WaQuAC-NET Newsletter

Water Quality Asian Cooperation Network

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For Safe Water, Do Network.

WaQuAC-NET Mini-talk No.7

The water source survey and workshop on the problem of the algae in MWA

On May 10th, 2013, the 7th Mini- talk was held in Tokyo, inviting Mr. Sasaki, staff of Yokohama Waterworks Bureau, as its lecturer. The participants were Mr. Arimura, Ms. Kamegai, Ms. Kawamura, Mr. Kudo, Mr. Horie and Ms. Yamamoto.

In MWA, since the flood in 2011, many algae had grown in the raw water canals, and they caused the problems in water purification. So, WaQuAC-NET has been cooperating for sending a expert and exchanging technology for measures of algae problems.

In this year, experts were requested to be dispatched during the period algae are growing. So Mr. Sasaki and Mr. Inoue from Yokohama Waterworks Bureau went to Thailand from April 21st to May 6th to take a water source survey and hold a workshop there. Mr. Sasaki, having just returned from Bangkok, made a report of their activities.

In early April, Ms. Sivilai (Director of Water Quality Development, Water Quality Department of MWA) asked in an e-mail, "Algae bloom have occurred! When are you coming!? I think it's now!" Because we had waited for the news eagerly, we immediately started to prepare for visiting Thailand. We supposed we could get prepared in a week, but we couldn't get air tickets to Thailand from Japan because of Thai Water Festival. Finally, we could leave for Thailand via Seoul, Korea and arrive at Bangkok in midnight of April 21st. On the next day, April 22nd, we had courtesy calls to executives and a meeting with MWA staffs. We discussed survey process.

I made a point of a survey to headwaters of Chao Phraya River in order to solve the fundamental problem. But MWA staff made a point of a survey on salinity intrusion and algae moving state at downstream area of Samlae Intake and survey on algae moving state between Ayutthaya and Samlae Intake in order to solve the immediate problem. Eventually, I accepted MWA's opinion and took a tough survey.

We took a water source survey in twice, on April 23rd and 29th. Then, since the discharging water from the dam above Chao Phraya River was limited, water level of the river was fallen and sea water flowed into the river. So, there were both of fresh water algae and marine algae.

Taking water samples by the speed boat borrowed by Royal Irrigation Bureau

On April 23rd, we took a survey in the downstream area. The sampling points were No.1: Samlae Pumping Station which pumped up water from Chao Phraya River to a raw water canal (96km far from its estuary), No.2: the canal (1 km downstream from Samlae Pumping Station), No.3: from a boat (71 km far from its estuary), No.4: from a boat (40 km far from its estuary) and No.5: (54 km far from its estuary). The sample water was obtained at the depth of 15 m and surface layer as the water depth of Chao Phraya River was approx. 27 m.

On April 24th, the workshop was organized with 5 young staff of each purification plant and water quality center. Then, we identified the samples taken on April 23rd with microscopic examination together and provided directions for the questions. And we shared questions and answers. In the results of identification, we could find *Chaetoceros*, which were diatoms grown in sea area.

Moreover, a lot of diatoms *Cyclotella* were found at deep layer of the river. They were mostly not living cells but dead cells. I think that the fresh water algae flowed down from the upstream area and were killed, because concentration of salinity was increased due to salinity intrusion. It is said that *Cyclotella* causes some problems of coagulation and sedimentation process, sand filter clogging, taste and odor, passing through filter and turbidity. But in my experience, problem of sand filter clogging was unlikely to be happened.

On April 29th, we took samples in Samlae Pumping Station and 6 sites above the Pumping Station. The most upstream area was an intake point of Ayutthaya PWA (Provincial Waterworks Authority), which was 149 km far from its estuary.

On April 30th, May 1st and 2nd, we identified the samples and discussed. We could find a lot of *Aulacoseira* in upstream area of Samlae Pumping Station. Moreover, in Pa Sak River flowing into the Chao Phraya Dam above Ayutthaya, *Aulacoseira* were found. It is supposed that eutrophication happened in the dam lake. As the reason for the eutrophication, pollution by sewage could not be its cause because there was no large city above the dam. But in the upstream area, there were farms which were developed by deforestation, so a lot of soil and fertilizer might flow off from there with rain. *Aulacoseira* causes the problem of coagulation and sedimentation process, sand filter clogging, passing through filter and taste and odor, but generally it is easy to settle them down by coagulation.

