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Study of Physicochemical and Microbiological Parameters of the Water of Lake FARIHY MIRAHAVAVY INFERIEUR (Sister Lake) Located in the District of Nosy-Be Region DIANA

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Abstract The physical parameters: the conductivity is 250 µS / cm, the turbidity is 1.5 NTU, the pH is 6.9 and the temperature is 20.5℃. The four physical parameters exactly meet the standards required for drinking water. Physical parameters: mineralization is 158 mg / L, total hardness is 20.25 ° f, calcium is 45 mg / L, magnesium is 15 mg / L, potassium is 6 mg / L , sodium is 85 mg / L, chloride is 130 mg / L, total iron is 0.15 mg / L, lead is 0.04 mg / L, and aluminum is 0.02 mg / L. The concentration of the chemical parameters found are admissible to international standards for water intended for human consumption, despite the insufficiency of some concentrations such as calcium, potassium and magnesium. Microbiological parameters: microorganisms at 22℃ are 200 MPN / mL, microorganisms at 36℃ are 35 MPN / mL, coliform bacteria 15 MPN / 100mL, Escherichia coli is 5 MPN / 100mL and enterococci gut is 2.5 MPN / 100mL The microbiological parameters found are very bad for drinking water.

Keywords Physico-chemical, Microbiological and disinfection parameters

1. Introduction

Nosy-be is the largest island in Madagascar, it is located north-west of Madagascar, it is between 13° 11’ and 13° 30’ south latitude and between 48° 22’and 48° 8’ longitude. It measures 30 km from north to south and 19 km from east to west. This lake is located in the district of DZAMANDZAR. The populations who live around the lake can use it as drinking water, which is why my research will be carried out to analyze the physico-chemical, microbiological and specific treatment parameters corresponding to the results found.

2. Objective of My Research

The first objective of my research is the determination of the concentration for the physical parameters compared with the international standards required for drinking water, respectively for the chemical parameters.

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The second objective is to determine the levels of microbiological germs to know whether the water ismicrobial or not.

The third objective is the specific treatment corresponding to the disinfection of the germs that exist in the water, in order to make the water drinkable without risk of contamination.

3. Research Methods and Materials

For physical parameters: measure directly using a thermometer for temperature measurement, pH meter for pH, measure with turbidimeter for turbidity and measure with conductivity meter for conductivity.

For chemical parameters: measurement of total hardness is titrated with CaCO3, calcium, magnesium, sodium, potassium and chloride are measured with the spectrometer apparatus and total iron, lead and aluminum are measured using a PERKIN ELMER lamp and acetylene gas.

For the microbiological parameters, we use the colimetry techniques H. Vincent method and the recommended Buttiaux technique to determine the concentration of germs that exist in water using a Smallest Number (MPN).

4. Characteristics of the Lake

It is a sacred lake named FARIHY MIRAHAVAVY (lower and upper sister lake), so the study is done by the lower FARIHY MIRAHAVAVY.

Lake	Surface (ha)	Volume ($10^3 m^3$)	Average depth (m)	Maimun depth (m)
FARIHY MIRAHAVAVY	7	100	3	6

Lake Mirahavavy inferior

5. Quality Standards

Table 1. Recommendation by the WHO

PARAMETERS		Acceptable limit	Unity
Physiques	Temperature	<25	℃
	Conductivity	180 - 1000	µS/cm
	pH	6,5 – 8,5	
	Turbidity	<5	NTU
CHIMIQUES	Minéralisation	1000	mg/L
	Total hardness	50	°f
	Calcium	100 - 140	mg/L
	Magnésium	50	mg/L
	Potassium	12	
	Sodium	200	
	Chloride	250	
	Fer totale	0,2	
	Plomb	<0,5	
	Aluminium	<0,2	
MICROBIOLOGICAL	Microorganismes à 22℃	<100	NPP/mL
	Microorganismes à 36℃	<20	NPP/mL
	Bacteries coliformes	0	NPP/100mL
	Escherichia coli	0	
	Enterocoques Intestinaux	0	

