TREATING POND WATER FOR FARM AND HOME USE

By

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Treating Pond Water For Farm and Home Use

By Jesse B. Brooks and Kermit C. Mills

Proper treatment can make pond water clear, pure, and completely safe for human consumption. Pond water may be used where wells, springs, or cisterns will not provide an adequate, dependable source of supply.

This publication presents an acceptable method of treating pond water; however, it is expected that better processes will be developed in the future as necessary research on this subject progresses. Several commercial water treatment units are available, and some dealers can give reliable information on those units. Farmers who wish to treat pond water must learn the fundamentals of treating water and operating a treatment system if a continuous supply of safe water is to be obtained.

THE POND

Locate the pond as near the home and farm buildings as possible. This will reduce the amount of pipe and electric wire needed, and the equipment will be easier to inspect and maintain.

A 3-foot depth of water around the edge of the pond is necessary to prevent plant growth in the water. The pond should be at least 10 feet deep in its deepest part. A pipe placed through the dam at the time of construction will allow for draining the pond or placing the treatment system below the pond if desired.

Waste water from barns and the home should not be allowed to drain into the pond. Diversion ditches or terraces may be used if necessary to carry contaminated water away from the pond.

There should be about 5 acres of watershed area for each acre-foot of water storage capacity in the pond. The watershed area should have a good cover of grass or timber to keep the pond water clearer and increase the efficiency of the filter system. If the watershed area is to be cultivated, it should be stripcropped, contour cultivated, or terraced to reduce silting into the pond.

The pond should be fenced to keep livestock out of the water. Place the fence away from the water's edge far enough that the grass and weeds near the pond may be cut with a power mower.

TREATMENT PROCESSES

The three basic processes generally used in treating pond or surface water are sedimentation, filtration, and purification.

Sedimentation

Suspended silt, clay, ordinary dirt, and organic matter such as algae ruin the appearance of water and made it undesirable for general use on the farm. The heavy suspended particles settle out in time by gravity if water is held quietly in large reservoirs. However, colloidal or very fine particles may never settle out. To hasten settling and remove fine suspended matter, a chemical coagulant is used. When a coagulant such as filter alum is mixed with turbid water, the particles in suspension tend to gather and form clusters or "flocs." The floc is heavy and when properly formed sinks promptly to the bottom of the settling basin.

Proper dosage of alum to form a good floc varies depending upon the physical and chemical characteristics of the raw pond water. By observation and experience the operator will soon learn when the correct amount of alum has been used. The object is to produce the best possible floc that will clarify the water with the least amount of alum.

Filtration

Some of the fine, suspended, or flocculated particles will not settle out in the settling basin but require filtration to remove them.

As the water flows by gravity through the sand bed of the filter, most of the suspended particles are trapped and held within the top few inches of sand. This blanket of silt, floc, and other matter actually improves the quality of the water being filtered; but at the same time this film retards the flow of water, and eventually the filter must be cleaned.

Purification

Even though it is quite clear, filtered water may contain harmful bacteria and must be purified before it is safe for human consumption. At present, disinfection with chlorine is the cheapest and most reliable method of purification. Automatic electrically operated devices for injecting chlorine into water are available on the market. Such devices are called "chlorinators," and those of the positive-feed type are preferred. A test kit for determining the amount of chlorine needed to make the water safe for drinking is usually furnished with the chlorinator. Frequent tests should be made, as the chlorine requirements will vary with the condition of the water and the amount of contamination. Local health authorities can help you in making

the first few tests of the water and advise you on correct chlorine dosage.

A 30-minute contact time of chlorine with water is required to assure purification. Note in the drawing on pages 8-9 (Fig. 5) that chlorine is added to the filtered water as it enters the reservoir.

THE TREATMENT SYSTEM

The system for treating pond water satisfactorily includes: (1) a flexible intake, (2) the settling basin, (3) a filter, and (4) a reservoir or clear well. Details of the basin, filter, and reservoir are shown in Fig. 5.

