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LOW COST INDIVIDUAL SANITATION IN DEVELOPING COUNTRIES: METHODOLOGY FOR THE TESTING OF DOUBLE VAULT COMPOSTING LATRINES IN IVORY COAST

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INTRODUCTION

Up to the present, the only design presented to developing countries regarding sanitation has been that used in industrialized countries, i.e., centralized network sewage systems. Although this classic main drainage system has been used without difficulty in the centres of large cities in developing countries, it is totally unsuitable with respect to the drainage of peripheral areas. The context of application is radically different, in particular, the speed of urbanization, the financial and technical capacity, cultural patterns and social habits, and the availability of water. The last factor is a particularly important point in rural areas (Fig. 1). It is not possible to envisage the use of water to handle excreta at the rate of an average of four 8-10 litre flushes per person per day.

Fig. 1. Supplying potable water

Several alternatives are possible between the basic latrine pit and sewers. These can be outlined under about ten headings, and are either dry or use water, and use or do not use transport, e.g., latrines with ventilated pits, double compost pits, watertight cesspools which can be emptied, septic tanks. The technical range is varied, as are prices, running from a factor of 1 to 20 per annum for a family installation. Septic tanks, an alternative used by 50% of the population of France, are situated in the upper part of the price scale when they are up to standard.

There is no standard answer in the search for a solution to the problems encountered. However, there are various methodological procedures, one of the most pertinent of which is that proposed by the World Bank in 1982.

With this in mind, 12 installations were experimented with in various suburban areas of Abidjan (Republic of the Ivory Coast) and in rural sites (see Fig. 2), taking into consideration the water resources, the relief, and ethnic groups and their cultural habits.

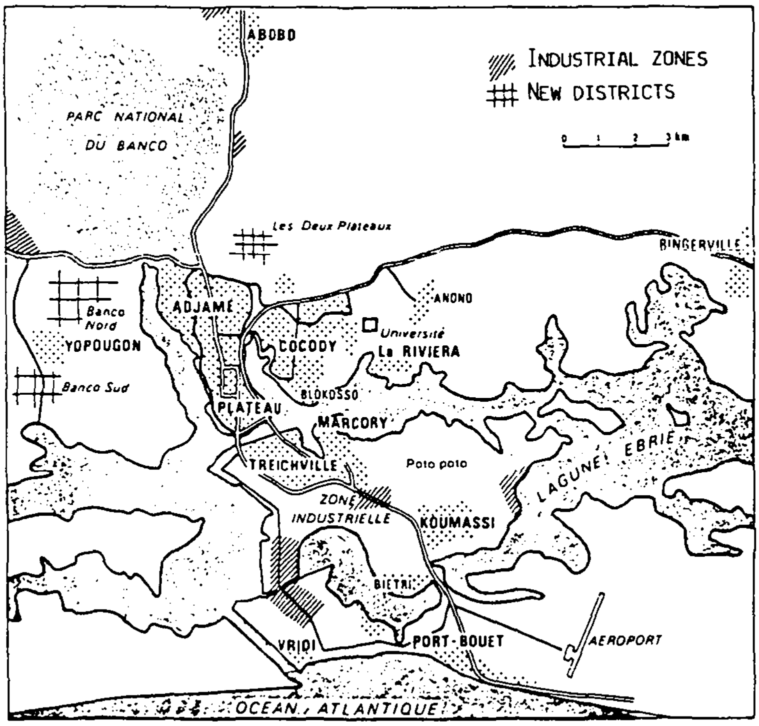

Fig. 2. Abidjan around Ebrie Lagoon (the destination of sewage from Abidjan)

CURRENT SANITATION OF THE AREA

Abidjan (Ivory Coast) has 1,650,000 inhabitants, of whom 800,000 use installations connected to the municipal sewerage system, with a potable water consumption of 70 to 500 litres per head per day. 450,000 have independent sanitation (watertight cesspits which can be emptied, septic tanks, etc.) with available potable water of 20 litres per head per day. 400,000 have no sanitation, and potable water consumption from 2 to less than 20 litres per head per day.

METHODOLOGY

Experimental Sites (Figs 3, 4 and 5)

There were six urban sites, consisting of: two with a closet and 2 pits of 2.25 to 2.75 m^3, and four with 2 closets over 2 lateral pits (2.25 to 2.75 m^3)

and a double capacity central pit. The pits were designed on the basis of 0.3 litres of soil per person per day for 25 users for one year.

There were six sites in rural schools, with 6 closets and 7 pits on the same basis as above, but for 200 pupils per year.

