Cau Nguyet Water Treatment Plant
Hai Phong, Vietnam

1. Background Information

Cau Nguyet Water treatment plant (CNWTP) is located in Kien An district, Hai Phong city with total area of 30.045 m^2. This water treatment plant is managed and operated by Hai Phong water supply company, Ltd. since 1976 with an initial capacity of 20,000 m^3/d which was then increased to the capacity of 40,000 m^3/d. It supplies water to Kien An district and some areas of An Lao district.

Table 1 Overall Information of the Can Nguyet Water Treatment Plant

Constructed Year	1976 - 1977
Upgrading Year	2008
Water Source	Da Do River
Number of connections (by 3/2013)	40,860
For Households	40,317 (98.7%)
For Administrations	254 (0.6 %)
For Manufactures	259 (0.6%)
For Business and Services	30 (0.1%)
Design capacity	40,000 m^3/day

2. Water treatment process flow

The major processes of CNWTP are illustrated in **Figure 1.**

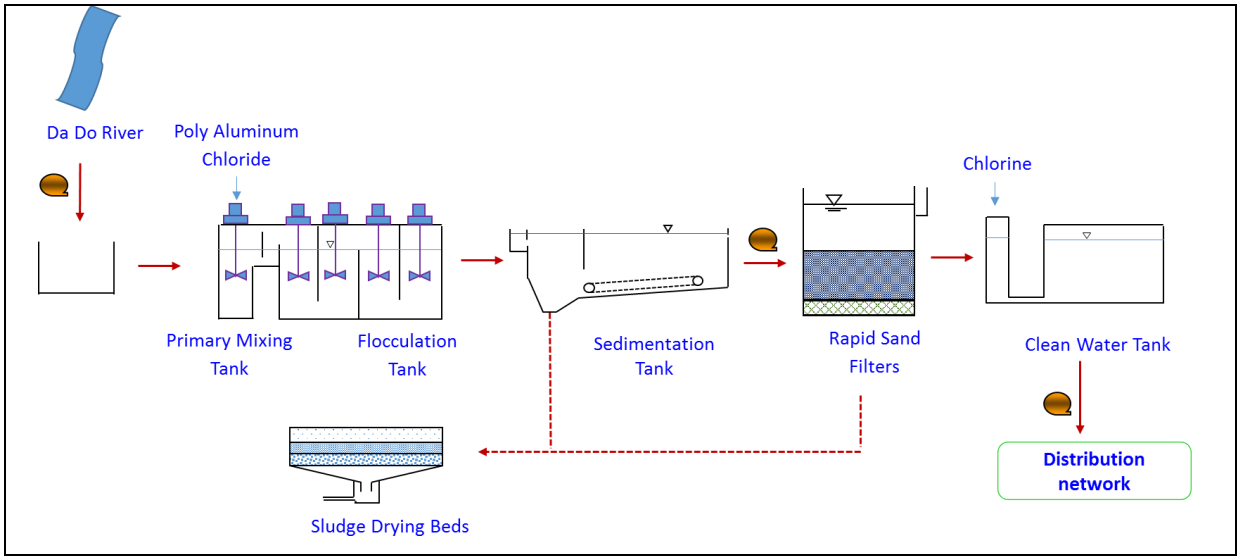

Figure 1: Water Treatment Process

2.1 Water intake

Da Do River is the raw water source for CNWTP. Float and bar screen (**Figure 2**) is installed at the intake to prevent duckweeds and other garbage from entering the pump.

Figure 2 Raw water collection at Da Do river

2.2. Pre-sedimentation tank

Volume of pre-sedimentation tank ranges from 3,000 to 5,000 m^3 and the water level in the tank depends on the water level of Da Do river (**Figure 3**). The retention time in the pre-sedimentation tank is 1-2 hour.

Figure 3 Pre-sedimentation tank

2.3 Chemical building

PAC (Poly aluminum chloride) or Alum sulfate ($Al_2(SO_4)_3$) are normally used as coagulants. The chemical doses are measured by Jar test in the technical quality department which also analyzes the characteristics of water source.

There are two chemical mixing tanks each with the volume of 8 m^3. The average concentration of solution is around 2 – 5 %. There are two metering pumps with the flow rate of 1.15 m^3/h and a reserve pump.

Figure 4 Chemical building

2.4 Mixing tank and Coagulation-Flocculation

Mixing tank includes three mechanical mixing compartments, each with the volume of 4.3 m^3 (corresponding to water level of 2.0 m). A mixing machine (type 2MC01-2MC03) is set up for each chemical mixing. The contact time is around 8 second. However, contact time differs with the fluctuation in water quality of Da Do river.

