



Impact of the use of filtration systems On the suitability of water for consumption.

Done by:

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Content:

| Subject | Page number |
|------------------------------------|-------------|
| Abstract | 2 |
| Research question | 3 |
| Introduction and literature review | 3-4 |
| Research methodology | 4-7 |
| Results | 8-10 |
| Result analysis | 10-11 |
| Conclusion | 11 |
| References | 12 |

Abstract :

The effect of using filtration systems on water suitability

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Our research aims to study the effect of filtration systems on water suitability, and we have asked the following two questions:

- 1- What is the effect of water filtration on its properties (acidity, salinity, conductivity, transparency and dissolved oxygen)?
- 2- How does filtration affect the suitability of water?

In order to answer these two questions, we decided to study the properties of water before and after using filters (normal filter and electric filter), and we applied the water protocol and the dissolved oxygen protocol to study the properties of each sample of water in terms of acidity, salinity, conductivity, transparency, and dissolved oxygen.

We have concluded, after research, experimentation and interviewing specialists, that the properties of water are not affected by the use of the first type of filters (the normal filter), but the use of the second type of filters (the electric filter) leads to the removal of most of the salts from the water. We also concluded that the water remains suitable for drinking if its salinity ranges between (120-1000ppm) / liter of water, but it becomes unfit for drinking if the percentage of salts in it is less than (120ppm), as it will negatively affect human health due to the lack of minerals useful to the body such as calcium and magnesium.

Based on the results, we recommend the need for specialists to direct and educate people about the specifications of potable water and urge them to examine the water before installing filters, so that if its salinity is within the normal range or conforms to the standards, there is no need to install filters. If the water salinity is very high and does not conform to the specifications, then filters must be installed. Electric filter for water filtration with the need to add a part to the filter to add the necessary minerals to the water so that its deficiency does not affect human health.

Key terminologies:

Filter: It is a means used to purify water from impurities to improve water quality.

Salinity: the amount of dissolved salts in water.

Conductivity: the extent to which water conducts an electric current.

Research questions:

1- What is the effect of water filtration on its properties (acidity, salinity, conductivity, transparency and dissolved oxygen)?

2- How does filtration affect the suitability of water?

Introduction and literature review:

increased interest in the quality of drinking water and its suitability for human consumption to ensure the preservation and protection of human health, and because many epidemics and their spread have been linked to polluted water, and this interest is shown through the installation of water filters, whether in homes, schools, hospitals or other places. The types of filters used in our society vary depending on the capabilities of the individual and his cultural background.

In this research, we will compare two types of filters used in our school for water purification:

The first: it is the regular type that contains 3 filters and is used to purify water from impurities.



The second type: is the one that works with electricity and is used to get rid of salts and impurities



The comparison will be about the effect of each type on the properties of water and on the suitability of water.

We have searched from various sources of information for previous studies on the specifications of potable water and we found that the World Health Organization has defined the standards that must be available in potable water as follows: Its acidity (PH) is between (6.5-8.5) and its salinity is between (300ppt - 1500ppt). ppt) and dissolved oxygen 5-8 salt / liter, and it must also be free of bacteria and pathogens, and it must also contain mineral elements in a specific percentage that does not exceed it, and among these salts: calcium (between 100-200 mg / liter) and magnesium (between 30-50 mg/l) and chloride (between 25-200 mg/l) and nitrates (between 25-50 mg/l).

Research methodology:

Research plan:

1. Collecting information on the subject of the research from the books available at the Learning Resource Center and from the information network.
2. Develop a research plan.
3. Setting a timetable for the implementation of the research plan.
4. Determine the protocols necessary to carry out the research.
5. Determine the devices and tools necessary to carry out the work (a pH meter, a device for measuring salinity and conductivity, a tube for measuring transparency, and a Dissolved oxygen kit).
6. Data collection and organization in tables.
7. Enter the data on the program website.
8. Data analysis and graphic representation.
9. Reaching conclusions and recommendations.

Timetable of the research plan implementation:

| name | task | date |
|--|---|----------------|
| Ryan Awad Al Farsi Jana Said Al Farsi | Collect information on the research subject from various resources. | September 2022 |
| Ryan Awad Al Farsi Jana Said Al Farsi | Collect water samples and apply different protocols to them using globe devices. | October 2022 |
| Ryan Awad Al Farsi Jana Said Al Farsi | Visit the water testing laboratory in Ibri municipality to learn about the specifications of potable water and methods of testing water | October 2022 |
| Ryan Awad Al Farsi Jana Said Al Farsi | Communicate with Diem Water Company to conduct laboratory tests for water and organize a visit to the company. | November 2022 |
| Ryan Awad Al Farsi Jana Said Al Farsi | Observing the final results and writing the research. | November 2022 |

Survey location

Sultanate of Oman - Al Dhahirah Governorate - Wilayat Ibri - Thaher Al Fawares village - (latitude: 23.37 and longitude: 56.38) months of September and October - the weather is moderate, the temperature ranges between (24-30 C) water and dissolved oxygen protocols were used.



