MEGA CITY DHAKA: GROWING WITH SANITATION PROBLEMS

MD. MAFIZUR RAHMAN[1]AND MOHAMMAD JAHANGIR ALAM[2],
[1]Associate Professor and [2]Undergraduate Student,
Department of Civil Engineering
Bangladesh University of Engineering and Technology,
Dhaka, Bangladesh

ABSTRACTS

Present Condition: Among the seven continents Asia is the most densely populated continent and so are their cities. The civilization of Asia is the oldest, which made the cities of Asia least planned. Lacking behind by education, technology, industrialization and economy Asia is suffering much from poverty in comparison with other continents. Moreover population growth rate has accelerated the danger of problems. The demographic mobility towards the cities in search of jobs in Asia is higher. So, day-by-day cities are being loaded with the people. But to keep pace with this, city authorities are not being able to provide basic facilities to the newcomers. The new consumers are sharing the existing facilities that the city dwellers were using. Thus the cities are becoming an unpleasant place to live in, an unwanted field to work with and an undesired area to move about.

The old cities that were built hundreds of years before, when proper technology was not available to create a planned area for the city, are now over crowded with people and so as with the associated problems. Among all the problems, the health hazard is the most alarming one. Public health in the cities is at great risk; the main causes creating this vulnerable situation are the unsafe water supply, improper drainage facilities, improper and inadequate sewerage system and emerging urbanization and industrialization causing the natural environment endangered. This paper will reflect the sanitation and sewerage problems of Dhaka City, taking it as a model of Asian Mega Cities and suggestions for the remedial of those problems from new technological point of view.

Sanitation Scenario of Dhaka: Dhaka, the capital of Bangladesh, is one of the oldest cities of Asia and the youngest in the list of Asian Mega cities. Dhaka is suffering a lot for its large number of population in consideration with its area. According to the study on the sewerage system in north Dhaka by Japan International Co-operation Agency (JICA), currently the municipal sewerage and collection system covers 20% of Dhaka and consisting of a network of 440 km of sewer mains, trunk lines and interceptor ranging in size from 200 to 1360 mm plus 15 sewerage lift stations. Some 70% of the 1339430 recorded households have sanitary latrines (BBS, 1992), some of which are connected to septic tanks in areas served by the sewerage system… of the remaining households 20% have other latrines (pit latrines, etc.), 30% have no latrine facilities at all. The existing sewerage system is filled with inefficient operation and

maintenance techniques. So for a poor country like Bangladesh to solve these much problems by the conventional sewerage system is a hard task. So it is of prime importance to invent or to find a new technology to face the problem.

1. INTRODUCTION

The sewerage system of Dhaka City was established in 1923 by the colonial English government. At that time, only the sewer system, the Narinda Pump Station and a sewage treatment plant using the Imhoff tank method were constructed and up to the 1940's, the sewerage project served only Old Dhaka, namely South Dhaka. The water supply and sewerage Master plan was formulated in 1950's to cope with the population growth in Dhaka City and DWASA was established in 1963 as the exclusive implementing agency for those public works.

The existing sewerage system is concentrated in south Dhaka (Table 1). According to JICA Interim Report, 1988 the DWASA sewer and sewage treatment system served only approximately 15% to 20% of the city population of 4.8 million. Of the remainder, 25% were serviced by on-site septic tanks, 15% by sanitary pit latrines, and 5% by bucket latrines. The remaining 35% to 40%, representing some 1.8 million people, were serviced by unsanitary systems, consisting mainly to kutcha latrines and open defecation, which deposits human wastes directly into the local living environment. But present (2003) situation is worse than that of 1988. Now Dhaka has become a Mega City with population more than 10 million. Sanitation problem has increased by leaps and bounds.

The problems so far encountered are listed bellow:

*In sewerage system

- blockage caused by disposal of solid wastes into the sewers through manholes and unauthorized connections.
- theoretical overloading in the old city area, although the numerous leaks in the system effectively prevents major overflows; and
- lack of finance to repair and extend.