Flexible Intake

A flexible, floating intake that will rise and fall with the water level of the pond is desirable. The intake should be placed where the water is deepest in the pond and about 18 inches to 2 feet below the water surface. Water near the surface of the pond contains less sediment and is less likely to have offensive tastes and odors than water near the bottom.

Two simple intakes are shown in Figs. 1 and 2. The intake should be installed high enough that mud from the bottom of the pond cannot enter the pipeline.

The intake pipe should be buried in a trench through shallow water near the banks of the pond and placed below frostline (2 feet, 6 inches at all points) to prevent freezing.

A section of ¼-inch hardware cloth formed into an 8-inch ball and clamped to the end of the intake pipe will provide an adequate screened intake. Since the intake may require frequent cleaning, it should be easy to raise or remove from supports for inspection.

Settling Basin

The settling basin is a tank where the raw pond water is treated with alum and the flow reduced to allow for sedimentation before the water goes to the filter.

The size of the basin is based on the daily water requirements, the period of retention estimated to give proper sedimentation, and a space allowance for sludge which accumulates at the bottom of the basin. Refer to Tables 1 and 2 (pages 10-11).

The water level in the basin is maintained by a float valve or a float switch. Use the latter if a raw water pump is located near the pond as shown in Fig. 1.

The under and over baffles of asbestos boards in the basin aid in directing the flow of water which mixes with the alum to obtain good sedimentation.

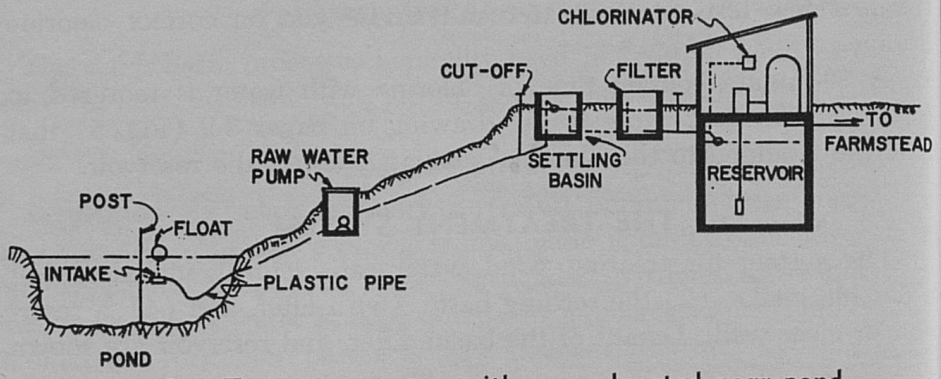

Fig. 1.— Treatment system with pump located near pond.

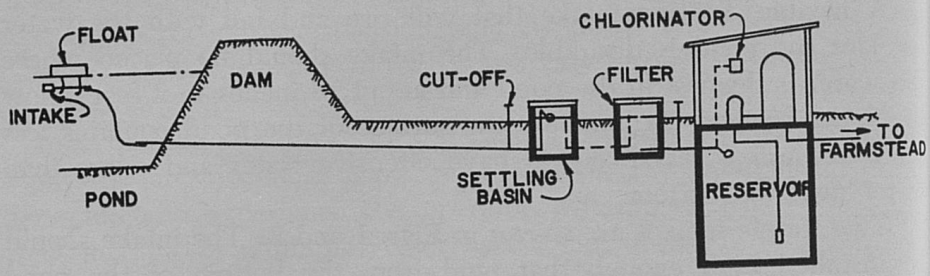

Fig. 2.— Treatment system located below pond (gravity flow).

