

P. A. OLUWANDE

development of the aqua- privy for urban sanitation

INTRODUCTION

The majority of the hot countries are also developing countries. The term 'developing countries' is often used euphemistically to describe all those countries which are not developed. While the environmental problems confronting the developed countries are those resulting from developments, those facing the developing countries are those due to lack of developments. These are characterised by poverty, ignorance, limited availability of technical know-how and inadequate research. Table 1 illustrates how poor certain developing countries are (Szego, 1973).

Table 1 Poverty in the Developing Countries (1972)
Compared with Certain Developed Countries.

Countries	Per capita GNP (US \$)	Population (1972) millions	Birth rates per 1000 of population	Annual population growth rates per cent	Infant death rates per 1000 live births
Namibia	40	0.7	44	2	-
Malawi	55	4.7	49	2.5	182
Nigeria	75	58	50	2.6	148
Guinea	100	4.1	47	2.3	216
India	110	584.8	42	2.5	139
U.K.	1890	56.6	16.2	0.5	18.4
Sweden	2920	8.2	13.7	0.4	11.7
Kuwait	3320	0.8	43	8.2	39.0
U.S.A.	4240	209.2	17.3	1.0	19.2

In addition to these defects, many developing countries often get their priorities in the wrong order, with the result that prestigious projects which are 'eye catching' and 'vote winning' are often embarked upon in place of simple schemes which will benefit the majority of the people. The old popular saying that 'there is no vote in sewage' is still very appropriate in the developing countries, with the result that up to 90% of the diseases which doctors see in hospitals and clinics are due to poor, inadequate or absence of sanitary conditions.

The sanitary conditions of many developing countries may be visualised by considering the situations in Nigeria, a very urbanised country with a population of about 70 million. In 1975 there is not a single town or city with a central sewage system though we have all types of modern sewage treatment plants serving institutions, housing estates and army barracks. Table 2 gives the housing conditions in eight major cities in Nigeria (Federal Office of Statistics, 1973). An observation of column 6 shows that even in main cities and towns, the majority of the people do not have a water carriage toilet system. In smaller towns and rural areas where more than 80% of the entire population live, the flush toilet is almost totally absent.

Table 2

1	2	3	4	5	6	7
Cities	Population	% of household occupying one room	Average no. of persons per room	% of houses with tap water	% of houses with flush toilets	% of houses with electricity
Lagos	850 000	72.5	3.8	71.7	43.5	93.2
Porthacourt	230 000	51.5	2.4	75	18.6	81.4
Benin	130 000	48.0	2.2	24.9	14.0	59.3
Warri	70 000	59.9	2.6	62.4	10.9	89.7
Kaduna	190 000	63.9	2.1	40.3	14.1	53.3
Kano	380 000	69.1	2.4	26.1	1.8	69.1
Ilorin	270 000	23.9	1.6	30.7	10.3	56.1
Ibadan	800 000	47.3	2.1	33.4	25.2	56.1

This paper therefore discusses the great potentials which the aqua-privy system has for the provision of safe sewage disposal in the developing countries. A very simplified approach to its construction at the village level will also be discussed.

2. COMMON SEWAGE DISPOSAL METHODS IN THE DEVELOPING COUNTRIES

In many developing countries, the methods of excreta disposal which the majority of the people use are

- (a) deposition on surface of ground in surrounding bush
- (b) bucket latrine
- (c) the pit latrine.

As already indicated in table 2, only a very small percentage of the people use flush toilets which employ the septic tank system. Unfortunately, the aqua-privy system, which is a convenient intermediate system between the pit latrine system on one hand and the septic tank

system on the other, is almost unknown. In Nigeria, the aqua-privy has just been introduced in Ibadan for public toilets and in comfort stations. It is not yet being used in private toilets.

