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Some possible solutions to future water needs of private water systems

Elmer R. Daniel

R. C. Peralta
Utah State University

a transparent supply of laundry bleach (so that the inspector could immediately see if the meter was operating or if water had been substituted for laundry bl[each].

CHARCOAL FILTER must be before treated water storage: and chlorination must always take place after charcoal filter to assure adequate residual (this regardless of any chlorination or any pre-chlorination in the sand filter.)

Contact time must be minimum of 30 minutes at 0.2 P. P. M. residual in treated water storage. (we have 7-1/2 hrs. contact time in sand filter alone and 1/2 hr. in treated water storage.

The usual recommendations of no livestock or plowed fields in the watershed of the pond is very important.

Quality Water for Home and Farm

from Proc. of 3rd Domestic Water Quality Symposium, 1979, ASAE

SOME POSSIBLE SOLUTIONS TO FUTURE WATER NEEDS OF PRIVATE WATER SYSTEMS

Elmer R. Daniel
Member ASAE

Richard Peralta
Student Member ASAE

This paper is related to the findings of three different research phases concerning individual water supplies over a period of 18 years at Oklahoma State University.

Much of Oklahoma's agricultural area does not have a satisfactory underground water supply for household use. The Oklahoma Water Resources Board reports that ground water reservoirs supply about 1/3 of the water used in the state. Annual rainfall varies across the state from 18 inches in the West to more than 50 inches per year in the Southeast. Surface water reservoirs, sometimes called ponds or tanks, provide a satisfactory livestock supply. Further treatment is needed for cooking, drinking and dairy use. The first thing needed in considering surface water for household use is a thorough chemical water analysis. A chemical analysis on the finished water from any treatment plant should be made periodically.

SLOW SAND FILTRATION OF SURFACE WATER

Our first study on pond water treatment began by attempting to develop a practical method of settling, filtering and storing pond water (Fig. 1). We found settling could be accomplished by changing the pH of the raw water. Settling the entire pond was unsatisfactory. The next rain would again muddy the raw water. The size of clay particles, not the amount of grass cover, in the watershed appears to be the major factor in causing turbidity. The standard procedure of adding alum as used in municipal water treatment plants is satisfactory. Muddy water responds quite well to a coagulant; however, filters need to be cleaned more often. By placing the treatment plant below the pond, a pump is not needed to deliver the water to the cistern (Fig. 2). Locating the treatment plant in the farmstead area will permit the use of untreated water for cattle and garden irrigation. Therefore, less potable water is needed so that the mud deck on the filter surface will need to be cleaned less often. A floating inlet, some two feet below the surface, will permit taking water from the "oxygen" zone which is the upper few feet of water of the pond. This water will have less taste and oder problems. A polystyrene float attached to a concrete building block with a nylon rope provides a good method of keeping the inlet in the position properly.

The authors are: Elmer R. Daniel, Associate Professor (Emeritus), and Richard Peralta, Graduate Associate, Agricultural Engineering Dept., Oklahoma State University.

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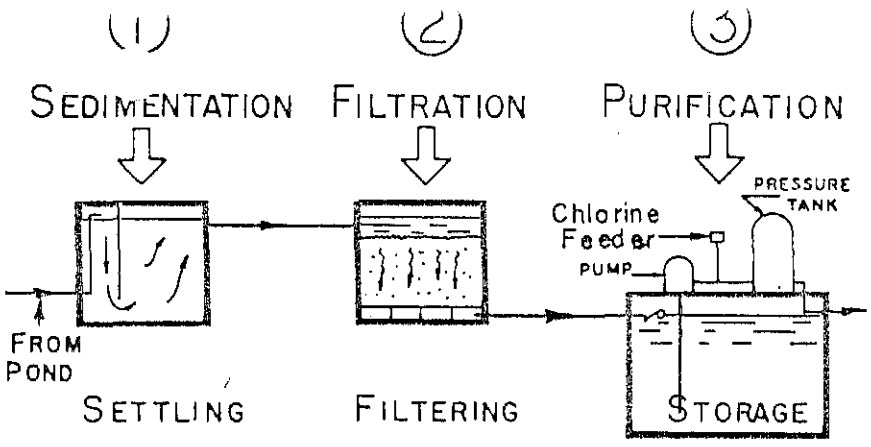

Fig. 1. The Three Main Steps in Treating Pond Water for Household Use are, (1) Sedimentation, (2) Filtration, and (3) Purification.