Until now, we have thought the reason why algae bloom occurred was the pollution of raw water canal by the Flood Crisis in 2011. But in this survey, we thought that the eutrophication occurred in the dam lake located at the upstream of the river. The algae grew there and flowed down into the downstream area.

There is a possibility that occurrence of the algae had happened even before the Flood Crisis in 2011. So we should take a survey in more upstream area of the river.

Sampling at Bangkhen Water Treatment Plant (the capacity is 3.6 million m3/day, treatment process are clarifier and two-layer sand filtration both anthracites and sand) were taken in the intake of raw water and both of influent and effluent of sand filter on April 25th. We identified the samples on the following day. I was concerned about geosmin because I felt musty odor when we took samples near the sand filter.

Mr. Eyick, a participant of the workshop, also felt same odor because he learned about musty odor in Yokohama. But other people couldn’t feel the difference between musty odor and odor of chlorine.

On May 3rd, the last day of the workshop, we held a seminar twice on the countermeasure against the water treatment problem by algae with the young staff of MWA and university students on internship in the morning and with Vice Governor of MWA and senior staff in the afternoon. Particularly, we actively discussed in the afternoon seminar, so I felt their highly interest in the problems caused by algae.

Identification of algae by all participants of the

-Suggestions-

1) The survey on eutrophication in the upstream dam lake is needed. So I want staff of MWA to have more interest in the eutrophication.

2) We could take a survey with borrowing a boat as the cooperation of Royal Irrigation Bureau. They manage Chao Phraya River and the upstream dams, so MWA should make up the framework for cooperation on a water source survey.

3) I think practice or OJT in workshop was very effective; all participants examined the same samples by microscope at the same time. Moreover, I answered each question immediately, and we shared the information. It enabled the participants to discuss actively each other, which was practical and effective.

4) I suggested to MWA as follows; you should change a generic term from *Melosira* to *Aulacoseira*, the number count from the number of colonies to the number of cells and count unit from 100 ml to 1 ml. But to avoid the confusion of staff, it is better to adopt the change next year.

5) We should consider the maintenance and control method for sedimentation basin and filter (including filter washing).

6) In addition to filter clogging, possibility of occurrence of the musty odor is increased. We should identify *cyanobacteria* (blue green algae), and make a training course for countermeasure against the odor.

As the 3rd training program for MWA, we are receiving 2 trainees in Yokohama in June. After that, we don't have any plan. But technical transfer for biological issue doesn't complete yet, because two weeks training is too short to acquire the technology. So I hope that we keep the good partnership, and continue the training and joint survey.

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Why are they so active!?

- Local activities specializing in human resource development, the Water Supply Council of Iwateshiwa-area -

Mr. Gensuke ARIMURA,
Water Supply Network News

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1. What is happening at the area adjacent to Morioka City?

"The Water Supply Council of Iwateshiwa-area" is a group organized by Waterworks bureaus of municipalities. Members of the council are Hachimantai City, Iwate Town, Kuzumaki Town, Shizukuishi Town, Shiwa Town, Yahaba Town and Takizawa Village; totally one city, five towns and one village. However, there is no doubt that you cannot grasp their locations if you are not from these areas. These municipalities are adjacent to Morioka City, and surrounding Morioka City from North-east to Southeast by anticlockwise. Namely, these municipalities did not choose the way of municipal merger to Morikoka City at the "Large merger of Heisei".

Mr. Gensuke Arimura

Introducing a concerning topic, Takizawa-Village is the largest village in Japan whose population exceeds 53,000 and is planed to be upgraded to a city. This will be the second case for upgrade from a village to a city after Tomigusuku City, Okinawa Prefecture under present Local Government Act. Although this may not be a big topic except for the persons concerned, the “Shiwa area” has become the big center of attention of people concerned about water supply. It is because their study meetings, which are implemented by the council, have been held almost every month and the contents can be reflected to their actual work. Consistent feeling “enjoy as a festival” can make the study meetings active, and those who attend this meeting from Tokyo has been increasing with each meeting. The study meeting has been held more than 100 times until now and, the 100th anniversary meeting was held as a big event beyond just as a lecture on May 16. What does this study meeting mean?

The forum of the study meeting

2. The beginning was just a study meeting

The council was set in 1983, it was thirty years ago, as just a study meeting for the purpose of collecting information and exchanging opinions on a topic of changing type of coagulant from current one to polychlorinated aluminum (PAC) which was spreading rapidly at that time. After the achievement of the original purpose such as procurement of PAC and judgment of the optimal injection ratio, the council had being lost its energy. It shows the difficulty of maintaining study and research meeting in active condition. However, it is a notable point of Water Supply Council of Iwateshiwa-area that the council was successfully regenerated and revitalized from that stagnant situation.

