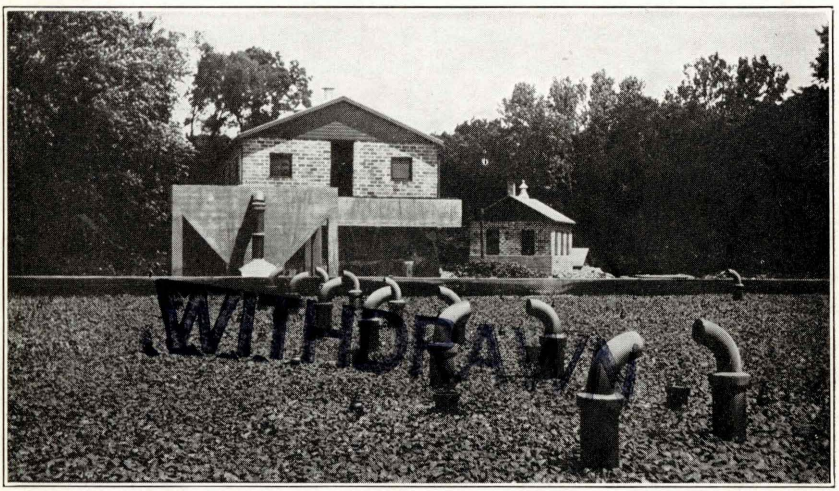
IOWA STATE COLLEGE
OF AGRICULTURE AND MECHANIC ARTS
OFFICIAL PUBLICATION

Vol. XXIII DECEMBER 31, 1924 No. 31

THE SMALL SEWAGE-TREATMENT PLANT

By EARLE L. WATERMAN

Presented at the Sixth Conference on Sewage Treatment
at Ames, Iowa, October 28, 29 and 30, 1924



Bulletin 68

ENGINEERING EXTENSION DEPARTMENT
IOWA STATE COLLEGE
AMES, IOWA

Published weekly by Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa. Entered as Second-class matter and accepted for mailing at the special rate of postage provided for in Section 429, P. L. & R., Act of August 24, 1912, authorized April 12, 1920.

CONFERENCES on sewage treatment are held annually at Iowa State College, under the auspices of the Engineering Extension Department. These meetings are of a practical nature and are arranged for municipal officials and all others directly or indirectly responsible for the operation of sewage-treatment plants.

This publication is one of the more general papers which were presented at the 1924 conference. Several others from this meeting are to be published. In addition to the more formal papers, considerable time on the program was devoted to the consideration of sewage-treatment plant construction and operation, as well as to the individual problems of those in attendance.

THE SMALL SEWAGE-TREATMENT PLANT

By Earle L. Waterman

Associate Professor of Sanitary Engineering,
State University of Iowa

Sewage-treatment plants which serve large cities have full-time operators who are trained in this special work. They have, moreover, laboratories from which valuable information is obtained concerning the manner in which the various units of the plant are operating. Records are carefully kept of the laboratory tests, the volume of sewage that the plant handles, the amount of sludge drawn from the tanks, together with the operating costs. The whole scheme of operating is conducted as a business. Certain raw products are received which, after passing through the different parts of the factory, finally come out as a finished product. This product must conform to certain definite standards, else the public which uses the product will very soon make its disapproval known to the factory owners.

An Industrial Analogy

The manufacturers of a certain popular automobile now advertise the fact that they own the mines from which their iron and coal are obtained, the transportation lines which bring these materials to their own mills where the steel used in building the motor cars is manufactured, and the huge power stations which furnish power for the operation of the factory in which the steel and iron are made into parts of the car and finally assembled into the finished product. The whole process is conducted along most efficient lines. At every point in the long route from mine to automobile every precaution is taken to provide the workers with the most efficient tools and to secure for them the most satisfactory working conditions. This particular company was a pioneer in demonstrating the fact that the most economical and efficient product could only be manufactured in a plant where the laborers were given every possible help that could be furnished.

It may seem a long way from an automobile factory to a sewage-treatment plant, and yet on second thought there are points of similarity. The sewage which originates wherever man lives and works is the raw material. It is carried by the transportation lines, which we call "sewers," to the factory—the sewage-treatment plant. The laborers are the bacteria, some doing one job, others another. The finished products turned out by this factory are inoffensive solid matter and a liquid which is incapable of causing a nuisance or of endangering public health. The sewage-treatment plant operator is the factory manager, and the success of the factory is very largely dependent upon his ability to plan the work

and to provide the best possible working conditions for his laborers. He must also keep the product up to an established standard. The same problems of variation in the quality of raw materials, of labor turnover, of strikes and the rise and fall of the market into which the factory products go, are his to solve. Truly the successful operation of a sewage-treatment plant is an important business.

Attention Needed by Small Plants

Every large sewage-treatment plant is operated as a business and on business lines—but how about the small plants which many of you gentlemen are operating? In far too many instances these small plants are considered to be perpetual-motion affairs which once started run on forever without let or hindrance; and great is the consternation when the factory fails to do what it was intended to accomplish. Until the factory owners and the factory managers realize that no sewage-treatment plant is an automatic machine, we shall continue to have sad failures at our small treatment plants.