Coagulation-flocculation tank (**Figure 5**) consists of three sub-tanks in which each sub-tank includes 4 compartment. These compartments are located consecutively and consists of 3 types of stirring machines with the capacity of 1.5 KW/6.5rpm for 1st, 1.1 KW/4.7rpm for 2nd and 0.75KW/3.6 rpm for the 3rd compartment. Moreover, 2 slow mixing machines are allocated for each compartment.

Figure 5 Coagulation-Flocculation tank

However, plant is currently operating under the production capacity of 40,000 m^3/d and operates only two sub-tanks. The reserve tank or the third sub-tank is operated when the production capacity of the WTP has to be increased to 60,000 m^3/d.

2.5 Sedimentation tank

The horizontal sedimentation tank (**Figure 6**) is 98m: 60m (L: W) in dimension and has a storage capacity of 17,640 m^3 with the average water level of 3.0 m. The sludge is discharged from sedimentation tank using suction pump at the discharging frequency of 6 hour per day.

Figure 6 Horizontal sedimentation tank

2.6 Pumping station

2.6.1 First pumping station

The first pumping station (**Figure 7**), pumps the treated water from horizontal sedimentation tank to the filtration tank and it consists of 2 horizontal centrifugal pumps. The specifications of these pumps are shown in **Table 2**.

Table 2 Specifications of pumps used in the first pumping station

Pump	Type - Model	Capacity (m^3/h)	Total head (m)	Power Motor (KW)
1	3P01	1,800	15	75
2	3P02	1,700	17	75

Figure 7 Pumps used in the first pumping station and backwash pumping station

2.6.2 Second pumping station

The second pumping station (**Figure 8**) is installed to deliver purified water from clean water storage tank to the distribution system and it consists of 3 horizontal centrifugal pumps with the total capacity of 2,500 m^3/h and operating pressure of 1.5 to 4.0 bar. The specifications of these pumps are shown in **Table 3**.

Table 3 Specifications of pumps used in the second pumping station

Pump	Type - Model	Capacity (m^3/h)	Total head (m)	Power Motor (KW)
1	3P04	1,800	40	315
2	3P05	1,800	40	315
3	3P05	1,700	40	200

Figure 8 The second pumping station

2.6.3 Backwash pumping station

This pumping station operates with 2 horizontal centrifugal pumps (Capacty: 700 m^3/h, Head: 7m, Power: 22 KW) with the function of back washing filter tank.

2.7 Rapid filtration tank

The rapid filtration (**Figure 9**) includes 10 compartments, each with an area of 31.5 m^2. The filtration media is silica sand and has the depth of 1.0 – 1.2 m and has a filtration rate is 5.9 m/h. The filter operates in semi-automatic mode and has the backwash cycle of 36 hour.

Figure 9 Rapid filtration tank

2.8 Disinfection process

CNWTP applies liquid chlorine and the dose is determined based on Jar test of the technical quality room. To test the free chlorine in water, DPD (Poly-(1, 4) D-glucosamine) tablet test or orthotolidine test is performed.

There are two chlorinators in the type of 3 kg/hr. It also consist of neutralization tower designed to ensure safety in case of chlorine leakage.

2.9 Purified water storage tank

There are two purified water storage tanks with the total containing capacity of 6,000 m^3 (**Figure 10**). The chemical disinfectant is injected in the water pipeline prior the storage tank and the retention time ranges from 30 min to 60 min.

Figure 10 Purified water storage tank

2.10 Sludge disposal

Sludge that is collected from sedimentation tank is discharged into the sludge drying beds. There are four sludge drying beds with the total area of 1,264 m^2. The dried sludge is dredged manually and then transferred to leveled dump every three month (**Figure 11**). The effluent from the sludge drying bed is sent to the pre-sedimentation tank.

Figure 11 Sludge drying bed

2.11 Distribution system

The treated water is supplied to consumers via water supply network whose leakage ratio was recorded to be 11.41% in 2012. The old pipeline constructed back in 1990 was replaced completely in 2008-2012. The distribution network includes main pipeline (D300-D800 in total length of 37.05 km), smaller pipeline (D150-D250, 30.354 km; D32-D100, 424.0 km) and smallest pipeline (D25, 120.0 km).

3. Aspects of treatment processes posing most difficulty for daily operation

The raw water (surface water from inland rivers) is affected mostly by organic pollutants from domestic wastewater and farmland. Hence, it requires increasing doses of coagulants, pre-chlorination and PAC (power activated carbon). This leads to a rise of treatment cost.

