Effective and stable water purification system in a mountain area

Y. Ishii*, T. Kubota**, A. Iwamura

* Bureau of Waterworks, Tokyo Metropolitan Government, 491-4 Kotaba, Okutama-town, Nishitama-gun, Tokyo, JP
ishii-yoichiro@waterworks.metro.tokyo.jp
** kubota-tadahito@waterworks.metro.tokyo.jp
*** Atsushi_Iwamura@member.metro.tokyo.jp

INTRODUCTION

Tokyo Waterworks has worked to expand their utilities through Metropolitan water unification. Reasons for this are the increasing demands of water that have followed explosive population growth from the 1960s onwards, and for the reduction of disparities in price standards and facility maintenance conditions that can be seen across different wards, cities, towns, and villages.
As a result, the supply area has grown to reach around 1,200 km² (90 km east and west, 30 km south and north) and the supply population has reached up to around 13 million people. In turn, this service area features a diverse range of topography, from urban areas lined with buildings to quiet residential areas, all the way to mountainous regions that boast an abundance of nature.

In view of a business entity that aims for expansion and the upgrading of deteriorated facilities, we will propose a model here for the streamlining of treatment systems and the stabilization of water supply in small-scale service areas of mountainous regions. This will be based on a case study of the upgrading of purification facilities and intake facilities in the town of Okutama (**Figure 1**), which is situated in a mountainous region in the western part of Tokyo.

Figure 1－The Whole View of Tokyo

Policies of streamlining water treatment systems

Features of Okutama's geography and waterworks facilities

1) The administrative division is mostly mountainous. (Figure 2)
The service area is small-scale and divided into many parts due to steep mountains and deep valleys.

2) There are large differences in elevation within the service area.
There are many additional facilities for adjusting pressure.

3) Raw water uses the surface water of rivers. (Figure 3)
When raining, there can be sudden rises in raw water turbidity due to the inflow of earth. (Figure 4)
Inflow and accumulation of leaves and earth risks intake equipment blockage and intake suspension.

Many small-scale waterworks facilities

Examining policies of streamlining water treatment systems

- Streamlining through reorganization of facilities
  ⇒ Difficult due to the geographical conditions of the mountainous region.
- Large-scale upgrade
  ⇒ The whole town area is a national park, so compact facilities in harmony with the surrounding environment are best.

For the streamlining of treatment systems, the streamlining of each facility's maintenance control is necessary.

- Automation of operation control and maintenance control.
- Filtered water turbidity control that is stable and reliable.

Figure2－The Whole View of Okutama

Figure3－ Water intake location during normal period

Figure4－ Water intake location during period of high turbidity

Figure5－ Accumulation of fallen leaves

Proposed model

1) Membrane filtration method [water treatment] (Figure 6)
- Able to arrange within small-scale structures
- Easy automatic operation and remote control
- Able to handle high turbidity in raw water

Figure6－ Membrane filtration equipment (inorganic MF membrane)

- Sedimentation basin function able to be substituted with auto strainer - economic usage of site. (Figure 7)

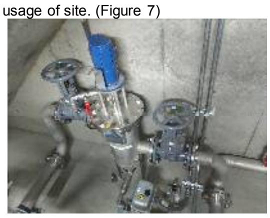

Figure7－ Auto strainer

2) Maintaining centralized monitoring control system*
- Constant monitoring of equipment
- Easy organization and visualization of data
- Unified management of scattered facilities (Figure 8)

Figure8－ Centralized monitoring control GUI

*Implementation is on the assumption of each facility's electrification. To prepare for power cuts due to electrical line damage caused by lightning or fallen trees, the introduction of backup equipment needs consideration.

3) Efficient usage of potential energy (Figure 9･10)
- Use elevation contrast from intake to purification facilities in transmembrane pressure difference
- Energy saving of membrane supply pump
- When raw water pressure is large, further utilization of potential energy is possible by installing small hydraulic power generation equipment.

Figure9－ Small hydraulic power generation equipment

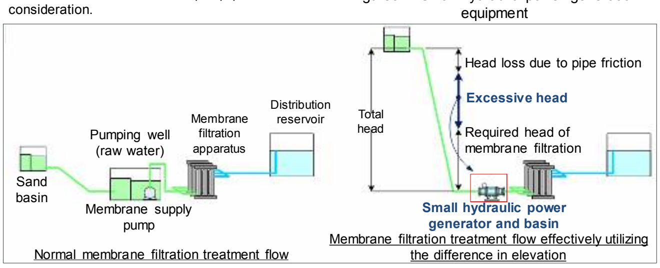

Figure10－ Membrane filtration treatment flow

4) Water screening method [water intake] (Figure 11･12)
- By earth and leaves becoming harder to accumulate, there is substantial reduction of field work.
- Harder to clog up making maintenance work a lot easier

Figure11－ Water screening

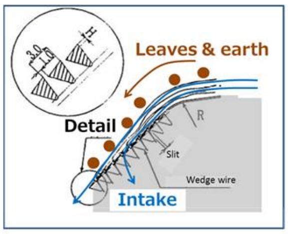

Figure 12 – The water screening mechanism

CONCLUSIONS

At one of the purification plants in the Okutama region, the water treatment system is being updated for the streamlining of maintenance control and the stabilization of water supply mentioned above.

Efforts and results

Efforts	Results
Automating operational control of various equipment at purification plants.	Rapidly gained control of abnormal values and points through real-time data.
Adopting membrane filtration.	Stabilized purification process even with highly turbid raw water (actual value: 50 degrees). *At older facilities (slow filtration), intake is suspended at 5 degrees turbidity.
Adopting water screening.	Inspection and cleaning of intake locations becoming substantially easier. Stable water intake.

Easy maintenance control in waterworks facilities of mountainous regions.

Stable water supply.

Based on these results, we will continue to work towards the streamlining of water treatment systems and the stabilization of water supply at Okutama.