Many of the small plants in Iowa do not require the full time of one man each to keep them in proper operating condition. This is one reason why most of them receive little or no attention, for it is not as easy to perform our occasional duties as it is to attend to those matters which are a part of our every-day tasks. However, if the small-plant operator will consider himself as a factory manager and will give his factory the careful if not continuous attention that any business should have, he will find that it is much easier to obtain satisfactory results.

System in Operation

Just as system is a first essential in a successful factory, so it is in the operation of a sewage-treatment plant. The operator must first learn just what each unit of his plant is to do and what must be done to keep it in successful operation. This information should be given to him by the engineer who designed the plant.

One of the best examples of this phase of the engineer's work is the very complete set of operating instructions which was given to the operator of the sewage-treatment plant at the State Hospital at Woodward, Iowa. This plant consists of an Imhoff tank, dosing chamber and sand filters. An isometric drawing (Fig. 1) was made which shows clearly the different parts of the Imhoff tank. This drawing, together with three typewritten instruction sheets, was posted at the plant. Forms were also provided for recording the operating details of the Imhoff tank and the filters. Such information, together with verbal instructions, outlines the policy of such a factory and provides for a record of the results obtained.

Operation Records

Actual records of plant operation are just as important for a small plant as for a large one. They enable the operator to build

up a history of what the plant has accomplished under varying conditions, and make it possible for him to operate the plant more intelligently. Intelligent operation is usually efficient operation. The records required at the small plant mentioned above were the daily records of the volume of sewage flow, the weekly records of the

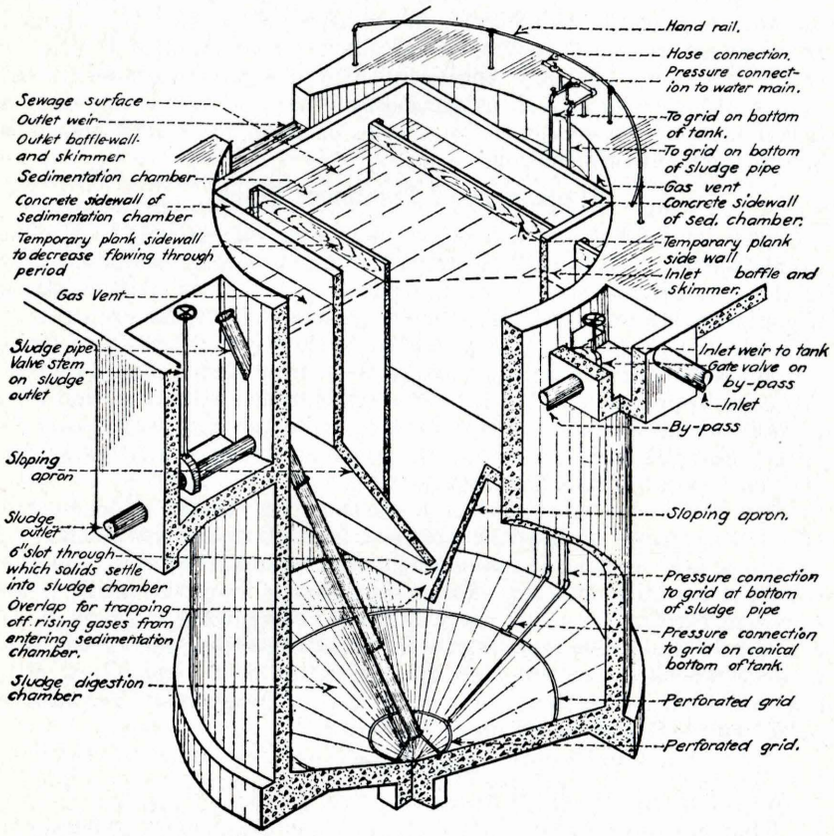


Fig. 1—Isometric drawing of Imhoff tank at the State Hospital, Woodward, Iowa.

depth of sludge in the sludge compartment of the Imhoff tank, the result of the weekly test of the sedimentation attained in the tank, and the methylene-blue test of the stability of the effluent from the filters. In addition to these definite daily and weekly records, other pertinent facts, such as weather, temperature, drawing of sludge, removal of sludge from the drying bed, raking of filter surface, and scraping of filter surface should be recorded under the appropriate

date. The careful keeping of such records will result in improved plant operation.

Many operators of small sewage-treatment plants are not as fortunate as the operator at the Woodward plant, for they are in the position of the man who has to learn to operate an automobile without having an instructor to teach him or an instruction book to guide him. In such a case the first thing to do is to get all the information possible concerning the plant. This information may be obtained from engineers in the service of the State Department of Health or from competent sanitary engineers who design sewage-treatment plants. Conferences, such as are held annually at Ames, provide an excellent opportunity for the operators of small treatment plants to acquire helpful information.

Appearance of Treatment Plant

There is another phase of the operation of sewage-treatment plants which deserves more attention than it usually receives. This is the general appearance of the plant. Does your plant look as though someone was interested in it, or does it have the appearance of neglected property? Are you glad to show your factory to visitors, or is the place avoided because it is dirty and generally unnviting in appearance? If the factory is shunned almost as much as a house which has a smallpox placard on it, how can you expect to obtain the public interest and the support which is necessary for efficient operation and maintenance?