The health hazards of depositing excreta on the surface of the ground in the bush and open field around the houses are grave indeed. The spread of diseases like typhoid, cholera, shigella and amoebic dysenteries is enhanced. Many publications have been written to show this (Moore et al, 1965; Schliessmann, 1959; Kourany and Vasquez, 1969; and Cvjetanovic, 1971). These diseases are still causing epidemics in many developing countries. Other worm diseases like ascariasis, hookworm, trichuris and Schistosomiasis are also very common in communities where faeces is disposed of in an insanitary manner (Sanders and Watford, 1974; Schliessmann et al, 1958). The bucket latrine is very cheap to start but it involves many operational problems. Improved forms of it reported by Pradt (1971) and CPHERI (1969) can be adopted when the system has to be employed for faeces disposal.

Though the pit latrine is the simplest and cheapest method which can be made sanitary, the vast majority of the people in the developing countries do not like it. It is impossible to operate it without smell and flies, although it is possible to keep odour and fly breeding to a minimum by good construction and correct maintenance (Oluwande, 1969). The septic tank system which the people often use when they feel too sophisticated for the pit latrine is more expensive than the aqua-privy to construct and maintain. It requires that water must be available to flush faeces into the septic tank, and to avoid blocking, toilet paper must be used for anal cleaning. These two conditions are often very difficult to satisfy by many families in the developing countries.

3. THE AQUA-PRIVY

As illustrated in figure 1, the aqua-privy is an intermediate method between the pit latrine on one hand and the flush toilet system of the septic tank on the other. Among its advantages over the pit latrine are:

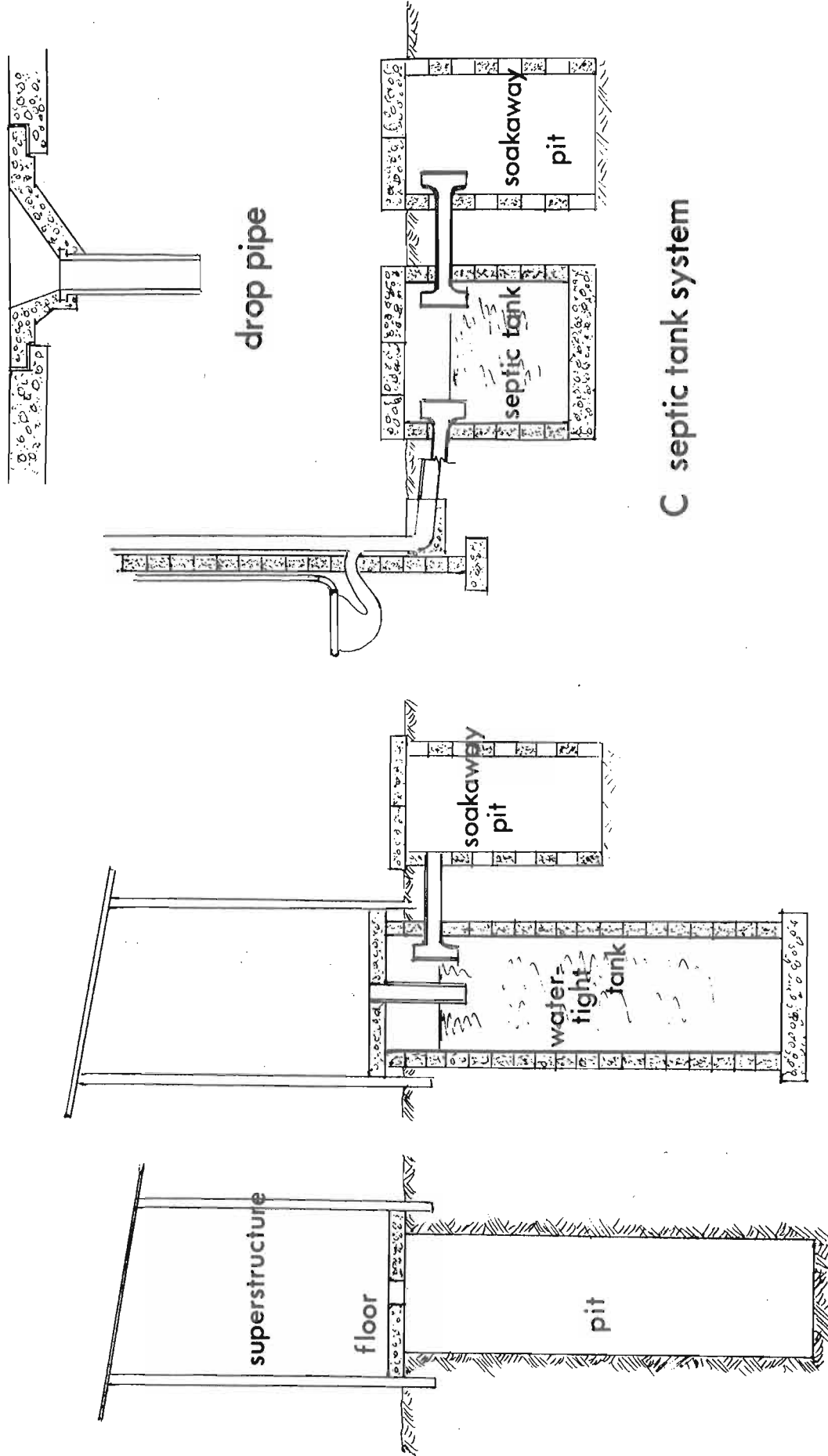
- (a) It operates odour-free as long as the tip of the inlet pipe is inside water
- (b) It operates fly-free as long as the inside of the inlet pipe is maintained clean

