Sang-Jani Water Treatment Plant
Islamabad, Pakistan

1. Background Information

Sang-Jani water treatment plant (SJWTP) is managed by the Capital Development Authority (CDA), Islamabad. It was constructed back in 2000 and has the design capacity of 196,000 m^3/d. SJWTP currently supplies treated water to the citizens of Islamabad and Rawalpindi. It intakes water from the Khanpur Dam which is situated about 40 km away from Islamabad Capital Territory in the village of Khanpur, Khyber Pakhtunkhwa. It supplies treated water to the citizens of Islamabad and Rawalpindi. The dam was completed in 1983 and has the storage capacity of 140 MCM.

The construction of SJWTP initially started in 1992 and the project was completed in 2000 with the total project cost of 6818.52 Million Pakistani Rupee. The total area of the treatment plant is 2.3 km^2. Currently, the plant is operating with the capacity of 98,420 m^3/day.

Table 1 Overall Information of Sang-Jani Water Treatment Plant

Constructed Year	2000
Water Source	Khanpur Dam
Design capacity (m^3/d)	196,000
Operating capacity (m^3/d)	98,420
Topography	Plain/Tropical
No of Connections	1200
Date of access of the source information	15 May 2016

Figure 1: Sang-Jani Water Treatment Plant

2. Water treatment process flow

The overall process for purification of raw water is basically done through coagulation, flocculation and sedimentation process. Raw water diverted from the dam is received in the 'receiving well' which is then sent to the alum mixing basin. Alum is well mixed with raw water with the help of rotating blades in alum mixing chamber from where it goes to coagulation chamber. Flocculation is being done with the help of baffles by providing zig zag path to the water for better mixing of alum and agglomeration of particles so that they can easily settle down in sedimentation basin. The water then undergoes filtration at the rapid sand filters for further purification. Finally chlorination is done at the end of the treatment process before distribution.

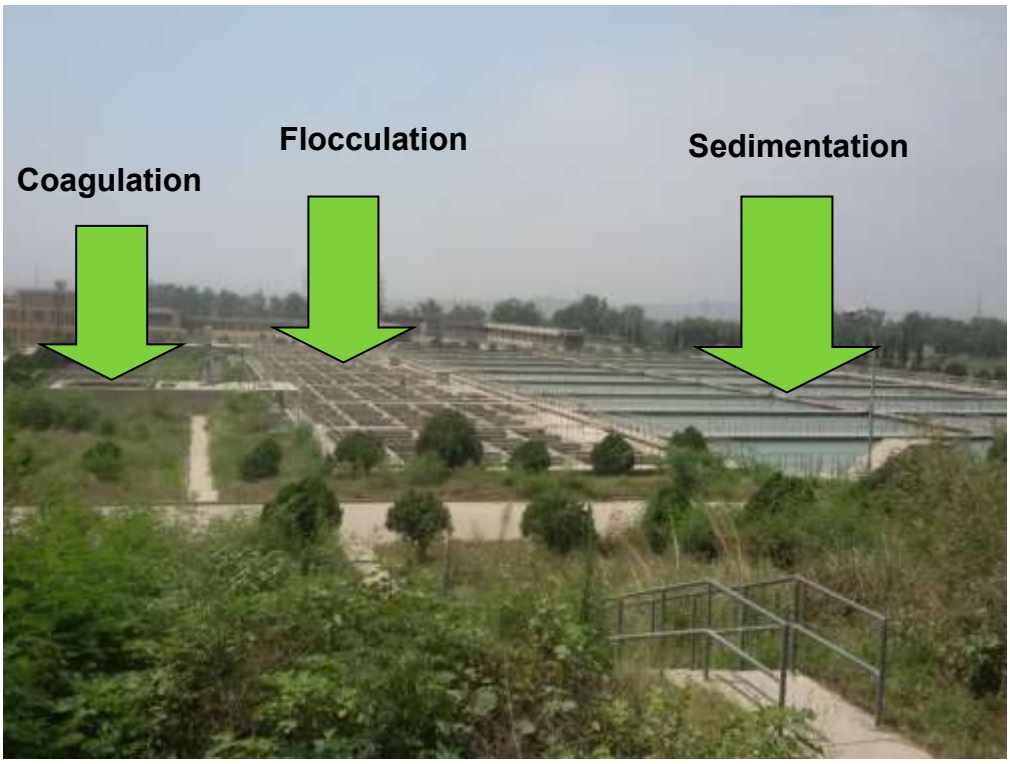

Figure 2: Treatment units at SJWTP

The major water treatment process at SJWTP includes:

Raw water extraction → Screening →Coagulation → Flocculation → Sedimentation → Rapid Sand Filter → Disinfection → Storage → Distribution.