Very little care is needed to keep the plant clean. Some extra effort is required to keep the grass trimmed, to provide walks, to set out a few trees and shrubs and possibly some flowers. Yet the results are well worth the effort. The sludge from the tanks is an excellent fertilizer, and its use will make the growing of grass, flowers, shrubs and trees very easy. If the sewage-treatment plant is a place which is interesting and attractive, more of your fellow citizens will visit it and share your pride in it. The result will be better public support and better plant operation.

Summary

To summarize briefly, it has been pointed out:

1. That a sewage-treatment plant is a factory whose owners are the public which it serves, and whose manager is the plant operator.
2. That this type of factory must be run as a business and on business principles if it is to be successful.
3. That the manager must understand his plant.
4. That records of the plant's operation are essential to successful results.
5. That the physical surroundings of the plant must be kept clean and attractive if it is to have the approval and support of its owners and to be a source of pride to its manager.

Appendix

Operating Schedule for the Sewage-Treatment Plant at the State Hospital, Woodward, Iowa

DAILY

1. Visit the plant.
2. Give every part of the plant careful inspection.
3. Record the amount of sewage flow.
4. Fill out the report blank for the day.

WEEKLY

1. Take samples of raw sewage and of tank effluent in the Imhoff conical glasses, and find the per cent removal of solids after 2 hours settling. It should average 95 per cent.
2. Break up the scum in the gas vents with the hose.
3. Measure and record the depth of sludge in the sludge chamber.
4. Clean the inflow channels and the inlet and outlet weirs.
5. Skim the sedimentation chamber.
6. Squegee the side walls, aprons and slot. (This may have to be done more, or less, frequently.)
7. Take a sample of the filter effluent for the methylene blue test for relative stability. When kept at a temperature of 68° F., the blue color should be retained for at least 10 days.
8. Operate all valves.
9. Turn water through the sludge grids for one minute.
10. Fill out the report blank to date.

NEVER

1. Never fill the tank with sewage when empty. Use water.
2. Never unnecessarily agitate the contents of the sedimentation chamber.
3. Never by-pass sewage either at the inlet or from the siphon chamber without recording the reason, date and duration, and notifying the State Board of Health within 24 hours.
4. Never run out large amounts of sludge at a time; better, small amounts every two to six weeks.
5. Never withdraw all the ripened sludge. Some should be left to seed the tank.
6. Never fill the sludge bed to a depth of more than 18 inches.
7. Never allow the sludge in the sludge chamber to rise closer to the slot than 2 feet.
8. Never stir the surface of the sand filters to a depth greater than ½ inch.
9. Never allow the filter beds to stand flooded.

10. Never by-pass sewage directly to the underdrains by digging holes through the sand.

11. Never allow weeds and grass to clog the surface of the filters.

12. Never add new sand which has not been approved by the State Board of health.

ALWAYS

1. Always recollect that the business of this plant is to transform the organic matter in the sewage so that the final filter effluent will be clear and non-putrescible.

2. Always keep in mind that only about 1/3 of the total organic matter settles out in the Imhoff tank.

3. Always remember that the remaining 2/3 must be oxidized by bacterial action in the filter beds into harmless mineral compounds.

4. Always back-fill the sludge pipe with water, and flush out the pipe running to the sludge bed, after withdrawing sludge.

5. Always clean the surface of the sludge bed before applying a new dose, and add more top sand if necessary.

6. Always make sure that there is enough room in the sludge chamber for the winter sludge.

7. Always note the distribution of sewage over the filters, and if uneven, correct it by re-leveling the beds or re-baffling the distributors.

8. Always keep the filter surface open by raking or harrowing to a depth not greater than ½ inch. When this fails to prevent ponding, remove the upper ⅛ inch of sand and surface mat. Not more than 1 inch of sand should be removed in one year.

9. Always give the beds a thorough over-hauling in the late fall just before freezing weather. Pile up the dirty sand in small piles 6 to 8 in. high and 3 to 6 ft. apart. These piles will help support the ice.

10. Always watch for warm days in winter, when the surface of the filters may be put into good condition.

THE COLLEGE

The Iowa State College of Agriculture and Mechanic Arts conducts work along five major lines:

AGRICULTURE

ENGINEERING

HOME ECONOMICS

INDUSTRIAL SCIENCE

VETERINARY MEDICINE

The Graduate College conducts advanced research and instruction in all these five lines.

Four, five and six-year collegiate courses are offered in different divisions of the College. Non-collegiate courses are offered in agriculture, home economics and trades and industries. Summer sessions include graduate, collegiate and non-collegiate work. Short courses are offered in the winter.

Extension courses are conducted at various points throughout the state.

Research work is conducted in the Agricultural and Engineering Experiment Stations and in the Veterinary Research Laboratory.

Special announcements of the different branches of the work are supplied, free of charge, on application. The general bulletins will be sent on request.

Address, The Registrar,

IOWA STATE COLLEGE,

Ames, Iowa