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A NEW WASTE DISPOSAL SYSTEM

BY

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TRANSLATED BY

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PREFACE

Any system of waste disposal that might reduce the cost of plumbing installations or the quantity of water required for the water-carriage of wastes is of primary interest to those who are concerned with the economic and safe removal of domestic wastes.

The Division of Building Research is interested in this subject because of its association with the National Building Code and its studies of problems associated with housing in the North.

The Division of Building Research records its thanks to Mr. H.A.G. Nathan of the Translations Section of the National Research Council Library for translating this paper.

Ottawa
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N.B. Hutcheon,
Assistant Director

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A NEW WASTE DISPOSAL SYSTEM

When underground sewerage systems were first built and the waste water was discharged into watercourses it was generally believed that an ideal solution to the sewerage problem had been found. Since the sewage was diluted considerably, nobody seemed to be concerned about the serious effects which the pollution of watercourses might have. But matters are different today. Waste water is fed into watercourses in ever-increasing quantities and an end to this situation does not seem to be in sight. The areas which are linked with more or less extensive sewerage systems (including those not in the vicinity of watercourses) are constantly growing and the waste water is usually discharged into a watercourse. The present "water pollution problem" is well known and need not be discussed in detail here.

In the absence of better methods, water has been retained as the means of discharging sewage. Water closets require the supply of large quantities of water solely for the purpose of discharging relatively small quantities of waste in solid form.

Recently the daily press devoted a great deal of attention to a system designed by civil engineer Joel Liljendahl, in which air in the form of a vacuum is used as the means of discharging the waste. Since the problem may be of interest to the readers of VVS, a report on this new sewerage system is given below.

Liljendahl began by reasoning that the purification of the waste water might be simplified, by treating the feces and urine, as far as possible, in concentrated form instead of diluting them to a great extent as in the case of water closets. Therefore, he took up the idea of having separate sewers for the toilet systems and for the other waste water from the bath, wash basin and laundry, designated in what follows as the BDT water.

Toilet Systems

Externally, the toilet resembles an ordinary toilet bowl and at the bottom it contains a quantity of water left over from the previous flushing just as does the water trap of the water-closet bowl (Fig. 2). But here the resemblance to the water-closet system ends.

The discharge pipe from the bowl is connected with a vacuum system, where the low pressure is generated either by mechanical pumps or by special vacuum producers designed by Liljendahl.

There is a vacuum in the entire system up to the "water trap". The latter is separated from the sewer by an outlet valve, which is regulated by a vacuum-controlled mechanism in the back portion of the bowl. The mechanism regulates the opening and closing of the valve as well as the supply of flushing water. In order to avoid misunderstanding, it must be pointed out here that the flushing water does not have any actual discharging function, but is intended for rinsing the inside of the bowl and for serving as a lubricant for the sewers. It also forms a stopper. The discharge pipe from the toilet bowl has considerably smaller dimensions than the sewers in use hitherto, i.e., the conventional 100 mm. cast-iron sewer has been replaced by 30 and 32 mm. plastic hose. The sewer runs from the bowl to a collector, which in turn is connected with a vacuum tank (Fig. 3).

The flushing is released in the usual way by raising a handle, starting the following series of actions. Water is flushed from the shutter nozzle underneath the seat in order to rinse the bowl from the inside, the outlet valve opens and since there is a vacuum in the sewer all the time, the feces are sucked first into the sewer and then into the collector. During the time the outlet valve is open the flushing is suspended. Finally the outlet valve closes and water is again flushed until the water trap is filled. Water is thus available when the toilet is used again. Approximately 1/2 litre of water is required for each flushing. The collector is drained during the shock-like action. As the result of this the bowl is flushed and the pipes are kept clean. The quantity of feces + urine is estimated to be 1.5 litre per person per day which thus gives a total of 5 litre per person per day*, i.e., approximately 10 percent of the quantity of water required for the bowl of a water closet. At certain points the plastic hose is provided with pockets which collect the waste water to form stoppers. This formation of stoppers is required for the vacuum discharge. Since it is not gravity but the vacuum which causes the discharge, the sewers need not be inclined downward but may be laid horizontally or even upwardly.

The collected waste water is to be treated in a similar way.

The toilet bowl is ventilated through an opening connected to the vacuum side of the sewer. This ventilation is operated by a simple contact device, which is actuated when the seat is pressed down (Fig. 4).

The BDT Water

It is a known fact that from the standpoint of disease propagation the discharge from toilets is considerably more dangerous than the waste water from the bath, wash basin and laundry (i.e., the BDT water). Therefore, Liljendahl begins with the supposition that the BDT water may as a rule be led directly to the receiver without special treatment. However, he points out that each individual case must be judged on its merits and that the installation of a sewer system of the type in question must be preceded by a receiver test.

It is pointed out that with respect to both the biochemical oxygen demand and the content of the nutrients nitrogen and phosphorus the BDT water does not represent higher values than highly purified waste water. A receiver which can admit such waste water should also be able to admit the untreated BDT water.

