Septic Tanks and Sewage Disposal

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Terms You Should Know

Sewage—Waste matter from the kitchen, bathroom, and laundry mixed with and carried along by water.

Sewerage—The system of pipes for carrying sewage away from the house.

Plumbing—The system of pipes, faucets, fixtures, traps, etc. for getting water to and waste away from the house.

Cesspool—A hole in the ground, usually curbed, into which raw sewage is emptied and from which the liquids leach away. There is very little septic action in a cesspool.

Septic tank—A watertight tank of steel, wood, concrete, masonry, or any other material in which raw sewage is held until liquefied by bacterial action.

Bacteria—One-celled plants which reduce organic matter to simpler forms.

Dry well or disposal well—A hole in the ground preferably to sand or gravel into which liquefied sewage is emptied.

Absorption bed—A system of shallow tile lines into which liquefied sewage is emptied at intervals.

Siphon—A device which automatically doses an absorption bed.

Sewer pipe—Vitrified clay pipe two feet long and with a hub at one end.

Drain tile—Clay or concrete pipe one foot long and without hub.

Organic substance—Something that has or has had life—plants and animals or their remains.

Inorganic substance—Without life—for example: rocks, clay, metals, etc.

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Disposal of household wastes from farm or suburban homes has always been a problem. The city dweller connects with the public sewer and forgets all about the sewage until the bills come in. The farmer or suburbanite, on the other hand, must provide his own sewage disposal system or something to take the place of it. For those people who live in unsewered areas and who want the advantages of a complete sewage disposal system, the cesspool or the septic tank with its absorption bed or dry well is the only choice. Since the days when raw sewage could be dumped into a running stream are over, that method will not be considered.

House plumbing is as much a part of a sewage disposal system as the septic tank or the disposal field. Any part of a sewage disposal system that does not function properly will affect the action of the whole system. The septic tank is often blamed for troubles caused by a faulty sewer, and frequently a disposal field fails to do what is expected of it because the septic tank was not designed or constructed correctly.

HOUSE PLUMBING

The selection and installation of plumbing fixtures should be considered carefully. Good serviceable equipment need not be expensive, but it must be sanitary. The proper selection of traps and fittings and an understanding of the purpose of venting these appliances will help in making the installation a success.

SEWERS

Private sewers are usually made of 4-inch or 6-inch vitrified sewer pipe laid with the bell or hub end toward the house. The joints should be carefully centered and tightly cemented with about a 1 to 2 cement-sand mortar.

If trees, such as elm, willow, boxelder, etc., are on the line of the sewer, they should be removed, the sewer built around them, or the sewer should be made of 4-inch cast iron soil pipe with leaded joints. Tree roots will extend laterally as far as the crown of the tree. If necessary, sewers may be curved horizontally, but they should have a constant grade from the house to the septic tank.

Be careful that no part of the sewer slopes downward toward the house. The sewer should have a grade of at least 2 feet in a hundred, but it may be steeper, if necessary. Figure 2 shows how to lay a sewer with the proper grade. A "Y" branch in the basement is well worth its cost if the sewer should become clogged. This allows the sewer to be cleaned without digging up the system.