Table 2. Recommendation by the EU

PARAMETRES		Acceptable limit	Unity
Physiques	Temperature	<25	℃
	Conductivity	180 - 1000	µS/cm
	pH	6,5 – 9,5	
	Turbidity	<5	NTU
CHIMIQUES	Minéralisation	1500	mg/L
	Total hardness	50	°f
	Calcium	100	mg/L
	Magnesium	50	mg/L
	Potassium	12	
	Sodium	200	
	Chloride	250	
	Fer totale	0,2	
	Plomb	<0,5	
	Aluminium	2	
MICROBIOLOGIQUES	Microorganismes à 22℃	<100	NPP/mL
	Microorganismes à 36℃	<10	NPP/mL
	Bacteries coliformes	0	NPP/100mL
	Escherichia coli	0	
	Enterocoques Intestinaux	0	

Table 3. Recommendation by the E.M

PARAMETRES		Acceptable limit	Unity
Physiques	Temperature	<25	℃
	Conductivity	180 - 1000	µS/cm
	pH	6,5 – 8,5	
	Turbidity	<5	NTU
CHIMIQUES	Minéralisation	<3000	mg/L
	Total hardness	50	°f
	Calcium	100	mg/L
	Magnesium	50	mg/L
	Potassium	12	
	Sodium	200	
	Chloride	250	
	Fer totale	0,2	
	Plomb	<0,5	
	Aluminium	<0,2	
MICROBIOLOGIQUES	Microorganismes à 22℃	<100	NPP/mL
	Microorganismes à 36℃	<10	NPP/mL
	Bacteries coliformes	0	NPP/100mL
	Escherichia coli	0	
	Enterocoques Intestinaux	0	

6. Analysis Parameters

Physical parameters:

Temperature: determines the natural heat of water, it measures directly with the thermometer.

Turbidity: determination of the transparency of the water, possibly the presence of suspended particles.

pH: the potential of Hydrogen is the measure of the concentration of H + ions, the water being acidic, basic and neutral.

Conductivity: determination of the amount of dissolved matter and dissolved salt in water.

Chemical parameters:

Total hardness: determination of the calcium and magnesium content in the water.

Calcium, magnesium, sodium, chloride and potassium: are abundant and very important elements in water for human consumption.

Total iron: obligatory element that exists in water, but their excess in concentration results in the existence of toxicity in water.

Lead and Aluminum: Existence in sample indicates water is toxic.

Microbiological parameters:

The existence of one in the sample of five required for water intended for human consumption indicates the water is microbial.

7. Analysis Results

I - Physical parameters:

1 – temperature [3]

Table 4. Temperature measurement

SITES	Temperature (°C)
FARIHY MIRAHAVAVY	20,5
WHO	<25
EU	<25
EM	<25

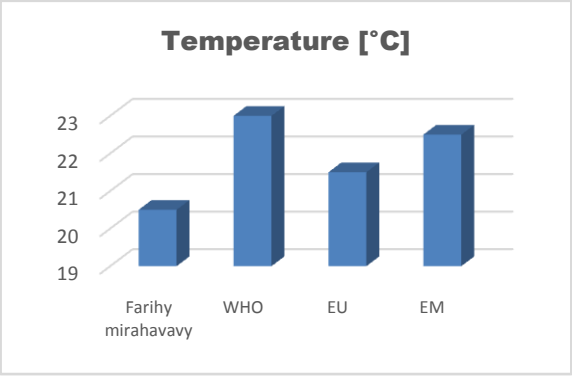

Figure 1. Temperature measurement

2 – Conductivity

Table 5. Conductivity measurement

SITES	Conductivity (µS/cm)
FARIHY MIRAHAVAVY	250
WHO	180 - 1000
EU	180 - 1000
EM	<3000

