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A SYSTEM

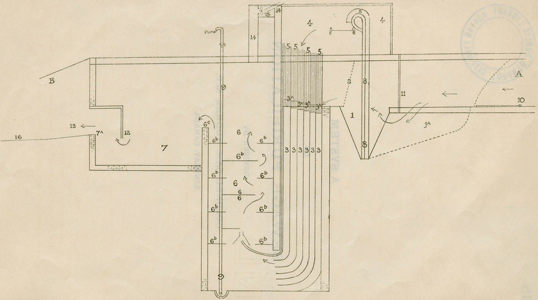
OF

SEWAGE PURIFICATION

DEVISED BY

COLONEL SAM. HUGHES, M.P.

LINDSAY, CANADA



Pump
A
B
1
1A
2
3 3 3 3 3 3
3A
4
4
5 5 5 5
6
6
6b
6c
7
7A
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A SYSTEM OF SEWAGE PURIFICATION

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This system of **sewage purification** operates as follows:—Let any convenient place on the **trunk sewer** be taken where a fall of four to five feet in the sewage above the lake or escape level may be obtained.

A to B is a section of the **main sewer** about one hundred feet in length.

1 is a **pit,** deflecting to one side and below the bottom of the sewer, to collect the heavier particles and to facilitate their removal.

1A is a **deepening** in the sewer, approaching the pit, to allow the sewage to pass under the guard wall (11).

2 is a heavy close-meshed **screen** on the exit side of the pit.

3 is a series of **conduit pipes,** descending at various levels from the line of sewer bottom, with **entrances** (3A) arranged in steps higher and higher, to meet varying conditions in the sewage flow. These pipes should be from three to four inches square. They descend to any depth, opening below on a curve into the **ascending passage** (6).

4 is a **Chlorine or Gas Chamber,** situated above these conduit pipes and above the sewer. Into this chamber the chlorine is blown from the manufacturing chamber, and from it the distribution takes place.

5 is a series of small **Gas Pipes** descending from the Chlorine or Gas Chamber (4), firmly cemented into the floor thereof and freely entering at each corner, and also in the centre, if necessary, of the conduit. These gas pipes project a short distance—say six or seven inches—into the conduit openings.

6 is an **Ascending Passage,** screened specially to give the liquid a devious course upward. At the lowest **Screen** is an **Exhaust Device** connected with a gas pipe direct from the Chlorine Chamber. This Ascending passage terminates at 6C, three to four feet below the level of the top of the lowest conduit pipe. This ascending passage broadens out and becomes considerably wider than the sewer towards the top (6C).

6B are the **Screening Devices** designed to give tortuous course to the ascending matter.

6C is the **Top of the Outer Wall** of the Ascending Passage.

7 is a **Tank**—as broad as the upper part of the Ascending Passage—from which the purified sewage passes to the lake. In a place like Toronto this tank could be practically dispensed with by deepening the conduit passage. In case the lake level were high the tank would be used as a pumping reservoir. This is not necessary in Toronto, as gravity will do the work.

8 is a **Pit Bucket Pump** to raise the solids and coarser materials from the Pit (1) into the Chlorine Chamber (4), where they are deposited on an **Endless Conveyer** (8A), which (A) allows the liquid to drain off to the conduit pipes, and (B) conveys the solids after purification to a dump box or pipe beyond the gas chamber, as **fertilizer.** This apparatus is so arranged as to prevent escape of gas to the open air. These **Conveyers** are used only as occasion demands and are operated by one power.

8A is the **Endless Conveyer** in the Chlorine Chamber referred to above.

9 is an **Ascending Passage Bucket Pump** for raising sediment.

10 is a **Shut-Off** or **Guard Door** on the approaching side of the Pit, opening down towards the Pit.

An **Emergency Outlet** in the side of the sewer before reaching the gate; a **Man-hole** into the Pit beside the sewer, and another in advance of the guard wall for removing any floating obstructions; as well as vents for the disposal of sewer gas either by burning or by mixing with chlorine or otherwise before escaping to the open air or to passages accessible to persons, may also be provided. The **Emergency Outlet** would be a **Switch-off**, re-entering the sewer below the Tank (7).

11 is an **Entrance Guard Wall,** with bottom below the level of the bottom of the sewer. This is designed to prevent needless escape of Chlorine and to assist in more perfect exhaust from the Gas Chamber.

12 is an **Exit Guard Wall** with bottom below the level of the purified sewage surface in the Tank (7). The object is to facilitate the blowing back of the unabsorbed Chlorine. if there be any, from the space above 6 and 7.

13 is the **Exit to the Sewer,** leading to the lake. At this point the **Switch-off,** if utilized, would re-enter the sewer.

14 is a **Gas Passage** from above the Ascending Chamber (6) to the chamber where the chlorine is made, so valved as to prevent return passage of gas.

15 is a **Blower** to draw the unused Chlorine from the ascending chamber space.

16 is the Lake Level.

All conduits, pipes, etc., coming in contact with chlorine must be porcelain, glass, vitrified brick, or similar non-destructible material.

