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Fluoride Contamination and Water Quality Status

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Abstract.

River fluoride contamination is one of public health problems. This study aims to determine the water quality status and fluoride contamination analyses of Cirarab River, Banten-Indonesia. Water sampling was conducted along the Cirarab River from up to downstream at eight (8) stations from February to June 2016. Water fluoride was analyzed using SPADNS method and STORET method for determining water quality status. Results show that the average water fluoride ranges from 2-2.24 mg/L. The maximum fluoride concentration obtained in station 4 (3 mg/L) was recorded in April 2016. Based on the World Health Organization's (WHO) maximum acceptable fluoride levels of 1.50 mg/l, the overall results show that the water quality status of the Cirarab River was heavily polluted. In some situations, there was a need for continuous monitoring and warning drinking water management resources to minimize the long term health effects on communities consuming, and also the policies that are necessary to achieve sustainable water quality.

Keywords: fluoride, Cirarab Rivers, water quality

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1. Introduction

The Cirarab River flows from up to downstream passes through the Tangerang district with a river length of 20.9 km. Cirarab River is an important surface water resource for households, drinking water supplies, irrigation, and industry. [1] Industrial activity can decrease environmental pollution. Industrial pollution has contributed to the environmental degradation of water sources due to fluoride pollution. [2] The main sources of fluoride pollution are industries, particularly phosphate ore production and use as well as aluminum manufacture, mining, and coal burn. [3] Fluoride contamination in drinking water at Cirarab River leads to potential health risk to the residents.

Fluoride toxin is one of the public health problems, its intake level seriously affects human health. [4] Studies have found that when the concentrations of fluoride in drinking water are low, it can prevent dental caries and strengthen bones. But when the concentration of fluoride in drinking water is higher than 10 mg/L causes dental fluorosis. [5]

Drinking water safe for fluoride consumption is between the 0.5 and 1.0 mg/L acceptable limits. [6] Indonesia Government regulation Standards for Drinking Water Quality, [7] The optimal permissible fluoride concentration in drinking water is 1.5 mg/L. [8]

The assessment of fluoride concentrations and water quality status in Cirarab River should aim to protect the environment and human beings from disease due to the consumption of water that may contain fluoride contributing to dental fluorosis. Determine influential water quality factors affecting the concentration of fluoride at Cirarab River analyzes in order to ultimately lay a foundation for future water quality management in Indonesia.

2. Methods and Equipment

2.1. Methods

2.1.1. Water sampling stations

The study is carried out in the Cirarab river basin in Tangerang district of Banten. Water sampling was conducted along the Cirarab river from eight (8) stations for a period from February to June 2016: Bitung bridge (Station 1), Pasar Kemis bridge (Station 2), Total Persada bridge (Station 3), Tomang village (Station 4), Kota Bumi bridge (Station 5), Kulkung bridge (Station 6), Sarakan bridge (Station 7), Cirarab bridge (Station 8). Grab sampling procedure was adopted as recommended by standard method for water quality analyses. [9]

2.1.2. SPANDS and STORET method

Water fluoride was analyzed using the SPANDS method. [10] And STORET method for determining water quality status in Cirarab River. [11] Determination of water quality status is based on the score at Table 1. [12]

Table 1: Storet Score And Water Quality Status.

Class	Score	Status
A	0	Meet quality standards
B	-1 to -10	Slightly polluted
C	-11 to -30	Moderately polluted
D	≥ -30	Heavily polluted

3. Results

3.1. Fluoride concentration

Table 1 shows that the average fluoride concentration of Cirarab (2-2.4 mg/L). Bitung (2.24 mg/L), Pasar Kemis (2.24 mg/L), Total Persada (2 mg/L), Tomang (2 mg/L), Kota Bumi (2 mg/L), Kulkung (2 mg/L), Sarakan (2 mg/L), and Cirarab (2 mg/L). The maximum fluoride concentrations were obtained in Tomang (3 mg/L).

Table 2: Fluoride concentration in Cirarab River.

Location	Fluoride concentration (mg/L)		
	Minimum	Maximum	Average
Sample 1	1.99	2.64	2.24
Sample 2	1.61	2.54	2.24
Sample 3	1.22	2.14	2
Sample 4	0.51	3	2
Sample 5	1.09	2.36	2
Sample 6	1.5	2.33	2
Sample 7	1.48	2.3	2
Sample 8	1.64	2.46	2

The seasonal variations in the fluoride concentrations among eight (8) stations can be seen in Figure 1. There were significant seasonal variations in the concentrations of fluoride in the Cirarab River. In general, the average concentrations of fluoride in April to May (2.19-2.24 mg/L) were higher than the concentrations of the other months of the Cirarab River, while higher concentrations average of fluoride was observed from April (2.19 mg/L) to June (2.12 mg/L). In contrast to the tributaries, lower concentrations of fluoride were found from February (1.57 mg/L) to March (1.86 mg/L).

