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Evaluation of Aluminum Levels in Drinking Water of Nouakchott

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Abstract: The drinking water of Nouakchott, the capital of Mauritania, comes from the Senegal River. The current water treatment is done with aluminum sulfate. In order to monitor the aluminum content, from September 2015 to August 2016, three samples were taken monthly for each water source: pretreated water (from Beni Naji treatment station), treated water (from PK17 treatment station) and the water tower. The analysis results of the aluminum content of the treated water (full treatment) and pretreated water (first treatment) showed that the aluminum content of all samples was between 0.03 mg/L and 0.09 mg/L, with an average value of 0.07 mg/L. The World Health Organization stipulates that the normal content of aluminum between 0.1 mg/L and 0.2 mg/l. In the course of the study, the changes of aluminum content in samples from different places were observed. This change can be explained by coagulation-flocculation of aluminum sulfate. The aluminum content of the samples met the World Health Organization standards for drinking water.

Key words: Evaluation, water, treatment, Aluminum, Nouakchott, Mauritania.

1. Introduction

Nouakchott the capital of Mauritania, located in West Africa and bordered by the Atlantic Ocean, is supplied with drinking water by the Senegal River.

Alumina sulfate water from the Senegal River was pretreated at the Beni Naji station then completely treated at the PK 17 station in Nouakchott, before distribution to the pipe network.

As part of the study, we obtained hundred samples for the analysis of aluminum in drinking water.

The different water samples was pre-treated, processed and then placed in polyethylene bottles with a capacity of one liter.

Aluminum is one of the important components of treated drinking water, because the aluminum content in drinking water affects many diseases, not just Alzheimer's disease [2].

All the international studies on this issue seem to converge.

When the concentration exceeds 100 mg/L, drinking water will become a catalyst for Alzheimer's disease. The World Health Organization estimates that aluminum in drinking water between 0.1 mg/L and 0.2 mg/L is harmless. In France, the concentration varies greatly from region to region, and generally should not exceed 0.2 mg/L [3].

In March 2004, several epidemiological studies was conducted in six countries found that high aluminum concentrations in drinking water can significantly increase the incidence of Alzheimer's disease.

Several epidemiological studies, in six different

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countries, have concluded that the incidence of Alzheimer's disease has increased significantly in relation to an excessively high concentration of aluminum in the drinking water. The Institute of Old Sanitary and two health security agencies have published reports and conclusions denying, despite the facts, the plausibility of such a relationship and thereby rejecting any preventive measures during water treatment [3].

While the risk of infection remains the primary objective of water treatment, the problem of chemical pollution has become more and more important. This is largely due to new detection techniques that highlight the presence of a variety of chemical contaminants at very low concentrations, with a lack of understanding of their effects. This is especially true for the by-products of water disinfection [4, 5]. High intake of aluminum from drinking water may be a risk factor for Alzheimer's disease [6].

The content of aluminum in living organisms is extremely low, but it is abundant in the environment, and its existence form is very low for humans and most biological species. Although aluminum is abundant in the earth's crust, there is only a small amount of aluminum in the water, and the concentration ranges from tens of micrograms to hundreds of micrograms per liter. In most cases, the high aluminum content in drinking water is caused by acid precipitation or aluminum brine treatment. The presence of aluminum in dialysis fluids has been considered to be the main cause of aluminum toxicity in patients with renal failure. Drinking water (> 80 mg/L) is associated with increased incidence rate of Alzheimer's disease among normal subjects, although the real role of the element in the development of the disease has not yet been clarified [7].

2. Materials and Methods

2.1 Sampling

The samples were collected in a period of 12 months, from September 2015 to August 2016.

Each month three samples from different sites were collected (Beni Naji treatment station, PK17 treatment station and the water tower), the samples were collected at the first, middle and the end of each month. During the study a total of 108 samples were obtained.

2.2 Tests for Total Aluminum in Natural and Treated Waters

The aluminum content is determined by a Photometer WagTech 7100.

Palintest Photometer WegTech 7100 is a precision colorimeter with a wide range of applications in color matching and analytical chemistry. Most importantly, the photometer is combined with the palintest analysis system, thus providing an instrumental analysis method for a wide range of soil and water tests.

Aluminum sulfate is widely used as a coagulant in drinking water treatment. In order to control the alum coagulation and filtration process in water plants, it is usually necessary to determine aluminum (residual alum).