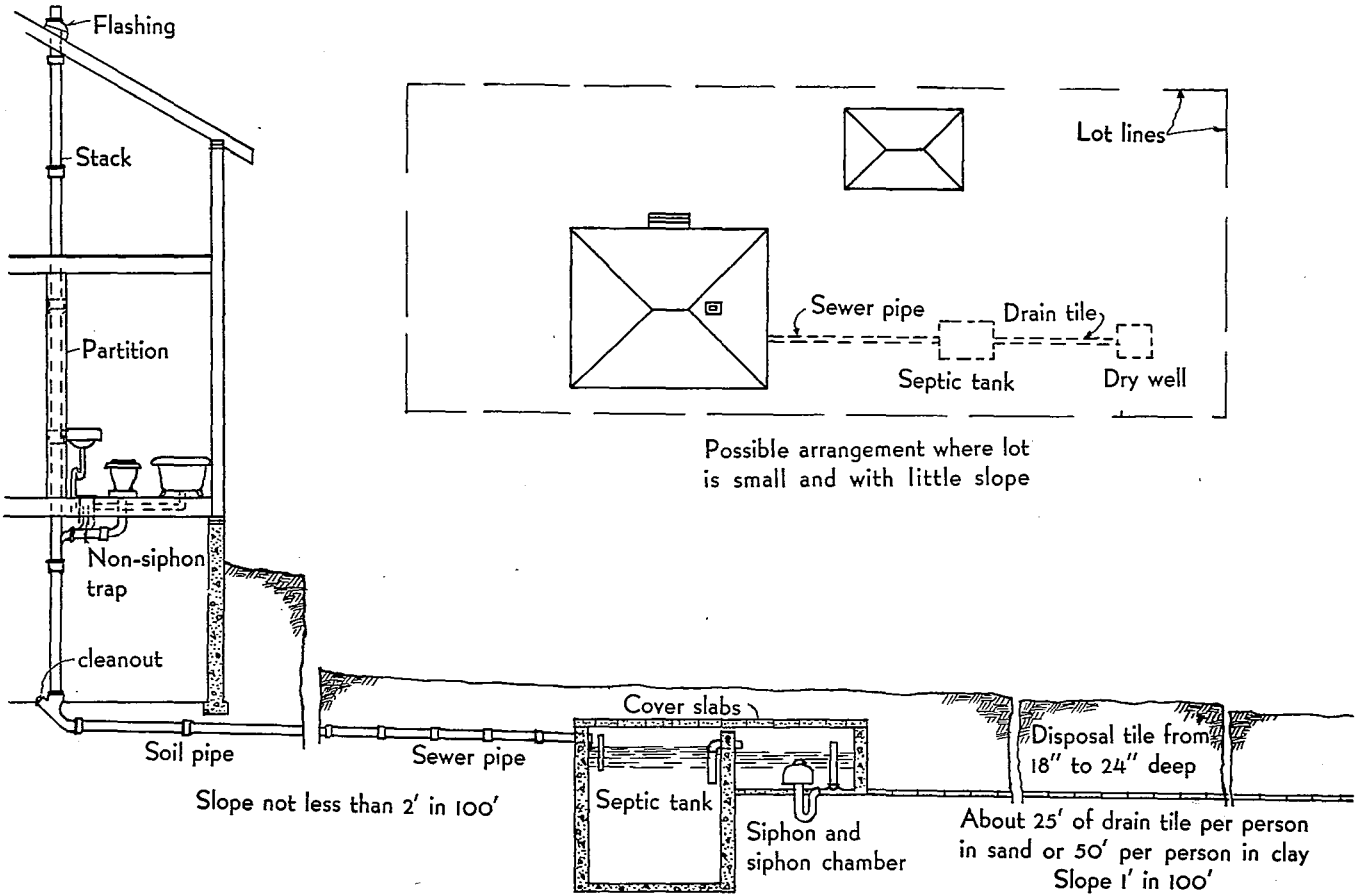

Fig. 1. Complete Sewage Disposal System

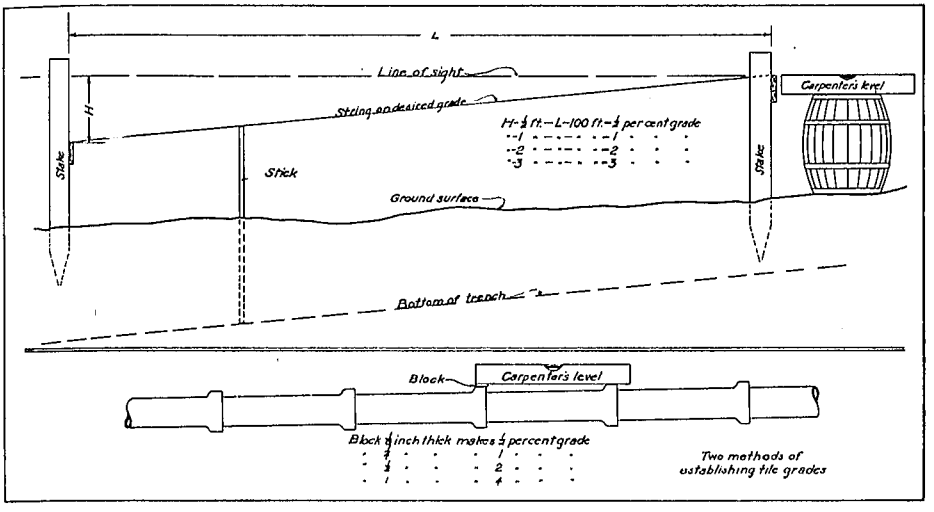

Fig. 2. Methods of Establishing Desired Grades for Sewers and Disposal Lines. Carelessly Laid Sewer Pipes Invariably Cause Trouble, and Disposal Tile Laid Too Flat or Too Steep Prevents an Even Distribution of Sewage.

Sewage

Ordinary domestic sewage is about 99 per cent water and one per cent solids either in suspension or solution. About half of this solid matter is inorganic and, therefore, not offensive, while the other half is organic and causes trouble unless properly handled.

The organic part is made up largely of proteins, carbohydrates, and fats. The proteins and fats are the chief source of trouble. The proteins break down rather slowly and the fats float or else congeal on the cold surfaces of drains and sewers.

The inorganic matter is made up of such things as soap curd and dirt washed from vegetables. This soap curd is the result of the action of soap on hard water. Water is hard because of the lime in solution. Soap breaks down or neutralizes this lime by converting it into an insoluble curd. When the water is very hard, this curd accumulates in grease traps and septic tanks with surprising rapidity.

The volume of sewage will, of course, depend on the size of the family and, to a lesser extent, on the age of the members of the family. In general children use more water and cause more clothes washing than adults. If the home is completely equipped with bathroom, kitchen sink, and laundry tubs, each member of the family will use about 30 gallons of water a day.

The composition of the kitchen waste will depend mostly on the cook. If many very greasy dishes are washed, more soap will be needed. The cook can help greatly by wiping greasy dishes such as frying pans with a newspaper and then burning it.

