

Paisadao Water Treatment Plant

Ratchaburi Province, Thailand

1. Background information on the water treatment plant

Paisadao Water Treatment Plant (Paisadao WTP) is situated in the Ratchaburi Province which is located in the central part of Thailand. Paisadao WTP is owned and operated by Provincial Waterworks Authority (PWA) of Thailand, a state-owned company established in 1956. This water treatment plant is one of the 233 water treatment plants under PWA. Paisadao WTP has two treatment units. The first water treatment plant (the conventional system) has the capacity of 13,769 m³/d and was built in 1969. The second water treatment plant (NoxKorea Unit), built in 2014, has the capacity of 1,500 m³/d. The location of Paisadao WTP is 13°36'37.38"N (latitude) and 99° 77'23.08"E (longitude).

Table 1 Overall information of Paisadao water treatment plant

Constructed Year	1969
Water Source	Paisadao water treatment plant reservoir
Number of connections	12,766
Peak Operating Flow (m³/h)	890
Operating capacity (m³/d)	13,769
No. of operators working at the plant	3
Treated water standard	Provincial Waterworks Authority (2007)
Automation	No
Date of access of the source information	2016
Reference	Paisadao WTP office (2016)

In 2016 Paisadao water treatment plant supplied 13,769 m³/d of tap water to 12,766 households of Pak Tho district, Ratchaburi province. The main characteristics of treatment process are hydraulic mixing, mechanical sludge collector system, fine sand filter, and water backwash with surface washing.

2. Water treatment process flow

The major water treatment unit processes are presented as below (**Figure 1**):

- ❖ Paisadao water treatment reservoir → Raw water pumping station → Hydraulic mixing (alum and chlorine) → Flocculation (Horizontal baffled channel type) → Sedimentation (rectangular, mechanical sludge collection with tube settler) → Rapid sand filters → Disinfection (chlorine) → Clear Wells → Elevated tank
- ❖ Sludge treatment: Sludge generated from sedimentation and backwashing are drained to a sludge pond

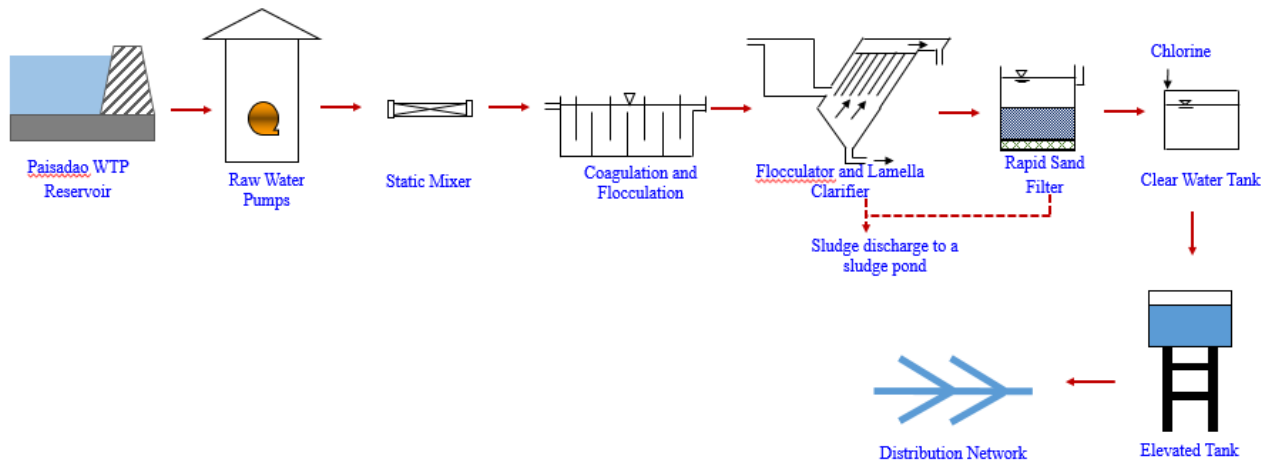


Figure 1 Paisadao water treatment system flow diagram

2.1 Water intake

The water source for Paisadao WTP is Mae Klong River which flows through an irrigation canal 19L-1R into a Paisadao water treatment plant reservoir. The reservoir located within the periphery of Paisadao WTP functions to collect water during the dry season. However, it also functions as pre-sedimentation unit improving the intake turbidity of the Paisadao WTP.

2.2 Chemical used

Two kinds of chemicals are mainly used for water treatment: powder poly aluminum chloride PAC (used as coagulant) and liquid chlorine (used for pre-and-post chlorination). Powder PAC is firstly dissolved in water in the solution tanks and then transferred to the storage tank (**Figure 2**). Chlorine is used in the form of liquid chlorine for pre and post chlorination, in a 100 kg container (**Figure 3**). The plant average uses 1 kg/h of chlorine and 150 kg/d of alum to treat the water. Lime is rarely used because pH of water is in the range 6.5 to 8.5.



Figure 2 Alum solution tank (left) and storage tank (right)



Figure 3 Chlorine containers

2.3 Hydraulic mixing

Alum, chlorine, and lime are injected through a static mixer in inflow pipeline (**Figure 4**). The main purpose of pre-chlorination is to prevent algae growth in flocculation, sedimentation, and filter basins.