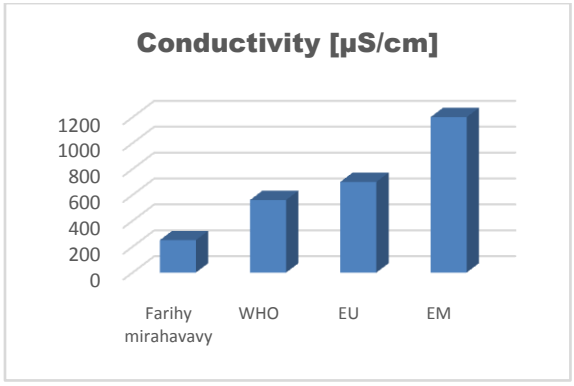

Figure 2. Conductivity measurement

3 – pH: [2], [3]

Table 6. pH measurement

SITES	pH
FARIHY MIRAHAVAVY	6,9
WHO	6,5 – 8,5
EU	6,5 - 9
EM	6,5 – 9,5

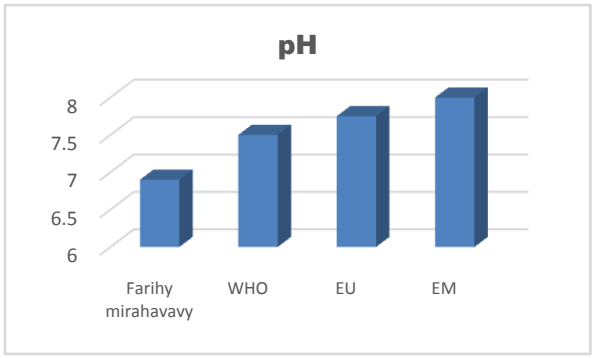

Figure 3. pH measurement

4 – Turbidity [1]

Table 7. Turbidity measurement

SITES	Turbidity (NTU)
FARIHY MIRAHAVAVY	1,5
WHO	<5
EU	<5
EM	<5

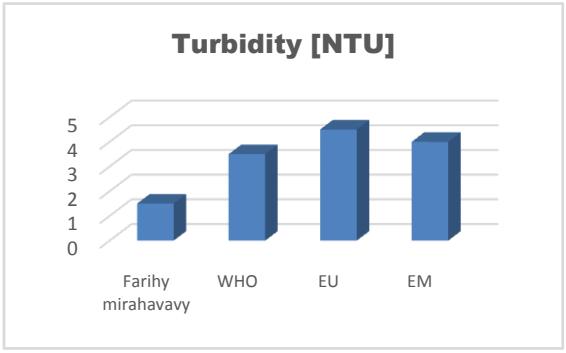

Figure 4. Turbidity measurement

II - Chemical parameters

1 - Mineralization

Table 8. Mineralization concentration

SITES	Minéralisation (mg/L)
FARIHY MIRAHAVAVY	158
WHO	1000
EU	1500
EM	1000

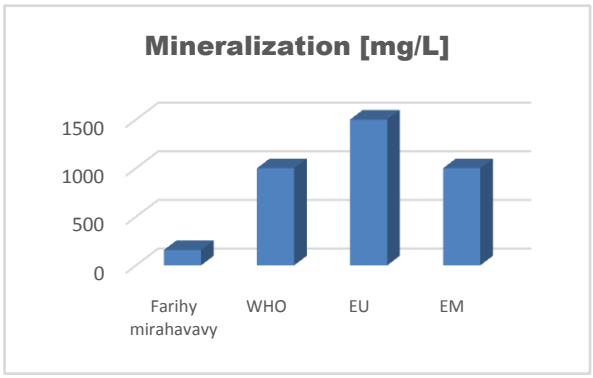

Figure 5. Mineralization concentration

2 – Total hardness [4]