A sink strainer fine enough to retain coffee and tea grounds will, if used, help keep drains and traps in working order.

Reduction of Sewage

Sewage is a mixture of water and organic and inorganic material in suspension or solution or both. Most of the matter in suspension will, if given enough time and left undisturbed, settle to the bottom of the tank. The matter in solution will not settle.

Inorganic matter.—The inorganic part of sewage is of little importance as far as its disposal is concerned. Most of it settles very quickly and forms a part of the sludge or indigestible matter which accumulates at the bottom of well-designed septic tanks. This sludge is always dark colored and frequently very black due to the large amount of carbon in it. In a general way sludge corresponds to the ash left when fuel is burned.

If domestic sewage is to be disposed of effectively and inoffensively, some knowledge of the process of reduction is necessary. Foodstuffs of all kinds are compounds of various elements put together mainly by the process known as growing. All animal and vegetable products are the result of this building up process. After death the plant or animal begins to disintegrate and form food for further plant or animal life. This reduction or breaking down process is variously known as decay, rotting, putrefaction, etc. If conditions of moisture and temperature are favorable, organic material, that is, the product of life, soon begins to decompose. This breaking down process is brought about by minute living organisms known as bacteria. Generally bacteria may be divided into two classes—aerobic and anaerobic. The aerobes need air while the anaerobes do not. Both classes need water, but the anaerobes work best under very wet conditions. No thoroughly dry product will ever rot.