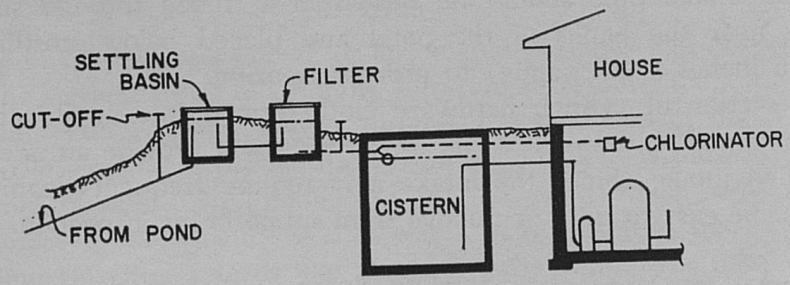

Fig. 3.— Treatment system with pump located near pond and cistern near house used for reservoir.

Details for installing the alum pot are shown in Fig. 4. The flow of solution from the pot is regulated by the amount of water allowed to pass through the valve at A. The top level of the solution in the alum pot should be about 2 inches above the high water level in the settling basin. The raw water outlet at B and the alum pot outlet should be adjusted so that the alum solution and raw water are thoroughly mixed.

A drain in the bottom of the basin facilitates cleaning, and a faucet or frostproof hydrant located nearby will provide water under pressure for flushing.

The Filter

Water is piped from the settling basin to the filter. The size of filter needed depends upon the daily water requirements on the farm (see Table 1) and the estimated rate of flow through the filter. Sizes shown in Table 2 are based on a filtering rate of 3 gallons per hour per square foot of filter bed area. A globe valve regulates the flow of water from the filter to the reservoir. The flow is adjusted to the estimated rate of filtration depending upon the total area of the filter bed.

The filter is built the same depth as the basin, and the water level in both is regulated by a float placed in the settling basin. The water level should be high enough to provide pressure to force the water through the filter and keep the blanket of silt over the filter wet at all times. Never allow this blanket to dry out as it will crack and reduce the effectiveness of the filter.

The bed of filter sand is supported by two layers of gravel.

Sand used for the filter may vary depending upon the type available. Some farmers use filter sand that will pass through 24- to 48-mesh screens. Others use washed, clean sand that has a well dis-

