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Wastewater - Hong Kong and Taiwan

S L Tang

ABSTRACT

The paper describes the historical development, the current situation and the expected future improvement as regard to the sewerage systems and the wastewater treatment facilities in Hong Kong and Taiwan. Water pollution control legislation in both places are then discussed and their respective characteristics are highlighted. It ends up by having a comparison of the merits and demerits of the two control systems based on the author's personal point of view.

1. SEWERAGE SYSTEMS

1.1 Sewerage Systems in Hong Kong

Hong Kong has a population of nearly 6 million and a total area of approximately 1000 km² of which 10% is highly urbanized (Hong Kong Island and Kowloon Peninsula) and the rest 90% less urbanized (New Territories) - Fig. 1. Although New Territories have been under tremendous development in the past two decades, as in the establishment of satellite towns/cities and industrial estates, only about 16% of the land until now is classified as built-up areas. The urban areas in Hong Kong have separate sewerage systems. According to a survey done in 1977⁽¹⁾, 98% of the population is served by public sewers in urban Hong Kong and 16% in New Territories, making an overall of 90% of the total population served by sanitary sewers. The remaining 10%, mainly in New Territories, have their sewage discharged to rivers or to the sea, with or without passing through septic tanks.

On the whole, the sewage collection system in Hong Kong is considered fairly satisfactory.

1.2 Sewerage Systems in Taiwan

Taiwan has a population of about 3 times and a total area of about 35 times those of Hong Kong. While the majority of the people in Hong Kong are living in urban districts, which occupy only a little more than one-tenth of the total area, the

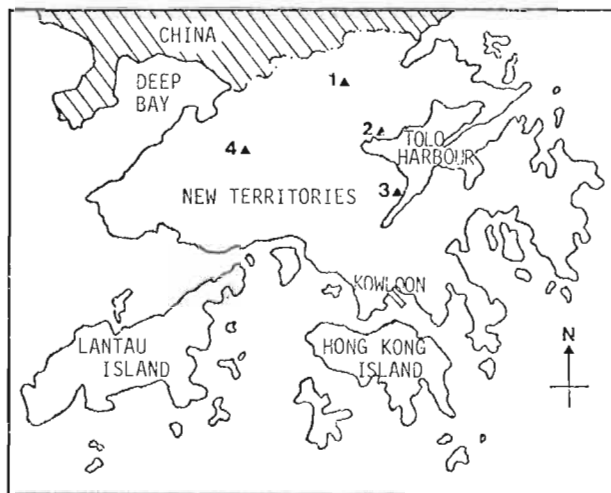


Fig. 1 Map of Hong Kong and Location of Sewage Treatment Plants: 1 - Shek Wu Hui STP, 2 - Tai Po STP, 3 - Shatin STP and 4 - Yuen Long STP.

situation in Taiwan in this respect is very different. The biggest city in Taiwan is Taipei (2.3 million people) and the second biggest is Kaohsiung (1.2 million people) - Fig. 2. The rest of the population is fairly evenly distributed in 311 towns/cities and an unknown number of villages in various parts of Taiwan, thus making it extremely difficult to have a high service level of public sewers for the whole population.

Before 1970, there was no separate sewerage system in Taiwan. The combined system, which was originally designed and constructed since the 1940s for collecting surface water, was used to serve both stormwater and wastewaters. Currently 82% of the population in Taipei and 50% of that in Kaohsiung are served by such systems⁽²⁾. Due to the serious pollution problems created by the untreated wastewaters discharged from these sewers, the Government of Taiwan commissioned in the late 1960s the WHO to look into the possibility of improvement for Taipei. A master plan⁽³⁾ was drawn up in 1970 in which the recommendation was made that a separate sewerage system be constructed in Taipei and that the new system be built in 3 stage. According to 1970 money value, Stage

I (1972 - 1980) costs NT\$2,638m or US\$64m, Stage II (1981 - 1988) NT\$3,423m or US\$86m and stage III (1989 - 2008) NT\$9,229m or US\$231m⁽⁴⁾. Stage I of the project has now been completed. In a recent revision of the progress it was found that the completion of Stage II has to be deferred until Year 1991. By that time about half of the population (as compared to 6.4% in 1983 and 0% in 1970) in Taipei will be served by public sewers for the collection of wastewaters⁽²⁾. As a temporary measure, at present, some of the combined sewers have had baffles installed⁽⁵⁾, near to their discharge points, to a height of a few hundred millimetres so that in dry weather the strong sewage may be led off and discharged to the Dihua Treatment Plant*.

