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AESTHETIC PARAMETERS IN DRINKING WATERS (TASTE AND ODOR)

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ABSTRACT

Water is one of the vital substance and indispensable for such as humans and all living organisms. All living organisms, collects their water need from sources such as stream, lakes and seas or bodies that provide water in the cavities or cracks on earth. Due to the rapid population growth in recent years, development of industrialization and unplanned urbanization, the need for water and water resources have increased with a tremendous speed. As a result, the water pollution problem emerged and has established drinking water treatment plants in order to ensure safe drinking water in urban areas. In this study, the reasons of taste and odor problems in water and the solution suggestions will be explained.

Keywords: Water, Taste, Odour, Quality

INTRODUCTION

Water is a fluid which is formed by the combination of 2 hydrogen and 1 oxygen atom. There is no color and no odor. There are forms of liquid, solid and gaseous. At sea level and at + 4 ° C the specific weight is 1. One cubic centimeter is 1 gram. Frozen at 0 ° C, boiled at 100 ° C. It boils more easily under low pressure. (8).

Drinking water has the most general shape and physical properties such as turbidity, color and temperature; Chemical properties such as hardness, alkalinity, pH, nitrate, metals, and microbiological properties such as bacteria and viruses. In this context, the characteristics of drinking water can be listed as follows:

a) Water should be odorless, colorless, clear and refreshing. Water should be at a temperature that water, colorless, clear and drinkable, such as phenols, oils, should not be substances that give off bad smell and taste to the water. The optimum temperature for drinking water is 8 to 12 ° C. Also the dissolved oxygen concentration in the water should be higher than 5 mg / L.
b) Water should not contain disease-causing microorganisms.
c) Water should not contain disease-causing microorganisms.
d) It must be suitable for water usage purposes. Water can be used as drinking water and industrial water. If used as drinking water, the content of iron and manganese in the water should be low.
e) Waters should not be aggressive. The aggressiveness of the waters is due to the fact that free carbon dioxide (CO_2) and bicarbonate (HCO_3) - ions are not balanced. The aggressiveness of the waters causes corrosion of the pipes, causing them to be ruined in a short time, thus causing additional costs. In addition, if the pipes are eroded, the elements that are separated from the pipe cause the water to deteriorate (3)

The taste of water should always be natural and pleasant to drink. The flavor of the water depends on the dissolved oxygen and carbon dioxide gases and other mineral salts, temperature and coldness. In particular, it provides the desired fresh water flavor, dissolved oxygen and carbon dioxide gases. If sodium chloride is present in the water, the salty flavor is felt. Magnesium chloride and potassium sulphate give a bitter taste to water. Iron salts give a bitter taste. If such waters are ventilated, the iron salts are oxidized to iron hydroxide and are purified from the salts (3).
The most important problems encountered in drinking water and their general resources are shown in Table 1. The odor and taste disorders can be originated from water source, drinking water treatment plant, network system and installation.

Table 1. Drinking Water Problems and Resources (4)

Water Source	**Water Treatment Plants**	**Network System**	**Internal Installation**
Nitrate Pesticide Industrial Solvents Odor and taste Iron Manganese Pathogens Hardness Alga toxins Radioactivity Arsenic Pharmaceuticals and personal care products Endocrine disrupting compounds	Aluminum Color Chlorine Odor and taste Iron Trihalomethanes Pathogens Fluoride Nitrite Acrylamide	Sediman Color Asbestos Odor and taste Iron PAHs' Pathogens Animals / biofilm	Bullet Virgin Zinc Odor and taste Corrosion Pathogens Asbestos fibers

1.1. Taste and Odor Problems Because of Water Sources:

The quality and quantity of surface water resources depends on the combination of climatic and geological factors. Along with the rains, a considerable amount of solid matter is transported to sources of drinking water, including dust, pollen, ash (volcanoes), bacteria, fungus spores and even occasional larger organisms. A wide range of chemicals such as nitrogen and sulfur oxides, which cause organic solvents or acid rain from many salt, domestic and industrial atmospheric discharges from the seas, also affect water resources at certain times of the year and in different locations through rain (5).

Many lakes are in and out, so they can be likened to slow-flow rivers. When the water is kept in the lake / dam for a long time, the organic matter found in the water due to the bacterial activity, the physical flocculation and the decontamination processes provide the small particulate matter removal and the water becomes cleaner. Improvement in quality is observed with water storage, but this also negatively affects water quality due to the fact that the algal population is much higher in sediment than in rivers and deep lakes/dams are thermally stratified especially in summer (Figure 1) (5).

