SERGIO R MENDONCA

waste stabilization ponds in Paraiba state, Brazil

INTRODUCTION

Brazil, because of its rapidly increasing population and industrial expansion, is one of the leaders among the developing countries. On the other hand, for its territorial extent, climate, diversity, regional resources and customs, it is a country where the problems reach great proportions.

The Brazilian provision of water supply and sewerage facilities situation by the end of 1960, was not favourable. Data from the Brazilian Institute of Geography and Statistics (IBGE) and the National Housing Bank (BNH) showed a challenging situation (Table 1). This condition should be moved at a reasonable time reaching rates of population served by basic sanitation facilities comparable to those of developed countries.

THE NATIONAL SANITATION PLAN (PLANASA)

In 1971, the Federal Government of Brazil initiated the National Sanitation Plan (PLANASA). This programme was designed to supply treated water to 80% and conventional sewerage facilities to at least 50% of the urban population by 1980. The PLANASA scheme provides finance for specific public health engineering works in accordance with national and regional programmes prepared by the state basic sanitation companies.

An important part of the duty of each state company is to study the water resources of its state and to ensure that all towns within the state should be equally served even though this might mean that the larger towns subsidised the smaller ones.

The money required to implement PLANASA is derived from two sources: loans from the National Housing Bank (BNH) and an investment by the state of 5% of its local taxation revenue (Water and Sewage Fund - FAEs). Normally, 50% of any capital investment would come from BNH and 50% from

FAEs. However, in those states unable to provide their half share, BNH is able to provide additional loans or the Federal Government may make a direct grant.

In order for each Water and Sewage State Company to be able to repay its loan to BNH and to maintain the liquidity of its FAE, it has to make as economic a charge as possible for the services it supplies within the ability of its public to pay. These charges are related to the official minimum salary payable to all workers, as follows:-

- water: 5% of minimum salary;
- sewage: 80 - 100% of water charges.

The basic water charge is for a hygienic minimum of 10 - 20 m^3 per dwelling per month with quantities above this amount charged for at the appropriate rate to the consumption.

TABLE 1

PROVISION OF WATER SUPPLY AND SEWERAGE FACILITIES IN URBAN AREAS IN PARAÍBA-BRAZIL (DATA FROM CAGEPA)

ITEM	PERCENTAGE OF URBAN POPULATION SERVED BY BASIC SANITATION FACILITIES			
WATER SUPPLY	1966 (state data)	1971 (state data)	1977 (state data)	1980 (estimate)
Piped supply to dwelling	47	61	72	88
Well or spring	29	25	19	9
Other	24	14	9	3
SEWERAGE				
Piped network	25	25	41	52
Septic tank	23	29	32	48
Ditch or similar	32	33	18	0
No provision	20	13	9	0
Total population of Paraiba x 10^6	1.6	1.9	2.4	2.7
Urban population x 10^6	0.8	1.0	1.3	1.7
% TOTAL	50	53	57	63

PARAÍBA - BASIC DATA

Paraiba State which covers an area of 56 372 km^2, is one of the most densely populated states in the Northeast, with some 2.5 million inhabitants spread over several physically and economically distinct regions.

The most important economic activity of the region is farming and cattle raising. The state of Paraiba is Brazil's second largest producer of sisal and the second largest grower of cotton in the Northeast. Additionally, Paraiba is the largest producer of pineapple in Brazil and produces sugar cane, tobacco, corn and rice. Its cattle raising activity is well developed due to cultivation of palm fodder.

The major concentration of industrial enterprises is in Campina Grande. Joao Pessoa, the capital, with cement factories, and Rio Tinto, with processing of farm produce plants and textile mills, are also important industrial centres. Sisal, cotton, pineapples and hides are among the principal exportable products.

In Paraiba there are 171 municipalities. Water supply works started five years before PLANASA, and in 1972 the construction of new sewerage facilities was initiated.

Table 1 shows the basic sanitation data in Paraiba State from 1966 to 1977 and the forecast for 1980. Comparing it with Table 2 (basic sanitation in Brazil) we see that this State has achieved higher levels in water supply and sewerage facilities. Its goals for 1980 are even more ambitious.

TABLE 2

PROVISION OF WATER SUPPLY AND SEWERAGE FACILITIES IN URBAN AREAS IN BRAZIL

ITEM	PERCENTAGE OF URBAN POPULATION SERVED BY BASIC SANITATION FACILITIES		
WATER SUPPLY	1960 (census data)	1970 (census data)	1980 (estimate)
Piped supply to dwelling	42	55	80
Well or spring	29	24	20
Other	29	21	0
SEWERAGE			
Piped network	28	30	50
Septic Tank	21	15	50
Ditch or similar	30	41	0
No provision	21	14	0
Total Brazilian Population x 10^6	70	93	120
Urban Population x 10^6	32	53	80
% TOTAL	46	57	67

TABLE 3

TYPES OF PONDS CONSTRUCTED IN PARAIBA-BRAZIL (DATA FROM CAGEPA)