Its main advantages over the septic tank system are:

- (a) It does not require water to carry faeces into the tanks, so houses in communities without piped water supply as well as those in communities with piped water supply but who cannot afford private water connections, can employ it.
- (b) It can withstand rough use because it cannot be easily blocked. Therefore, families which find it difficult to buy toilet paper may use materials like pieces of wood, newspaper and cobs of maize for anal cleaning. The only danger is that these types of materials will make the tank full prematurely.
- (c) It is cheaper and simpler to construct and maintain than the septic tank.

Table 3 gives the costs of providing the three systems in the Ibarapa division of Western State of Nigeria in March 1973. The cost of the pit latrine and aqua-privy could be much smaller if the family is prepared to use self labour and local material for the super-structure.

Figure 1: PIT LATRINE, AQUA-PRIVY AND SEPTIC TANK SYSTEMS COMPARED



A the pit latrine B the aqua privy

C septic tank system

Table 3 Costs of Pit Latrine, Aqua-privy and Septic Tank Systems

Items	Pit latrine	Aqua-privy	Septic tank
	N	N	N
1. Labour for digging	16	30	30
2. Cement	2	30	30
3. Gravel	2	6	6
4. Sand	1	8	8
5. Bricklayers labour	4	18	24
6. Pipe fittings	-	6	35
7. Water closet flush tank and seat	-	-	42
8. Plumbers labour	-	-	15
9. Super-structure	20.50	20.50	20.50
Total	45.50	118.50	210.50

Note: N1 = 1.5 U.S. dollars

4. CONSTRUCTION OF AQUA PRIVY

Much has been done and written about the aqua-privy - its construction, and maintenance. Wagner and Lanoix (1958) discussed its different aspects in some detail including dimensions of its components. Marais (1973), Vincent et al (1961), McDonald (1952), Maclaren International Ltd (1970) and McGarry (1975) discussed various aspects of its construction and maintenance including how other domestic wastewater may be discharged into it to ensure that the free end of the inlet drop pipe is constantly beneath the water level. They also discussed how the aqua-privy tanks can be made to form a primary treatment unit in a central sewage system of a community. Sewers which convey effluent from such aqua-privies can have very gentle gradients since the bulk of settleable solids will settle in the aqua-privy tanks. Such sewers will therefore be cheap to construct.

One very important aspect of the aqua-privy construction which has not been discussed much in the literature is how to incorporate simply the inlet drop pipe into the floor slab. The devices suggested in many publications involve the use of moulds which are very difficult to construct (see figure 1D). This aspect differentiates construction of aqua-privy from that of a simple pit latrine and that of a septic tank system. Three simple approaches have been employed by the author for casting the floor slab for the aqua-privy (Oluwande, 1974). These are:

- (a) the trench method
- (b) the hole method
- (c) the raised platform method.