Organic Matter.—When organic matter is broken up by bacterial action, liquids and gases are formed. These products nearly always have foul odors which are very objectionable around homes. It may be well to point out that the products of anaerobic bacterial action (action not needing air) in a septic tank are never pure. The statement that septic tank effluent is as pure as spring water is pure fiction.

The sole function of a septic tank is to assist in converting solids into liquids and gases so that they may be disposed of more easily in a sanitary manner.

Cesspools

There is some confusion as to the distinction between cesspools and septic tanks. A cesspool is simply a hole in the ground into which sewage is emptied. The liquids leach away into the soil leaving the solids behind. There is practically no reduction of sewage in a cesspool. Moreover, there is danger that leachings from cesspools may contaminate adjacent shallow wells.

At its very best a cesspool is nothing more than a temporary expedient which is very apt to cause trouble at most inopportune times. Many epidemics of typhoid fever or other intestinal diseases have been traced to water supplies polluted by cesspool leachings.

SEPTIC TANKS

A septic tank is any container in which sewage is held until septic action takes place. With exceptions to be

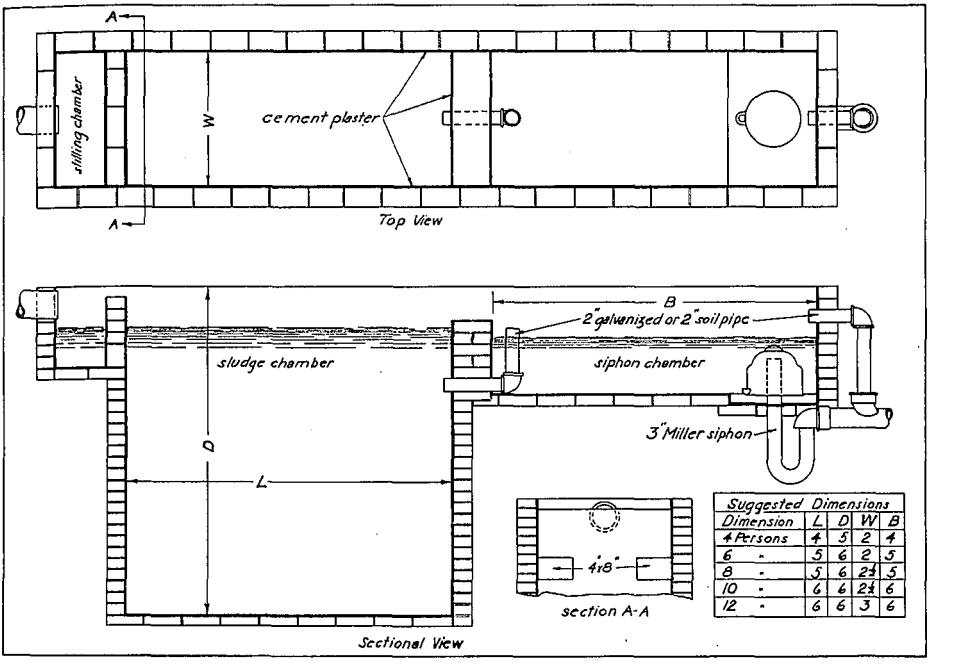

Fig. 3. A Brick Septic Tank with a Siphon Chamber. Concrete Blocks or Glazed Tile May Be Substituted for the Brick. No Form Is Needed. The Stilling Chamber May Not Be Necessary.

noted later, the shape, size, and material of which the tank is made are of little importance. The number of chambers is not important so far as septic action is concerned. The location of the tank with reference to the house is a matter of convenience Of course, the tank should not be placed in the basement nor should foundation walls form a part of the tank.

Depth of Tanks

The depth of the tank below the ground surface depends almost entirely on the contour of the land. In rare instances frost has interfered with the action of a septic tank, but generally speaking a foot of earth cover is all that is necessary. If the house plumbing is vented as it should be, and the sewer from house to tank is laid on a constant grade, no additional means of ventilation is needed. If it is necessary to have a septic tank deep in the ground, man holes with rings and covers will permit easy access for inspecting or cleaning.