Figure 4 Static mixing of alum, lime, and pre-chlorine

2.4 Flocculation

Paisadao WTP consists of a horizontal baffle (**Figure 5 and 6**) for the flocculation. There are four units of flocculation tank. It has the retention time of 20 to 30 minutes.



Figure 5 Baffle channel type

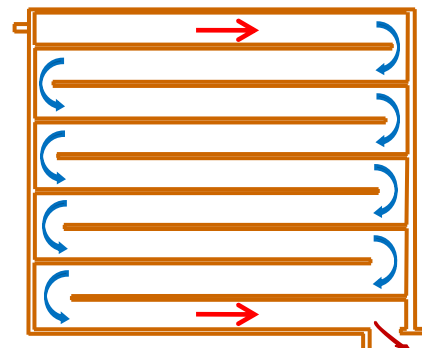


Figure 6 Horizontal baffled channel type (plan)

2.5 Sedimentation

The effluent from the flocculation unit flows to the sedimentation unit which is rectangular in shape and is equipped with tube settler to increase the settling capacity of the basin. The tubes are inclined at 60° and are adjacent to each other. The retention time in the sedimentation unit is 2 to 4 hours.



Figure 7 WTP sedimentation basins

2.6 Filtration

The media utilized in rapid filters is a fine sand with an effective size of 0.45 to 0.7 mm and filter depth of 0.6 to 0.7 m. Backwash process utilizes elevated tank which is filled with pumped clean water and used for backwashing the filter. Average filter run time is of 4 days.



Figure 8 Filter Tanks

2.7 Clear water tank

Paisadao WTP consists of two clear water tanks with the storage capacity of 1,000 and 2,000 m³. Furthermore, it has an elevated tank with the volume of 300 m³ to distribute the water in Pak Tho district. The elevated tank can save the power consumption by using a gravity force to distribute water to consumers with terminal pressure is 1 kg/cm².



Figure 9 Clearwater tank at Paisadao WTP



Figure 10 Elevated tank at Paisadao WTP

2.7 Sludge pond

Sludge which is blown from the sedimentation tanks and filtration tanks is released to a sludge canal and flown into a sludge pond at the periphery of Paisadao WTP. Dredging the sludge pond is handled by a private company when the sludge pond is shallow.



Figure 11 Sludge canal



Figure 12 Sludge pond

3. Explain, what aspects of treatment processes pose most difficulty in terms of daily operation

Usually, the backwashing should be done every day. However, due to low turbidity in raw water and operation policies, backwashing is performed in 3 to 4 days interval.

4. Explain, what aspects of water services management, in general, pose most difficulty at the moment

Inadequate raw water supply has resulted in not meeting the required water demand. Especially in dry season, it is difficult to continually supply water to consumers when the water level in the reservoir is less than 1 m. The raw water pump cannot work properly if inadequate raw water level. However, the reservoir can serve water 2 months during the dry season. Thus, Paisadao WTP has to reduce distribution pressure in pipelines depending on end-user activities. Normally, the water is supplied at 2.8 kg/cm² but during the dry season, the pressure is reduced.

5. Measures taken to cope 3 and 4

During the dry season, the raw water is pumped from the irrigation canal when the water level is lower than the inlet pipe. The pump station is located opposite to the Paisadao WTP.



Figure 13 Pump by the irrigation canal (left) and irrigation canal 19L-1R (right)

6. Recent investment made for the plant's improvement

Recently, Nox Korea has piloted a high-rate sedimentation filtration system which can treat 1,500 m³/d of water. It uses an advanced patented technology to treat the water. Low retention time, low land requirement, high pressured filtration, etc. are the highlights at this system.

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

Besides the addition of the new unit (high-rate sedimentation filtration system) as mentioned above, no other advanced technology are in place.

8. Other Highlights

Two kinds of chemicals are usually used: alum and chlorine. Alkaline chemical (lime) is not used in the treatment process because water quality is in the standard (pH 6.5-8.5).

Laboratory facility is equipped to measure simple parameters only (pH, turbidity, jar-test and residual chlorine). Nonetheless, bimonthly monitoring of major parameters is done by PWA mobile laboratory team.

9. Water quality data

The data of water quality were obtained from PWA head office (**Table 2**). All measured parameters are under PWA standard.

Table 2 Water quality data

Parameters	Unit	Raw water (2016)		Treated water (2016)		PWA Standard (Thailand)
		Min	Max	Min	Max	
pH	-	6.07	7.45	6.1	7.4	6.5-8.5
Temperature	°C	29.8	30.0	33.6	34.2	-
Turbidity	NTU	30.4	40	1.08	2.50	5
EC	µs/cm	303	390	-	-	-
Alkalinity	mg/L as CaCO ₃	90	100	50	90	-
Iron	mg/L	0.2	0.5	0.1	0.2	0.3
Manganese	mg/L	0.38	0.40	0.08	0.14	0.3
UV ₂₅₄	cm ⁻¹	0.071	0.079	0.028	0.036	-
Residual chlorine	mg/L	-	-	0.05	1.30	-

10. References

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