Q&A

11Q2: Small black particles came out from tap in some supplied areas. Why did quality of tap water change? I am researching the reason. Could you help us?

A1： The dissolved iron/manganese are oxidized by the chlorine and it settled in the pipe as insoluble oxidize. The iron/manganese is supposed to be from raw water. Usually, particles of iron/manganese (absorbed in turbid) are removed by water treatment process mostly. And dissolved iron can be removed by the process easily too. However, the dissolved manganese removal is difficult so that the specialized manganese removal treatment is required. According to the monitoring result of alkalinity, the water quality of raw water seems not to change a lot. Please check the following parameters by the accumulated monitoring data; such as iron, manganese (total and dissolved), pH, and residual chlorine.

（A1, Answerer: KUDO Yukio, JWWA, 2012）

A2: Manganese is oxidized by chlorine. The reaction is rather slow. Portion of manganese can be removed in sedimentation and filtration after oxidizing. But most of manganese is in excited state. *Excited state is the state that an atom or a molecule has higher energy but not enough to change its form. Manganese in excited state is finally oxidized after long hours under reaction with chlorine. Then, manganese oxide, including hydroxide, is settled in pipe.

Manganese deposition will be much amount after many years. That amount depends on concentration of manganese in treated water, water flow, temperature, residual chlorine, etc.

In "12.79 Manganese" of WHO guideline for drinking water quality 3rd edition, additional comment is mentioned as follows:

"The presence of manganese in drinking-water will be objectionable to consumers if it is deposited in water mains and causes water discoloration.

Concentrations below 0.05-0.1mg/l are usually acceptable to consumers but may sometimes still give rise to the deposition of black deposits in water mains over an extended period; this may vary with local circumstances."

For the case of Yokohama City, manganese concentration in treated water is 0.0001-0.0005mg/L. Manganese oxide is deposited for long years even though manganese concentration is quite low. And manganese deposition sometimes comes out from tap when water flow is remarkably changed. For your case, manganese concentration is 0.001-0.04mg/L. So, manganese deposition can be formed easily. We cannot realize no manganese deposition in pipeline network while raw water contains manganese. But we can reduce amount of deposition by removing manganese in treatment process. The most popular way is using manganese sand (green sand) in rapid sand filter. For good removal, pre-chlorination is recommended for enough long contact time of chlorine.

*Manganese sand is coated with manganese oxide. Manganese in excited state is oxidized on that coating easily. Manganese oxide coating works as catalyst for reaction.

(A2, Answerer：Mr. SASAYAMA Hiroshi、Yokohama Waterworks Bureau, 2012)

A3: Your case seems typical drinking water problem, it is called as 'red water' in Japan. From my experience, almost all heavy metals including iron and manganese can be removed by the combinational use of pre-chlorine, intermediate- chlorine and manganese sand if the treatment process is working sufficiently. On the other hand, if pH is lower than 7.5 and more likely in case of lower than 7.0, iron contained in pipe dissolves into supplied water and re-settles inside of pipe of distribution line. The uncoated GP (Galvanized steel Pipe) enhances the dissolution of iron and causes the 'red water'. Mortar lining pipe is also damaged, when seal coat exfoliates and mortar dissolves.

Settled iron/manganese in pipeline can break away easily by the sudden change of water flow speed or flow direction, and causes the large scale 'red water (black water)' problem.

The effective countermeasures are;

1) To renew the pipe from uncoated pipe to lining pipe.

2) To coat the pipe by rehabilitation, if 1) is difficult.

3) To add alkali at the outlet of filter basin to keep the pH 7.5 in case of low pH.

I succeeded to reduce metal concentration by the procedure 3). The pH value was raised from 6.6 to 7.4, the concentration of metals at the tap was dramatically decreased, e.g., from 0.087 to 0.023mg/L for copper, 0.015 to 0.005mg/L for iron, 0.014 to 0.004mg/L for zinc, 0.002 to less than 0.001mg/L for manganese. It was the case of groundwater, so it might not be so effective for surface water.

In your case, pH seems relative high, but sometimes it shows lower value in April and May. The addition of alkali in this period could be effective for improvement water quality. But the settled iron remains in pipeline, so that the solution of 'red water' problem will need certain time period. There is a method to flush out water in pipe forcibly by drainpipe, but it has a risk of complaining by users. The explanation to the people is essential.

(A3, Answerer: Mr. ODASHIMA Akihiko, Kitakami City Waterworks Bureau, 2012)

A4: The deposition of Black particles of iron and manganese in the pipeline has been very popular in our network before. You know, in our case we have ever met big problem of iron and manganese, because the water source of the upstream area was changed by the activity of hydroelectric dam. The flow of river became slower, so concentration of manganese and iron was increased. The treated water had high concentration of iron and manganese. Manganese concentration was around 0.07 – 0.1 mg/L and iron was around 0.05-0.1mg/L.

It's the reason of deposition in the pipeline. At that time we did not apply manganese sand, pre-chlorination and increasing of pH value. Since August of 2009, we applied all of the process mentioned above, so treated water is better now. At present, the treated water quality as follow: Mn < 0.02 mg/L Fe <0.05 mg/L

However, we still have a plan to check deposition frequently and clean the pipeline, if necessary.

（A4, Answerer: Ms. Tran Thi Minh Tam, Hue province water supply company, Vietnam, 2012）