Besides Taipei, Kaohsiung also has its separate sewerage projects started recently, and will have about half of its population served by the system by the end of 1980s⁽²⁾. The total costs of construction (including pumping stations, treatment plant and marine outfall) were revised in 1981 to NT\$3,640m⁽⁶⁾. For Taiwan as a whole, about a quarter of total population is expected to be served by sanitary sewers by the end of this decade, the total investments on which will amount to NT\$30,500m(1983 money)⁽²⁾.

2. SEWAGE TREATMENT

2.1 Sewage Treatment Facilities-Hong Kong

Before 1960, when the New Territories were much less developed than today, there was no sewage treatment facilities besides septic tanks in Hong Kong. At that time a very high percentage of the population gathered around Hong Kong Island and Kowloon Peninsula which is nowhere more than a few kilometers from the sea coast. Wastewaters collected from the sewerage system were discharged without treatment through submarine outfalls to the sea where a final dilution of at least 500 times takes place due to the availability of fast moving currents. Until now this method has been found to be most economical and efficient, and will continue to be used in Kowloon and the

* Dihua Treatment Plant is located at north-west of Taipei City. The first stage has been completed in early 80s and is now capable of treating sewage of 750,000 P.E. (ie. population equivalent). The second stage will be completed in 1990/91 and will have a 1,100,000 P.E. capacity.

Island, except that screening plants (preliminary treatment) are now constructed at certain locations near the sea where discharges take place via submarine outfalls to eliminate discernible solids down to 10 mm size. There are altogether 9 screening plants at present and 17 more are either under planning or construction. The overall strategy is to use as many submarine outfalls as possible to take advantage of the natural dilution by current.

With the development of satellite towns in the New Territories, Hong Kong experienced a decline in environmental conditions, particularly from pollution by wastewaters in areas which are at some distance from the coast and also from areas, which although near to the coast, have the sea-water adjacent to them lacking of natural currents to dilute the wastewaters. Typical examples are Tolo Harbour and Deep Bay (Fig. 1). The establishment of industrial estates in Tai Po and Yuen Long in 1970s also contributed to the adverse environmental conditions. To control the problems of water pollution arising from the development, 4 secondary treatment plants, all of which are activated sludge process, have been constructed since 1974 in various parts of

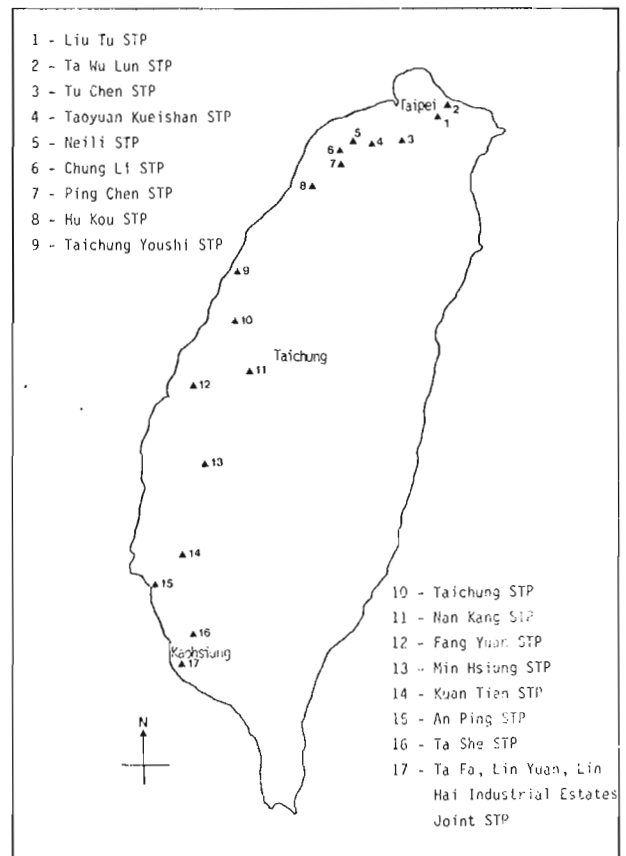


Fig. 2 Map of Taiwan and Location of Industrial Sewage Treatment Plants.

