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Determination of Fe Ions Content in Well Water Samples from Dumai Timur Subdistrict of Dumai Municipality

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Abstract. One of the raw water sources in Indonesia is well water. However, the water mostly smells, turbid, and dirty. Dumai Timur is one of the subdistricts in the Dumai municipality that have bad quality water. People use well water for daily activities but the water is the smell and the color is yellowish and leaves rust stain in functional partitions. This rust stain estimated as iron ion (Fe^{2+} and Fe^{3+}). Iron ion needed in red blood cell formation; however, if it exceeds the defined level, this ions is harmful. This research aimed to identify the iron ions level in well water used by people at Kecamatan Dumai Timur. Samples obtained from some well water in Dumai Timur that consist of five Kelurahan. Technique sampling was random sampling and the iron ion was detected in a laboratory using SNI 6989.4:2009. The result compared with the defined level by the Minister for Public Health No. 416/1990.

Keywords : clean water; Fe ions; water quality, well water

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Introduction

The function of water for human life cannot be replaced by other compounds [1][2]. Water as a component of the environment will affect and influenced by other components. Poor quality water will result in adverse environmental conditions that will affect the health and safety conditions of humans and other living things [3][4].

Water quality, in general, shows the quality or condition of water associated with a particular activity or need. For example, the quality of water needed for drinking and cooking needs will be very different from the quality of water used for aquaculture purposes. Water used for consumption must have good quality, both from the physical quality and chemical quality of water [5][6].

Dumai Timur Subdistrict is one of the subdistricts in the Dumai Municipality that has poor quality water. The condition of the well water used usually smells and is brownish yellow and leaves yellow marks on the walls of the well. The yellow color thought to be ferrous ions (Fe) which are Fe^{2+} and Fe^{3+} . Iron ion-containing water, if left in the open air, will form a precipitate. This sediment will stick to the reservoir and if used for household purposes such as washing, it will leave stains on the laundry cloth [7]. The body needs iron ion in small amounts in the process of metabolism and red blood cell formation [8]. Lack of iron ion levels in the body will cause anemia, but excess iron ion will cause vomiting, diarrhea, and intestinal damage [9][10][11].

Therefore, this research carried out to determine the levels of Fe ion contained in well water used by the people in the Dumai Timur Subdistrict area. So, if it turns out that the well water contains Fe ions that exceed the threshold set by the government, the community can be more careful in its use.

Experimental

Instruments and Materials. The instrument used in this study is the Atomic-Absorption Spectrophotometer, pH-meter, plastic bottles, goblets, and dropper pipettes. The material used is water samples from several residents' well water in Dumai Timur Subdistrict and nitric acid.

Methods. The sampling process in this study carried out randomly (random sampling), wherein each village contained in the Subdistrict of Dumai Timur taken as many as 5 points that are considered to be representative of the whole. Dumai Timur Subdistricts in the Dumai Municipality with a land area of 47.52 km² (Figure 1). Lies the Subdistrict of Dumai Timur right in the middle of the Dumai Municipality Subdistrict capital Teluk Binjai. Characteristics of the subdistrict of Dumai Timur according to elevation (height above sea level/dsl) is located between 0-25 m.

The whole region is the land and the topography is relatively flat. Dumai Timur Subdistrict consists of 5 villages, namely Buluh Kasap, Bukit Batrem, Jaya Mukti, Teluk Binjai, and Tanjung Palas Village [12]. These samples are put into plastic bottles and nitric acid is added to maintain its durability before the measurement process. Fe total content measurements as Fe^{2+} and Fe^{3+} ions were carried out in the laboratory using the Atomic Absorption Spectrophotometer (SSA) (SNI 6989.4:2009) [13].

Result and Discussion

Results. The results of ions Fe measurements in well water samples used by residents in the Dumai Timur Subdistrict seen in Table 1. In each village, 5 points taken that were considered to represent the whole. The measurement results compared with the quality standards set by the government. The quality standard for clean water contained in the Regulation of the Minister of Health of the Republic of Indonesia Number 416 of 1990, where the permitted Fe ions content is only 1.0 mg / L.

Discussion. Humans need low levels of iron ions in the process of metabolism and red blood cell formation. The amount of iron needed by the body per day is around 7 .0-35 mg, which is not only obtained from water [15]. Iron deficiency can cause a decrease in red blood cells or known as iron deficiency anemia. Iron deficiency anemia is a health problem in society because it can cause various complications such as impaired cognitive function, decreased endurance, changes in behavior, decreased productivity, and stunted growth and development for children. Although the body needs iron ions, excessive amounts will cause various diseases such as damage to the intestinal wall [16], cause chronic effects such as hemochromatosis which will cause cirrhosis of the liver and pancreatic damage [17][18].