*In solid waste management – lack of finance and insufficient tax collection.

- lack of manpower and infrastructure.
- incomplete and insufficient collection and disposal system; and
- improper design of communal bins.

Table 1 shows the present potential of DWASA.

2. FACTORS CONTRIBUTING TO ACCELERATE THE DEGRADATION OF THE CONDITION

Only one sewage treatment plant: The Pagla sewer treatment plant with a 40 IMGD (2.1 cu.m/day), serves 38,950 connections with a 450 km

network. Whereas the dry season flows total about 75 MLD and wet season flows equal the system capacity of about 120 MLD. Further opportunities for expanding the service within the existing network are very limited. Unless the system is expanded, infiltration rates are reduced, or further connections are limited, the system will become overloaded within the next few years, resulting in the flooding of sewerage throughout the city. Table 2 shows the general outline of Pagla Sewage Treatment Plant.

Table 1: Outline of Existing Sewerage System

Item	Existing Quantity	Locations
Sewer Line	624 km. (531 km.)	(93 km.) of sewer line in Mirpur is Small-Bore sewerage system.
Sewer Pump Station	1 in No.	At Narinda
Sewer Lift Station	19 in Nos.	At Bashabo, Sayedabad, Faridabad, Azimpur, Nawabganj, Hazaribag, Asad Gate, New Market, Tejgaon, Banani, Mohakhali, Mogbazar, P & T, Medical College, Mothertake, Goran, other three locations.
Sewage Treatment Plant	1 in No.	At Pagla

Table 2: General outline of Pagla Sewage Treatment Plant

Item	Description		
Location	Dhaka City, Pagla District		
Site Area	110.5 ha (whole area) 87.7 ha (present site area)		
Ground Level	Present GL = +1.8 to +6.9 Design GL = +6.7to +6.9		
Land Use	East & South- farming, West– railroad and industrial area and North- marsh Sewerage System: Separate System		
Treatment Method	Sewage Treatment = primary sedimentation tank + facultative lagoon Sludge Treatment = sludge lagoon (digestion and drying)		
Receiving Water Body	Buriganga River; H W L = +6.7		
Sewage Effluent Quality	Water Quality Index	Influent (mg / l)	Removal Ratio
	BOD	200	75 %
	SS	200	70 %

Another alarming issue is the rapid increase of slums in size, in population and in numbers. According to one of the surveys conducted by the Urban Research Centre, the number of slums in metropolitan Dhaka is 3007, of which 679 have been set on government and 2328 on private land.

The total area occupied by the slums in Dhaka is about 1038 acres. Some 22900 families are living in these slums, which have added about 3.3 million people to the city's population. Most of these slums are located near or over water bodies. Slum dwellers usually take these water bodies as their waste disposal ground as they have no other options left. So they act as breeding ground for diseases and epidemics.

The existing sewer system is based on gravity flow and consists of laterals, trunk lines, interceptors and lift stations. Due to general flatness of the city the sewer lines have to be laid from a depth of about 2 meters to 8 meters. The sewage flows by gravity to lift stations where it is lifted and flows by gravity to the next lift station until it reaches the treatment facility. The sewage load is 10,40,000 cubic meter/ day whereas the treatment capacity is only 1,20,000 cubic meter/ day. During rainy season inefficient storm water drainage system adds load to the sewer system. The yearly rainfall in Dhaka city varies from 2814 mm (Max) to 1183 mm (Min) considering a 6 years cycle from 1987 to 1992 with an average of 2050 mm (Kazi; 2000). This huge rainfall (230 Million cubic meter/year) threatens the whole sewer system, as the system is old dated which let rainwater to infiltrate and proper drainage facilities for storm water is not available.