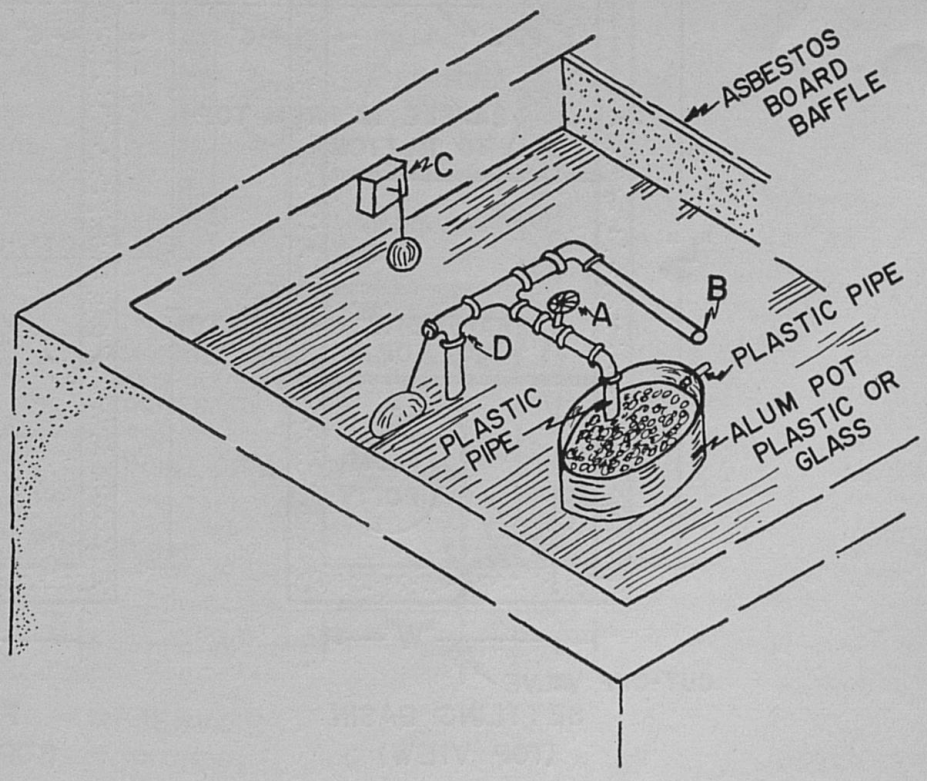

Fig. 4.—Settling basin. Note: Use float switch "C" if pump is used at pond as in Fig. 1. Use float valve "D" if system is placed below pond as in Fig 2.

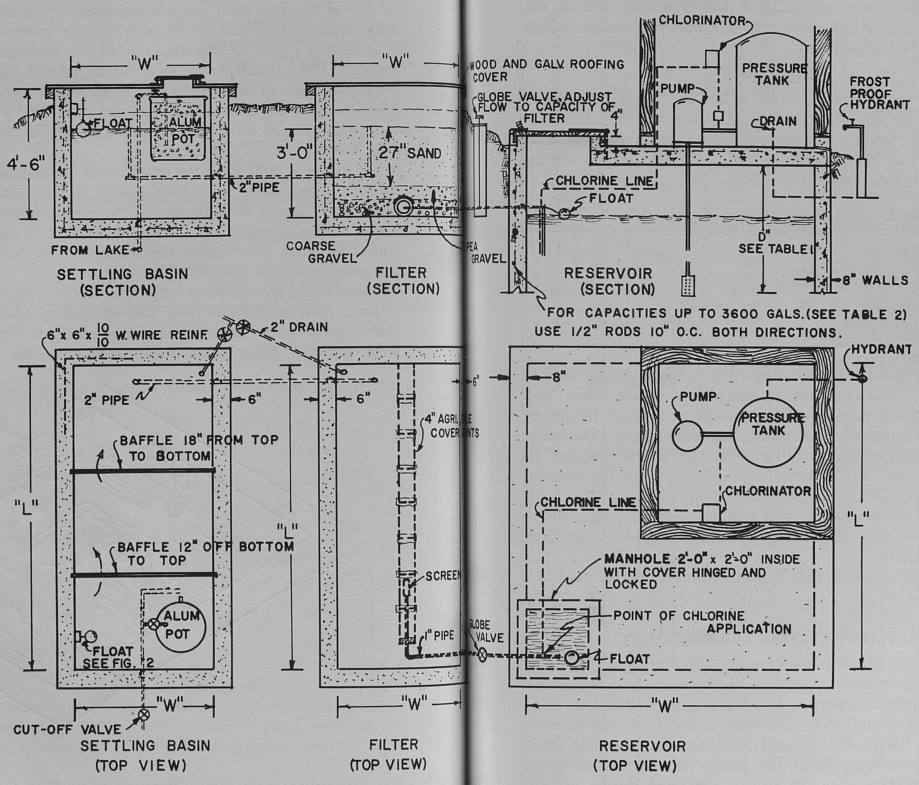

Fig. 5.— Plan for a pond water treatment system. (See Table 2 for dimensions and capacities.)

tributed particle size up to 1/8 inch. Concrete sand that will pass through a 1/8-inch screen can be used if it is washed free of silt. Regular mortar sand is also acceptable if it does not contain a high proportion of very fine particles.

Reservoir

The flow of water from the filter is low in gallons per minute, yet this flow is continuous for 24 hours. A reservoir will allow for accumulation and storage of filtered water during off-peak load periods. A reservoir large enough to hold a 2½ days' supply for the farm is advisable (see Tables 1 and 2).