Data collection and analysis:

The research questions will be answered as follows:

Using the water protocol to determine the acidity of water (pH) using a device (pH meter) and a salinity and conductivity meter to measure the salinity and conductivity of water and a transparent tube to determine the transparency of water and using the dissolved oxygen protocol to determine the amount of dissolved oxygen in water.

Methods of data collection:

- 1- Visiting the Ibri municipality and having an interview with Ms. Layla Al-Muqbaliya, head of the food and water laboratory in the municipality of Ibri, to collect information about the specifications of potable water according to Omani standards.
- 2- Collect 3 samples of water (the main water source, from the normal filter, from the electric filter).
- 3- Use globe software devices to study the properties of water in all samples (transparency - acidity - salinity - conductivity - dissolved oxygen).
- 4- Collecting samples of water by Deem Water Company to study the properties of water and the elements in it.
- 5- Visit the headquarters of the Omani Water Company and discuss the results of the samples with a. Aisha Al-Wahshiyya, Head of the Water Laboratory Department in Ibri.
- 6- Compare and analyze the results.



Visit the headquarters of Oman Water Company (Haya – Deem)



Testing water samples inside the school laboratory.

Ibri Municipality Visit



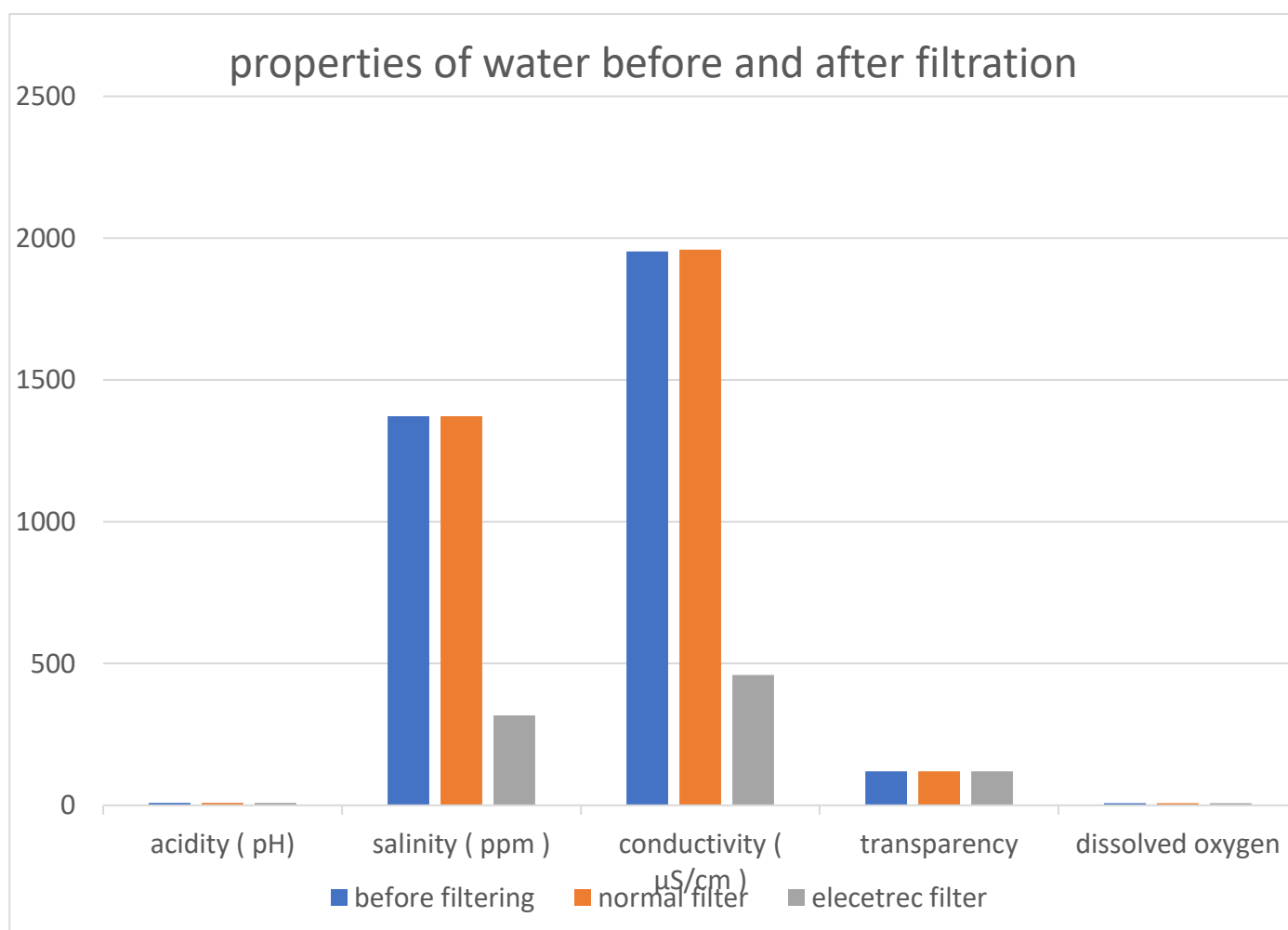
Aisha Al , Wahshia
Oman Water

Results:

First: Water properties data before and after filtration using GLOBE devices:

| characteristics | Before filtering | Normal Filter | Electric Filter |
|--|------------------|---------------|-----------------|
| Acidity (pH) | 8.2 | 8.3 | 8.4 |
| Salinity (ppm) | 1372 | 1372 | 317 |
| Conductivity ($\mu\text{S}/\text{cm}$) | 1953 | 1959 | 460 |
| Transparency | 120 | 120 | 120 |
| Dissolved oxygen | 8 | 8 | 8 |

Table 1



shape 1

Second: Comparison of the results of water properties before and after filtration using GLOBE devices and Oman Water Company (Haya - Deem)

1- Before filtering:

| characteristics | Before filtering | |
|--|------------------|---|
| | GLOBE devices | Oman Water Services Company (Haya & Deem) |
| Acidity (pH) | 8.2 | 8.2 |
| Salinity (ppm) | 1372 | 1322 |
| Conductivity ($\mu\text{S}/\text{cm}$) | 1953 | 2035 |
| Transparency | 120 | - |
| Dissolved oxygen | 8 | - |

Table 2

2- After filtering:

| characteristics | After filtering | | | |
|--|-----------------------------|----------------------------------|-------------------------------|------------------------------------|
| | Normal Filter Globe devices | Normal Filter Oman Water Company | Electric Filter Globe devices | Electric Filter Oman Water Company |
