

Q&A

12Q5: 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 about 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 eutrophication. Nitrogen and phosphorus are indispensable elements for algae growing. 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.

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) problems of coagulation and sedimentation process, 3) filter clogging, and 4) flow out from tap. Moreover, 5) 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) Problems of coagulation and sedimentation process: 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 were green algae and blue-green algae. By species, *Cyclotella* is 7 cases, *Microcystis* and pico-plankton were 3 cases in the report.

5) Increase of iron and manganese concentration:

When the huge number 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.

3. Measures

1) Prevention of eutrophication

1-1) 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: 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

1-2) 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

2-1) Chemical spray

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

2-2) 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.

2-3) 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 number of algae which come into raw water

3-1) Reducing or stopping taking water

3-2) Mixing with another water source

3-3) 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

4-1) Micro-strainer

- To remove the algae by a filter device

4-2) Aeration (Air stripping)

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

4-3) Flotation

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

4-4) Powdered activated carbon

- adsorb taste and odor-causing substances

4-5) 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.

4-6) 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)

4-7) 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

5-1) Low concentration or intermittent dosage of pre-chlorine

5-2) Shading of sedimentation basin and filter basin

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

6) Installing advanced water treatment system

6-1) 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.

6-2) 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.

6-3) 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 2 and 3 were quoted from “Handbook for Preventive Water Treatment against Biological Problems” (Japan Waterworks Association, March 2006)

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