CITY	Type of Treatment	Area (ha)	Cost $ 1000	Date
JOAO PESSOA	Primary Sedimentation Tank	-	-	1976
CAMPINA GRANDE	Aerated Lagoon	2 x 1.95	2 090	Aug/75-Oct/76
SAPE	Facultative Pond	2.6	1 250	Aug/75-Feb/76
PATOS	Aerated Lagoon	2 x 1.5	435	May-Sept/74
SOUZA	Facultative Pond	5.4	736	Apr-Aug/76
CAJAZEIRAS	Facultative Pond	5.4	1 022	May-Sep/76
SANTA RITA	Anaerobic + Facultative	-	482	1978
BAYEUX	Discharges directly in Joao Pessoa Treat	-	-	1977
ITAPORANGA	Facultative Pond	-	353	1974
ALAGOA GRANDE	Facultative Pond	-	780	1977

All the sewage treatment works in Paraiba are for domestic sewage, although water quality standards are being established there for both coastal areas and inland rivers. The major states in Brazil have already established their own standards.

It is very difficult to compare regions in Brazil because of its enormous area. The Northeast of Brazil is a tropical region and its climate is ideal for the use of sewage treatment works such as waste stabilization ponds, aerated lagoons and oxidation ditches. Due to the high ambient temperatures it is possible to minimize both costs and maintenance requirements.

In Brazil there is more than sufficient land available. Therefore, waste stabilization ponds should always be the first method adopted for sewage treatment in hot climates. The principal reasons are: a) low cost; b) extreme simplicity of operation and maintenance; c) superior removal of faecal bacteria and d) protein production in the form of algae, fish, ducks and crops.

Aerated lagoons and oxidation ditches are usually reserved for use in large cities whereas ponds are suitable for all community sizes, from rural and urban towns to the largest of cities.

WATER POLLUTION CONTROL SITUATION AND GOALS

Originally there were only two sewage treatment works in Paraiba. Both Joao Pessoa, the Capital, and Campina Grande, the second most important city in this state had only primary treatment for their sewage works.

The primary treatment for Joao Pessoa, consists only in a primary sedimentation tank divided in two equal parts for domestic sewage decantation. This tank was built near the Sanhaua river and its operation is due to the flux and reflux of the tide. While one is empty the other is full of sewage. The retention time is about six hours. The new design provided two more tanks. The forecast population is up to 1990. Due to the tank shape, it will be possible in the future to increase the efficiency of each tank, at least twice, without modifying its civil construction. It will be supplied by mechanical aeration through the installation of horizontal cage rotors placed across each tank (channel). They will be adapted to oxidation ditches.

The former sewage treatment for Campina Grande was a primary treatment which consisted of screening, grit-chamber, primary sedimentation tank and digestor. It was adapted to be used for research as an experimental station under the supervision of the University of Paraiba. Nowadays, sewage is taken from the new interceptor and metered into the following reactors:-

- 4 independent facultative stabilization ponds;
- 5 ponds connected in series (one anaerobic, two facultative and three maturation ponds);
- 2 anaerobic ponds, each discharging into a facultative pond, with facility for recirculating the facultative pond effluent;
- 1 high rate pond.

These facilities have been in operation since February 1977 and are intended to be expanded to cover aerated lagoons, oxidation ditches, upflow filters (for septic tank effluent), bio-filtration and activated sludge including the ANOX process for nutrient removal.

A new laboratory block has been constructed where sophisticated waste water analysis equipment such as an atomic absorption spectrophotometer, a complete gas chromatograph and a visible and UV light spectrophotometer were installed. Watson-Marlow variable speed peristatic pumps are used to meter the influent into each pond.

The new sewage treatment plant designed for Campina Grande was a system of aerated lagoons, with two cells. In each cell there are 12 aerators. At the present time all of them are out of work and the two cells are working as facultative pond because of the weakness of the sewage.

In order to create adequate conditions for research in the state, many different kinds of ponds were designed. In Brazil there is an acute shortage of local design parameters for certain treatment processes, e.g. waste stabilization ponds. The types of treatment used in the eight biggest cities in Paraiba are listed in Table 3. Types of pond in use are:

- facultative ponds
- aerated lagoons
- 1 anaerobic + 1 facultative + 1 maturation pond.

DISCUSSION

Table 1 shows a tendency of a continuous increase in the urban population in Brazil. In 1978 it comprises over 60% of the total population, and the forecast for 1980 is about 67%. Therefore, at the starting of the national programmes held and sponsored by the National Housing Bank (BNH), all their targets and goals were directed to urban populations.

Last year the first programme for small and rural communities was initiated. By 1980, 80% of the urban and rural population will be supplied with treated water and 50% of them will be served by sewerage facilities.

CONCLUSION

The incidence of water-borne diseases such as typhoid fever, dysentry and other internal disturbances caused by pathogenic micro-organisms, has suddenly dropped after the implement of PLANASA.

Life-expectancy is gradually increasing, ranging from 52 years in the poor regions to 68 years in the more prosperous ones.

Within a few years Brazil is expected to reach a good level of basic sanitation all over its territory.

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