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Feasibility Test of Refill Drinking Water in Batam

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Abstract

Water is one of the things that are important for human life, plants and animals. Water that is contaminated by heavy metals negatively impact the health whether both in the high and low concentrations. The chlorine compound used during the disinfection of mineral water is able to kill the bacteria during the treatment of drinking water, but the increasing dose of chlorine injection during the disinfection process led to the increasing of unwanted disinfection by-products (DBPs) and one of them is compound of Trihalomethanes (THMs). In the city of Batam, the mineral water refill port uses the water from the Water Company or PDAM (though managed by PT. ATB). Most of the existing drinking water depot in Batam does not specify the eligibility certificate of mineral water according to the standards that have been set. According to the Regulation of the Ministry of Health No. 492 year 2010, the quality of mineral water is assessed from the chemical parameters, such as aluminum (Al), ferrum (Fe), chloride (Cl) and copper (Cu). The purpose of this study was to determine the feasibility of mineral water refill port in the city of Batam with the indicators such as aluminum (Al), ferrum (Fe), chloride (Cl) and copper (Cu). The study was conducted in the laboratory of PT. Sucofindo Batam, Riau Islands, Indonesia. This research is a descriptive laboratory. Data is obtained by using the simple technique of random sampling and the analysis of Fe, Cu, Al and Cl uses atomic absorption spectroscopy (AAS). The results of this study indicate that all samples meet the qualifications of Ministry of Health Regulation No. 492 year 2010 about chemical parameters of Aluminum (Al), ferrum (Fe), chloride (Cl) and copper (Cu).

Keywords: Unwanted disinfection by-products (DBPs), Trihalomethanes (THMs), Refill drinking water

1. Introduction

The fresh water resource is maldistribution around the world and the availability of them becomes a rare thing due to population growth and a range of activities undertaken by the human [1]. Water is one of the important things that support all requirement of plant or animal life and generally water is derived from two main natural sources of land and surface water such as freshwater lakes, and rivers. But one of the most important environmental issues today is the water that contaminated by heavy metals because of strong toxicity even at low concentrations is already harmful to health [2].

Heavy metals are generally identified in water consist of arsenic, copper cadmium, Lead, chromium, nickel, mercury, and ferrum. The metal released before processing cause a significant dangers both in water and for public health. The metal will accumulate through a biological chain, causing acute and chronic illness. Nowadays, the environmental pollution has gained global attention [3-4].

Consumer safety against microbial contamination and proliferation in water distribution systems (DWS) is done by using drinking water disinfection. Chlorine compounds are often used during disinfection of drinking water worldwide in order to kill bacteria over mineral water processing. However, the increased injection of chlorine dose during the disinfection process causes an increase of *unwanted disinfection by-products* (DBPs) [5-6].

Trihalomethanes (THMs) are one of DBPs compounds produced by sodium hypochlorite with natural organic matter (NOM) which is carcinogenic and non indirect exposure, such as inhalation and skin contact during a bath that can pose a risk for human health. Therefore in post-disinfection management of WDS is very important to keep the rest of chlorine and THM concentrations above or below the prescribed threshold. In particular, the minimum threshold value of chlorine residual concentration is set in mineral water standards [4]. In many countries, disinfection DWDs required to maintain residual chlorine because it can make smell and taste problems or disinfection by the products that are harmful to human health. Chlorine is lost by reaction of the substance remaining in the water after processing particularly organic compounds and inorganic substances such as ferrum, aluminum, manganese or ammonia [7].

Cu element is one of the heavy metals that are widely used in industry, especially in the electroplating industry, textile and industrial metal (alloy). Ion Cu (II) can accumulate in the brain, the skin tissue, the liver, the pancreas and the myocardium. Therefore, the process of handling the waste becomes a very important part in the industry. CU is belonging to the group of essential metals, where in the low level required by the organism as a Coenzyme in metabolic processes of the body, the nature of their toxicity is emerging in high levels [5], [8]. Aluminum Metal can be found a variety of forms in nature, has always been stable and does not interfere with the biologically. However, at low level of pH, metal Al biologically be able to enter into the food chain and crops occurring in rocks and soil.

Aluminum toxicity towards humans, plants and animals are associated with the ability to subtitute the ferrum and other metals in protein. Toxicity of Aluminum became the major factor that limited the plant growth on acid soils. Aluminium in clinical biochemistry is largely associated with neurotoxicity. The accumulation of aluminum causes kidney failure, dementia, encephalopathy, Alzheimer's disease and illness Parkin for children [6].

Ferrum dissolved in the water generally ferrous valent, and often bound with complex organic substances. Ferrum which is compounds with organic matter complexes are generally more difficult to oxidized.

Humans and other creatures need ferrum in specific levels as nutrient, humans and other creatures need ferrum in specific levels as nutrient, but for excessive levels can cause an awful taste in mineral water, giving a reddish brown color that is not expected [9-11].