Table 1.— Daily Water Requirements in Gallons

Person	50	Pig (30 lb)	1 2/10
Steer	10	Hog (200 lb)	4
Dry Cow	12	Sow	6
Milking Cow		Sheep	3
Large Breed	23	Hen (each 100)	5
Small Breed	12	Broiler (each 100)	5
Cleaning barn, each cow	12		

The reservoir should be located so that the high water level in the reservoir will be slightly below the bottom of the filter. This difference in elevation produces the required flow of water by gravity through the filter especially as the filter becomes clogged. The water level in the reservoir is maintained by a float. A float switch should be connected to the motor of the pump for protection in case the reservoir level should drop below the intake of the pump.

The reservoir should be of good quality watertight concrete. A concrete slab top, properly reinforced, may be used as the floor of the pump house.

If there is a good cistern already on the farm it may be used as a reservoir (see Fig. 3).

TREATMENT SYSTEM ARRANGEMENT

Locate the units of the treating system 100 feet away from possible sources of contamination such as septic tanks, sewage disposal lines, and barnyards. Since the system will require frequent servicing and inspection, it should be located close to the farm residence for convenience. If the pond is located some distance from the farmstead and is not easily accessible, two pumps may be used as shown in Fig. 1. The cost of extending electric service to pumps and the treatment system should be considered. Make a survey of the present water facilities and note the presence of cisterns, storage tanks, pumps,

Table 2—Suggested Inside Dimensions for Settling Basins, Filter, and Reservoir Shown in Fig. 5.

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WATER NEEDED		SETTLING BASIN			FILTER			RESERVOIR			
Gallons Per Day	Gallons Per Min	Capacity Gallons	"W"	"L"	Sq. Ft.	"W"	"L"	Capacity Gallons	"W"	"L"	"D"
360	1/4	180	2'-0"	5'-0"	10	2'-0"	5'-0"	900	5'-0"	5'-0"	6'-0"
720	1/2	180	2'-0"	5'-0"	10	2'-0"	5'-0"	1,800	6'-0"	6'-0"	8'-0"
1,080	3/4	270	3'-0"	5'-0"	15	3'-0"	5'-0"	2,700	5'-0"	8'-0"	10'-0"
1,440	1	360	3'-0"	7'-0"	20	3'-0"	7'-0"	3,600	7'-0"	10'-0"	8'-0"
2,680	2	720	4'-0"	10'-0"	40	4'-0"	10'-0"	* 6,700	10'-0"	10'-0"	10'-0"
4,320	3	1,080	6'-0"	10'-0"	60	6'-0"	10'-0"	* 8,300	12'-0"	12'-0"	10'-0"
5,760	4	1,440	6'-0"	14'-0"	80	6'-0"	14'-0"	*14,400	12'-0"	14'-0"	10'-0"
7,200	5	1,800	7'-0"	14'-0"	100	7'-3"	14'-0"	*18,000	12'-0"	12'-0"	11'-0"
8,640	6	2,160	8'-0"	15'-0"	120	8'-0"	15'-0"	*21,600	12'-0"	30'-0"	10'-6"

*Wall thickness and reinforcing specified for the reservoir in Fig. 5 do not apply to reservoirs of these capacities.

and pipe lines that might be used in the new system. If a cistern is available, Fig. 3 shows how the treatment system can be arranged to use this cistern as a reservoir.

INSTRUCTIONS FOR OPERATING THE POND WATER TREATMENT SYSTEM

The cost of operating a treatment system is small. The chlorine and alum usually will cost less than 3 cents per 1,000 gallons of water used. Chlorine will always be needed, but alum may not be required at all during periods of low rainfall or when the raw pond water is almost clear.

Relatively little time is required for maintaining the system, but a rigid schedule of inspection is important to assure safe water. Daily chlorine tests are advisable. These tests should be made under good lighting conditions since determination of chlorine strength is a matter of distinguishing between slight variations in color.