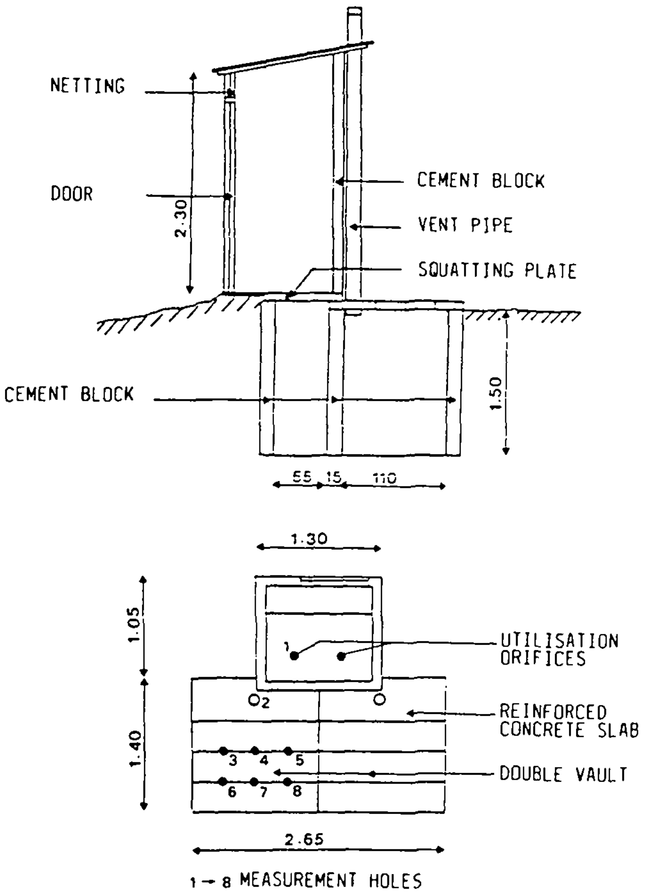

Fig. 3. Example of experimental site: single latrine

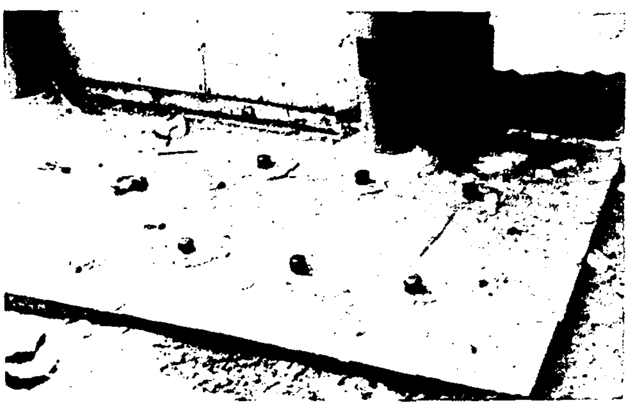

Fig. 4

Fig. 5

In Situ Measurements

The following in situ measurements were made:

- rate of filling, determined using a gauge at 6 holes in the slab and the utilization and ventilation apertures (Fig. 6);
- temperature, measured with a thermocouple fixed to the end of a metal rod 2 m long;
- pH, measured using a field pH meter at two points: utilization and ventilation apertures.

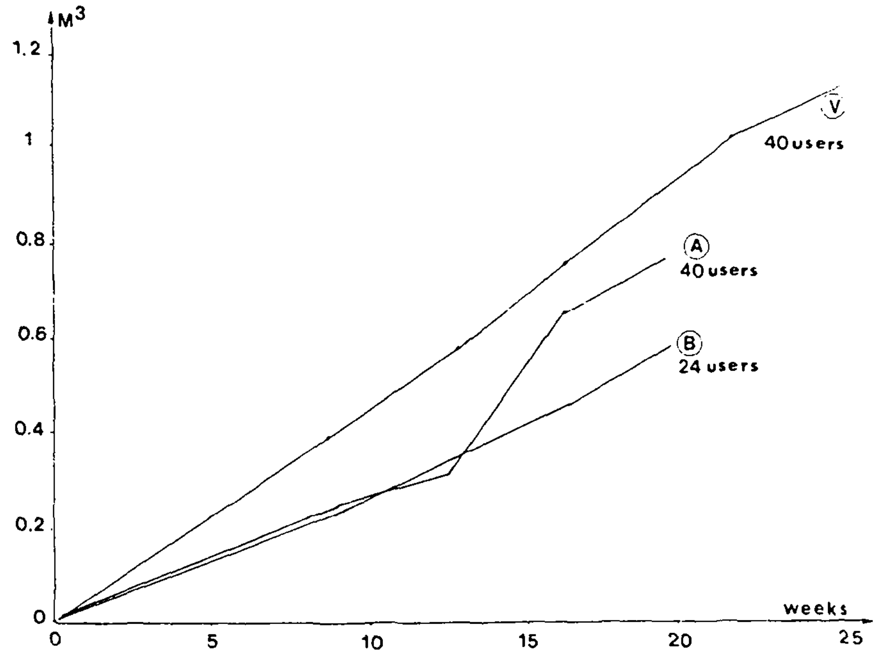

Fig. 6. Cumulative volume of night soil as a function of time

Laboratory Measurements

The following laboratory measurements were made (Table 1):

- water content, by oven drying at 105°C;
- mineral substances, from residue after heating to a temperature of 525°C;
- organic matter, from residue after drying at 105°C minus residue after heating to a temperature of 525°C;
- nitrogenous compounds: NTK, NO_2^-, NO_3^-, NH_4^+.

TABLE 1 Double Vault Composting Latrines During Filling: Chemical Monitoring in g per 100 g of Fresh Matter

Time, weeks	Night soil volume, m^3	Filling, %	Water content	Organic matter	Mineral substances	NTK-N	NH_4^+-N	NO_3^--N
13th	0.58	20	90.3	7.8	1.9	0.63	0.36	0.023
18th	0.87	30	92.6	5.7	1.8	0.67	0.39	0.013
25th	1.12	39	89.6	9.4	1.1	0.57	0.38	0.023

CONCLUSIONS

The design and social impact of this type of low cost individual sanitation unit have already been the subject of numerous reports. However, there are no data in the literature on the physico-chemical evolution of these installations which would make possible suitable sizing and optimal operating conditions to lead rapidly to compost with the least possible risk to health.

The methodology that we propose for the monitoring of the biological reactor formed by the dry composting tank appears acceptable at the present stage of experimental work (7 months) as regards both sampling and analysis.

Nevertheless, the technical approach alone cannot solve the problem of sanitation in high density, low income populations. It is essential to inform users with regard to the satisfactory operation of this type of installation, e.g., no use of water, regular rotation, removal of compost after a certain time, etc. A long term sanitary education programme leading to making the population responsible is a primary factor.