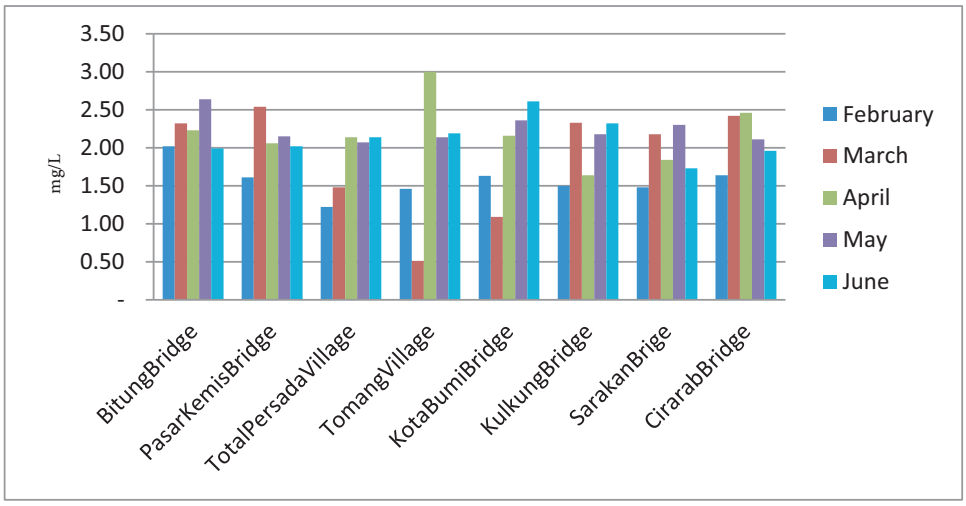

Figure 1: Fluoride concentration for each sampling site.

3.2. Water quality status of Cirarab River

The assessment of river water quality based on the STORET method shows that the water quality of the Cirarab River is heavily polluted. (See table 3).

TABLE 3: Water quality status of Cirarab River.

Location	Score	Status
Station 1	-66	Heavily polluted
Station 2	-64	Heavily polluted
Station 3	-56	Heavily polluted
Station 4	-57	Heavily polluted
Station 5	-60	Heavily polluted
Station 6	-54	Heavily polluted
Station 7	-60	Heavily polluted
Station 8	-62	Heavily polluted

4. Discussion

4.1. Fluoride concentration

Based on the concentration of fluoride (table 1), the highest concentrations of fluoride were distributed in the eight (8) stations on the Cirarab River (average: 2-2.4 mg/L). Natural sources (granites and volcanic rocks), and anthropogenic activities also play an important role in the process by which fluoride is transported into the waters. [13] The high density of industrial activity easily polluted the surface water. Fluoride concentration

in water changes due to various factors, such as the dilution, temperature, pH, and salinity. [4]

People who live in Cirarab River, Tangerang, Banten, use water from the river for daily drinking. The water is generally high fluoride level (1.50 mg/l acceptable limits) so that the people who consume it become more susceptible to suffer and implication for human health. [14] Health promotion strategies and measures, carry out fluoride prevention and ensure drinking water safety to protect the health of residents.

Further, the comparison of the data of dry and wet seasons shows that the fluoride concentration is lower in the wet season as compared to the dry season. Based on the Indonesian Agency for Meteorological, Climatological and Geophysics (BMKG), the rainy season will start in December with the peak of the rainy season in February. It clearly indicates the dilution mechanism, which considerably reduces the concentration of fluoride due to monsoon rainfall infiltration. [15]

4.2. Water quality status

The water quality status of the Cirarab River in heavily polluted (STORET score: $\geq$ 30), the geological formation and release of industrial pollutants and municipal waste and causing serious environmental degradation. [16] Thus, chemical and organic waste from factories must be treated before being discharged to the rivers. The water quality of rivers in Indonesia is poor. Monitoring results show that over 50% of the parameters, such as biological, chemical, do not meet the norms set for water quality class. Implement a national integrated water quality management program on a priority basis.

5. Conclusion

It can be concluded that all the monitoring stations in the Cirarab River, Tangerang, Banten are not recommended to be used as drinking water. The water still can be used as clean water, but more the water treatment needed to produce clean water. In some situations, support the need for continuous monitoring and threaten drinking water to minimize the long term health effects on communities consuming and policies are necessary to achieve sustainability of water quality and ecology in Banten Province.

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Conflict of Interest

The authors have no conflict of interest to declare.

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