The north Dhaka was developed later on especially Uttara (in the early 1980's) on low lands and marshy areas with foreign soil having lower permeability and infiltration capacity. In absence of conventional sewerage system citizens of this area depend on septic tank system. Because of poor soil quality and absence of proper soak peat that is to be designed for septic tank, effluent outlets from most of the septic tanks are exposed to surface drains. Moreover the city authority does not provide any means for disposal of septic tank effluents, which makes the users bound to dispose the effluents near by watercourses. The effluent from the septic tank is only partially treated and still contains high concentration of microorganisms, BOD, phosphorous and nitrogen, which should not be discharged directly into a public watercourse or on land. Further treatment or other means of disposal are required.

3. SOME TECHNOLOGICAL OPTIONS

To solve the sanitation problem of Dhaka city, conventional sewerage system cannot be an optimum option. This is because mainly a poor country like Bangladesh cannot afford a costly conventional sewerage system. Moreover the areas, which depend on septic tank system, will be economically looser as they have already invested much money on constructing septic tanks. So it will be wise to choose such an option, which utilizes the septic tanks as well, for example small bore sewerage system.

For slums if other better options are not possible, proper onsite sanitation facilities should be provided. To save the whole community from health hazards sanitation facilities for slums are equally important. Some

technological options along with their advantages over other options are described here.

3.1 Small Bore Sewerage System

There are three basic elements to a small bore sewerage (here in after SBS) system: * septic tanks * small bore sewer network * treatment plant. The SBS system collects wastewater discharges from all the fixtures in households in a similar fashion to the conventional sewerage system. The basic difference the two systems is the incorporation of septic tanks within the individual premises as part of the SBS system. The wastewater collected in the septic tank is then transported under gravity through a network of reticulation sewers to a treatment plant comprising a series of stabilization lagoons. In the case of an existing septic tank system the sewer installation commences immediately downstream of the existing septic tank, and new developments must install septic tanks to be able to connect to the SBS system.

The SBS system has specific technical advantages over the conventional sewerage system as listed below:

- Sewer sizes can be reduced because each septic tank tends to act as a balancing tank, largely eliminating surge.
- Since the wastewater contains minimum solids, self-cleansing velocities are not necessary and hence sewer grades can be substantially reduced.
- Sewer blockages are minimal as septic tanks retain most of the solids content.
- Volume of excavation is considerable reduced because of smaller sewers and lower grades.
- Solids handling at the secondary treatment site is minimum.
- Rapid construction is possible because of lesser volume of excavation and fewer numbers of manholes to be constructed.

The differences in the initial capital costs between the systems are result of the following factors:

- Reduction in the sewer sizes.
- Reduction in the minimum grades, thereby reducing the volume of excavations.
- Reduction in the number of manholes.
- Reduction in hydraulic and organic loading of wastewater due to the existence of septic tank, thereby reducing the treatment plant area and cost.
- Less costly pumps with minimal solids handling capacity are required.

A reduction in the maintenance costs in the SBS system due to:

- Fewer numbers of manholes.
- Less frequent cleaning of sewers because the possibility of blockage due to solids depositions is minimum.
- No sludge handling is required at the treatment site.

The SBS system holds significant promise economically and can be considered as a viable alternative to the conventional sewerage system for the present condition of northern Dhaka. Application of SBS systems has recently been initiated in low-income housing areas at Mirpur in Dhaka. These schemes collect effluents from medium (length=9 m; width=3 m; depth=2.4 m) to large (length=8.25 m; width=2.75 m; depth=2.45 m) communal septic tanks and discharge them into low-lying areas without treatment. For not maintaining the septic tanks (as there is none responsible for the task of maintenance of a communal septic tank) and for not following the standard guidelines set for SBS systems the project is not performing properly.