| Acidity (pH) | 8.3 | 8.39 | 8.4 | 7.24 |
| Salinity (ppm) | 1372 | 1101 | 317 | 279.5 |
| Conductivity ($\mu\text{S}/\text{cm}$) | 1959 | 2003 | 460 | 430 |
| Transparency | 120 | - | 120 | - |
| Dissolved oxygen | 8 | - | 8 | - |

Table 3

The data has been entered and sent to the program website (www.globe.gov) Via App (DATA ENTRY).

The GLOBE Program
Science Data Entry

pH - Expand/Collapse | ✕ Re

Measured with: pH Meter *

pH Paper

pH Meter

1 *

If salt added, conductivity

μS/cm

pH 8.2

Value of buffers used

pH 4 pH 7 pH 10

Comments

The GLOBE Program
Science Data Entry

Dissolved - Expand/Collapse | ✕ Rem

Oxygen

Method used: Kit

Kit

Probe

Dissolved Oxygen kit

manufacturer Other

model

1 *

Dissolved Oxygen

8 mg/l

Salinity

Results analysis:

Through the data collected, we find that:

- The properties of water before and after filtration with the normal filter did not change, as the values of salinity, conductivity and acidity decreased by very little, as shown in Table (1) and the graph shown in Figure (1), Table (2) and Table (3), whether with the devices of the Globe program or the results of testing samples in the laboratory of Oman Water Company (Haya – Deem) where the salinity values were about (1100-1300 mg / l) (Appendix No. 1 and 2), where this percentage of salinity is slightly high according to the Omani standards for drinking water, which determined the salinity of drinking water between (120-1000 mg / l) as explained to us by Ms. Laila Al-Muqbaliya, Head of the Water and Food Laboratory in Ibri Municipality, and Ms. Aisha Al-Wahsha, Head of the Ibri Water Laboratory Department at the Oman Water Company (Haya - Deem) and it is between (300-1500 mg / liter). Therefore, a normal filter is preferable to use When the salinity levels in the water are within the Omani standards for drinking water in order to separate impurities and dust only from the water.
- On the other hand, we find that the electric filter removed most of the salts from the water, where the salinity and conductivity decreased significantly, whether using the devices of the Globe program as shown in the graph (Figure

(1)) and Table (1) or the results of the examination of samples in the laboratory of the Oman Water Company as shown in tables (2 and 3) and Appendix No. (3). The salinity decreased from (1372 to 317 ppm) using the salinity meter and from (1372-279.5 ppm) according to the results of the examination of samples at Oman Water Company. However, this percentage of salinity remains within the Omani standards for drinking water specifications (120-1000ppm) as well as the standards of the World Health Organization.