A satisfactory and less expensive treatment system is shown in Fig. 3 and Fig. 4. Such a system is easier to operate and the initial investment is lower than the previous method. The small pond below the large pond is filled periodically when needed. Alum is mixed with the water as it enters the settling basin. The incoming water should flow over a burlap bag containing lump alum. Usually within a few hours the water will have a turbidity of less than 5 ppm. The water then moves through the sand filter bed in the bottom of the second pond at a controlled rate of flow of less than 50 gal. per day per sq. ft. of sand surface. Two days supply should be stored in the cistern. The water is chlorinated with a chemical feed pump as the supply pump operates.

When the flow through the filter finally slows down due to the impermeable mud on the sand surface and does not meet the daily needs, the water in the set-

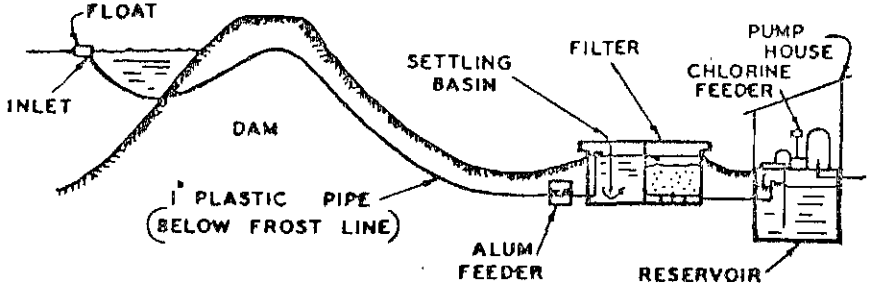

Fig. 2. This Plan Shows Treating System Below Level of Pond Dam to Provide Gravity Flow of Water.

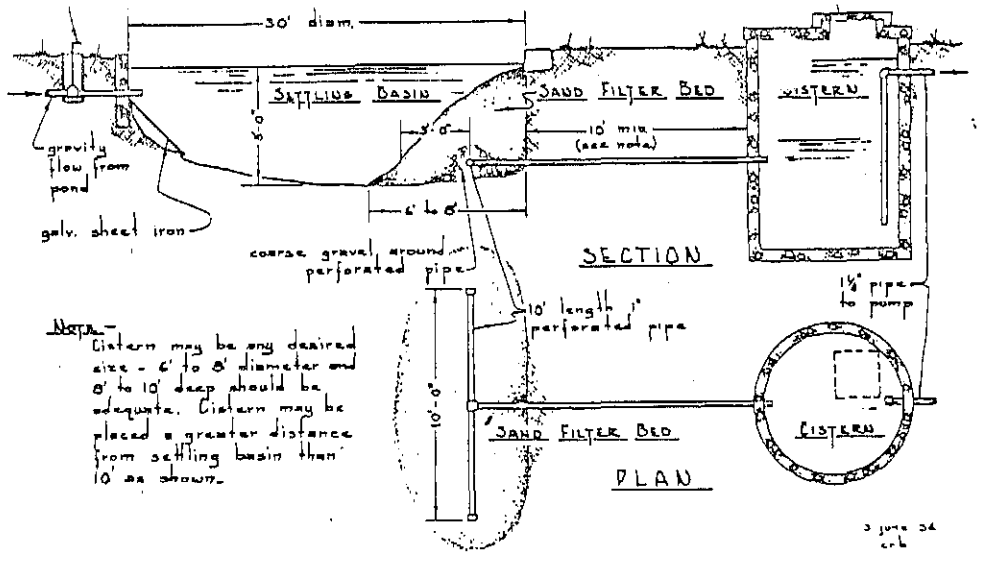

Fig. 3. Small Earth Pond Used as Settling Basin and Filter Bed, with Nearby Cistern for Storage. Ground Plan Layout is Shown in Fig. 4.

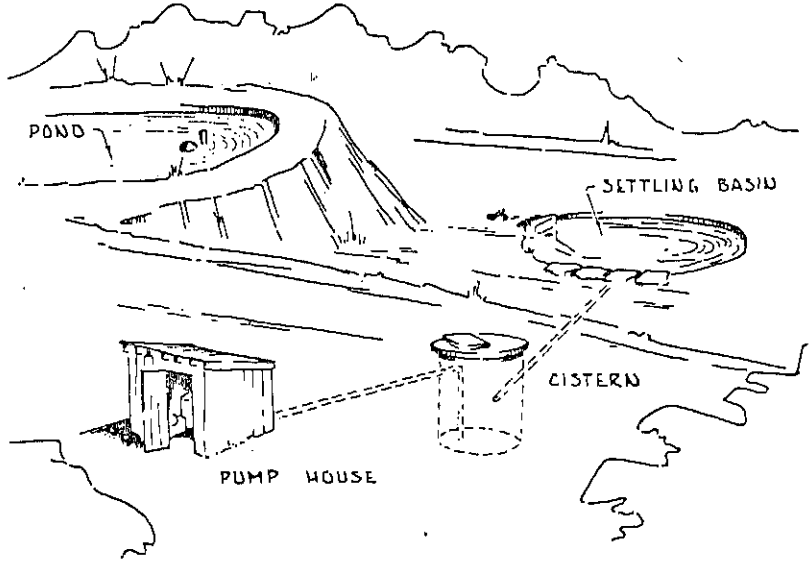

Fig. 4. Layout of Earth Settling Basin in Relation to Large Pond, Cistern, and Pumphouse.

