NewTap
Network on Water Technology in Asia and Pacific

Do Son Water Treatment Plant
Hai Phong, Vietnam

1. Background Information

Do Son Water treatment plant (DSWTP) is located in Van Son ward, Do Son district, Hai Phong city with total area of 12.67 km^2. As the WTP is located far away from the river water resources, it receives the raw water through upstream pumping station (He river intake pumping station). It runs under the management and operation of Hai Phong Water Supply Company, Ltd. DSWTP was constructed in 1959-1961 with a capacity of 1,000 m^3/d which was then expanded to the treatment capacity to 5,000 m^3/d in 1987 and 7000 m^3/day in 2013. This plant supplies treated water for the entire Do Son district, several areas along to 353 street of Duong Kinh district and Kien Thuy district. The raw water is treated in two stages. Firstly, it is treated in the He river intake pumping station and is then treated in the DSWTP. Further background information about Do Son water treatment plant is presented in **Table 1**.

Table 1 Overall Information of Do Son Water Treatment Plant

Constructed Year	1959 - 1961
Water Source	He River
Number of connections (by 3/2013)	9,092
For Households	8,804 (96.8%)
For Administrations	93 (1 %)
For Manufactures	53 (0.6%)
Capacity (m^3/day)	7000
Automation	No
Topography	Plain/Tropical
Date of access of the source information	5 September, 2015
References	Water Safety Plan (2013) Hai Phong Water Supply Company

2. Water treatment Process

2.1 He river water supply station

The major process as follows:

Raw water intake (Bamboo Screen, bar screen) → Pre-Chlorination → Coagulation ($Al_2(SO_4)_3$)→ Flocculation → Sedimentation → Filtration (Silica sand/Silica sand + Anthracite carbon) → Chlorination Disinfection (Dose: 0.5 – 0.8 mg/L) → Pumping station.

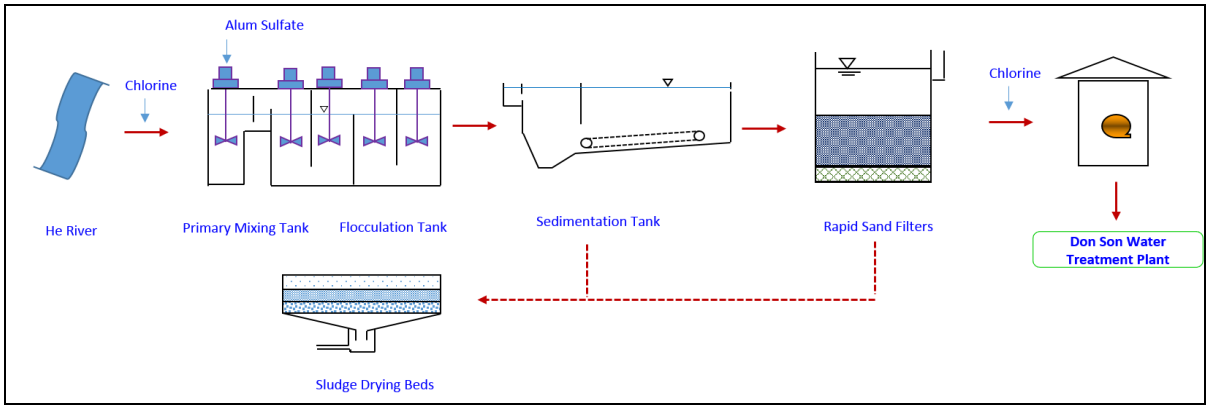

Figure 1 Schematic Diagram of He water Intake Pumping Station

2.1.1 Chemical feeding and mixing

Alum sulfate is mainly used for water treatment as a coagulant and liquid chlorine for pre- and post-chlorination.

There are two mixing tanks (each with the volume of 1.5 m^3) and one solution tank. The mean solution concentration is around 5%. Mixing machine with the capacity of 1.5 KW and 75 rpm is used.

2.1.2. Sedimentation

Sedimentation basin has a surface area of 1,000 m^2 and volume of 3,000 m^3. The water level of this tank is in the range of 1.6–3.0 m. Retention time of sedimentation basin is 4 hours at the production capacity of 350 m^3/h.

2.1.3. Filtration

There are two rapid filtration tanks in DSWTP. The first rapid sand filter was constructed in 2007 and it has 8 sub-tanks, each with a surface area of 1.82 m^2. The second filtration tank was constructed in 2011 and it consists of 10 sub-tank, each with the surface area of 1.89 m^2. The operational capacity of both the rapid sand filter is 300 m^3/h.

The media used in filters is fine sand with filter depth of 70 cm. The filtration rate is maintained in the range of 8 -15 m/h. This filtration tank is semi-automatic and it has a backwash cycle of 8-12 h. The turbidity of the filtrate is less than or equal to 3 NTU.

