

Q&A

12Q7: We have blue-green algae problems in hottest and coldest seasons when turbidity become up to 200 NTU at the highest. What should we deal with removing these bluegreen algae from raw water?

(From Mr. R. C. C, Zambia)

A1: 1) To solve the problem, Mr. Answerer (Mr. A) asked following questions and got these answers from Questionnaire (Mr. R) as follows.

Mr. A: Are the algae species blooming and their problems in hot season and cold season same?

Mr. R: In hot seasons, algae grain like green algae (* No answer for the algae in cold seasons).

Mr. A: Do you know the name of algae? For example, *Microcystis*, *Anabaena* or *Oscillatoria*.

Mr. R: I don't know. Please check the pictures. (See Attachment1)

Mr. A: Do the algae have odor?

Mr. R: Yes.

Mr. A: Do the algae make filters clogging?

Mr. R: No, they go through filter

Mr. A: Do the algae make increase of turbidity in treated water?

Mr. R: Yes

Mr. A: Do you have problems anything else?

Mr. R: Increases of pH and chlorine demand.

Attachment 1: Pictures of algae blooming in WTP (07-25 Sep 2016)



Answer1-1: I suspect that the algae may cause coagulation inhibition in sedimentation basin. In case the algae are the green algae, they causes algal odor. In case they have musty odor, the algae may be *Anabaena* or *Oscillatoria* genus. Judging from the picture's bubble and color, it may not be *Microcystis* genus.

2) Mr. Answerer again asked following additional questions.

Mr. A: What kind of odor is there? Musty odor or algal odor?

Mr. R: Algal odor.

Mr. A: Do you have pH control equipment?

Mr. R: No.

Mr. A: What kind of coagulant do you use?

Mr. R: Aluminum sulfate (Alum).

Mr. A: Do you have data of pH and turbidity?

Mr. R: Yes (See Attachment-2).

Attachment 2: Raw Water Quality

RAW WATER QUALITY FOR AUGUST, SEPTEMBER AND OCTOBER 2016.

Date	AUGUST 2016		SEPTEMBER 2016		OCTOBER 2016	
	pH	Turbidity(NTU)	pH	Turbidity(NTU)	pH	Turbidity(NTU)
1	6.6	34.35	6.9	42.41	7.4	32.25
2	6.9	21.04	7.2	40.75	7.7	28.65
3	6.9	24.56	6.8	39.33	6.9	25.00
4	6.9	21.33	6.3	49.93	7.4	39.66
5	6.7	29.84	6.6	66.00	7.3	33.47
6	6.4	30.25	7.0	10.23	7.0	28.66
7	6.9	41.37	7.4	139.00	5.9	63.11
8	7.2	39.01	7.5	149.00	7.6	31.21
9	6.7	23.95	7.8	174.00	6.8	37.97
10	6.7	16.95	7.6	59.00	7.1	21.91
11	6.7	15.63	6.4	80.00	6.9	99.00
12	7.1	16.03	6.5	61.00	7.4	114.00
13	6.7	16.12	6.8	43.69	7.0	48.29
14	7.0	22.36	6.9	77.00	7.4	21.66
15	7.0	34.11	7.0	45.38	7.5	32.45
16	7.2	28.79	7.1	46.25	7.4	36.32
17	7.1	24.96	7.1	48.89	7.4	46.94
18	7.4	29.74	7.0	39.61	7.4	28.57
19	6.9	28.08	7.2	40.24	7.7	47.29
20	7.6	46.31	7.2	32.26	6.8	70.00
21	6.9	41.79	7.0	21.19	6.9	61.00
22	6.9	41.79	6.9	23.15	6.1	123.00
23	6.9	64.00	6.5	22.03	6.7	63.00
24	7.0	8.47	6.8	17.45	7.4	20.67
25	7.2	24.32	6.7	17.45	7.0	21.45
26	7.0	39.25	6.9	19.78	7.0	22.13
27	6.8	36.17	7.2	17.49	7.6	49.89
28	7.2	38.09	6.1	35.80	5.8	58.00
29	7.0	50.00	6.4	20.34	7.4	27.74
30	6.0	60.00	6.8	25.80	7.4	74.00
31	6.0	659.00	-	-	7.0	102.00

Answer 1-2:

1. Mechanism of coagulation disorders cause by algae bloom

In general, pH becomes higher when algae are growing in raw water because algae absorb dissolved carbon dioxide by assimilation. On the other hand, aluminum sulfate works well in pH range from 5 to 7 for coagulation. In case pH value is more than 8, it means alkaline condition, aluminum sulfate don't work effectively. So, when the algal makes raw water pH high, aluminum sulfate doesn't work well.

2. Countermeasures

1) pH control (Target pH is approximately 7).

Measure 1: To make pH low, put aluminum sulfate of 2 times volume as usual into raw water. Aluminum sulfate makes pH low by consuming alkalinity and hydroxyl ion.

Measure 2: To make pH low, put sulfuric acid or carbon dioxide into raw water. In case the sulfuric acid injection facility is not available, polyethylene tank with tap can be used as a temporary facility. Drop liquid sulfuric acid into receiving well or raw water channel.

2) Pre-chlorine

Measure 1: Put chlorine into receiving well to kill algae. The concentration of pre-chlorine is determined by chlorine demand but normally it's ranged from 0.5 to 1.0 mg/L while the residual chlorine will not remain in clarified water after sedimentation basin. Contact time; it is effective in only less than 5 minutes. Dead algae can be easily removed by coagulation/sedimentation process.

Measure 2: When algae having odor substances come into the receiving well and you cannot use activated carbon, you must stop pre-chlorine and add more coagulant than usual to prevent odor problems. That is because killed algae release odor substance into water and odor concentration become high as a result.

Please try them in order from the ones which you can do. Each chemical amount can be determined by jar-test. If you have any more question, don't hesitate to ask me. I will make a specific counter measures according to your actual situation. When something changes on the treatment process after you carried out some measures, please contact me. (Answerer : Mr. SASAKI Shinichi, Yokohama Waterworks Bureau O.B, 2017)

A2: I suspect following phenomenon occurs in dam lake.

- 1) Formation of thermocline (thermal stratification) in the lake
- 2) Elution of nutrient salts at the bottom of lake
- 3) Development of Eutrophication
- 4) Blooming of algae

In addition to remove algae directly, I recommend you control algae growth at dam lake. The circulation-aeration method for lake water is effective way. It can be the fundamental solution though the effect would not show up in a short time. For example, the circulation by aeration equipment was installed in dam lake at Hitokura Dam, Hyogo prefecture, Japan by Japan Water Agency. Two years after installation, it was found out to be effective and the *Microcystis* genus decreased. There are many cases all over Japan and there are several kinds of equipment for circulation by aeration.

*** Reference**

*1: "Handbook for Preventive Water Treatment against Biological Troubles" published by Japan Water Works Association. *[Chapter VII Countermeasures against Biological Problems](#) (WaQuAC-NET translated it into English and has all responsibility in the translation).

*2: There are lots of information on internet about equipment for circulation by aeration.

https://en.wikipedia.org/wiki/Water_aeration

Explanation by EPA (United States Environmental Protection Agency)

<http://www.epa.state.il.us/water/conservation/lake-notes/aeration-circulation/aeration-circulation.pdf>

Pictures

<https://www.google.co.jp/search?q=lake+aeration+systems&biw=1138&bih=494&tbm=isch&tbo=u&source=univ&dpr=1.2>

(Answerer: Mr. HAYASHI Shingo, Osaka Water Supply Authority, 2017)