# CHAPTER 12
# PLAN OF INDUSTRIAL WASTEWATER TREATMENT AND MANAGEMENT

## 12.1 GENERAL

Appropriate industrial wastewater treatment and management is essential to realize the proposed target water quality at several points in the Yaque del Norte river as described in section 11.4. Since the future volume and pollutants loads of industrial wastewater produced in the Study Area and their discharge to the proposed sewerage system have been explained in chapter 9. This chapter mainly discusses the industrial wastewater to be treated at factories' own treatment facilities or common facilities such as those in the Free Zones. To improve and promote appropriate industrial wastewater treatment and management, the following issues identified through our surveys have been discussed and some Japanese practices are introduced as examples in Appendix 10, Volume III Supporting Report.

- Public financial aid system to promote improvement/installation of industrial wastewater treatment facilities;
- Coordinated management system, including setup of viable regulations, and organizations; and
- Human resources development to ensure the capacity building for personnel involved in industrial wastewater treatment and management.

## 12.2 INDUSTRIAL WASTEWATER TREATMENT STRATEGY PLAN

### 12.2.1 WASTEWATER TREATMENT AND DISPOSAL

Among 184 factories, 140 factories (76% in number of factories) are planned to discharge the wastewater directly or after pre-treatment to sewerage. The main reasons many factories are planned to discharge their wastewater to the proposed sewerage system in the Sewerage Master Plan are:

- A centralized public WWTP is more reliable than an individual treatment facilities in factories;
- A centralized public WWTP is more economical than individual small treatment plants, due to the scale-up merit.

The remaining 44 factories are planed to use their treatment facilities with necessary improvements to comply with the effluent standards for surface water, considering the present situation and wastewater characteristics. The following industrial wastewaters are proposed to treat at their own or common treatment facilities and discharged to the rivers:

- Wastewater treated at the existing centralized (common) facilities in FZIEs or privately owned individual (on-site) facilities; and
- In appropriate wastewater to biological treatment processes commonly used for public sewerage system, like inorganic wastewater discharging from construction materials production factory.

The existing treatment facilities are four centralized treatment facilities serving 32 factories and 12 individual treatment facilities, shown in table below.

**Industrial Wastewater Discharge to the Yaque del Norte River**

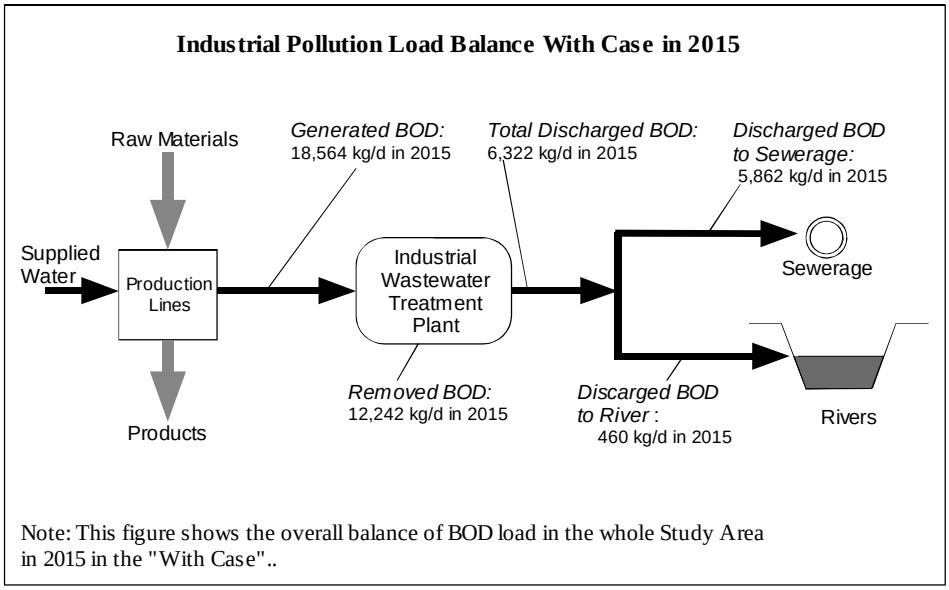
| | |
|---|---|
| **1. After treatment at Central Wastewater Treatment Facilities** | |
| 1) CIP FZIE: | Wastewater from 11 factories |
| 2) Gurabo FZIE: | Wastewater from 5 factories |
| 3) Pisano FZIE: | Wastewater from 7 factories |
| 4) Santiago FZIE: | Wastewater from 9 factories, textile-related factories, in Santiago I, II and III FZIE |
| **2. After treatment at Individual (On-site) Treatment Facilities** | |
| 1) Factories discharging Inorganic wastewater: Three (3) construction materials production factories located in the riverside | |
| 2) Factories outside the Study Area: 9 factories | |

### 12.2.2 VOLUME AND POLLUTANT LOAD

#### (1) General

As discussed in chapter 9, the industrial wastewater generation volume will be increased from 20,427 m3/day (as of 2000) to 44,407 m3/day in 2015 and the respective BOD loads generation will be 8,539 kg/day to 18,564 kg/day.

Under the proposed sewerage implementation plan, about 25,550 m3/d of industrial wastewater will be discharge to the proposed sewerage system in 2015 and the remaining 18,870 m3/d of industrial wastewater will be treated by their own treatment facilities and discharged to the rivers. Figure below shows the change of BOD loads in 2015.