2.1.4 Disinfection

Liquid chlorine is utilized for pre and post-disinfection. Chlorine dose is determined based on Jar test performed in the technical quality room. To test the free chlorine in water, DPD (Poly-(1, 4) D-glucosamine) tablet test or orthotolidine test is employed.

It consists of two functional chlorinator and a reserve chlorinator. Among the two functional chlorinator, one with the capacity of 5 kg/hr is used for the pre-chlorination while the other one with the capacity of 2.5 kg/hr is used for disinfection

2.1.5 Pumping station

There are two horizontal centrifugal pumps with the following specifications:

Capacity =350 m^3/h
Total Head= 60 m
Power motor= 75 KW
I= 132 A

2.2 Do Son Water Treatment Plant

The treatment processes in DSWTP are as follow:

Water source from He river intake pumping station → Raw water reservoir → 1st pumping station → Rapid sand filtration → Disinfection → Pure water storage tank → 2nd pumping station → Distribution system

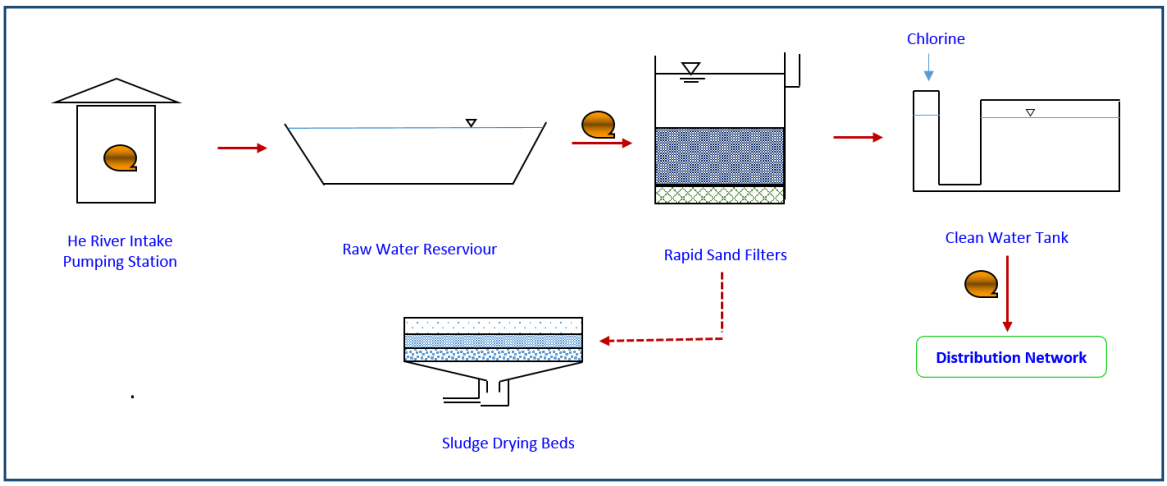

Figure 2 Schematic Diagram of Don Son Water Treatment Plant

2.2.1 Raw water reservoir

This reservoir consists of an area of 2,800 m^2 and has a volume of 8,000 m^3 (**Figure 3**). The water level is in range of 1.0 – 2.8 m and has a retention time is 20 hours in the case of operation capacity of 250 m^3/h.

Figure 3 Do Son raw water reservoir

2.2.2 The first pumping station

There are 5 operational pumps in the first pumping station which can pump water with the maximum capacity of 345 m^3/h (**Figure 4**). The details are shown in the **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)	I (A)
1	8BA-18	285	18	22	40
2	100E-80A	176.4	28	22	41.8
3	100E-80A	176.4	28	22	41.8
4	Д1000-15 (wash)	1,000	13	76	137
5	N5 (air)	25.2 m^3/min	--	28	52

Figure 4 Do Son raw water reservoir

2.2.3 Filtration

DSWTP utilizes anthracite carbon (0.5 m) and silica sand (0.7 m) as filter media and has a filtration rate of 8-10 m/h. DSWTP has a circular filtration tank with the surface area of 28 m^2 and a rectangular filtration tank consisting of three segment, each with an area of 3.4 m^2.

(a) Circular filtration tank

(b) Vertical filtration tank

2.2.4 Disinfection process

The liquid chlorine (**Figure 6**) is used for the disinfection and the quantity to be used is determined from the Jar test performed in the technical quality room. The residual (free) chlorine in treated water is tested by DPD tablets or Orthotolidin solution. There are two chlorinators with the capacity of 2 kg/hr.

Figure 6 Filtration tanks

2.2.5 Treated water storage tank

DSWTP consist of a clean water storage tank with a volume of 1,000 m^3. The liquid chlorine is injected into water pipeline which conveys water to the storage tank. It has a retention time of 30 min.