Size and Shape of Tank

The size of the septic tank, of course, depends on the size of the family. In general, a liquid volume of 8 cubic feet for each person is about right.

Rectangular concrete tanks are quite popular because of their low cost and ease of construction (figs. 3 and 4). The inlet should be at one end and the outlet at the other. Deep tanks are

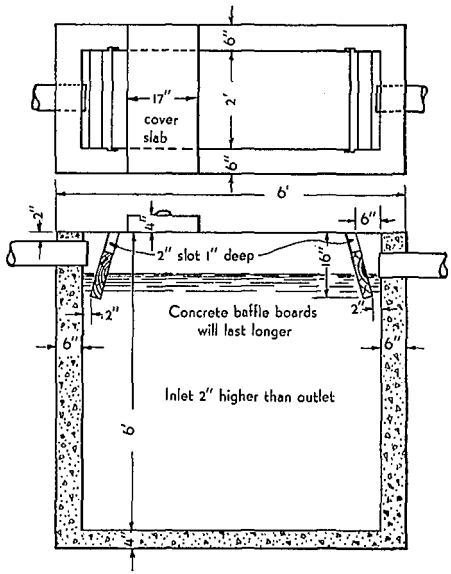

Fig. 4. A Simple Concrete Tank Suitable Where the Velocity of Entering Sewage Is Not High and Where the Final Disposal Is into a Drainage Tile Line or Ditch. The Tank's Liquid Capacity Should Be About 8 Cubic Feet for Each Person.

better than shallow ones because they provide more undisturbed sludge space. Circular steel septic tanks are easily installed and give good service unless they are overloaded. It is unfortunate that some of the steel septic tanks are so grossly overrated.

Any septic tank that is working as it should will have to be cleaned periodically. The intervals between cleaning will depend on many things but should range from 5 to 10 years.

The septic action which takes place in a tank is a perfectly natural one which would eventually take place outside the tank. If a few simple rules are observed, there should be no trouble. The bacteria in a septic tank are living organisms and function best at temperatures ranging from 70° to 100° Fahrenheit. They are easily killed by strong acids or alkalies. They must have food and should be disturbed as little as possible. The products of septic action are not pure and must be disposed of in a sanitary manner.

Single and Multiple Chamber Septic Tanks

There is a more or less common belief that a septic tank will work better if it has more than one chamber. In general, this is a mistake. Partition walls help strengthen the tank, but they have very little, if any, effect on bacterial action. Most of the so-called two-chamber tanks consist of a digestion chamber and a siphon chamber with one common wall. The only reasons for this kind of construction are convenience and a somewhat lower cost because less form work and concrete is needed.

The depth of the sludge or digestion chamber is the most important dimension; it should be such that there is at least 5 feet of liquid. Deep tanks have to be cleaned less frequently. The siphon chamber, however, should be as shallow as possible.

ABSORPTION SYSTEMS

The most common way of disposing of the effluent from a septic tank is by some sort of an absorption system. A line of drain tile laid in the upper 2 feet of the ground is the best possible arrangement. The soil contains the type of bacteria needed to finish the process started in the tank. These nitrifying bacteria are most numerous near the surface and decrease in numbers with depth.

Amount of Tile Needed

The number of tile to use depends on the amount of sewage, the type of soil, the exposure, and the cover. Light or sandy soils absorb liquids more rapidly than heavy ones. South or windward facing slopes dry out faster than others. A field in crops uses more water than a fallow one. In general, however, from 25 to 50 feet of absorption tile for each person using the system is about right (fig. 1.) If the amount of land is limited, as it might be under suburban conditions, a hole or dry well at the end of the absorption tile may be helpful.