Fundamentally the sewer system is laid out in a way similar to that described above, but by an ingenious design the water is

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* Translator's note: According to a communication received from the author, the total is based on the assumption that the WC is used by each person three or four times every 24 hours.

discharged into the sewers here through the vacuum which the water itself produces by its potential energy.

Rain Water and Industrial Waste Water

Rain water has the characteristic that it can be led directly into a ditch or receiver. This can be done either by a conventional method or by the method described here.

In industry, waste water containing poisonous or otherwise harmful matter frequently accumulates. By means of the vacuum system the various types of waste water may be led to plants for treatment in a simple and smooth way.

Sewerage Within a Residential Area

It is thought that sewerage based on the vacuum principle may be used for a separate building or an entire residential area. In the latter case the systems may be grouped together, whereupon the various groups are combined to form one treatment plant. Since the operation of the system requires the presence of a vacuum of a certain size, a sufficiently large leak, for example, may put the entire system out of order. Therefore, a smaller section (e.g. a sewer main, where the leak is located) is shut off automatically. Within the region shut off the toilet bowls then cannot operate, since the existence of a vacuum is essential for the operation of the bowl. To some extent the sewerage systems described above are found in finished constructions, but certain details have not yet been attended to.

An installation for toilet sewer with an ascent of approximately 15 m. has been in operation in a one-family house for three years and operates satisfactorily despite the ascent. Even 500 m. of piping laid in hilly ground showed faultless drainage capacity (Fig. 5).

Prospects

The new sewerage system is intended to provide a smooth but effective solution to the problem of purifying the waste water. Designs preferred hitherto aimed at reducing the waste water to a form that would render purification superfluous and at solving the discharge problem satisfactorily from the point of view of hygiene and economy. The purification problem itself is under constant study, but it is not intended to discuss the details here. However, the improved system for indoor discharging of waste water may already be considered as promising. Comparison with the conventional sewerage system and water closet would be interesting.

A pipe pressure of 0.4 - 0.6 kgm./sq.cm. is found to be sufficiently large to impart high speed to the discharge while flushing and also in the sewer. This in turn will have the result that the pipes are kept clean and the risk of blocker pipes seems to be considerably smaller here than in conventional pipes. Sanitary napkins which are flushed down into the water closet and which adhere to the pipes are a common cause of blocked sewers. Repeated tests (even in pipes of 500 m. length) have shown that sanitary napkins pass the vacuum pipes without difficulty.

A minor leak in a water conduit to an ordinary sewer causes a leakage of water and an odour in the vicinity. An average leak in the vacuum sewer produces suction from outside to inside. For this reason there is no risk of odour and only a minor risk of leakage. More serious defects call for immediate action in either system. The vacuum sewer is insensitive to the effects of cold and produces quieter flushing than the ordinary sewer.

The fact that the hot BDT water can be separately and rapidly drawn off, without the possibility of being cooled by the cold waste water from the toilet constitutes a favourable condition for the utilization of heat from waste water in the new system.

These are structural advantages which are especially attractive to the builders of sewers. Building designs are evolving in a direction such that it becomes more difficult to conceal the pipes in the joist floor (e.g. thinner joist floors) and at the same time to obtain sufficient slope for the pipes. In the vacuum system the pipes have been replaced by seamless plastic hose of small dimensions which can be laid at varying levels without having to take the slope into account.

Finally, the designer points out that both in operation and installation the vacuum system is cheaper than the conventional sewer with cast-iron pipes and parts.

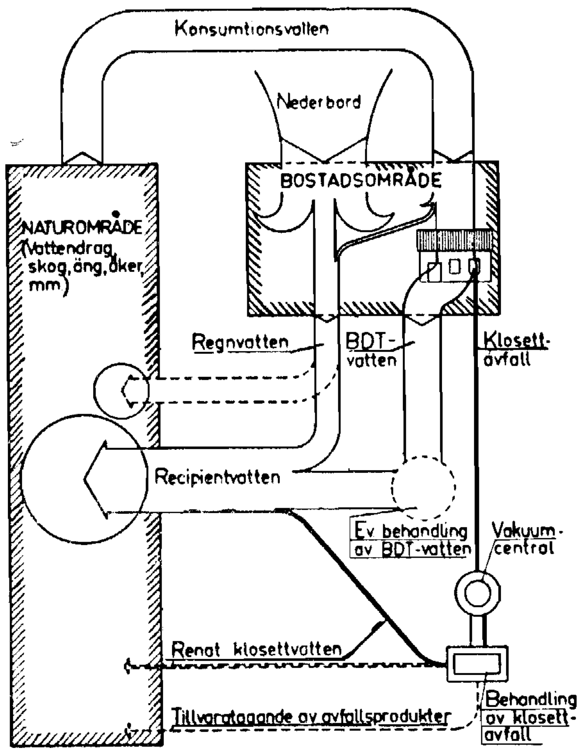

Fig. 1

Skeleton drawing showing the new sewerage system for a residential area. The closet waste is separately discharged and purified while the BDT water (after receiver test) is directly led to the receiver

Naturområde (Vattendrag, skog, äng åker mm.) = Natural grounds (watercourse, woodland, meadow, pasture land, etc.).