Sludge generated from sedimentation tank and filtration backwash is sent to Sludge Lagoon. The backwash water is then recycled back to the receiving pond, whereas the settled sludge is disposed to 'Nullah' which is a rainwater fed natural stream flowing through the city through the valve.

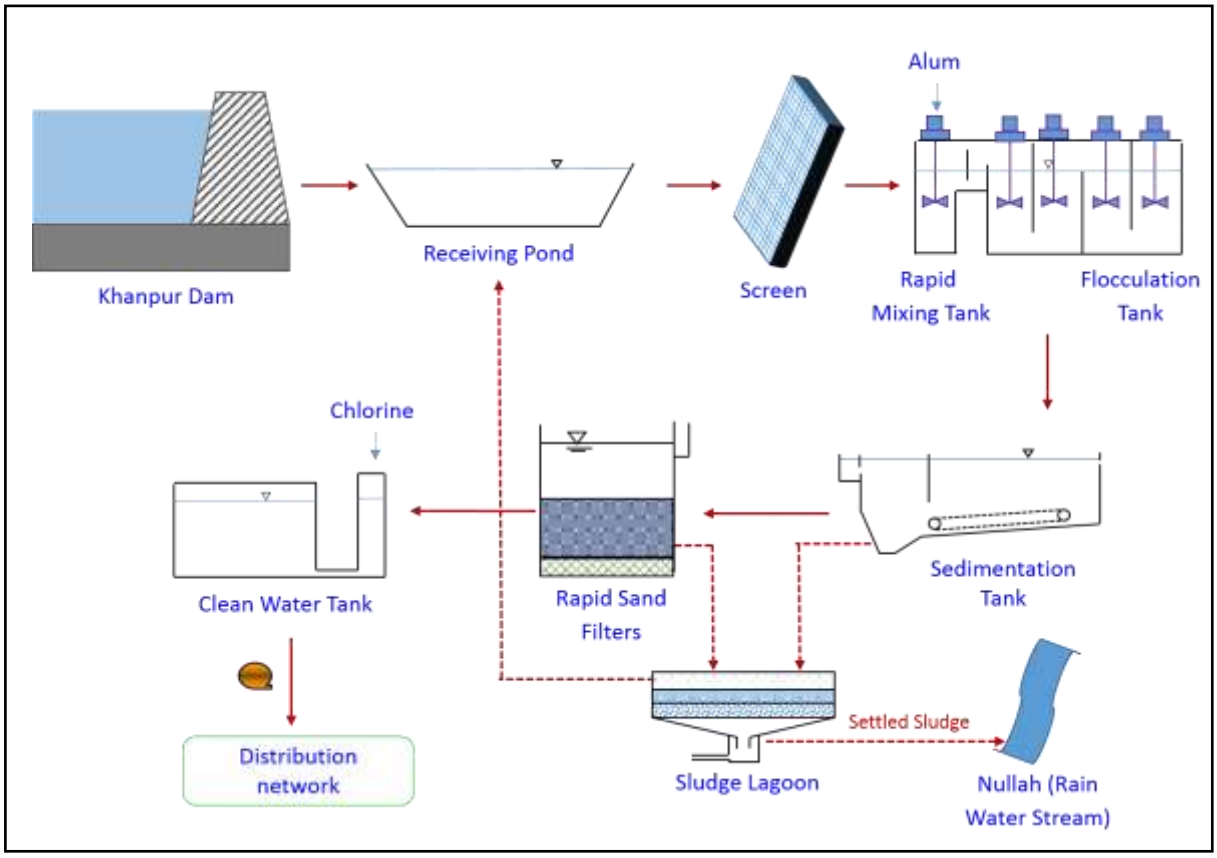

Figure 3: Schematic Diagram of Water Treatment Processes

2.1 Screening

Water from the Khanpur dam is conveyed to the receiving well **(Figure 4)** through pipes utilizing the gravity flow. Receiving well is equipped with the screen and it functions to remove the large floating materials, plastics, leaves, etc. from the raw water.