Based on the data in Table 1, it can be seen that almost all regions in Dumai Timur Sub-district have water with very high Fe ions content. Of the five existing villages, only one village whose water can be said to be decent as clean water. Four other villages have Fe ions content

Palas Village at sampling point 4 with a value of 6.6158 mg / L, and in Teluk Binjai Village at sampling point 1 with a value of 6.0416 mg / L.

The presence of Fe ions in groundwater caused by several factors, including originating from the soil itself or from other sources such as corro-

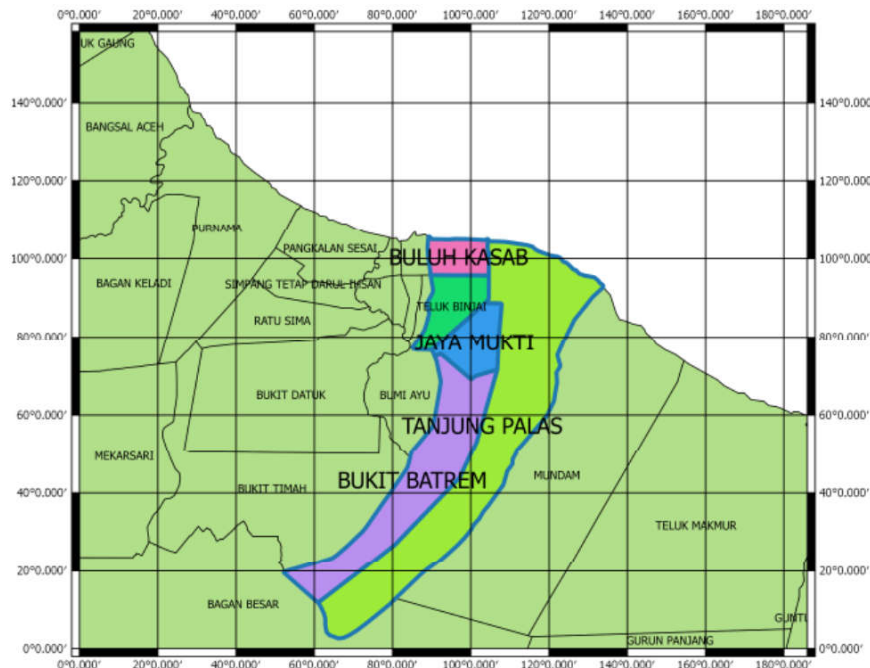


Figure 1. Map of Dumai Timur Subdistrict [12].

Table 1. Fe ions Content of Well Water Samples in Dumai Timur Subdistrict

Sampling Point	Units	Quality Standards*	Village				
			Buluh Kasap	Bukit Batrem	Jaya Mukti	Teluk Binjai	Tanjung Palas
1			2.6238	0.1885	2.0675	6.0416	1.9488
2			7.5193	0.1216	3.5100	3.0849	1.939
3	mg/L	1.0	0.1249	0.1044	9.8971	2.6587	2.9058
4			0.1663	0.1121	2.9136	2.134	6.6158
5			0.4803	1.2668	3.2427	1.6769	1.7311

Source: PerMenKes RI No. 416 Th. 1990 [14]

far above the quality standards set by the government. However, unfortunately, people continue to use this water as their raw water source.

The highest concentration of Fe ions is found in Jaya Mukti Village at sampling point 3. The measurement results show that the value of Fe ions is 9.8971 mg / L. In addition to Jaya Mukti Village, the largest Fe ions concentration was also found in Buluh Kasap Village at sampling point 2 with a value of 7.5193 mg / L, Tanjung

Palas Village at sampling point 4 with a value of 6.6158 mg / L, and in Teluk Binjai Village at sampling point 1 with a value of 6.0416 mg / L. The presence of Fe ions in groundwater caused by several factors, including originating from the soil itself or from other sources such as corro-

Table 2. The pH value of community water wells in Dumai Timur Subdistrict

Sampling Point	Quality Standards *	Village				
		Buluh Kasap	Bukit	Jaya	Teluk	Tanjung
1		5.5	6.7	6.8	6.6	5.7
2		5.4	6.5	4.0	5.6	6.5
3	6.5-9.0	6.1	6.2	5.4	5.0	4.4
4		6.9	5.0	5.8	4.9	5.9
5		6.0	5.5	6.2	5.1	6.3

Source: PerMenKes RI No. 416 Th. 1990 [14]

Based on Table 2, seen the pH value of the residents' well water samples found in the Dumai Timur Subdistrict is at a low acid / pH condition. The Government in the Regulation of the Minister of Health RI No. 416 of 1990 set the standard quality value for clean water to have a pH between 6.5-9.0. This low water pH value is one of the causes of the high levels of ferrous ions found in groundwater in the Dumai Timur Subdistrict.

CONCLUSION

Based on the results of the research and analysis above, it concluded that almost all well water used by the community in Dumai Timur Subdistrict had not met the clean water requirements stipulated by the Government in the Republic of Indonesia's Minister of Health Regulation No. 416 of 1990. The well water has a very high iron ions content so it is not suitable for use as raw water.

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