethylene film of 4 to 8 mil thickness has been used. If clay or earth is used, it must possess low permeability independent of compaction.

The costs range from about $.75/sq. yd. to as much as $2.00/sq. yd.

WATER-BORNE SEALANTS

Because of the widespread interest in sealing methods that can be accomplished without draining the reservoir or pond, considerable development work has been completed during the past few years on water-borne sealants. Materials developed include SS-13 and Chevron Soil Sealant. Bentonite has also been used. In this method, the sealant is despersed into the water in the pond. The sealing action is concentrated in the loss areas. Costs have ranged from below $.01/sq. yd. to as high as $1.50/sq. yd.

CONCLUSIONS

A number of experimental methods of sealing and lining ponds have been mentioned in this paper. If you would like to receive additional information in regard to the research in this field being carried on by the Civil Engineering Section of Colorado State University Experiment Station, please do not hesitate in writing to me directly. We will gladly send information to you.

As two additional sources of information on the linings and sealers, the Bureau of Reclamation, Denver Federal Center and Dr. C. W. Lauritzen, Utah State University, Logan, Utah are also excellent sources of information.