Figure 4: Receiving well

2.2 Chemicals

Chemical used in the SJWTP are the alum for the coagulation and chlorine for the disinfection. The gas chlorine concentration of 1.2 to 2 mg/L is maintained at the source. Alum is used as coagulant if the turbidity is above the threshold of 30 NTU and the dosing rate is determined through the Jar test.

2.3 Alum mixing chamber

To remove the suspended particles in the form of turbidity, alum is added in water. There are 6 motors equipped with the rotating edge blades which ensure the mixing of alum in the chamber. The alum dosing rate is determined based on the 'Jar test.' However, when the turbidity is less than 30 NTU, alum is not added in the treatment process.

Figure 5: Alum mixing chamber

2.4 Coagulation Chamber

Alum mixed water is then conveyed to the coagulation chamber (two units) which has the HRT of 1.5 minutes. The minute particles form micro-flocs in the coagulation chamber.

Figure 6: Coagulation chamber

2.5 Flocculation

The micro-flocs from the coagulation chamber further agglomerate to form flocs in the flocculation chamber. The water from the coagulation chamber is passed through the zig-zag path created with the use of baffles in this chamber. There are 8 units of flocculation chamber and the chamber has the hydraulic retention time of 29 minutes.

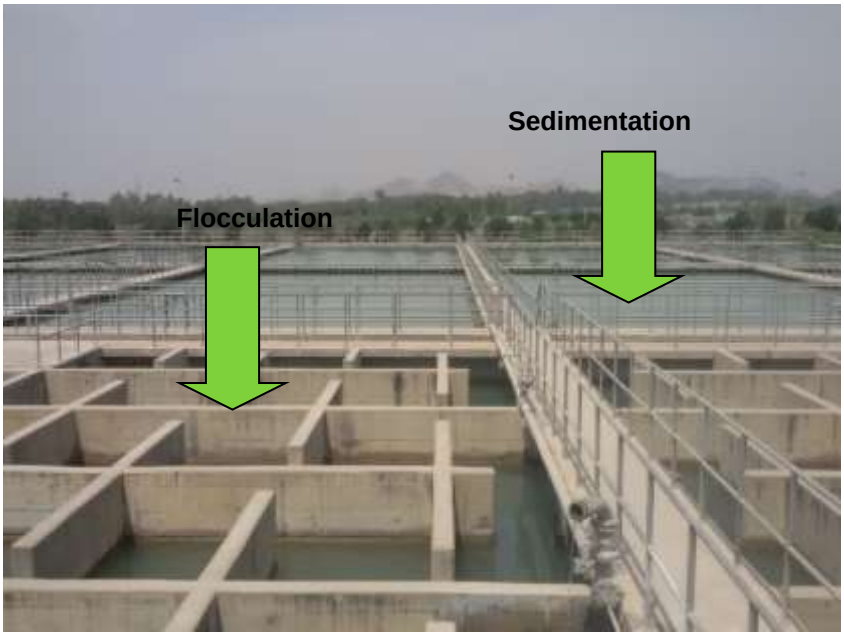

Figure 7: Flocculation and sedimentation basins

2.6 Sedimentation

Large flocs are removed by gravity settling, in the process of sedimentation. There are 8 units of rectangular sedimentation basins which have the surface loading rate of 1.3 m/h. The sedimentation basins have the velocity gradient of 0.6 m/min and the HRT of 149 min. Clearwater goes for further purification while settled sludge with the help of sludge wasting valves is removed from the sedimentation basin. The discarded sludge is transferred to the sludge lagoon.

2.7 Rapid filtration tank

This unit process further treats the effluent from sedimentation basin. The rapid sand filtration process is used for the filtration. The media utilized in the rapid sand filter is silica sand with the effective size of 0.6mm and filter depth of 0.76 meters. There are 20 filter beds at the SJWTP with an individual filtration rate of 5.3 m/h. When sand is clogged and head loss increases, backwashing is performed for the smooth operation of the filter bed. Backwashing is done with the help of air scouring and water wash. It takes approximately 10 to 20 minutes for the backwashing process with the backwashing rate of 0.6 m^3/m^2.min. The backwash water is then sent to the sludge lagoon.