3. Specialization on human resource development, fix of the chairperson and the secretariat

There are three biggest challenges Japan water supply utilities facing: i) steady decrease of revenue from water charge every year due to the aging society with fewer children, ii) serious shortage of experienced staff due to reduction of new employment, iii) aging facilities and delay of rehabilitation of these aging facilities. We are facing the challenge on “human, facility, finance”, which are considered as fundamental resource. It was a turning-point of re-starting the Council that the Council changed its purpose to specialize in education, by regeneration and revitalization of the existing council, to rise up skillful staff who can solve these difficulties. Mr. Ritsuji YOSHIOKA from Yahaba Town and Mr. Toru TANIGAWA from Takizawa Village played a key role for the re-start.

The Council concentrated on the aims “bringing up personnel with high expertise to realize optimal and rational management of the business in each utility” and “bringing up personnel with high capability of policy proposing”, and the chairman was fixed to a person in a manager of Water Supply and Sewage Section in Yahaba Town (currently, Mr. Michiaki FUJIWARA) and the secretariat was set also in Yahaba Town. It was a great significance to fix the chairman and secretariat in Yahaba Town because continuous responsibility has been taken by fixing it. The council which was re-started in 2002 has achieved 10th year and totally reached to 100 times of the study meetings. That is, it has been held by the frequency as almost once a month. On top of that, it is also noteworthy that the council broadly asks for the attendance from companies, and friendly discussion time after the lecture has been an occasion for valuable exchange. In the first part of

100th study meeting, Mr. Jun MATSUAKI, Director of Research Division, JWWA and I had a lecture. In the second part, Dr. Yasumoto MAGARA, Chief Director of Tokiwamatsu Educational Institution had a special lecture. I would like to add that he (Dr. MAGARA) is a leader for many members of WaQuAC-NET and the person who made the current framework of developing countries assistance.

NSF International Visiting

Manabu Sugino
SOUGOUMIZU INSTITUTE Ltd.

I got a chance to visit and see the headquarters of NSF International in Michigan, USA from May 12th to 18th, 2013. NSF International was founded in 1944 from the University of Michigan's School of Public Health as the National Sanitation Foundation.

Mr. Manabu Sugino (In front of NSF)

NSF International is an independent, non-profit organization that aims to protect the environment and improve the quality of life. Specifically, they develop standards for public health and safety, and test and certify whether they meet the standards as the third-party certification body. The service area is wide from water, food, environment, health science and customer products. It has more than 1200 staff including microbiologists, toxicologists, chemists, engineers, environmentalists and public health professionals. They have about 14,850m2 of state-of-the-art laboratory space.

In this visiting, we could hear about the Water Division, and see their laboratory. Since taking picture was not allowed at all, it's difficult to tell about the lab. However, I'm sure that you understand how big the lab is in terms of the previously described number of the space. I've been in PUB's science lab in Singapore for 6 months. The lab was also wonderful. NSF'lab is about 5 times bigger. My first expression was it was a plant rather than a lab. It's possible because of USA that is a wide country. There were many state-of-the-art analytical instruments. The rooms were separated for each instrument as like GC-MS, IC, HPLC and so on. When I saw only instruments that had been set the samples operated in wide unmanned room, I marveled the richness of the space, facility and staff.

Entrance of Headquarters of NSF International

The Water Division certifies specific materials or products that come into contact with drinking water, drinking water treatment chemicals, such as pipes, faucets, jointing, media, paints, as well as pool and spa equipment. It is covered by NSF/ANSI 61 [Drinking Water System Components-Health Effects]. It corresponds extraction test (JWWA and JIS S 3200-7) in Japan. The interesting thing is that Japanese government referred NSF/ANSI 61 and visited several times NFS International when they made JWWA or JIS method. Basic procedure is same, but the major difference is as below. There are several extraction conditions in case of NSF/ANSI 61. Additional analysis item to the regulated analysis items is needed to analyze, and toxicologic staff select the additional item based on formulation information of the product and material. The reason why several extraction conditions are necessary seems to be the national politic factor in US. Each state of US has own law and regulation as well as a policy, for example, chloramine disinfection is adopted in some states and chlorine disinfection is adopted in some states. Therefore, unlike Japan, one testing condition can not cover everything.