In Batam city, mineral water refill port use water source from PDAM (directly managed by PT.ATB) and do not include a certificate of eligibility mineral water standard that has been set. The purpose of this research is to determine the eligibility of mineral water refill test in Batam City based on parameters of ferrous metals, chloride, copper and aluminum.

2. Materials and Methods

This research was conducted in the laboratory of PT. Sucopindo branch of Batam, Riau Islands, Indonesia at September 28th, 2015. Population covered the entire mineral water refill port (AMIU) in Batam city. 6 (six) sample of population was taken based on each sub district in Batam city by using *simple randomized sampling*. Sampling was directly taken by buying mineral water refill in Batam city.

The 6 (six) samples mineral water refill port which was taken are Salsabila Batam Center, Pak De Qua Tiban, Fun Qua Batu Ampar, Fresh Qua Bengkong, Salwa Qua Batu Aji, dan Alam Qua Piayu. Furthermore, the sixth samples above were tested the containing of aluminum metal, ferrum, and copper chloride parameters in PT. Sucofindo Batam laboratory that is based on standards used by PT Sucofindo Batam i.e. Standard Methods for Water and Waste Water from the American Public Health Association, 22nd edition in 2012.

Tools and materials

The tools used are atomic absorption spectroscopy GBC Avanta Ver 1.33 who have been calibrated at the time of use, the filter paper Whitman No. 42 µm, and other glassware. The material used is mineral water refill in Natural Aqua Piayu depot, Fresh Qua Bengkong depot, Salwa Batu Aji depot, Salsabila Batam Center, Pak De Qua Qua Tibandepot and Fun Qua Batu Ampar depot, standard solution of Fe, standard solution of Cu,

standard solutions of Al and standard solutions of Cl, HNO_3 p.a, HCl p.a, and aqua bides.

The creation of a standard solution of Fe, Cu, Al

a. The creation of 100 ppm standard solution
   Pipette 5 ml of 1000 mg/l master solution and put in 50 ml measuring flask, diluted with aquades which has been acidified to mark lines, then shuffled.
b. The creation of 10 mg/l standard solution
   Pipette 5 ml of 100 mg/l standard solution and put in 50 ml measuring flask, diluted with aquades which has been acidified to mark lines, then shuffled.
c. The creation of standard series solution 0,2 ; 0,4 ; 0,6 ; 0,8 and 1,0 mg/l
   Pipette each of 1 ml, 2 ml, 3 ml, 4 ml and 5 ml of 10 mg/l standard solution and put each of them into a 50 ml measuring flask, diluted with aquades which has been acidified to mark lines, then shuffled.

The creation of Cl standard solution

a. The creation of Cl 100ppm stand art solution
   Pipette 5 ml of Cl 1000mg/l master solution and put each of them into a 50 ml measuring flask, diluted with aquades which has been acidified to mark lines, then shuffled.
b. The creation of Cl 10mg/l standard solution
   Pipette 5 ml of Cl 100mg/l master solution and put each of them into a 50 ml measuring flask, diluted with aquades which has been acidified to mark lines, then shuffled.
c. The creation of standard series Cl 0,2 ; 0,4 ; 0,6 ; 0,8 and 1,0 mg/l
   Pipette each 1 ml, 2 ml, 3 ml, 4 ml dan 5 ml of 10 mg/l standard solution and put each of them into a 50 ml measuring flask, diluted with aquades which has been acidified to mark lines, then shuffled.

The creation of Standard Curve

Each absorbance measured standard series solution 0,2; 0,4; 0,6; 0,8 and 1,0 ppm with Atomic absorption spectrophotometer at a wavelength of (λ)= 248,3 for analysis λ= 213,9 nm for analysis Cu, λ= 309,3 nm for analysis Al, and λ= 558 nm for analysis Cl.

Sample Preparation

a. Pipette 100 ml of the sample into a 250 ml cup glass
b. Added 5 ml of concentrated HNO3 into a cup glass which contains the sample footage
c. Destroy snippet on water bath until the volume becomes ± 5 ml
d. Diluted footage into a 50 ml measuring flask with hot aquades
e. Let into room temperature and then added aquades to limit line
f. Filtered solution with paper Whatman 42 into test tubes
g. Acidified solution with HNO3 to pH < 2
h. Create blanko 100 ml aquades in the form of an acidified with HNO3 and HCl (p) (p) for Cl blanko until pH <

Measurement Of The Sample Absorbance

The results of sample preparation is measured by Atomic Absorption Spectrophotometer at a wavelength (λ) = 248.3 nm for analysis of Fe, λ = 324.7 for analysis of Cu, λ = 309.3 nm for the analysis of al, and λ = 558 nm for Cl analysis.