3.2 Other Options

For low income planed development areas the simplified sewerage system (shallow sewerage) is particularly suitable for its lower-cost sanitation technology. The system is the outcome of critical review of the justification for conventional sewerage design standards. This review led to sweeping changes in conventional sewer design standards for minimum diameters, minimum slopes, minimum depths and the spacing and location of manholes. Simplified sewerage systems have proven to be substantially cheaper than conventional sewerage system. Cost savings ranging from 20 to 50 % have been reported (Otis et al., in Mara 1996). The initial projects in Brazil have shown a cost reduction of about 40 %.

3.3 Options for Slums

As slums are not permanent settlement, it will not be economical to set permanent sanitation facilities for the squatters at their slums. It is better to build more public toilets and easy access for everybody. New on site sanitation techniques are the other options left, which costs least but provide sufficient safety against health hazard. As most of the slums are over water bodies, floating large watertight plastic containers can be used as septic tanks over which squatting slabs is to be set on bamboo stages (Figure 1).

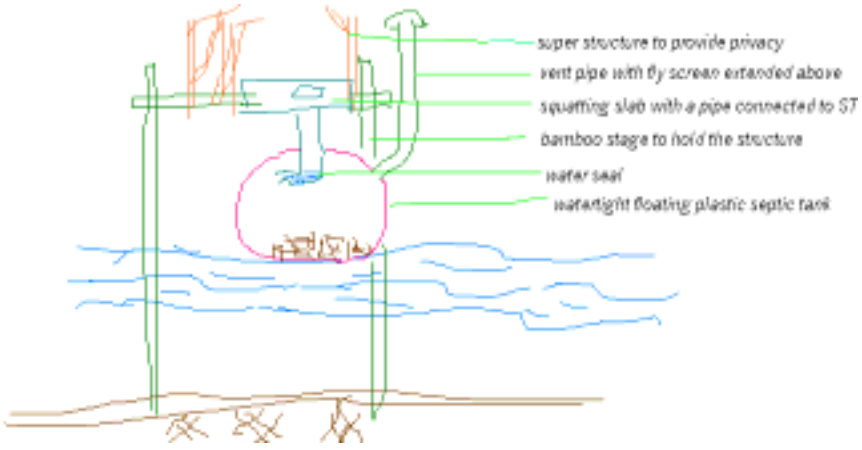

Figure 1: Floating Septic Tank

This sort of sanitation facility is of a wet off-site system. The basic advantage of this system is that it can be installed anywhere with a minimum span of time and of course with minimum cost. Following the constraints of space availability it can be both common for several families and individual for a single family. A treatment plant at a convenient location to desludge the septic tanks should be arranged by the City Corporation Authority. To carry the septic tanks to the treatment plant, the present trucks that carry the solid wastes are sufficient. The desludging intervals depend on the volume of the tank, number of users and the extent to which water is used for anal cleansing.

4. CONCLUDING REMARKS

Now Dhaka is at a crux of the situation with sanitation problems. Serious health hazard born out of this condition may cause the normal life of the citizens collapse. Protection from that last stage will cost a lot; it is better to prevent the hazard right now. Prevention at this stage needs only proper understanding of the problem by the decision-making authorities. New technologies (e.g. small bore sewerage system), which are both efficient in performance and cheaper in cost should be encouraged to be applied with immediate effect. Sometimes many projects planned by DWASA cannot be implemented due to lack of fund. At this stage it is advantageous to implement the project by dividing it in several zones and then implementing the planned job for the zones separately one after another matching with the available fund. Scarcity for resources in a country like Bangladesh is natural. So new technologies that suit the local condition and meet the resource constraints is to be applied to save mega city Dhaka from any obnoxious situation created from sanitation problem.

REFERENCE

Bangladesh Environment (2000). Bangladesh Poribesh Andolon (BAPA).

JICA (1998). The Study Report on The Sewerage System in North Dhaka, Japan International Cooperation Agency Nippon Jogesuido Sekkei Co. Ltd., Japan.

M. Feroze Ahmed (2003). Water Supply and Sanitation, State of the Environment, Banglades, Reports 2000 and 2001.