Cleaning and Disinfection

The inside walls and floors of the settling basin, filter, and reservoir should be cleaned and disinfected before the system is started. For cleaning use a stiff brush and a strong solution of baking soda and water. Allow the solution a few minutes contact with the surface and flush off with clean water. The soda and water solution will help remove the "lime" taste imparted to water held in new concrete structures. If the "lime" taste persists after the reservoir is filled, a solution of baking soda and water may be added to the storage reservoir.

After the system is completely installed, it should be treated with a solution of heavily chlorinated water to remove all contamination. The following method is suggested: (1) Fill the entire system with water, allowing filtered but unchlorinated water to enter the reservoir. (2) Stop the system and add a chlorine solution (mixture given below) by hand to the settling basin, filter, and storage reservoir. (3) Start the system again, opening all faucets, and allow the water to run until the chlorine odor is noticeable at all outlets (about 30 minutes). (4) Stop the system (including the flow into the reservoir) and allow the strong chlorine solution to stand in the entire system for a period of 8 hours. (5) After this standing period, the settling basin, filter, and reservoir should be emptied and the system restarted with the chlorinator in operation.

The quantity of chlorine needed to disinfect the system is based on 50 parts of chlorine to a million parts of water. This is about the

same as 1 gallon of 5 percent chlorine solution (laundry bleach) for each 1,000 gallons of storage capacity in the settling basin, filter (including sand), and storage reservoir (see Table 2). Care should be taken to distribute the chlorine over the water surface in the treating units. A clean garden sprayer with the nozzle removed can be used for applying the chlorine solution to the storage reservoir through the manhole cover. Mix the solution with the water as it is applied. But do not enter the reservoir as the chlorine fumes may be toxic.

Adjusting Filtering Rate

The flow of water from the filter to the reservoir should be adjusted to the filtering rate determined in the original planning of the system. A filtration rate of 3 gallons per hour for each square foot of filter bed area was used in sizing the filter. The flow is regulated with the globe valve between the filter and storage reservoir. For instance, the flow from a filter 3 feet wide and 5 feet long should be adjusted to 45 gallons per hour or 3 quarts per minute. The filtration rates given in Table 2 are maximum. If a lower flow through the filter is found to supply the farm needs, the globe valve may be turned to reduce the flow accordingly. A lower rate will give longer filter runs between cleanings, and the water will possibly be clearer.

The filtering rate will be reduced as the layer of suspended material accumulates on top of the filter. In time the filter must be cleaned.

Alum Dosage

The alum pot (2 to 5 gallons capacity) can be placed in the settling basin on concrete blocks, bricks, or a wooden stand. The pot and pipes to be in contact with alum should be of plastic, glass, or other acid-resistant materials.

Place the pot in position as shown in Fig. 4, and fill it with plain granulated or lump filter alum. Filter alum is much cheaper than the chemically pure form usually found in drugstores. Your druggest may order the filter alum for you, or it may be purchased from the local water treatment plant.

Valve A (Fig. 4) is adjusted to regulate the flow of water through the alum pot and, in turn, the alum dosage to the raw water entering the settling basin. The raw water outlet at "B" is raised or lowered so that the water and alum solution leaving the pot will be well mixed. The water level in the alum pot should be from 2 to 3 inches above the water level in the settling basin.

The dosage of alum required to produce satisfactory water varies widely. As stated before, the quantity of alum required will depend upon the turbidity of the water. During periods of low rainfall and

when the pond water is quite clear, the alum supply may be cut off entirely. The correct dosage can be determined by observing flocculation within the settling basin and the filtered water entering the reservoir.

In starting a new system it is recommended that the valve at "A" be almost closed so that about 25 drops per minute are leaving the alum pot while raw water is entering the settling basin and clear water is leaving the filter. As the system is operating, samples may be collected in glass jars from the settling basin and reservoir to observe the job the system is doing. Excess alum dosage only wastes the chemical and may impart a disagreeable alum taste to the water. Insufficient dosage decreases the efficiency of the entire treatment system.