If the soil is unusually tight, an under-drained filter bed may be necessary. The trench for the disposal tile is made about 2 feet deeper than would otherwise be necessary, and drain tile are laid at the bottom and covered with crushed rock or coarse cinders up to the level of the disposal tile. The under drain should be open to the air at one end so that the filter bed will have some ventilation.

The slope of the drain tile will depend to some extent on the nature of the soil, the lighter the soil the steeper the slope. Under ordinary conditions 1 foot in 100 is about right. Figure 2 shows how to establish this slope.

SIPHONS AND SIPHON CHAMBERS

When sewage is emptied continuously onto or into the soil, there is danger of ponding or saturating the soil. Whenever this happens, the action of the nitrifying bacteria is retarded. Discharging the sewage into the tile line or lines at intervals avoids this difficulty. Although there are a number of ways of doing this, the automatic siphon is undoubtedly the best.

If a siphon is used, it must be placed in a chamber of its own which may or may not be attached to the septic tank. The construction of a siphon chamber attached to a septic tank is shown in figure 3.

The depth of the siphon chamber will be governed by the siphon used, but it is usually less than 2 feet. The length and width should be such that the capacity is about half the daily flow of sewage. Under these conditions the absorption field will be dosed about twice a day with digestion and aeration periods alternating.

Siphons may be made or bought. If time is worth anything, the commercial siphon is usually cheaper.

DRY WELLS

A dry well or disposal well is the alternative to an absorption field. Sometimes an absorption system is not feasible. The lot may be too small, the soil may be too tight, or trees or shrubs may interfere. In such cases the dry well must serve.

This dry well may be round or square and should, if possible, be deep enough to reach sand or gravel. Square wells are usually curbed with plank and round ones with brick laid without mortar. Directions for building both types of wells are given in figure 5. The plank curbing will rot eventually but should give 15 to 20 years of service.

The useful life of a dry well will depend on the condition of the liquid entering it. If the liquefied sewage carries much suspended matter, the dry well

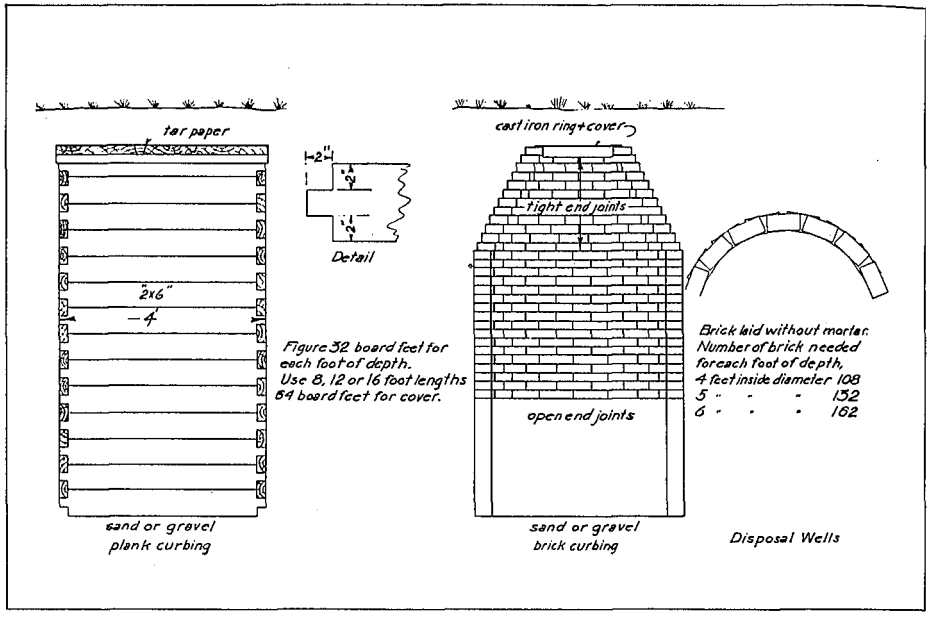

Fig. 5. Disposal Wells. Wells Must Be Curbed To Be Satisfactory. Square Wells Are Best Curbed with Plank, While Round Wells Require Brick, Building Tile, or Stone.

will clog in a year or two or even less. In those locations where the ground water is high, dry wells are an impossibility.