Konsumtionsvatten = water for use

Nederbörd = precipitation

Bostadsområde = residential area

Regnvatten = rain water

BDT vatten = BDT water

Klosettavfall = toilet waste

Recipientvatten = water to receiver

Ev. behandling av BDT vatten = possible treatment of BDT water

Vakuum central = vacuum producer

Tilvaratagande av avfallsprodukter = collection of waste products

Behandling av klosettavfall = treatment of toilet waste

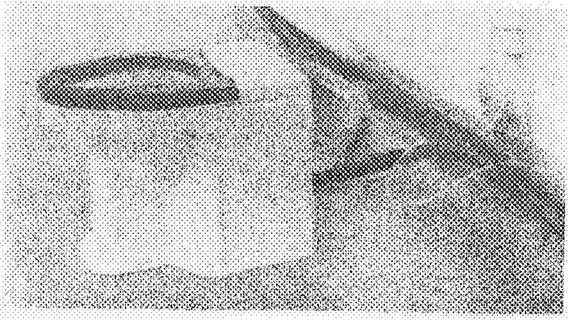

Fig. 2

The waste from the closet bowl is discharged through the more heavy-gauged plastic hose to the collector (seen in Fig. 3). From the left runs a sewer showing a transparent pocket of plastic pipe. In this pocket the waste is collected to stoppers

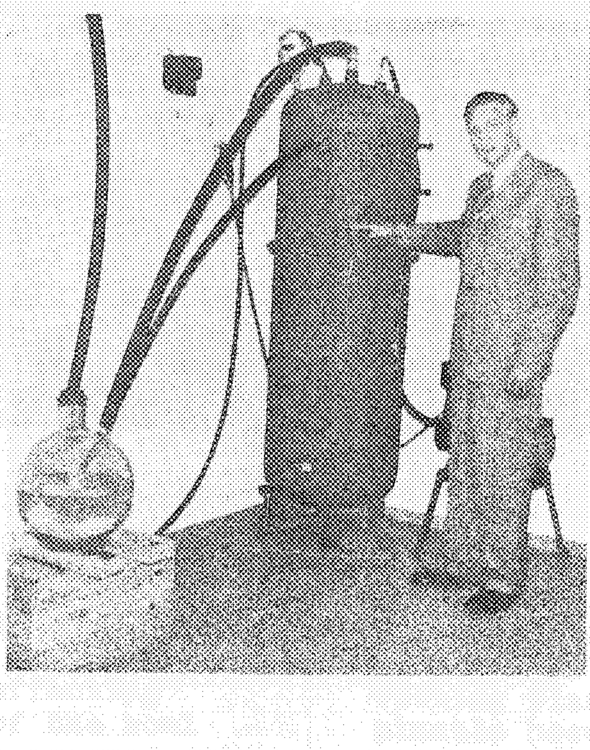

Fig. 3

Vacuum device for creating the required vacuum in the sewer. The waste water runs through the vertical pipe to the left and is collected in the transparent collector

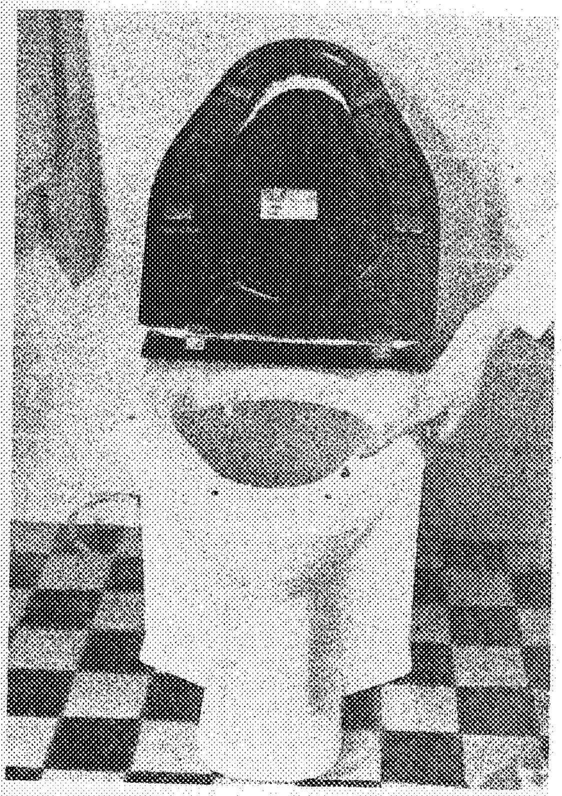

Fig. 4

Contact device effecting the evacuation of the bowl when the seat is pressed down

Fig. 5

Testing plant with 1500 ft. plastic hose. The pockets required for stopper formation are shown as transparent portions