#### (2) Sewerage Discharge

Table below summarizes volume and loads of the industrial wastewater to be discharged to sewerage system in 2015.

To meet the discharge standards to the sewerage, the generated BOD loads of 15,384kg/day should be reduced to 5,863 kg/day, before discharge to sewerage. Thus, the require BOD load reduction is 9,521kg/day by their pre-treatment facilities.

This study estimated that only 12% of the required BOD load removals could be covered by the existing facilities and the remaining 88 % of required BOD load shall be treated by the future expanded facilities. To achieve this, 42 factories among total 140 factories (30 % in number of

factories) in eight sewerage districts will be needed to install a certain treatment facilities to improve the treatment capacity or their efficiency. Thirteen (13) factories will be needed to install treatment facilities to remove nitrogen from their wastewater.

**Industrial Wastewater Pre-treatment and Discharge to the Sewerage in 2015**

| Industrial Wastewater to Sewerage | | Planned | |
|---|---|---|---|
| Discharge Flow to Sewerage | ($m^3$/d) | 25,538 | |
| Pollutant Loads | | BOD | SS |
| Generation | (kg/d) | 15,384 | 11,826 |
| Discharge Requirement | (kg/d) | 5,863 | 6,089 |
| Reduction Requirement | (kg/d) | 9,521 | 5,737 |
| By Existing WWTP | (kg/d) | 1,167 | 1,156 |
| By Expanded WWTP | (kg/d) | 8,354 | 4,581 |

### (3) River Discharge

Table below summarizes volume and loads of the industrial wastewater to be discharged to rivers in 2015.

Four centralized treatment plants serving 32 factories and 12 individual in-plant treatment plants are planned continuously discharge their wastewater to the rivers. About 18,900 $m^3$/d of industrial wastewater will be treated by their treatment facilities and discharged to the rivers in 2015. Before discharging the wastewater to the rivers, following pollutants loads reduction by their own treatment facilities are needed in 2015 to comply with the discharge standards specified by the new Norm (AG-CC-01): 2,732 kg/d in BOD load and 11,111 kg/d in SS loads. About 40 % of required BOD load reduction could be treated by the existing facilities and the remaining 60 % should be treated by the expanded facilities. In addition, six (6) factories will be needed to improve the treatment facilities to remove nitrogen from their wastewater.

**Industrial Wastewater Self-treatment and Discharge to the Rivers in 2015**

| Industrial Wastewater to the Rivers | | Planned | |
|---|---|---|---|
| Discharge Flow to the rivers | ($m^3$/d) | 18,869 | |
| Pollutant Loads | | BOD | SS |
| Generation | (kg/d) | 3,193 | 12,057 |
| Discharge Requirement | (kg/d) | 461 | 946 |
| Reduction Requirement | (kg/d) | 2,732 | 11,111 |
| By Existing WWTP | (kg/d) | 1,090 | 4,125 |
| By Expanded WWTP | (kg/d) | 1,642 | 6,986 |

It should be noted that the textile-related factories located in the Santiago-I, II and III FZIE, which use a communal laundry wastewater treatment plant, will continue to comply with more stringent effluent standard: less than 30 mg/l of BOD and SS, in compliance with the request from the foreign purchasers of their goods.

## 12.2.3 REQUIRED COSTS

### (1) General

As mentioned above, to comply with the effluent standards to sewerage or river discharge, it is necessary to construct new industrial treatment facilities and/or expand the existing facilities. Among 184 factories, a total of 84 should be equipped with certain types of wastewater treatment facilities. To know the magnitude of the necessary capital cost, a preliminary cost estimates has been conducted. Refer the methodology, assumptions and conditions on the cost estimate to Appendix 10, Volume III Supporting Report.

### (2) Cost Estimate

The resulted cost estimates are summarized in table below. Approximately US$ 28 million is needed for construction and US$ 3.7 million is needed for annually O&M.

**Required Cost for Industrial Wastewater Treatment Improvement**

| Industrial Wastewater Treatment Facility | Construction Cost (1000 US$) | O&M Cost (1000 US$ per year) |
|---|---|---|
| 1) Discharge to Sewerage | | |
| Cienfuegos District | 1,003 | 132 |
| Embrujo District | - | - |
| Licey District | 292 | 39 |
| Los Salados District | 700 | 98 |
| Rafey District | 12,518 | 1,886 |
| Tamboril District | 2,164 | 351 |
| Zona Sur District | 0 | 0 |
| Herradura District | 654 | 92 |
| Sub-Total | 17,331 | 2,597 |
| 2) Discharge to the River | | |
| CIP FZ Central System | 1,069 | 86 |
| Gurabo FZ Central System | 974 | 97 |
| PISANO FZ Central System | 741 | 74 |
| Laundry Wastewater Treatment System | 2,666 | 267 |
| On-Site Treatment Systems (Individual 12 facilities) | 5,471 | 629 |
| Sub-Total | 10,921 | 1,152 |
| 3) Total | 28,252 | 3,749 |

Source: JICA Study Team

Private company running the factories are in principle responsible for financing installation and operation of industrial wastewater treatment facilities under the "Polluter Pays Principle". However, financial constraints, especially in small companies, tend to delay to invest the construction or improvement of facilities, violate the effluent standards and resulted in water pollution in the environment. Therefore, to facilitate and promote the development of industrial wastewater treatment facilities and to ensure their proper operation, any non-structural measures have to be addressed and established: for example, any financial intensives: such as public financing aid system, tax discount systems etc.,