CONCLUSION

The foregoing brief discussion of septic tanks and sewage disposal is intended to be general rather than specific. Conditions vary to such an extent that no one plan could possibly serve all Minnesota. A disposal system suitable for the southeastern part of the state might be entirely useless in the Red River valley. In some places frost goes down 7 or 8 feet and in others hardly at all. In certain parts the groundwater is so near the surface that an outlet for a disposal system is impossible. Sand and gravel for concrete are not always available. Summer cottages and some farms are not occupied during the winter, and a septic tank has to be used all the time.

In some cases the slope from house to tank is so steep that the sewage will enter the tank at a high velocity thoroughly stirring up the contents. When this happens, the absorption field or dry well will not last long. Occasionally a field drain or drainage ditch may serve as a means of final disposal. Streams and lakes, with permission of the State Board of Health, are sometimes used.

Danger of Polluting Water

The danger of polluting the water supply from the sewage disposal system is always present. When the well

is deep and cased to the surface, there is little danger. Shallow dug, driven, and bored wells are another matter. Groundwater is nearly always moving and the surface slope, if any, is no sure indication of the direction. No one can tell definitely which way nor how far sewage will travel underground from a dry well or disposal field. It is better to be safe than sorry. Fifty feet is usually enough but 100 feet is better.

Protect Against Frost

The danger from frost is ever present. North facing slopes and the ground under walks and driveways usually give the most trouble. Sewers and drains 5 feet deep are reasonably safe. Disposal tile lines 18 inches deep seldom freeze if they are dosed intermittently. The temperature in a working septic tank probably never gets below 50 degrees. Sewage at this or higher temperatures, if flooded in tile lines, will actually raise the ground temperature. If the liquid trickles out as it would if a siphon were not used, it will get colder and colder as it moves along and finally freeze. If necessity requires shallow sewers or if exposure conditions are unusually bad, straw or manure or even branches over the tank or sewer will help to retain snow which is a very good insulator.

Tanks Must Be Cleaned

Contrary to the belief of some people, septic tanks have to be cleaned occasionally. Whenever the sludge accumulates to the point where the working volume of the tank is materially reduced, it should be pumped out.

Construction Hints

OFTEN details give us the most trouble in making the things we need. Since a few pointers often eliminate most of the trouble, here are a few on building a septic tank.

Lay the sewer before building the tank. Make the tank fit the sewer, and not the sewer fit the tank. Be sure the tank outlet is about an inch lower than the inlet.

In digging the hole for your tank, keep the dirt back from the hole to avoid caving in.

The thickness of the walls and bottom of the tank is not important. If they are too thick, however, too much concrete will be needed; if they are too thin, the concrete will be hard to place. Make the walls about 6 inches thick, the bottom about 2 inches.

Pour the walls first, and pour the bottom after removing the forms. Keep the concrete level around the forms—do not pour it all in one place. The cover slabs can be made on any flat surface at any convenient time.

Make the top of slabs because less form work is necessary. The wider the tank, the thicker the slabs should be. If the tank is not over 2 feet wide, a slab 4 inches thick will do. Reinforcing rods near bottom of the slab are good insurance.

If you use bank gravel, a concrete of 1 to 6 is suitable for the walls and the bottom, and 1 to 4 for the cover slabs. Small stones, 4 to 5 inches across, may be used in the walls. They should be clean and bedded in the concrete. Do not pour concrete over the stones.

If concrete is too wet, the cement will be lost through the cracks of the form; if it is too dry, the concrete will be hard to place. Use about 5 gallons of water to a sack of cement. Damp sand or gravel will reduce amount of water needed.

Forms will be easier to remove if their corners are bevelled or rounded. Do not use more nails than necessary and brace the forms securely.

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