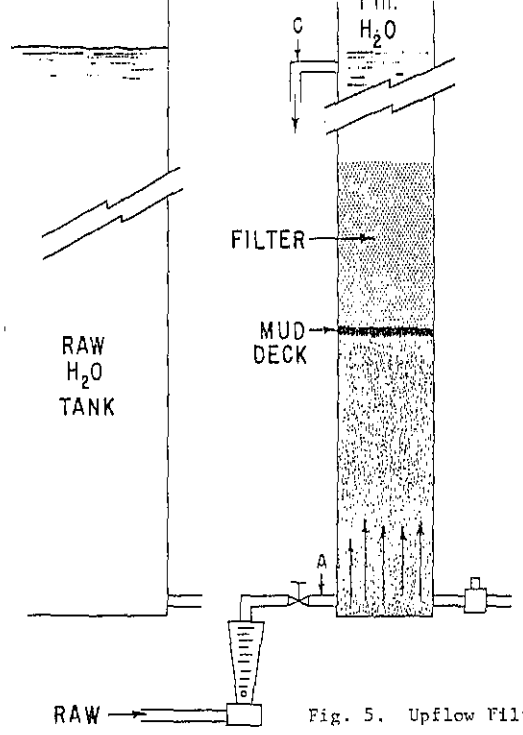

Fig. 5. Upflow Filtration

tling basin is lowered and the mud cleaned from the sand filter surface by removing about 2 inches of sand. A warning light may be placed on a pole above the cistern to indicate when the water level is low in the cistern and it is time for the filter to be cleaned. For an average family, the small pond below the large pond will need to be filled every 4 to 6 weeks or even less often.

Rapid Upflow Filtration

An upflow rapid filtration research study, Fig. 5, followed the slow sand filter study. Various filter media were studied such as wax, various sands, ground walnut hulls, glass beads and commercial media. A filter of 2 sq. ft. and flowing at 1 gpm per sq. ft. will accommodate a 4 gpm demand which is adequate for most farmsteads. Backwashing the filter requires a small percent of the finished water; however, this is minimal. After exhaustive studies we concluded this system had limited application for a demand flow system. A small upflow unit operating continuously and storing a 2 days supply in a cistern is more satisfactory for less turbid waters. Water coming from the foundation drainage of a Soil Conservation Service detention reservoir or filter water from a sand spring can also be treated by this method. This water usually has a turbidity of less than 10 ppm.

Sometimes additional treatment is needed to maintain a balance between pH and total alkalinity. Finished water should be maintained within the equilibrium

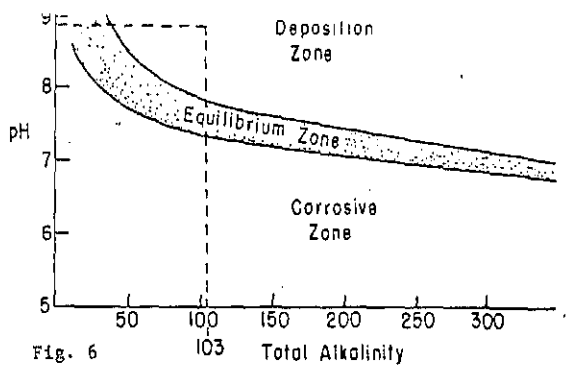

Fig. 6

zone shown in Fig. 6. A new concrete treatment plant will initially show high alkalinity. The alkalinity test should be made after 30 days operation to obtain a valid analysis. Finished water not in the equilibrium zone may result in either pipe corrosion or chemical deposition inside the household piping system.

RURAL WATER DISTRICTS

In October, 1965, the 89th Congress passed the Rural Water and Sanitation Facilities Act permitting Farmers Home Administration to finance rural water districts. This act has meant almost as much to agriculture as the Rural Electrification Act in Oklahoma. (This view may not be shared elsewhere.)