Note: Most pond waters are neutral or slightly alkaline in nature. Alum reacts best to form a floc in waters that are slightly alkaline. For this reason alum is favored in pond water treatment because it is generally the only chemical needed to remove turbidity.

In some cases waters may have insufficient alkalinity to react with the alum. In those cases lime may be added to improve flocculation.

If lime is needed a trial mixture of 1 part lime to 2 parts alum by weight may be used in the alum pot.

Chlorination

Manufacturers of chlorinators will furnish all the information needed on mixing chlorine solutions and regulating the amount of chlorine required to purify the water. Kits for testing chlorine in water and water purity are usually supplied with the chlorinator.

Even though the chlorinator is completely automatic, it cannot be neglected. Daily inspections are advisable to assure safe water.

Cleaning the Settling Basin

After 12 inches of sludge or sediment have accumulated in the bottom of the basin, it should be drained and cleaned. The walls and floor may be brushed with a stiff brush and flushed with pure water.

Cleaning the Filter

The silt blanket which forms on top of the bed of sand in the filter reduces the flow of water through the filter. The filter must be cleaned when the flow is reduced to the extent that daily water requirements on the farm are not satisfied.

To clean the filter turn off the water at the cut-off valve at the settling basin and let the water drain through the filter until there

is no water standing over the filter. Close the globe valve at the outlet of the filter. (Do not let the filter drain dry.) With a scoop, trowel, or shovel remove the silt and the top inch of sand. Do not rake or disturb the filter surface.

After cleaning the filter 5 or 6 times, add new sand to rebuild the bed to its original depth (27 inches). After several cycles of cleaning and rebuilding, it may be necessary to remove and replace all of the sand in the filter.

Tastes and Odors

The presence of offensive taste and odor in water may be due to: (a) the presence of algae; (b) dissolved gases or chemicals from the watershed area or chemicals used in the water treatment such as chlorine or alum; or (c) decomposing organic matter or contaminated areas within the watershed area or the pond.

A heavy growth of algae in the pond will clog the filter and impart an unpleasant taste and odor to water that cannot be removed by the filtering process. Directions for the use of copper sulfate to control algae in ponds can be obtained from your county extension office.

It is best to treat ponds so that a heavy growth of algae never accumulates. Killing large amounts of algae in a pond may have adverse effects since the decaying mass may harm fish and temporarily cause an offensive taste and odor in the water.

Large amounts of chlorine are sometimes needed to treat highly contaminated water. For adequate protection a residual of chlorine is always desirable. While chlorine may be somewhat offensive when detected in drinking water, the water is usually safe if the chlorine smell is present.

An excess dosage of alum may cause an acid or "alum" taste in water. This taste is not detected where normal amounts of alum are used.

Contaminated areas within the watershed may cause water to be less palatable. Barns, barnyards, catch basins, septic tank sewage, and garbage disposal lines should be located so that drainage will not be toward the pond.

Several special devices are on the market for removing tastes and odors in filtered and chlorinated waters. Most of the units are for refiltering or aerating treated waters. Activated carbon is often used in the filters. Some small filters are available that attach to a faucet and absorb excess chlorine. Aerators are special in design and require the services of a competent dealer to install.

If the pond is located close to the farmstead and all of the water

under pressure is to be treated, the treating system may be placed below the pond as shown in Fig. 2.

Water for livestock does not have to be filtered. The flow of water to livestock tanks and drinking cups should be regulated by non-siphoning type floats. Faucets or water outlets located any place on the farm tempt those who are thirsty, and pure water at all outlets regardless of location is good health insurance.

CONCRETE BLOCKS FOR WALLS OF SETTLING BASIN AND FILTER

If properly reinforced and waterproofed, the walls of the settling basin and filter may be built of concrete blocks. Plans for concrete block wall construction for these units may be obtained from your county extension office or by writing to the Agricultural Engineering Department, University of Kentucky, Lexington.

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