Table 9. Determination of the total hardness concentration

SITES	Total hardness (°f)
FARIHY MIRAHAVAVY	20,25
WHO	50
EU	50
EM	50

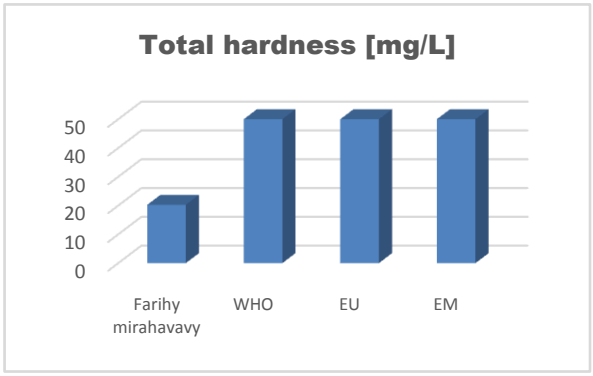

Figure 6. Total hardness concentration

3- Calcium [6]

Table 10. Determination of the calcium concentration

SITES	Calcium (mg/L)
FARIHY MIRAHAVAVY	45
WHO	100 - 140
EU	100
EM	100

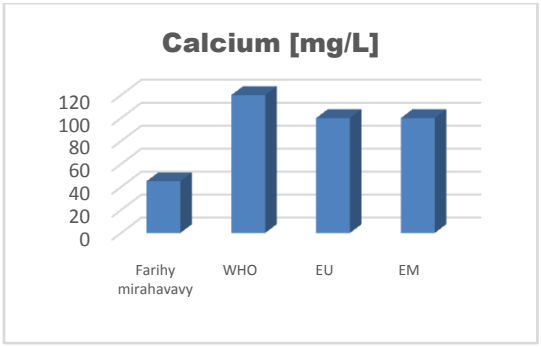

Figure 7. Calcium concentration

4 – Magnesium [6]

Table 11. Determination of the magnesium concentration

SITES	Magnesium (mg/L)
FARIHY MIRAHAVAVY	15
WHO	50
EU	50
EM	50

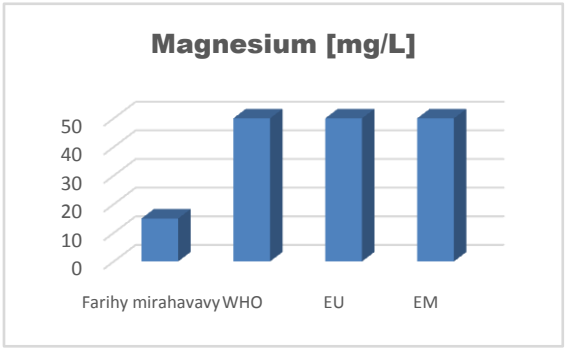

Figure 8. Magnesium concentration

5 - Potassium [9]

Table 12. Determination of the potassium concentration

SITES	Potassium (mg/L)
FARIHY MIRAHAVAVY	6
WHO	12
EU	12
EM	12

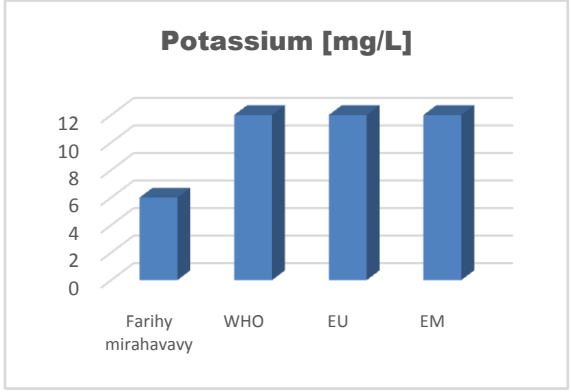

Figure 9. Potassium concentration

6 – Sodium [9]