Table 1 (7)

S.T.P.	Capital Cost	Design Capacity (P.E.)	Status	Treatment
Shek Wu Hui (Stage I)	HK\$145m (1983 money)	230,000	in operation	secondary
Tai Po (Stage I & Stage II)	I - HK\$11.5m (1979 money) II - HK\$136m (1983 money)	I- 16,000 II-125,000	I- in operation II- construction recently completed	secondary
Sha Tin (Stage I)	HK\$365m (1980 money)	400,000	in operation	secondary
Yuen Long (Stage I)	HK\$207m (1984 money)	200,000	construction recently completed	secondary

the New Territories (Fig. 1). Their sizes and capital costs are given in Table 1. 7 more secondary treatment plants, together with a number of primary treatment plants, which are in various stages of planning and construction, will be established in the next ten years. The total amount invested by the Hong Kong Government in these projects is estimated in 1983 to be about HK\$2,000m⁽⁷⁾ or US\$256m.

2.2 Sewage Treatment Facilities-Taiwan

The first wastewater treatment plant was constructed in Liu Tu (六堵) and has been in operation since 1963. Liu Tu is the first industrial estate in Taiwan. Currently there are 42 industrial estates (totally 7176 Ha) already established and 20 more (totally 6437 Ha) are being developed⁽⁸⁾. 23 central industrial wastewater treatment plants, with some of them also treating small quantities of municipal wastewater, are sited in various locations in Taiwan (Fig. 2) to provide treatment facilities for the effluents from the industrial estates. 17 out of the 23 are in operation and 6 are in the stages of construction or design. The plants designed were based on the

following strategies⁽⁹⁾:

- (i) Large industrial estate should have a central treatment plant.
- (ii) Priority should be given to the central treatment plant serving several nearby industrial estates.
- (iii) Factories whose effluents exceed the specified standards are to pretreat them before releasing them to the sewerage system.
- (iv) Factories in small industrial estates have to treat their wastewaters individually and there will be no central treatment plant.

The treatment methods employed in these 17 already constructed plants include bio-filtration, conventional activated sludge process, oxidation ditches, aerated lagoons and so on. The total costs of construction for all the 17 plants amount to NT\$2,500m (1980 money) excluding the cost of sewerage systems⁽⁸⁾.

The development of industrial estates and industrial wastewater treatment in Taiwan is at least ten years in advance of Hong Kong. That of municipal wastewater treatment however is a little behind. This is probably due to the lack of

Table 2

S.T.P.	Capital Cost	Design Capacity (P.E.)	Status	Treatment
Stage I Dihua ⁽¹⁰⁾ (Taipei)	NT\$800m (1978 money)	750,000	in operation	primary
Min Shen ⁽¹⁰⁾ (Taipei)	NT\$100m (1982 money)	50,000	in operation	secondary
Chung Hsing Village ⁽¹¹⁾	NT\$6m (1963 money)	16,000	in operation	secondary
Stage I Kaohsiung ⁽¹²⁾	NT\$1,600m (1983 money)	600,000	in construction	primary

efficient separate sewerage systems in the past. There are currently three municipal wastewater treatment plants (2 in Taipei and 1 in Taichung) under operation and one (in Kaohsiung) under construction (Table 2). The construction of treatment plants are planned to tie in with the development of sewerage systems as already mentioned in Section 1.2.

3. LEGISLATION AND MANAGEMENT

3.1 The Scene in Hong Kong

The first legislation, the Water Pollution Control Ordinance, was introduced in July 1980⁽¹³⁾. There are four characteristics in this ordinance :

- i) Implementation of the legislation is in stages by dividing Hong Kong into about ten Water Control Zones. One zone will be enforced at a time**. Priority is to be given to the zone which most urgently requires the control.
- ii) Different Water Control Zones have different water quality objectives. Only principles are stipulated in the objectives, leaving the quantitative standards to be decided on individual or industry-to-industry basis.
- iii) Existing discharges are exempted.
- iv) Pretreatment is not to be encouraged. Only minimal pretreatment will be employed when essential. Normally untreated wastewaters will be discharged directly to the sewers.

Thus the legislation in Hong Kong is very flexible. Public objections and appeals are also provided in the ordinance. The authority which formulates the policy is the EPA (Environmental Protection Agency) and the one to carry out the legislative control is the EDD (Engineering Development Department). It is believed that these authorities have been delegated sufficient power to perform their duties.