Aluminum salt is found in natural water. It is reported that the concentration of acid rain is still increasing, especially in areas affected by acid rain. High aluminum content may be toxic to fish and aquatic organisms. Therefore, the determination of aluminum is necessary for environmental control and testing of water used in fish farms.

The WagTech WTD Aluminum test provides a simple method of measuring aluminum content in the range of 0-0.5 mg/L in natural and drinking water.

2.3 Method

Aluminum reacts with Eriochrome cyanine R indicator in slightly acid solution to induce a pink-red complex. The presence of ascorbic acid eliminates the interference of ions and manganese. In the WagTech WTD Aluminum method, the necessary reagents are added to two test tablets.

The test is carried out by adding one of each tablet to a water sample. The first tablet acidifies the sample and

the second tablet buffers the solution to provide the correct test conditions.

The intensity of the color produced in the test is proportional to the aluminum concentration and is measured by the WagTech WTD Photometer.

2.4 Reagents and Equipment

Aluminum No.1 Tablets

Aluminum No.2 Tablets

WagTech WTD Automatic Wavelength Selection Photometer

Photometer Round Test Tubes, 10 ml glass (PT 595).

2.5 Test Procedure

1. Fill test tube with sample to the 10 ml mark
2. Add one piece of aluminum No.1 Tablets, crush and mix well to dissolve
3. Add one piece of aluminum No.2 Tablets, crush and mix well to dissolve. Avoid violent agitation
4. Let the color develop completely for 5 minutes
5. Select of parameter 3 for Aluminum assay on the photometer.
6. Take photometer reading in usual manner (see photometer instructions)
7. The result is displayed as mg/L Al

3. Results

The aluminum content of drinking water samples in Nouakchott was investigated at three sampling points:

- Pre-treated water to the outlet of the Beni Naji of the treatment station
- Treated water out of the PK17 for the treatment station in Nouakchott
- Water tower of Nouakchott city.

3.1 Evolution of Aluminum Content

The analyzes show that the Aluminum of all water samples pretreated in the Beni Naji treatment station is between 0.04 mg/L and 0.09 mg/L, with an average value of 0.075 mg/L (Table 1).

Table 1 Results of the aluminum content obtained at the outlet of the treatment station of Beni Naji (pretreated water).

	Unit	Minimum	Maximum	Average
Aluminum	mg/L	0.04	0.09	0.075

The analyses show that the Aluminum of all water samples of PK17 treatment plant of Nouakchott is between 0.03 mg/L and 0.09 mg/L, with an average value of 0.07 mg/L (Table 2).

Table 2 Results of the content of aluminum in the output of the PK17 for the treatment station of Nouakchott (treated water).

	Unit	Minimum	Maximum	Average
Aluminum	mg/L	0.03	0.09	0.07

The analyzes show that the aluminum of all treated water samples from water tower of Nouakchott is between 0.03 mg/L and 0.09 mg/L, with an average value of 0.06 mg/L (Table 3).

Table 3 Results of the content of aluminum in consumer castle of the city of Nouakchott (drinking water).

	Unit	Minimum	Maximum	Average
Aluminum	mg/L	0.03	0.09	0.06

The analyzes show that the aluminum of all water samples from Nouakchott is between 0.03 mg/L and 0.09 mg/L, with an average value of 0.07 mg/L (Table 4).

Table 4 Results of Aluminum content in the waters of Nouakchott.

	Unit	Minimum	Maximum	Average
Aluminum	mg/L	0.03	0.09	0.07

4. Discussion

In our study, we conducted 100 samples for physicochemical analysis. The different water samples untreated and treated were taken for analysis. The samples were collected in polyethylene bottles with a capacity of 1 liter.

The water treatment at Nouakchott is currently carried out with Aluminum Sulfate. The content of aluminum varied over the study from 0.03 mg/L to 0.09 mg/L (Table 4), the standard rate of aluminum is

set by the European Committee between 0.1 mg/L and 0.2 mg/L.

During the study, it was observed a variation in the aluminum content in the samples from the various sites. This variation can be explained by the coagulation-flocculation treatment methods used by aluminum sulfate.

5. Conclusions

The results of the analysis of aluminum in the treated water from Nouakchott city presented in this work have shown that the aluminum content of all samples is between 0.03 mg/L and 0.09 mg/L, with an average value of 0.07 mg/L.

During this study period, the aluminum contents remain below the standard set by the WHO (0.2 mg/L). The use of aluminum sulfate for coagulation is the main source of the increase in aluminum levels in drinking water. Aluminum's tenure values meet WHO drinking water standards.

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