Table 13. Determination of the sodium concentration

SITES	Sodium (mg/L)
FARIHY MIRAHAVAVY	85
WHO	200
EU	200
EM	200

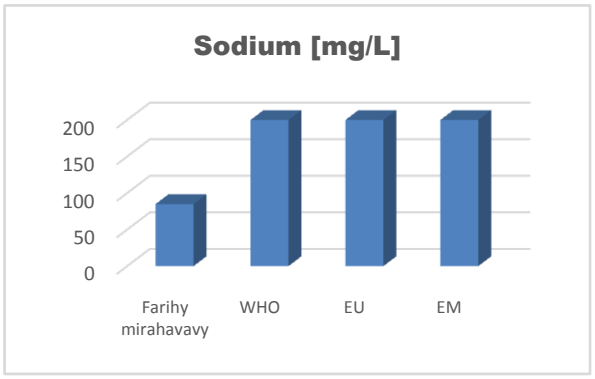

Figure 10. Sodium concentration

7 – Chloride [7]

Table 14. Determination of the chloride concentration

SITES	Chloride (mg/L)
FARIHY MIRAHAVAVY	130
WHO	<250
EU	<250
EM	<250

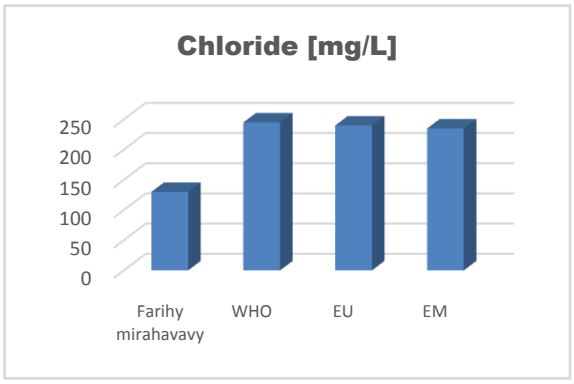

Figure 11. Chloride concentration

8 – Total iron [8]

Table 15. Determination of the total iron content

SITES	Total iron (mg/L)
FARIHY MIRAHAVAVY	0,15
WHO	0,2
EU	<0,5
EM	<0,5

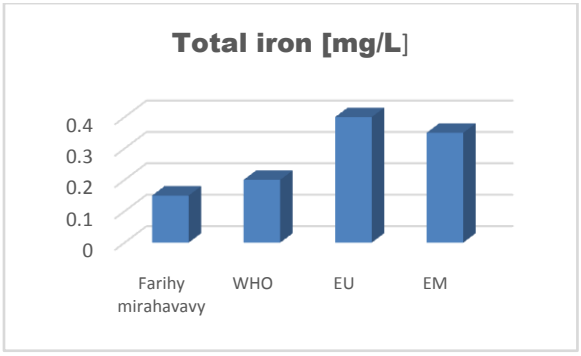

Figure 12. Total iron concentration

9 –Lead

Table 16. Determination of the lead content

SITES	Lead (mg/L)
FARIHY MIRAHAVAVY	0,04
WHO	<0,5
EU	<0,5
EM	<0,5

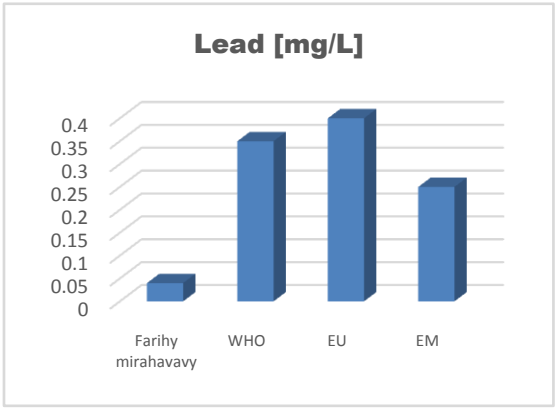

Figure 13. Lead concentration

10 – Aluminum [5]