IN OPERATION

The **Sewage** flows into and across the **Pit,** the solids falling to the bottom and being disposed of by the **Bucket Pump** (8). The liquids pass the screen and flow into the **Conduit Pipes** (3). The descending liquids cause a vacuum in each small **Gas Pipe** (5), which draws the **Chlorine** down with the liquids. Entering the **Ascending Chamber** (6) the liquid is further commingled with the fresh jet of Chlorine; while the **Screening Device** (6B) assists in the thorough mixing of gas and sewage. If the **Tank** (7) were sufficiently large to hold the liquids for even a few minutes, the effect would be beneficial and would require less Chlorine. But by descending deeper with **Conduit Pipes** (3) and drawing back through the **Gas Passage** (14) any unabsorbed Chlorine more economic and equally efficient results are obtained. The **Purified Sewage** flows from the **Tank** to the **Lake.**

The Chief Claims for favorable consideration of this process are:—

(a) The perfect, economical, effective and automatic mixing of the gas and the sewage.

(b) Chlorine, the gas, the most powerful purifying agent known, is used. Experiments have been made with bleaching powder, chloride of lime, and, while the results were satisfactory, the cost was, owing to the lime and labor, higher and the maintenance greater than with Chlorine. **Chlorine** is produced much more cheaply; it gives no trouble; and the efficiency of the gas is much greater than **Chloride.** The Chlorine works automatically; not so the chloride.

(c) The **By-Products** are valuable and materially reduce the cost of production.

1. **Caustic Soda** is an important by-product from the manufacture of chlorine.
2. From the purified sewage solid matter, considerable value in **Fertilizers** may be obtained.
3. The treated sewage, containing chlorine, would gradually **purify the marshes and foul spots** of Toronto and Ashbridge's Bays.
4. Danger from **ptomaine poisoning** from polluted fish taken in these waters, would be eliminated. **Scientists have frequently recommended the use of Chloride of Lime near oyster and fishing beds in sewage laden waters.**

(d) The area required for the entire plant is small. The whole system would take up only about one hundred feet along the sewer, while a lot fifty feet wide would be ample for the gas producer.

(e) The cost of installation, maintenance and attention is a minimum. **Working automatically** the system would require the attention of only one man. Its complete installation for Toronto would cost a mere trifle.

(f) Instead of citizens objecting to locating the purifying station near them, it would be welcomed, as guaranteeing pure water along the shore in the immediate locality.

(g) **It would destroy everything objectionable in the sewage.**

A **Plan** of the process is included herewith.

Extracts from Report by Professor Dr. F. B. Allan, of the Chemical Laboratory of the University of Toronto, to Colonel Hughes, show that almost perfect results have been obtained from **Chloride of Lime**; and that much better results would be had by the use of **Chlorine.** The gas is readily absorbed by the sewage. Its effect is much greater and its cost much less than the Chloride.

"Sewage has been treated with chlorine in Bengal, several places in Germany and in Ohio. In these places the chlorine has been used in the form of bleaching powder. The effect of chlorine in sewage has been specially studied by Rideal, an English observer, and at the Sanitary Research Laboratory of the Massachusetts Institute of Technology.

Rideal found great reduction in bacteria when he used 20 to 30 parts chlorine per million parts of raw sewage, or 25 to 45 parts chlorine per million for sewage from septic tanks, and 0·5 to 20 parts chlorine per million for sewage from filter beds.

The work of the Sanitary Research Laboratory of the Massachusetts Institute of Technology shows that 5 parts chlorine in one million parts sewage which had been filtered, if left in contact for two hours, removed 99·96 % of the total bacteria and practically all of those remaining were harmless. They found that 99·993 % of Bacilli Coli were removed and conclude that such a treatment will practically eliminate all typhoid organisms present.

It is estimated that the cost of treating sewage with chlorine (in the form of bleaching powder) at the rate of 5 parts to a million parts sewage would be $1.05 per million gals. of sewage.

The experimenters at the Sanitary Research Laboratory also say that chlorine gas would be better than bleaching powder because it would not add lime to the water and would also be cheaper. They estimate that the cost of electrolytically produced chlorine for 5 parts per million would be 83 cents per million gallons of sewage, and this calculation makes no allowance for the caustic soda produced as a by-product in the operation.

It is obvious that water containing only 5 parts chlorine per million would be unobjectionable when discharged into any body of water, and indeed this method of sewage treatment has been specially recommended for cities situated near oyster beds."

Should an experiment be desirable take an ordinary pipe, say four inches in diameter and thirty feet long. Connect at the base by a curve or semi-circle with another pipe, eight inches in diameter, ascending to within four feet of the top of the first one. Over these place a chlorine chamber. From the chlorine chamber let five or six one-inch pipes descend into the four-inch pipe a distance of, say, six inches. A hopper around the four-inch pipe top to hold a full head of sewage would be necessary. The gas is simple to make. Let the chamber be kept filled with chlorine ; and pump the sewage into the hopper. Then analyse the result.

Experiment would determine just how small an amount of chlorine is needed in a large sewage system.

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