Figure 7 Pure water storage tanks

2.2.6 The second pumping station

There are 7 pumps (5 horizontal centrifugal pumps and 2 vertical centrifugal pumps) with the combined capacity is 360 m^3/h and pressure of 3-4.5 bar (**Figure 8**). Specifications of these pumps are illustrated 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)	I (A)
1	125PJMO-200	150 - 180	45	30	56
2	125PJMO-200	150 - 180	45	30	56
3	4BA-64	105	69.5	40	74
4	4BA-64	105	69.5	40	74
5	YHC 180	180	45	30	56
6	CR32	30	29.6	4	8.95
7	CR32	30	29.6	4	8.95

Figure 8 Pumps used in the second pumping station

2.2.7 Distribution system

Distribution system has a high leakage ratio of 21% as recorded in 2012. The treated water is supplied to consumers via water supply network which consists of following pipelines:

Table 4: Distribution of Pipeline

SN	Diameter	Total Length (Km)
1	D300	9.47
2	D150-D290	15
3	D32-D100	35
4	D25	27

Distribution system consists of two horizontal centrifugal pumps (specification in **Table 5**) and two storage tanks (800 m^3 and 1,000 m^3).

Table 5 Specifications of pumps used in distribution system

Pump	Type - Model	Capacity (m^3/h)	Total head (m)	Power Motor (KW)	I (A)
1	Д320-50Т	160	50	22	50
2	125PJMO-200	135	20	15	32

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

The raw water is often contaminated by organic pollutants from domestic wastewater and fertilizers which causes increased dosage of coagulants and disinfectant resulting in the rise of treatment cost.

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

Raw water from He river is contaminated from pollution sources as:

- Industrial wastewater along 355 street, Duong Kinh district which is discharged to Tieu Tra and Hoa Binh canals.
- Sewage, domestic solid wastes and water leakage from septic tanks of households living along with these canals.
- Pollutants from agriculture activities as pesticides, herbicides, fertilizers, livestock wastes.
- High percentage of non-revenue water

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

There has not been any recent investment for the improvement of DSWTP but the company has plans to modify the He river intake pumping station to high pressure pumping station and construct a new WTP for Do Son area in next five year. The company has also planned to replace the distribution system to minimize the leakage ratio in next five year.

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

- Online monitoring system should be installed for better control and operation
- Since surface runoff from the farmland pollutes the raw water leading to high operational cost of treatment, efforts to reduce the inorganic pollutants at different level is needed as a part of social campaign.

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

DSWTP majorly receives the complaint regarding the odor in the treated water through telephone, which is acted as soon as possible by the operator. In case of any unresolved or unacted complaints, complainer can further register their complaints to the Customer Relation Office in Hai Phong Water Supply Company.

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

Online monitoring system is needed for the real time monitoring of the water quality at different level to increase the efficiency of the operators.

10. Other highlights

In 2012, the percentage of non-revenue water was 21.0%.

11. Water quality data

All the measured parameter were below the Vietnam standard for drinking water.

Table 6 Water quality data for the year 2014

No	Parameters	Unit	Raw water of He River		Do Son treated water		QCVN 01:2009/BYT - Standard
			Min	Max	Min	Max	
1	Color				<5	<5	*≤ 15*
3	Turbidity	NTU	12.84	16.72	0.18	0.31	*≤ 2*
4	pH		7.23	7.52	7.04	7.36	*6.5-8.5*
5	Total Ca and Mg	$mgCaCO_3/L$	90	156	93	152	*≤ 300*
6	Cl^-	mg/L	35.94	92.21	45.80	87.86	*≤ 250*
7	Permanganate	mgO_2/L	3.06	6.03	0.85	1.78	*≤ 2,0*
8	Mn	mg/L	0.087	0.596	0.007	0.028	*≤ 0.3*
9	Nitrate/N	mg/L	0.442	1.266	0.480	1.335	*≤ 11.36*
10	Nitrite/N	mg/L	0.010	0.116	<0,002	0.013	*≤ 0.91*
11	Total Fe	mg/L	0.104	0.857	<0,02	0.050	*≤ 0.30*
12	Sulfate	mg/L	NA	NA	22.00	54.18	*≤ 250*
13	Residual chlorine	mg/L	NA	NA	0.53	0.73	*0.3-0.5*
14	Total Coliform	MPN/100mL	2956	8422	0	0	*0*
15	Fecal Coliform	MPN/100mL	2956	8422	0	0	*0*

12. Other graphical information

Table 7: Yearly data of the treated water

Year	No. of samples	Turbidity (NTU)	Salinity (mg Cl/L)	Permanganate (mgO2/L)	Free Chlorination	Total Coliform	Fecal Coliform
2010	816	0.32	53.41	1.36	0.7	0	0
2011	806	0.28	44.25	1.28	0.7	0	0
2012	807	0.24	47.56	1.24	0.7	0	0
QCVN: 01_2009/BYT		≤ 2	≤ 250	≤ 2	0.5 – 0.8	0	0

13. 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 of Hai Phong water supply company, Ltd.

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