Only the trench method will be described briefly in this paper. There are four steps involved in this trench method:

- (i) A trench about 150 mm deeper than the length of the inlet pipe and 750 mm wide is dug. The length of the trench will depend on the number of slabs to be cast at a time.
- (ii) Planks about 25 mm thick and 300 mm wide are cut into pieces one metre long. Four such pieces will be required for a floor slab 900 mm long by 900 mm wide. The pieces are placed side by

side on the trench and a circular hole 200 mm diameter is cut through the two pieces in the middle to accommodate the inlet pipe.

- (iii) A piece 675 mm long is cut from a 150 mm diameter pipe. An asbestos cement pipe is preferable because it can be easily cut. Four holes with diameters big enough for 100 mm long nails are made equally spaced on the circumference of the pipe. The centre line of the four holes must be about 25 mm from the end of the pipe. Nails 100 mm long are passed through the holes with their big ends inside the pipe.
- (iv) The platform planks are arranged over the trench and sheets of newspaper or cement bags are laid over them. The portion of paper over the middle hole is removed. The free end of the prepared piece of pipe is passed through the central hole until the pipe is supported on the platform by the nails. The steel reinforcing rods for the floor slabs are arranged so that they pass under the nails. A special wooden cover is made for the hole of the pipe. The main mould for the slab is placed in position and 1:2:4 concrete mix is used to cast the slab.

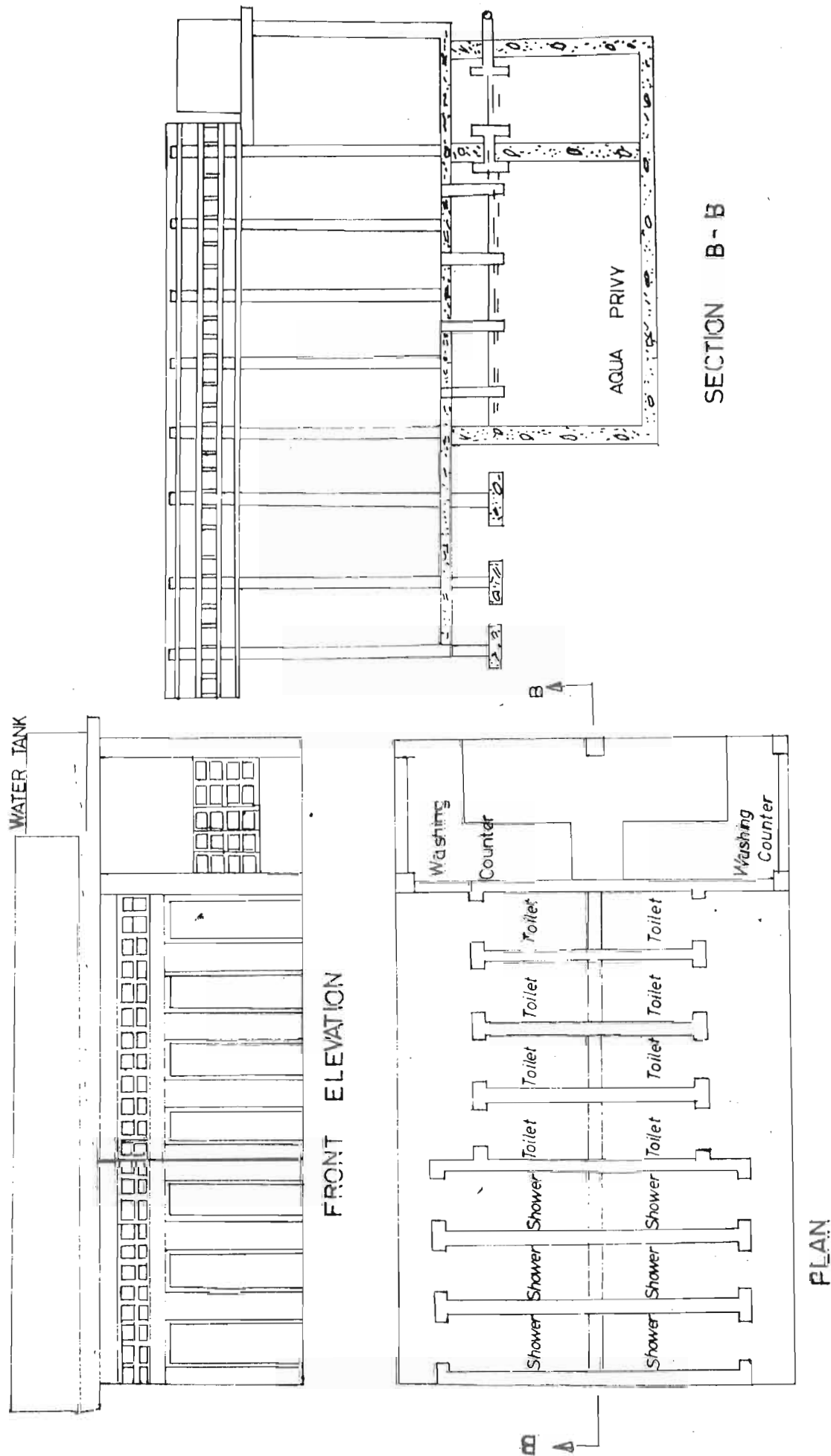
Another aspect of the aqua-privy construction is the provision of an aqua-privy system with the tank above the ground level. This will enable people in areas with a high groundwater level and other riverain areas to construct the aqua-privy tanks cheaply and simply. Any watertight container may be used as the tank for the aqua-privy system. As discussed previously, a large proportion of money used for the construction of an aqua-privy system is spent on construction of the aqua-privy tank. Huge savings can be made in construction cost if materials like wood, membrane bags filled with sand (ITDG, 1969) and other locally produced materials which are very cheap are used for producing the watertight tanks.