Figure 8: Rapid sand filter

2.8 Disinfection process

To kill the virus and bacteria from the water and to make it potable for the public supply, liquid chlorine is used and the chlorine dosage varies from 1.5 to 2 mg/L depending upon the level of contamination. Only one chlorinator is functional at SJWTP and the chlorine contact time of 20 minutes is maintained. The residual chlorine of 0.2-0.5 mg/L is maintained for the treated water.

Figure 9: Chlorinator

2.9 Purified water storage tank and Distribution

Treated water is then transferred to the concrete storage tank. Treated water is then pumped to 19,000 m^3 reservoir at Shah Allah Ditta for Islamabad through 900 mm DIP conduction line. The treated water is also pumped to discharge pool at Tarnol through 1400 mm DIP which is then conveyed to 38,000 m^3 reservoir at Tomar under gravity flow for the people of Rawalpindi. The reservoir at Shah Allah Ditta distributes water to the residents of Islamabad city with the help of transmission line of 6960 m* 900 mm while the citizens of Rawalpindi city receives water from Tomare reservoir through the transmission line of 6200 m* 1400 mm. The residual chlorine at Shah Allah Ditta and Tomare is 0.8 & 0.6 mg/L respectively

Figure 10: Clearwater storage tank and pumping station room

2.10 Sludge disposal

The sludge lagoon functions to settle down the muddy water and has a very short retention time. The water is then recycled back to the receiving well whereas the sludge is disposed to the nearby Nullah (Rainwater stream).

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

- The treatment plant lacks a sludge treatment unit. The settled sludge from the sludge lagoon is disposed of manually with the help of a valve to the nearby stream.
- Inorganic pollutants from the cement factory located upstream pollute the raw water

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

A lot of treated water is lost in the distribution line in the form of Non-Revenue Water. Illegal connections on the line are the main reason for high NRW. The distribution network is good but the problem of illegal connections is the main issue. Additionally to increase the water pressure, the some of the customer use motors to pump the water. The distribution line is also old and needs frequent repair.

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

To remove or reduce the illegal connections on the distribution line, security guards are hired.

6. Recent investment made for the plant's improvement

No recent improvement for the plant rehabilitation and up-gradation have been made.

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

Treated water from the SJWTP meets the WHO and Pak (NEQS) Water Quality Standards, but the problem lies in the distribution network. Intrusion of sewage water in the distribution line are also recorded. Hence, distribution network needs to be upgraded and proper monitoring is required.

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

Customers are satisfied with the quality of water but not with the quantity of water. Due to the high population growth and high per-capita water consumption of the Islamabad and Rawalpindi, the quantity of the supplied water is often the issue from the consumer end.

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

The operator can monitor the operating condition and troubles online through the use of SCADA.

10. Water quality data

At SJWTP, quality of treated water is based upon following parameters. In the laboratory, daily analysis of different parameter is done at inlet and outlet to ensure the palatable water.

Table 2 Raw water and treated water quality

No.	Parameters	Unit	Raw Water		Treated Water		Standard (Pak-EPA)
			Min	Max	Min	Max	
1	Hardness	mg/L	120	200	95	185	<500
2	Turbidity	NTU	10	750	0.25	1.3	5
3	pH		6.2	7.5	7.18	7.25	6.5-8.5
4	Dissolved oxygen (DO)	mgO_2/L	3.5	5	2.8	4.5	6-10
5	Total dissolved solids	mg/L	250	550	110	410	1000
6	Nitrite	mg/L	10	25	1.5	2.5	<3
7	Total Residual Chlorine	mg/L	NIL	NIL	0.5	1.2	0.5-1.5
8	Fecal Coliform	CFU/100mL	35	155	NIL	NIL	NIL

11. References

Ali, A., Hashmi, H. N., Baig, N., Iqbal, S., & Mumtaz, K. (2012). Performance evaluation of the water treatment plants of Islamabad Pakistan.*Archive Environmental Science*, *6*, 111-117.

Prepared by:

Saimar Pervez
Assistant Director Water Quality
Water and Sanitation Agency (WASA), RDA

Date: 29 March, 2016

URL: http://www.jwrc-net.or.jp/aswin/en/newtap

Email: newtap@jwrc-net.or.jp