

## Q&A

**11Q6:** We have a problem of Zebra Mussel growing in the water intake pipe. It will make the pipe diameter smaller and generate odor. We want to share your experience for our measures.

**A1:** Hanshin water supply authority (HWSA) had huge outbreaks of golden mussel\* (Limnoperna fortunei) in the intake pipe. HWSA has studied the countermeasures since 1995. Although the type of shellfish is slightly different from that of questioner, surveys and the countermeasures by HWSA are described below.

\*Golden mussel has characteristics similar to zebra mussel. It distributes widely from East Asia to Southeast Asia. (note by WaQuAC-Net)

### 1. Problems caused by golden mussel

- ① Mussels adhering inside a pipe peeled off after their death, and shells were mainly removed out by the screen cleaning machine. In summer, when the amount of dead mussels removed was large, it was necessary to change the operating conditions of the screen cleaning machine. The mussels also accumulated in grit chamber and flocculation basin. It was necessary to dispose of 20 to 50 m<sup>3</sup> shells a year.
- ② Both alive and dead mussels clogged in joints of small pipes (made of vinyl chloride) for water quality monitoring, resulting in decreasing the amount of water. HWSA has installed joint free pipe and strainer.
- ③ As mussels were adhered to water level gauges and protective covers for the screen cleaning machine, the malfunction happened. Then, HWSA cleaned them regularly.
- ④ When the facility was shut down, the accumulated water had septic odor. But it was not appreciable in the water-flowing state.

### 2. Survey of adhesion state

There was concern about further obstructions such as blockage of the intake pipe and conveyance pipe by golden mussel. So, HWSA surveyed the living state of golden mussel from the intake to the water treatment plant.

- ① Although the amount of adhesion changed depending on location and year, mussels mainly adhered to the inside surface of pipes, and no individual mussels adhered each other.
- ② Golden mussels occur in summer and grow to about 18 mm in one year.
- ③ Most of golden mussels which have grown to about 18 mm die. Some grow further to about 30 mm, but they also die in about 2 years.
- ④ There is no need for manual removal because dead mussels peel off after a few months.
- ⑤ The adhesion density at the bend is higher than that of the straight pipeline, and the adhesion

density is low at a flow velocity of 1 m/s or more.

### 3. Countermeasure

Based on the survey results, HWSA has judged that it was unlikely to cause serious problems such as conveyance pipe obstruction. HWSA did not take any special measures. In recent years, the adhesion of mussels and the accumulation of shells have decreased. No damage has been caused by the golden mussels.



However, as there are the regions with different circumstances, HWSA also cooperated the research on adhesion prevention techniques for aquatic lifeforms such as golden mussel. As the result, a countermeasure technology adding silver to the seal coat and applying to the surface of the inner mortar lining, was developed.

HWSA adopts this technology at the rehabilitation of the intake pipe which has operated in 2005. Recent surveys have shown that even in the intake pipe where this measure has been taken, the adhesion of the golden mussel is observed, and although a certain effect can be seen, it has not reached a drastic measure.

(A1, Answerer: Mr. NAGASHIO Daishi, Hanshin water Supply Authority, 2019)

**A2:** Regarding the zebra mussel problem, I provided the questioner suggestions based on the experience of Kitakyushu City Water and Sewer Bureau in Hai Phong, Vietnam as follows:

➤ Short term measure:

Dose 1 mg/L chlorine for 2 days per 1 month

➤ Long term measure:

Change the pre-chlorine dosing point from the receiving tank to the intake point.

This suggestion is based on the result of measures in Hai Phong. Therefore, you use the above value as the initial value, and must determine effective values (frequency, amount of chlorine, etc.) in your case by repeated experiments.

(A2, Answerer: Mr. YAYAMA Masashi, Kitakyushu City Water and Sewer Bureau, JICA Cambodia Expert, 2019)

**A3:** So far, we don't have this problem because our conveyance is open channel. I have heard many waterworks have that problems. Yes, they have to use chlorine routinely and they have to experiment how often to apply chlorine. For example, Singapore New Water doses chlorine once every two days routinely at the intake facilities. I found a report of US cases by AWWA, as follow.

[https://www.awwa-ia.org/assets/Annual\\_Conference/2018annualconference/Presentations/pres-101718-AWWA-IA\\_Annual\\_Conf-ZebraMussel.pdf#search=%27Zebra+Mussel+Issue+in+AWWA%27/](https://www.awwa-ia.org/assets/Annual_Conference/2018annualconference/Presentations/pres-101718-AWWA-IA_Annual_Conf-ZebraMussel.pdf#search=%27Zebra+Mussel+Issue+in+AWWA%27/)

(A3, Answerer: Ms. Siwilai Kitpitak, Metropolitan Waterworks Authority, Thailand, 2019)

**A4:** Excerpt from “Guidebook on water treatment against biological problems”, Japan Water Works Association, 2006, (translated by WaQuAC-Net)

### **Chapter VIII: Problems by Small Animals and Measures, Case study 2.1 -1 Problems by the golden mussel**

There were clogging in piping of water quality monitoring equipment and strainers of sludge treatment facility at water treatment plant, whose water source is Yodo River, belonging to the waterworks department of Osaka prefectural government (now, Osaka Water Supply Authority; OWSA). The cause was shells of the golden mussel according to the result of surveillance. Chlorination and drying at sand washing basin were tried as countermeasures. By the experiments, 100% of golden mussel was died by contact with 0.8 to 1.0mg/L of free chlorine for 9 days. 100% of golden mussel was also died by drying for 6 days.

### **Chapter IX: Measures against Biological Problems in Overseas**

1. Excerpt from “Problem Organism in Water: Identification and Treatment, Second Edition, AWWA, 1995”

#### 1.4 Zebra mussel

**Chemical treatment:** Larva and adult of zebra mussel can be killed by continuous or periodic chlorination. But for usual cases, residual chlorine in wastewater must be eliminated before discharging into the environment. Higher concentration of chlorine restricts biological treatment in slow sand filtration and might cause troubles in odor and taste. Potassium permanganate is effective to raw water containing rich organic matter that can cause trihalomethanes production. Using polymer is also effective to control zebra mussel. Ozone and other oxidizing agents are considered as alternatives of chlorine.

With any method, removing dead mussel and cleaning facilities are necessary not to cause clogging by shells and rotten mussel.

Permission by federal, state, county or municipality government is necessary to use any chemical treatments.

The study on the coating materials to protect attaching or colony forming without any toxic substance is implemented.

**Physical treatment:** Heating treatment with higher than 40°C for hours, generally more than 1 hour, treatment of reducing dissolved oxygen with sealing the intake facility for several weeks, ultrasonic

treatment, and etc. are effective, but extra facilities are needed.

**Mechanical treatment:** Strainer, screen or membrane can be attached to the intake facility.

Attached mussels are removed by manual work or high pressure washing.

Some methods should be combined for effective treatment because there is no method that can ensure any requirements by only itself.

(The responsibility for the excerpt and its translation is on the WaQuAC-Net)