5. AQUA-PRIVY AND COMFORT STATIONS

The comfort station as introduced to Ibadan in Western State of Nigeria is a communal convenience owned by a compound of many houses and consisting of latrine, shower and clothes washing apartments. The comfort station was designed to solve sewage disposal problems of houses in core areas of the city where houses are so closely built without any order that there is no space for individual toilet facilities. It is also impossible to provide sewers. The general plan of the comfort stations in Ibadan is given in figure 2. The size of each station depends on the population of the compound which the station serves. The number of toilet compartments is determined by allowing one compartment for 15 people, the shower compartments are decided by allowing 20 people for one, while the size of the clothes washing space is fixed by allowing 25 people per unit. For ease of maintenance, each household is allocated a toilet and a shower compartment.

The comfort stations built so far in Ibadan have been provided through aided self-help. The families provided land and part of the labour, while the World Health Organization provided materials and the Government provided technical supervision. Each comfort station similar to that shown in figure 2 cost about ₦5200 or \$7800. The annual maintenance cost including cost of water, electricity, salary of a maintenance attendant and other miscellaneous charges is ₦708 or \$1062. Up to date ten comfort stations have been built and 24 others are under construction.

Figure 2: LAY-OUT OF THE COMFORT STATION



6. OPERATIONAL OBSERVATIONS

The performance of the comfort stations is being monitored under a special programme financed by the World Health Organization. Observations so far highlight certain important operational difficulties which are vital for the success of the system as a method to be adopted in built up areas of the cities of developing countries. Some of these observations are:

a. Effects of 'Dual Living Pattern'

The majority of the people using the comfort stations have houses in Ibadan and in villages near their farms. They live long periods in the village houses while they only come to the houses in Ibadan for special occasions like big traditional and religious feasts. During these short periods they stay in Ibadan, they mess up the comfort stations.

b. Inability of the People to Pay Water and Electricity Bills

The comfort stations make water readily available to the people who used to obtain water from more distant public taps. This increases the daily water consumption rate of the people considerably. Since water for the stations is metered, there is a perennial problem of the people being unable to pay for water and electricity used. Electricity to the stations is being disconnected and only the generosity of the State Water Corporation prevents disconnection of the water supply to the stations.

c. Inability of the People to Employ Competent Attendants

When the comfort stations were designed, it was intended that there would be a paid attendant in charge of each station to carry out routine maintenance and repairs. Absence of these attendants makes the stations poorly maintained.