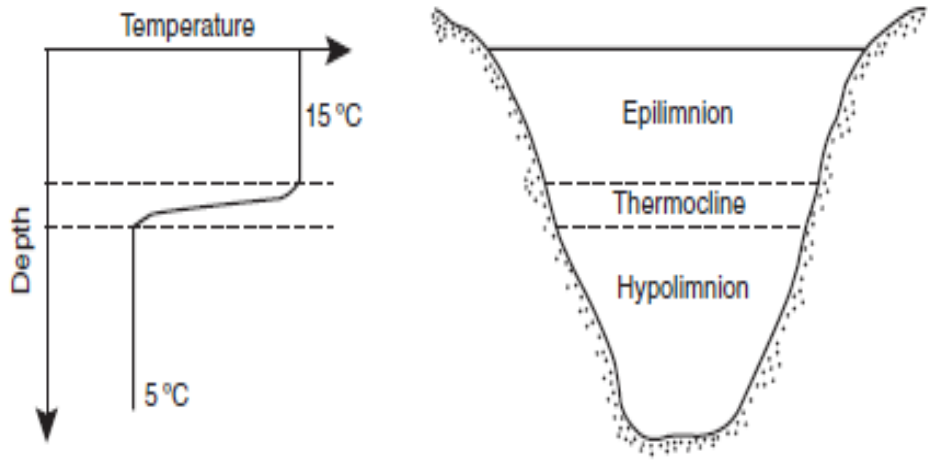

Figure 1. Thermal stratification in deep lakes and dams (4)

The temperature is the same everywhere in the layer because the epilimnion layer is mixed by the wind. This layer is both warm and suitable for the development of algae as they take direct sunlight. Algae growth is observed in the entire epilimnion layer, in the presence of high amounts of nutrients such as nitrogen and phosphorus, present in the water by agricultural surface flow, etc. and in large quantities called eutrophication. In more serious cases, large changes can also be seen in the water color. In this layer, the water is usually clear and the oxygen content is high. However, when eutrophication occurs, unwanted taste and odor formation and toxins released from some species must be removed from the water. Algae produce oxygen by photosynthesis in the presence of daylight but can consume all the oxygen in the water when it breathes in the night. This can cause fish deaths and problems in the treatment plant. (5).

In the hypolimnion layer there is very little mixing and movement, so it becomes very stagnant and oxygen-free. Dead algae and organic matter from the upper strata collapse into this lower plate. In hypolimnion, oxygen is completely consumed and under anaerobic conditions, iron, manganese, ammonia, sulphates, phosphates and silica pass through to sediment water and nitrate is reduced to nitrogen gas. This situation makes the purpose of drinking water irrational. Because of this, water will cause complaints of color and bad taste due to iron and manganese. It will combine with ammonia chlorine to consume oxygen faster and act like a nutrient element to form eutrophication environment (similar effect of phosphorus and silica). Sulphates also have a decrease in oxygen It will bring bad odor and taste (5).

For example, manganese causes stains in pipelines and laundry with undesirable taste in concentrations exceeding 0.1 mg / L. At low concentrations such as 0.02 mg / L, it may form a layer in water pipes, which may accumulate over time in black precipitate. Many countries have set a standard value of 0.05 mg / L for manganese due to problems associated with color change (15).
For example, the chloride concentration in surface waters is generally below 100 mg / L; Can be seen at higher concentrations in groundwater, especially if salt water intervention is available (2). If the chlorine concentrations exceed 250 mg / L, the water may give a salty taste. However, consumers may also be familiar with the values on this concentration over time (10).

1.2. Taste and Odor Problems Because of Water Treatment Plant:

Surface waters are providing from rivers, lakes, dams and floods. These sources water quality shows large changes over time and color and turbidity of them are over. In addition, surface waters may be contaminated with domestic and industrial wastewater. Thus, substances such as organic substances, taste and odor substances, phenols, detergents, metals can also be found in surface waters. These conditions must be considered when designing the treatment plant.
For example, in the treatment of drinking water, aluminum sulphate, etc. It is possible for the sulfate levels in a treatment plant using it as a chemical coagulant to rise above the source levels at the treatment outlet. Due to the chemicals used in the treatment of drinking water (aluminum sulphate etc.), the concentration of sulphate measured at the source at 12,5 mg / L in the Ontario province of Canada was measured as 22.5 mg / L at the outlet of treatment (13).
The taste threshold of the sulphate can be given as 250 mg/L as the sulfate salt (13). In anoxic conditions, sulphate is reduced by reducing bacteria, sulphite sulphite is reduced, and due to the formation of hydrogen sulphide can cause undesirable taste and odor as well as increased corrosion in the network (2).
Today, drinking water treatment plants are projected according to the latest technology and the water resources are monitored regularly, including seasonal changes, and are operated with expert technical staff. Drinking water given to the main cities such as İstanbul and Ankara is inspected by taking the samples with the teams authorized by the Ministry of Forestry and Water Works within the scope of the Turkish Public Health Authority and different projects and there is no negativity.