3.2 The Scene in Taiwan

The first legislation, the Water Pollution Prevention Act (水污染防治法) was introduced in July 1974. It was then revised in May 1983⁽¹⁴⁾. It differs from the one in Hong Kong in the following aspects :

- i) Numerical quality limits are specified for effluents.

- ii) Pretreatment is necessary for individual factories if their effluents exceed the specified limits. (See strategy (iii) of Section 2.2)
- iii) No exemption is given to existing discharges.
- iv) Staged implementation is not provided in the legislation.

The legislation in Taiwan is much more strict than that in Hong Kong. The disadvantage of too flexible a legislation is that it creates a very heavy work load to the authorities concerned as the latter has to assess every discharge on individual basis. Some people hence think that time and effort are "wasted" in this very tedious task. Also, confusion can easily arise when the authority is carrying out the control. While the author has considerable reservation concerning the high flexibility of the Hong Kong legislation, it must be pointed out that a flexible legislation in general has some advantages. That only principles are spelled out in the legislation but not quantitative details for effluent standards allows the possibility of avoiding unnecessary expenditure in overtreatment, for different locations do have different toleration in water qualities. With the provision for staged implementation together with the exemption from control of all existing discharges the new legislation exhibits a realistic and adaptable approach which most probably results in a minimum of reaction from industrialists. Finally, it is possible that large central treatment plants for the processing of wastewaters are more realistic than a number of smaller units in that not only are large plants usually more economical to create and operate but they also minimize the degree of inhouse pretreatment required at each industrial unit. The high flexibility in a legislation will naturally encourage this desired situation.

Legislations in water pollution control both in Hong Kong and in Taiwan are newly introduced and it is definitely too early yet to judge their merits and demerits. Time will reveal the pros and cons. But one common principle should be applicable to the two, that is, periodic revision and adjustment must be exercised during implementation in order that the legislation does remain alive and useful.

** The first Water Control Zone is Tolo Harbour.

Reference

1. Environmental Resources Ltd., "Control of the Environment in Hong Kong – Final Report", Secretary for the Environment, Hong Kong Government, 1977.
2. 蕭江碧, "推動台灣地區下水道建設發展之策略", 下水道工程實務研討會論文集, 台北6/1983。
3. Camp Dresser & McKee International Inc., "Sewerage Planning in the Greater Taipei Area – Master Plan Report", WHO/UNDP, 1970.
4. Thomas, R.H., "Wastewater System for Taipei, Taiwan", J. WPCF, Vol. 44, No. 8, 8/1972.
5. 王明, "台北市新生排水溝及環河街沿線截流設施之探討", 下水道工程實務研討會論文集, 台北6/1983。
6. "高雄市仁愛河污染整治及污水下水道工程計劃簡報", 台灣高雄市政府9/1982。
7. Information obtained during the interview with Mr. K. F. Leung (梁錦輝), Senior Engineer of Hong Kong Engineering Development Department, in March 1984.
8. 於幼華編, 楊萬發等著, "工業區廢水處理之研究(III)", 國立台灣大學環境工程研究報告No.10, 5/1980。
9. Che, S.; Lee, T. Y. & Chen, C. P., "Industrial Wastewater Treatment for Industrial Parks in Taiwan", Proceedings of International Conference on Water Pollution Control in Developing Countries, Bangkok, 2/1978.
10. Information obtained during the interview with Mr. W. K. Liu (劉文樾), Director of Sewerage Engineering Department of Taipei and Mr. R. Y. Chung (鍾瑞源), Head of Dihua and Min Shen S.T.P.s in January 1984.
11. Information obtained during the interview with Prof. Yang Wan-Fa (楊萬發) of National University of Taiwan in March 1984.
12. Information obtained during the interview with Mr. C. Y. Wu (吳宗榮), Head of Kaohsiung S.T.P. and Mr. C. T. Li (李建德), Engineer of Sewerage Engineering Department of Kaohsiung in January, 1984.
13. "Water Pollution Control, Ordinance No. 41 of 1980", Hong Kong Government, 1980.
14. 1983年5月27日公布之"水污染防治法", 可參考台灣經濟部工業局暨經濟部工業污染防治技術輔導小組於1983年12月合編印之"工業污染防治有關法令", 頁11—16。