We learn a lot from NSF lab, and we continue technical interchange and improve our analysis technology.

Welcome Party for MWA staff

On June 25th, we had a welcome party for Ms. Wichuda Bamrungpon (Wi-san) and Mr. Kitiphat limprasirt (Kau-san) at 49 floors of Shinjuku high building. They are staff of MWA and came to Yokohama for participating in the training on the measures of algae problems from June 16th to 30th. They said two weeks training is so short because they loved Japanese cuisine and life. They also had a fruitful result of biological training by Spartan education (Hard training??) by the lecturer, Mr. Sasaki. They are expected to work as young leaders in water quality field in Thailand. After drunk, Mr. Sakamoto talked to them his experience in Africa and they were interested in Sakamoto's story (JICA volunteer activity in Ghana)

(from left) Sakamoto, Kudo, Kamegai, Yamamoto, Kau, Wi, Yariuchi, Sasaki

Question & Answer Corner

We welcome any opinions, and questions to this Q & A Corner.
Please contact us.

Q: I heard that the problems of filter clogging and taste and odor occurred by bloom of algae which was caused by the eutrophication of water source. I want to know the eutrophication, the influences and measures. (Ms. N.S. Thailand)

A-1: Eutrophication

The closed surface water body such as shallow lake/pond, stagnant river and bay are sometimes polluted by domestic wastewater, industrial wastewater and fertilizer discharged from farm. The state that nutrients like nitrogen and phosphorus are contained excessively in the water body is called eutorophication. Nitrogen and phosphorus are indispensable elements for algae glowing. In case that there is enough sunlight, photosynthesis is accelerated and algae bloom occurs. This phenomenon causes a red tide in sea water or blue-green color in fresh water. A large amount of algae consume dissolved oxygen at night. Also when algae die and sink to the bottom, they consume a lot of dissolved oxygen for their decomposition. And fish and shells get damaged heavily because of lack of dissolved oxygen.

A-2: Influence of eutrophication to water supply system

In case that water source of water supply eutrophicates and algae grow, it causes several problems to water supply system such as 1) taste and odor problem, 2) coagulation and sedimentation process problem, 3) filter clogging, and 4) flow out from tap.

Moreover, concentration of iron and manganese in the bottom layer of water sources increases sometimes.

"the research group for formulating guideline for assessing biological problems in the water treatment process maintenance" was organized by Japan Water Works Association. And the national research for actual cases of biological problems was conducted in 2001~2002 and 188 cases were reported. The results were as follows;

1) Taste and odor problems: 93 cases out of 188 cases were taste and odor problems. About the kinds of odor, 82% was musty and 13% was fishy odor. About the causing algae, most cases were *Anabaena,* followed by *Phormidium*, *Oscillatoria* and *Uroglena* in order.

2) Coagulation and sedimentation process Problems：15 cases were reported. Most of causing organism is *Diatom*, followed by *Cyanophyceae*, (Blue-green algae)

3) Filter clogging problems

48 cases were reported. 93% was *Diatom* as causing organisms. As kind, *Synedra* was main causing organism.

4) Flow out problem

21 cases were reported. As causing algae, a half of them were *Diatom*. The second large numbers was green algae and blue-green algae. By species, *Cyclotella* is 7 cases, *Microcystis* and *pico-plankton* were 3 cases in the report.

- **Increase of iron and manganese concentration**

When the huge amount of algae die and sink to the bottom of water and are decomposed, they consume a lot of dissolved oxygen. Because of it, bottom layer of water body become anaerobic conditions. Therefore iron and manganese contained in the sediments elute from sediments. Concentrations of iron and manganese in the bottom layer water increase. When water utilities take such water without proper treatment, it causes color and taste problem.

A-3：Measures

1) Prevention of eutrophication

＊Preventing inflow of polluted water.

・Set up a meeting of stakeholders related water source.

・Establishing a law on measures for conservation of lake water quality (or an eutrophication control ordinance). Formulating a master plan on eutrophication control (set up the target concentration of nitrogen and phosphorous for target water area based on the law or ordinance)

*Japanese cases: the Ordinance for the Prevention of Eutrophication of Lake Biwa 1980

Law concerning special measures for conservation of lake water quality 1984

・Promoting the development of sewerage system and combined jokaso for preventing or reducing inlet of domestic wastewater.