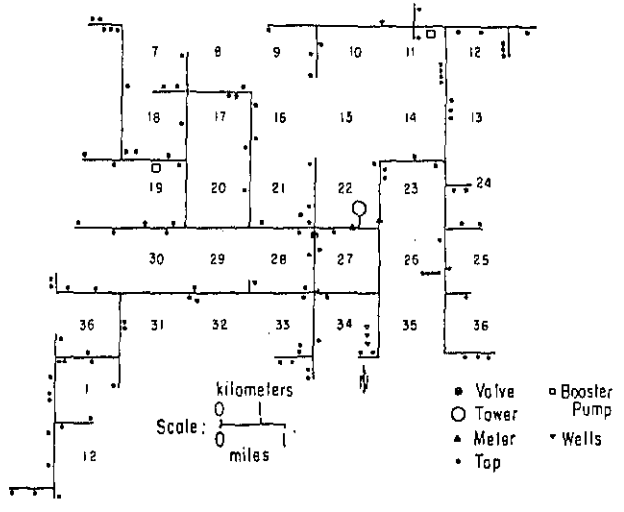

Fig. 7. Payne County Rural Water District No. 3
(Not all Residences are Shown)

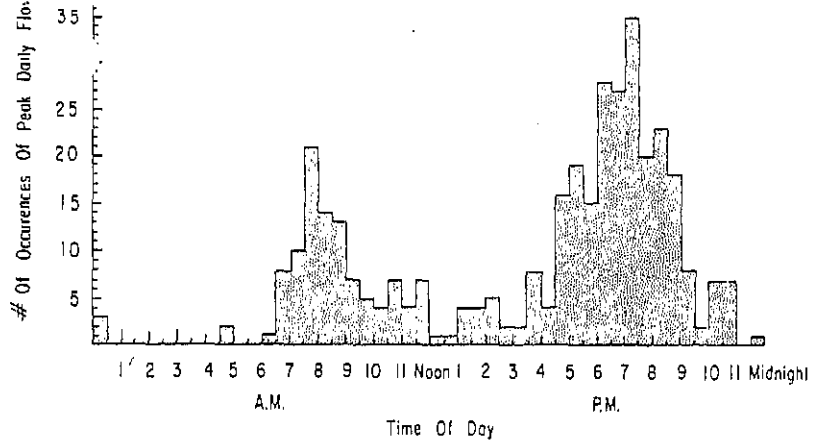

Fig. 8. Histogram of Time of Occurrence of Peak Flows.

Farmers Home Administration reports that more than 400 rural water districts and public authorities are presently serving 1/3 of the population in Oklahoma. Oklahoma State University Agricultural Engineers conducted a research study on one of these early districts named Payne County Rural Water District #3. Figure 7 shows the first section of this water district which initially had 132 meters. Water is delivered from 3 wells located in Section 34 and transported through a 4 inch pipe to the stand-pipe in Section 22, 2 miles distance and 100 feet higher in elevation. The original design was based on a 2-day storage of usable water (above 40 feet in stand-pipe). Each pump has the capacity to supply the daily need if operated continually.

The stand-pipe is located at the load center. A booster station in Section 11 and another in Section 19 provide extra pressure for the higher altitudes. The system was designed to deliver a minimum of 5 gpm with 20 psi, at the end of the line. When the pressure at the meter at lower altitudes exceeds 80 psi, pressure regulators are used at the meter. Less than 5% line pressure loss was experienced for the entire piping system. The operator must have special training and be certified by the Oklahoma Health Department and is compensated for his services at a unit cost per meter.

Rural water districts may be a satisfactory alternative in areas where adequate ground water supplies are not available on an individual basis.

SUMMARY

Slow Sand Filtration

The slow sand filtration method of water treatment provides a satisfactory practical means of obtaining a dependable potable water supply when a suitable underground source is not available. Pertinent facts to remember are:

A. For coagulation a constant feed for the raw water and the coagulate should be used. The chlorine feed pump and the main supply pump should be activated with the same pressure switch.

C. The filter should be kept wet at all times after it is [illegible]

D. The mud deck should be skimmed off the filter surface when filter flow becomes too slow. The filter should never be [illegible]ed by punching holes in the mud deck surface. This will cause mud to penetrate through the filter sand and render the filter useless.

E. Evaporation in Oklahoma is some 60 inches per year and a pond with a capacity of at least 2 acre feet is needed for a modern home. Aproximately half the pond capacity is available for a potable supply.

Upflow Filtration

A. An upflow filtration unit should adequately handle a household if sufficient storage is provided and the water is not excessively turbid.

B. An upflow filtration system has limited use.

Rural Water Districts

Water districts have provided the answer for many urban and rural homes as well as small towns in Oklahoma. Such a source eliminates the need for the user to maintain an individual well system and the initial investment is usually less. However, where an adequate underground water supply is available and water consumption is large, a well water supply usually is more economical.