When the research on the operation of the comfort stations is concluded much will be known about this method of providing safe sewage disposal in built up areas. At the moment the effluent from the stations, which is similar to septic tank effluent, goes either to rivers or soak-away pits. It is intended that when central sewage treatment plants are built for Ibadan, the effluent from the stations will be discharged into the central sewers.

7. CONCLUSIONS

The aqua-privy has great potentials for cheap safe sewage disposal in the developing countries. Efforts should be made to introduce it since at the moment many countries that can benefit from it do not seem to know about it. Its construction can be considerably simplified and its cost can be drastically reduced by using local materials.

ACKNOWLEDGEMENT. The opportunity offered by Ibadan Waste Disposal Board to visit the comfort stations and to collect all the information required is greatly appreciated. The author also thanks Ibadan University and Loughborough University of Technology for the opportunity offered to attend this Conference.

REFERENCES

- CENTRAL PUBLIC HEALTH ENGINEERING RESEARCH INSTITUTE (1969),
Annual Report, Nagpur, India.
- CVJETANOVIC, B.(1971), Sanitation versus vaccination in cholera
control in strategy of cholera control. WHO paper BD/Cholera/
71.5, Geneva.
- FEDERAL OFFICE OF STATISTICS (1973) Ministry of Economic Planning and
Reconstruction, Lagos.
- INTERMEDIATE TECHNOLOGY DEVELOPMENT GROUP (1969), Introduction of
catchment tanks and micro-irrigation to Botswana, I.T.D.G.: London.
- KOURANY, M. and VASQUEZ, M. (1969) Amer.J. Trop. Med. and Hyg.
Vol 18, no 6 pp936 - 941.
- MACLAREN INTERNATIONAL LIMITED (1970) Immediate measure report for
master plans for waste disposal and drainage in Ibadan.
- MARAIS, G.V.R. (1973) Design criteria for community wastewater
collection system for developing countries. WHO CWSS/WP/73.6
- MCDONALD, D.J.S. (1952) Small sewage disposal systems, 1st ed.
Harrison and Grosfield Ltd: London.
- McGARRY, M. (1975) Developing countries sanitation. A report
prepared for IDRC, Canada.
- MOORE, H.A., De la CRUZ, E. & VARGAS-MENDEZ, O. (1965)
Amer.J. Epidemiology vol.82 no 2 pp 162 - 184
- OLUWANDE, P.A. (1969) Experimental investigations into factors which
affect the strength and cost of pit latrine concrete floor slab.
J. Soc. Hlth., Nigeria vol 4, no 4 pp 137 - 147.
- OLUWANDE, P.A. (1974) Cheap sewage disposal in developing countries
(In Press) Ibadan University Press.
- PRADT, L.A. (1971) Water Research, vol 5, no 8.
- SAUNDERS, R.J. & WATFORD, J.J. (1974) Public utilities report no RES 2.
International Bank for Reconstruction and Development, International
Development Association Research Working Paper Series March 15th.
- SCHLIESSMANN, D.J. (1959) Diarrhoeal disease and the environment.
Bull. WHO. vol 21 pp 381-386.
- SCHLIESSMANN, D.J. et al (1958) Public Hlth Monograph 54, U.S. Dept of
Public Health and Welfare.
- SZEGO, G.C. (1973) Energy key to development. A paper presented at
3rd World Congress of Engineers & Architects in Israel, Tel Aviv,
December 17-21 1973.
- VINCENT, J.L., ALGIE, W.E. & MARAIS, G.V.R. (1961) A system of sanitation
for low cost high density housing (CCTA Publication 84) Niamey 1961.
- WAGNER, E.G. & LANOIX, J.N. (1958) Excreta disposal for rural areas and
small communities. WHO, Geneva.