・Promoting eco-life style Promoting industrial wastewater treatment system

・Promoting livestock wastewater treatment system

＊Preventing the elution of nutrients which contained in the sediments of the bottom of lake/pond.

・Dredge of the bottom sludge.

2) Control of algae grown by eutrophication at water source

＊Chemical spray

Chemicals usually used for water source are cupper sulfate and chlorine agents. Cupper sulfate is particularly effective to algae. Chemicals must be sprayed carefully as not affecting fishery or agriculture.

＊Forced circulation of lake/pond water

・Methods are intermitted aero-hydraulic gun method, diffusing pipe method and etc. It is a procedure to circulate the lake water in order to spread the algae which are grown in the upper layer to lower layer for delaying the algae growth. At the same time, the dissolved oxygen was sent into lower layer and it prevents the dissolution of iron and manganese from bottom sediment.

＊ Lake/pond surface shading

・Method is to shade sunlight by use of light shielding plates which float on a part of surface of lake/pond. Algae move under the plates. As result, their growth are controlled.

3) Measures for reducing the amount of algae which come into raw water

＊Reducing or stopping taking water

＊Mixing with another water source

＊Selective intake

- This method is to avoid troubles by selectively taking the water which algae do not exist or present at low concentration by means of changing depth of water taken; for this purpose, intake tower which has multiple intakes at different depth is used.

4) Algae removal by water treatment process

＊ Microstrainer

- To remove the algae by a filter device

＊ Aeration (Air stripping)

- To release the taste and odor-causing substances into the atmosphere by blowing air into the raw water.

＊ Flotation

- To remove floc of algae with fine air bubble by flotation because it is difficult to remove the algae by sedimentation.

＊Powdered activated carbon

・To adsorb taste and odor-causing substances.

＊Stop of pre-chlorination

・Most taste and odors-causing substances remain within the algae in the early stage of growth. At that time, the taste and odor-causing substances are eluted by dosage of chlorine. Therefore, pre-chlorination should be stopped so that the algae with the taste and odor-causing substances can be removed by coagulation and sedimentation process. However, in the period of decline in growth of algae which generate taste and odor-causing substances, most taste and odor-causing substances are discharged to the outside of the algae. In order to remove the eluted taste and odor-causing substances, adsorption treatment by activated carbon is necessary.

＊ Improvement of coagulation and sedimentation.

・Increase of dosing rate of coagulant or change of coagulant

・pH decrease procedure at coagulation (Acid dosage)

・Two stage coagulation (re-coagulation)

＊Countermeasure at filtration process

・Change of back washing cycle of filter：It is a procedure to wash a filter by less amount of water at higher frequency for preventing filter clogging. The longer surface washing of filter is recommended.

・Change of back washing rate：To increase filter washing rate (flow speed) temporally and remove the abnormal floc accumulated on the surface of the filter..

5) Countermeasures against algae grown in water treatment plant

＊Low concentration or intermittent dosage of pre-chlorine

＊Shading of sedimentation basin and filter basin

・Covering, shading sheet, green color filter, etc.

6) Installing advanced water treatment system

＊Biological treatment

- Contact filter media which has several kinds is installed in treatment tank so that microorganisms can grow on the surface of the media. Raw water is cycled in the tank and contacted with microorganisms to be treated. It is effective for decreasing ammonium nitrogen, general bacteria, manganese and taste and odor-causing substances.

＊Ozonation

- Ozone is strongly oxidative, so it is effective to reduce taste and odor substances. But ozonation forms by-products as well, so it requires granular activated carbon process after ozonation.

＊Granular activated carbon treatment

- Activated carbon removes taste and odor substances using its adsorption capacity. Adsorption capacity is limited. It is necessary to change activated carbon when adsorption capacity is lost. The biological activated carbon treatment, which is bred microorganisms in activated carbon, uses a biodegradation capacity and can keep adsorption capacity for a longer time. Before this treatment, chlorine cannot be used because microorganisms are killed. Several advanced water treatment methods are used usually in combination.

＊a part of A-2 and A-3 were quoted from "Handbook for Preventive Water Treatment against Biological Problems" (Japan Waterworks Association, March 2006)

Ms. Yamamoto Keiko (WaQuAC-NET Office)

Introduction of New Members

- Mr. N.M. Abdul Matheen (Sri Langka)
- Mr. Kitiphat Limprasirt (Thailand)
- Ms.Wichuda Bamrungpon (Thailand)

◎We welcome new members anytime◎
Please contact us

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