Table 17. Determination of the aluminum content

SITES	Aluminum (mg/L)
FARIHY MIRAHAVAVY	0,02
WHO	<0,2
EU	2
EM	<0,2

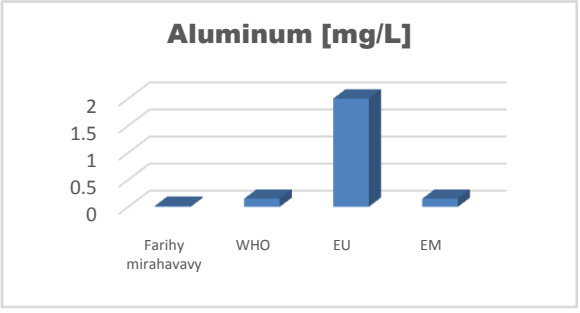

Figure 14. Aluminum concentration

III - Microbiological parameters

Table 18. Determination of the concentration of microbiological parameters

FARIHY MIRAHAVAVY	Results	Unit	WHO	EU	EM
Microorganisms à 22°C	235	NPP/mL	<100	<100	<100
Microorganisms à 36°C	35	NPP/mL	<20	<10	<10
Coliform bacteria	15	NPP/100mL	0	0	0
Escherichia coli	5	NPP/100mL	0	0	0
Intestinal Enterococci	2,5	NPP/100mL	0	0	0

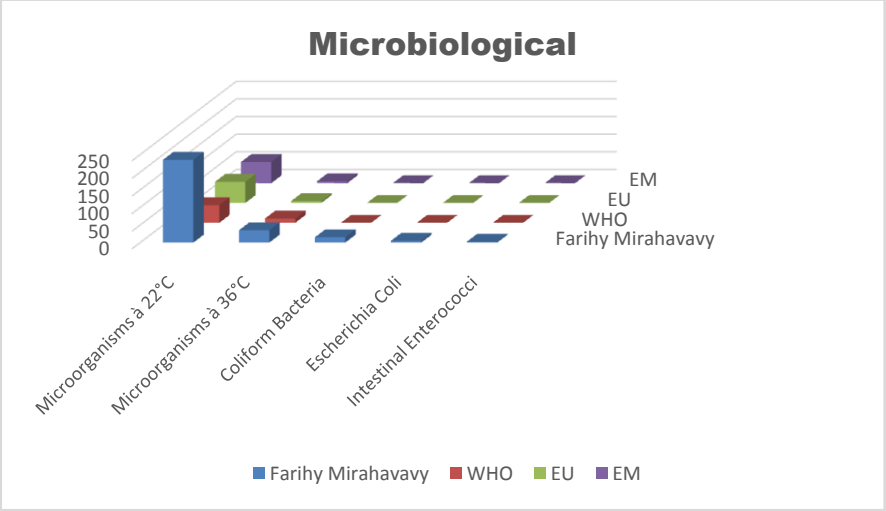

Figure 15. Concentration of microbiological parameters

According to this analysis, the values found exceed international standards, therefore the lake water is microbial, it must be treated before use.

Treatment method [10]

The method used is disinfection by calcium hypochlorite by the "Break-Point" method, ie determining the optimal dose of chlorine for the disinfection of the water in FRIHY MIRAHAVY.

The result of the chlorine demand is given in the following table 19.

Table 19

Concentration of calcium hypochlorite (mg/L)	0,1	0,125	0,15	0,175	0,2	0,225	0,25	0,275	0,3	0,325	0,35	0,375	0,4
Residual chloride after 30mn of contact (mg/L)	0,05	0,2	0,1	0,3	0,25	0,25	0,5	0,6	0,7	0,8	0,9	1	1,1