4. Aspects of water services management in general posing most difficulty at the moment

Raw water is contaminated from several point and non-point sources. The pollutants from the agricultural land also substantially pollute the raw water source. Moreover, the sewage, domestic solid waste and water leakage form septic tanks further pollutes the raw water. Thus, lack of unscientific agricultural practice and information to basic sanitation in the river basin has posed difficulty to the CNWTP.

5. Measures taken now to cope with 3) and 4)

Hai Phong water supply company has implemented the water safety plan (WSP) following the manual of WHO since 2011. The main objectives of WSP are indicated as follows:

- Ensuring: maintenance of water pressure, stable supply of water in sufficient quantity and meeting required water quality standards.
- Planning to cope with unexpected incidents and hazards which may occur during the entire production process (water intake to distribution).
- Contributing to protect public health, reducing water-related disease and disease prevention
- Contributing to reduce wastage, saving water resources and environmental protection

Some activities carried out to protect the raw water sources are:

- Compliance monitoring of the industries to prevent illegal discharge of waste and wastewater in the water source
- Conducting public awareness programs to raise the residential awareness level.

6. Recent investment made for the plant's improvement

Telemetry system has been recently installed in the control building to monitor and supervise the operation of the plant. It can monitor the parameters such as flow, pressure, pH and chlorine residual at some points over the water network

7. Technologies, facilities or other types of assistance needed to better cope with operational and management difficulties in 3) and 4)

- Increasing public awareness on scientific agricultural practice
- Increasing the labor productivity

8. Customer's opinion on water quality and water services in general

In the annual survey conducted by the Hai Phong water supply company, Ltd, 99% of the customers were reported to be satisfied with the water quality and services.

9. Advanced technology used in this water treatment plant or any points to improve the process, water quality and capacity

Telemetry system is used for the monitoring of the treatment processes. It also monitors various parameters at several sampling points.

10. Other Highlights

- It is one of the oldest WTP of Vietnam.
- Telemetry system has been installed in the plant making the operational activity simple and cost-effective.
- The dried sludge which is inorganic is nature, is used for the farming activity. The sludge quality is checked once a year to know if it is compatible for the farming purpose.

11. Water quality data

Table 4 Water quality data for the year 2014

No	Parameters	Unit	River water		Treated water		QCVN 01:2009/BYT - Standard
			Min	Max	Min	Max	
1	Color				<5	<5	*≤ 15*
2	Taste				-	-	-
3	Turbidity	NTU	17.14	39.00	0.15	0.19	*≤ 2*
4	pH		7.34	7.70	7.29	7.70	*6.5-8.5*
5	Total Ca and Mg	$mgCaCO_3/L$	82	134	85	108	*≤ 300*
6	Cl^-	mgCl-/L	7.82	22.10	10.03	26.18	*≤ 250*
7	Permanganate	mgO_2/L	1.67	3.23	0.69	1.16	*≤ 2.0*
8	Mn	mg/L	0.058	0.142	0.007	0.018	*≤ 0.3*
9	Nitrate/N	mg/L	0.495	1.210	0.550	1.290	*≤ 11.36*
10	Nitrite/N	mg/L	0.010	0.111	<0.002	<0.002	*≤ 0.91*
11	Total Fe	mg/L	0.118	1.335	<0.02	0.028	*≤ 0.30*
12	Sulfate	mg/L	NA	NA	12.00	28.08	*≤ 250*
13	Residual chlorine	mg/L	NA	NA	0.54	0.69	*0.3-0.5*
14	Total Coliform	MPN/100mL	1500	2456	0	0	*0*
15	Fecal Coliform	MPN/100mL	1500	2456	0	0	*0*

NA: Not Available

12. References

http://haiphong.gov.vn/Portal/Detail.aspx?Organization=DOANHNGHIEP&MenuID=4756&ContentID=12156

http://www.msbs.com.vn/Sites/QuoteVN/SiteRoot/1_201507cdab5._Ban_cong_bo_thong_tin_cap_nuoc_HP.pdf

Water safety plan 2013 of Hai Phong Water Supply Company, Ltd.

https://www.google.co.th/maps/place/nh%C3%A0+m%C3%A1y+n%C6%B0%E1%BB%9Bc+c%E1%BA%A7u+nguy%E1%BB%87t/@20.780842,106.6147238,755m/data=!3m2!1e3!4b1!4m2!3m1!1s0x314a76c51c9aebe7:0xc5551b6d6ad0f73!6m1!1e1

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