

## PHYSICAL/MECHANICAL CONTAMINATION OF WATER

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### Summary

Problems related to the contamination of water on physical properties are color contamination, offensive odors, corrosiveness (pH), turbidity and radionuclides.

Color contamination of water bodies is caused by metals, dye pollution, soil particles, and by the occurrence of water bloom caused by eutrophication. Color contamination of a water body is a problem because of the harm it inflicts on the scenery and when it used as drinking water or for other domestic uses, its color distresses the users.

Musty odor is a typical offensive odor in drinking water. Microorganisms that produce musty odor are *Cyanobacteria*, *Oscillatoria*, *Phormidium* and *Actinomyces Streptomyces*.

Radionuclides may contaminate drinking water source naturally or by human activity. People who use water supply system for drinking, cleaning and showering may be exposed to radiation. International movement of algae species by ballast water may affect the original ecosystem, and may cause domination of algae that produce toxin.

### 1. Introduction

Physical contamination refers to contamination affecting physical properties of water: coloration, odor, and pH. Such contamination of water does not directly harm people's bodies, but domestic use of the water is very harmful. Problems related to the contamination affecting physical properties are color contamination, offensive odors,

corrosiveness (pH), turbidity. Color contamination of water bodies is caused by metals, dye pollution, soil particles, and by the occurrence of water bloom. Offensive odor and taste of water are caused by metals and by microorganisms that produce musty odors. Because residents are distressed if their drinking water and other domestic use water is colored or smells badly, water treatment must completely remove colored or malodorous constituents of water. If the pH value of a water body is far from neutral, it affects the growth of living organisms of the ecosystem, and high acidity of soil or agricultural water prevents the growth of plants and agricultural products. pH is, therefore, an important index of environmental pollution. Contamination of radionuclides is also physical contamination because they emit radiation and affect people's health. Contamination of water by radionuclides was caused by elements such as radon, uranium and radium. Mechanical contamination occurs when exhaust gasses discharged by ships are dissolved by seawater, and when ships spill petroleum. Another cause of contamination is the ballast water that ships carry to remain balanced.

## 2. Color and Turbidity

Color contamination of water bodies is caused by metals, dye pollution, soil particles, and by the occurrence of water bloom caused by eutrophication. Color contamination of a water body is a problem because of the harm it inflicts on the scenery. And when it used as drinking water or for other domestic uses, its color distresses the users. Typical algae species that color water resources such as rivers, lakes and reservoirs include Cyanobacteria (blue-green algae) *Microcystis*, *Oscillatoria*, *Phormidium*, *Anabaena*, and *Aphanizomenon*, Chlorophyceae (green algae) *Euglena*, *Closterium*, and *Ankistrodesmus*, Bacillariophyceae *Synedra* and *Melosira*, and the Flagellatae, *Peridinium*, and others. When Cyanobacteria and Chlorophyceae form a bloom, the water body is colored by their pigments. When Bacillariophyceae have formed a bloom, the water turns brown. The Flagellatae *Peridinium* forms bloom in dam reservoirs, turning its water reddish-brown.

Color pollution is also caused by the metals: aluminum, copper, iron, and manganese. When algae die, they sink to the bottom and are decomposed by bacteria. Dissolved oxygen of the bottom layer decreases, leaching out the iron or manganese from sediment occurs. If the water resource is contaminated by iron or manganese, laundry is colored and the taste of the water is harmed. It is, therefore, essential that water treatment include measures to remove iron and manganese. Objective values for the metals that color water specified under water quality in Waterworks Law (Japan) include those for manganese, aluminum, and copper, and the Guidelines for Drinking Water Quality of WHO stipulates objective values for the aluminum, copper, iron, and manganese (Table 1).

Color contamination is caused by the inflow of wastewater containing dye. Dyes include direct dyes, acid dyes, and basic dyes, and dye wastewater discharged by dye factories contains large quantities of inorganic salts, organic acids, surfactant, water-soluble polymer compounds, and so on. Dye wastewater not only causes color contamination; other problems are that many dyes contain persistent substances and some are toxic.

Water quality in Waterworks Law in Japan	Manganese	$\leq 0.05\text{mg} \cdot \text{l}^{-1}$
	Aluminum	$\leq 0.2\text{mg} \cdot \text{l}^{-1}$
	Copper	$\leq 1\text{mg} \cdot \text{l}^{-1}$
Objective properties as drinking water in Guidelines for Drinking Water Quality of WHO	Aluminum	$0.2\text{mg} \cdot \text{l}^{-1}$
	Copper	$1\text{mg} \cdot \text{l}^{-1}$
	Iron	$0.3\text{mg} \cdot \text{l}^{-1}$
	Manganese	$0.1\text{mg} \cdot \text{l}^{-1}$

Table 1. Standards for chemicals causing color in drinking water

Humic acid and humin are coloring agents formed by the transformation of the remains of plants and animals into dark or blackish brown humus by the action of microorganisms in soil. Lakes contaminated by large quantities of these substances are called dystrophic lakes, and their water is either yellowish brown or brown. Because humin is a color contamination agent and also reacts with chlorine to form the carcinogen, trihalomethane, when a large concentration of humin is in water resource, the humin must be completely removed. Environmental water standards concerning color are not established, but objective value for drinking water is set at 15 TCU in the Guidelines for Drinking Water Quality of the WHO.

After rain falls, brown turbidity appears in rivers, reservoirs, lakes, and marshes as a result of rainwater carrying soil into their waters. Water bodies in regions where sediment with low specific gravity called laterite has been deposited are always turbid because of sediment. Turbidity seriously harms the scenery and detracts from the hydrophilic role of water bodies by, for example, discouraging swimming. When turbid water is obtained as a source of drinking water, it damages treatment plants by plugging their treatment systems. As turbidity indices, environmental standards set suspended solid levels measured using glass fiber filter paper. In the Guidelines for Drinking Water Quality of the WHO, the objective value for potable water is 5 NTU.

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