1.3. Taste and Odor Problems due to Mains Line and Internal Installation:

With the use of aspest, copper, iron or aluminum network lines of treated drinking water or pipes made of these materials in domestic installations, deterioration of the taste and smell of the waters can be experienced. For example, when a material made of copper or brass is used in pipes and equipment carrying drinking water, the copper element can cause stains (blue/blue-green) in laundry and sanitary ware at concentrations above 1 mg/L; and at concentrations exceeding 2,5 mg/L, the water gives an unpleasant bitter taste (14). At higher concentrations (4-5 mg/L) the water colour can also change (4).
In the water distribution system, iron can be found in drinking water, which is the corrosion end of cast iron pipes. In a mineralized spring water with a total solids content of 500 mg / L, the threshold of detection by taste is 0.12 mg / L. At a level of 0,3 mg / L and below, there is usually no noticeable change in the taste of the water. The formation of stains on laundry and ceramics is also observed in iron concentrations of 0.3 mg / L. Iron may also cause undesirable bacterial growth in the water network (iron bacteria) and formation of deposits in the form of a slurry coating in the pipelines (9).
The primary source of zinc which is another element in drinking water, is the corrosion of galvanized steel tanks and installation pipes, which is due to low pH water. This corrosion in galvanized steel pipes is significantly increased even at very low concentrations of copper (4). Also zinc levels in potable drinking water (> 0,1 mg / L) can be a sign of increased cadmium concentrations in water. Concentrations of zinc in excess of the taste threshold value of about 4 mg / L (as zinc sulphate) give an undesirable bitter taste to the water. At concentrations exceeding 3-5 mg / L, turbidity (opacity) may appear and may form an oily film when boiled (14). Detection of the end consumer in the tap water is mainly based on the corrosion of the pipes and can be controlled by anti-corrosion measures (5).

CONCLUSION AND RECOMMENDATIONS

Aesthetic problems such as odor can often be avoided by optimization of conventional purification processes such as coagulation, sedimentation and chlorination. However, if a more special treatment is required; Processes such as ventilation, granular/powder activated carbon and ozonation, efficient methods of removing organic and some inorganic chemicals causing odor (14).

Ventilation:
In general, the taste and odor elimination in the water, oxygen from the air and unwanted gases in the water are made to take. Vertical cascade aeration is generally used as a classical method for ventilation of waters. The flow rate is important when these units are being designed. There may be problems in not adequately ventilating the units that are projected incorrectly.

Ozonation:
Although ozone is not a widely used disinfectant in the United States, EPA has begun investigations into the potential use of ozone in the event of admission in Europe (1). The reasons for using ozone in drinking water processes are listed below:

- Color removal,
- Iron and manganese removal,
- Algol repair,
- Taste and odor elimination,
- Flocculation of suspended solids,
- Bacterial disinfection,
- Virus inactivation,
- Oxidation of dissolved organic materials.

Ozone is especially odor control by the removal of pollutants originating from natural sulfur-based pollutants and natural organic substances. Besides the advantages of ozone, there are disadvantages as well. These;

1. No permanent disinfection,
2. Cost is high,
3. In the presence of colloids, more doses are needed,
4. Analytical techniques are not sufficient in terms of process control and efficiency. (6).

Active Carbon Application:
The compounds causing taste and odor can also be removed by adsorption with activated carbon.
Color, odor and taste can be provided by supporting the filters with granular activated carbon. Granular activated carbon is generally used in adsorption columns or filters, and is regenerated or removed when pollutant removal occurs from the carbon bed.
If the activated carbon is powder, it is added at any point before the filtration process. The powder is removed from the water in the course of precipitation or filtration after completing the active carbon adsorption function.
Due to the lack of regeneration systems in Turkey, the use of active carbon in high-capacity filters is a problem and is therefore not preferred. In powder activated carbon applications, the dosage amount needs to be adjusted correctly and difficulty in preparing the solution may lead to operational problems. It has been determined that in laboratory-scale experiments, taste and odor can be reduced to measurable levels at maximum 8 mg / L powdered active carbon dosage for 25-30 minutes contact times (7).
In the solution of taste and odor problems, the advantages and disadvantages of the remediation methods should be evaluated well when the cause of the problem should be determined first, the water resources and basin control should be done well and the treatment plants are being designed.

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