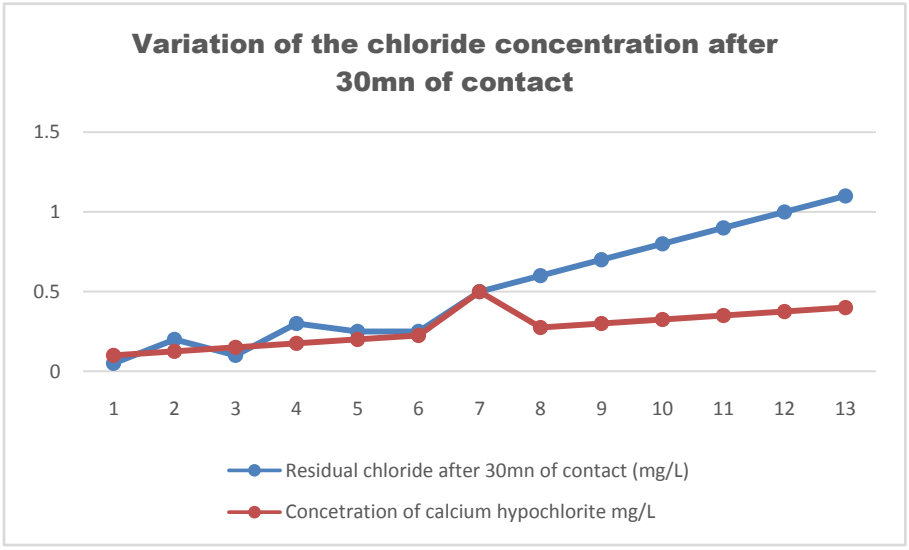

Figure 16. Variation of the chlorine concentration after 30mn of contact

From 1 to 3 mg / L: chlorine in the form of amino compounds.

From 3 to 4 mg / L: progressive increase in Chlorine.

The optimum dose of calcium hypochlorite from the Break-point, the chlorine content of 3.5 mg / L is taken for disinfection.

Result immediately after disinfection

Table 20

FARIHY MIRAHAVAVY	Results	Unit	WHO	EU	EM
Microorganisms à 22°C	1,25	NPP/mL	<100	<100	<100
Microorganisms à 36°C	0,5	NPP/mL	<20	<10	<10
Coliform bacteria	0	NPP/100mL	0	0	0
Escherichia coli	0	NPP/100mL	0	0	0
Intestinal Enterococci	0	NPP/100mL	0	0	0

8. Discussions

For the physical parameters, respectively temperature, pH, turbidity and conductivity, the values found are admissible to the standards required for water intended for human consumption.

For the chemical parameters: calcium, magnesium, sodium, potassium and chloride, the concentrations found are acceptable for the international standards required for drinking water, despite their insufficient concentrations such as calcium is 45 mg / L potassium 15 mg / L and sodium is 85 mg / L.

For heavy metals such as lead, aluminum and total iron, the concentrations found are very low, so the water is not a risk of contamination, but it is necessary to take the measurement every season and clean the border this lake.

For microbiological parameters: the results are very bad, ie the water is microbial, it must be treated before use.

I choose the "Break-Point" method for the treatment. According to this method we take the dose 3.5 mg / L of calcium hypochlorite can be taken for disinfection, finally the population uses the water of FARIHY MIRAHAVY without risk of contamination on everything during the rainy season.

9. Conclusions

The water of FARIHY MIRAHAVY is good according to the analysis of the physical parameters, that is to say, the value found is acceptable according to the international standards for drinking water.

For the chemical parameters, it is good, despite the insufficient concentration of calcium 45 mg / L, magnesium 15 mg / L and sodium 85 mg / L; The water is drinkable and without risk to health, but lacks the very important elements in water intended for human consumption.

Heavy metals Aluminum is 0.02 mg / L and lead is 0.04 mg / L, comparison to international standards require that the limit value less than 0.5 mg / L, for heavy metals; based on this concentration, water is found to be safe for toxicity.

For microbiological parameters, water is bad and very dangerous for health. It is necessary to treat by the method of chlorination with the optimal dose of 3.5 mg / L of calcium hypochlorite before being used, in the end the populations who live in the range of FARIHY MIRAHAVY drink this water in complete safety. especially during the rainy season.

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