3. Results and Discussions

The results showed that the entire mineral water refill port that is used as the sample is already worth to drink based on chemical parameters with indicators of metal aluminum (Al), ferrum (Fe), chloride (Cl) copper (Cu) and provide the variation results, the value of the test results of aluminum (Al), ferrum (Fe), chloride (Cl) and copper (Cu) in a row of < 0.02 mg/l, < 0.07 mg/l and 0.04 < mg/l for all mineral water refill port that have been tested. The result of chloride (Cl) test have been much variation, highest chloride results contained on the Natural Qua Qua Rock Piayu mineral water refill port and Salwa Aji of 34.10 mg/l. The analysis results can be seen in Table 1 to Table 6.

Table 1. Test result analysis of Qua Piayu natural mineral water refill port

Parameters	Unit	Result	Standard
Aluminium	mg/l	<0,02	0,2
Ferrum	mg/l	<0,07	0,3
Hydrochloric	mg/l	34,10	250
Copper	mg/l	<0,04	2

Table 2. Test result analysis of Fresh Qua Bengkong mineral water refill port

Parameters	Unit	Result	Standard
Aluminium	mg/l	<0,02	0,2
Ferrum	mg/l	<0,07	0,3
Hydrochloric	mg/l	3,23	250
Copper	mg/l	<0,04	2

Table 3. Test result analysis of Salwa Qua Batu Aji mineral water refill port

Parameters	Unit	Result	Standard
Aluminium	mg/l	<0,02	0,2
Ferrum	mg/l	<0,07	0,3
Hydrochloric	mg/l	34,10	250
Copper	mg/l	<0,04	2

Table 4. Test result analysis of Salsabila Batam Center mineral water refill port

Parameters	Unit	Result	Standard
Aluminium	mg/l	<0,02	0,2
Ferrum	mg/l	<0,07	0,3
Hydrochloric	mg/l	27,85	250
Copper	mg/l	<0,04	2

Table 5. Test result analysis of Pak De Qua Tiban mineral water refill port

Parameters	Unit	Result	Standard
Aluminium	mg/l	<0,02	0,2
Ferrum	mg/l	<0,07	0,3
Hydrochloric	mg/l	1,29	250
Copper	mg/l	<0,04	2

Table 6. Test result analysis of Fun Qua Batu Ampar mineral water refill port

Parameters	Unit	Result	Standard
Aluminium	mg/l	<0,02	0,2
Ferrum	mg/l	<0,07	0,3
Hydrochloric	mg/l	0,32	250
Copper	mg/l	<0,04	2

The results analysis that conducted in the laboratory of PT. Sucopindo Batam indicated that the metal content which was obtained in every mineral water refill port nothing exceeds from the threshold value that set by KEPMENKESRI No. 907/MENKES/SK/VII/2002.According to the standard KEMENKES RI 2002 content of metal aluminum (Al), ferrum (Fe), chloride (Cl) and copper (Cu) in a row is 0.2 mg/L 0.3 mg/L, 250 mg/L and 2 mg/L.

The result analysis of Aluminum metal content, ferrum (Fe) and copper showed that the levels of all the mineral water refill port as the sample object of the study ordered lower than 0.02 mg/L, lower than 0.07 mg/L and lower than 0.04 mg/L.

The levels of chloride (Cl) contained in Salsabila Batam Center mineral water , Pak De Qua Tiban, Fun Qua Batu Ampar, Alam Qua, Fresh Qua, Salwa Qua have variation. The highest chloride levels are presented in naturaln mineral water of Qua Piayu mangsang village, Sei district. Beduk and Salwa Qua Batu Aji indicated 34,10 mg/L and the lowest chloride level can be found in Fun Qua mineral water refill port in Batu Ampar that contained 0,32 mg/L.

Aluminium initially not considered endangering health significantly in mineral water, but within the last decade the aluminum causing danger to people who have disorders of the kidneys and cause factor in Alzheimer's disease [8].

Ferrous metals formed in geology, acid drainage and waste disposal, the amount of the excess ferrum i.e. associated with organoleptic and the aesthetics primarily mineral water turbidity, color or fishy smell, the clothes become stained and vegetable will be changed the color when cooking. This is caused by the large number of Fe3+ is soluble in water through complex reactions between Fe3+ with soil and rocks [8].

Chloride Naturally present in waters with varied concentrations, in fresh water source chloride derived from soil and rocks as well as waste disposal. Chloride is become an indication of waste disposal occurs in an area if there is an increase of chloride up to 5 mg/L. Raw water treatment normally by chloride disinfection to kill microorganisms that can cause various diseases [9].

The presence of copper in mineral water could be caused by the industrial waste and existing copper in the ground, copper is not toxicly to humans but will cause a change in the taste of the water in case of an increase above 1 mg/L and Cu is also used as a drug with a dosage of 20 mg/L. Abuse of copper as toxic algae will result in the death of fish [10].

4. Conclusion

Determination of the levels of Al, Fe, and Cu, Cl is used as a raw mineral water quality parameter which feasible and safe to consume. Based on the results of this study showed that six samples of mineral water refill as the object studies has quality standards for raw drinking water based on the regulation of the Minister of health number 492/MENKES/SK/IV/2010.

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