- The percentages of calcium, magnesium and chlorine salts in the water after filtering with the electric filter decreased to a high degree, as shown by the results of the examination of samples in the laboratory of the Oman Water Company (Appendix No. (2)), but its percentage remains in the normal range of the Omani standards for drinking water specifications, as explained by Ms. Laila and Ms. Aisha .

Conclusion:

We thank God Almighty for the completion of this research, in which we used GLOBE protocols (Water Protocol and Dissolved Oxygen Protocol) to compare the properties of water before and after the use of two filtration systems and the extent of their impact on the validity of water and we have reached after research, experimentation and interview specialists that the properties of water are not affected by the use of the first type of filters (normal filter), but the use of the second type of filters (electric filter) leads to the removal of most salts from the water. We also found that water remains drinkable if its salinity ranges between (120-1000ppm) / liter of water, but becomes undrinkable if the percentage of salts in it is less than (120 ppm), as it will negatively affect human health due to the lack of minerals beneficial to the body such as calcium and magnesium.

Therefore, we recommend the following:

- 1- The need for specialists to guide and educate people about the specifications of drinking water and urge them to check the water before installing filters so that if its salinity is within the normal range or conforms to the standards, there is no need to install filters.
- 2- If the salinity of the water is very high and does not conform to specifications, electric filters must be installed to filter the water, with the need to add a part to the filter to add the necessary minerals to the water so that its deficiency does not affect human health.
- 3- Using natural sources of drinking such as falaj or river water, where the salts are balanced, and staying away from bottled water.

Thanks and Appreciation:

We extend our sincere thanks and appreciation to the Assistant Principal of the School for her continuous cooperation and support to the GLOBE program team, and I also extend my thanks to Ms. Laila Al-Muqbaliya, Head of the Water and Food Laboratory in Ibri Municipality, Ms. Aisha Al-Wahshia, Head of the Water Laboratory Department in Ibri at the Oman Water Company (Haya - Deem) and all laboratory staff for their cooperation with us in collecting and testing samples, and providing important information related to the results of the research. I thank all those who cooperated with us from the faculty members of the school, and of course thanks go to Ms. Hidaya Al-Farsi for giving us the opportunity to conduct this research and follow up on us during its preparation.

Badges selection :

1 – I MAKE AN IMPACT.

2 – I AM A STEM PROFESSIONAL.

3 – I AM A DATA SCIENTIST.

References:

1- Technical Office of the GLOBE Program. (2014) Water Protocol Note for the GLOBE Teacher Training Program.

2- Technical Office of the GLOBE Program. Dissolved Oxygen Protocol Memorandum for the GLOBE Program Teacher Training Program.

3- Ministry of Education (2013) Science book for the eighth grade.

4- Faculty Of Science (2012, April 29). Drinking water specifications according to the World Health Organization, retrieved on 8/2, 2015 from <https://ar-ar.facebook.com/faculty.science.aleppo/.../396398910383527>

5- Atka Al-Borini (2018, November 9). Standards of potable water. Retrieved on October 2, 2022 from <https://mawdoo3.io>

appendix:

| TEST PARAMETERS | | METHOD OF TESTING | | OMAN STD No. 8/2012 | | UNIT | LOQ | RESULTS | REMARKS |
|--------------------------------------|-------------|-------------------|-----|---------------------|--|-------|------|----------|---------|
| | | MIN | MAX | | | | | | |
| On Site Tests | | | | | | | | | |
| Appearance | APHA 2110 | | | | | n/a | | Pass | |
| Odour | APHA 2150 A | | | | | n/a | | Pass | |
| Taste | APHA 2160 | | | | | n/a | | Pass | |
| Temperature | EPA 150.1 | | | | | °C | | 25.00 | |
| Physical Chemistry | | | | | | | | | |
| Colour | APHA 2120 B | | | | | n/a | | Negative | |
| *Electrical Conductivity | EPA 120.1 | | | | | µS/cm | 10 | 2003.00 | |
| *pH | EPA 150.1 | 6.5 | 9 | | | | 1 | 8.39 | |
| TDS | EPA 120.1 | 120 | 600 | | | mg/L | n/a | 1101.85 | OOS |
| Temperature | EPA 150.1 | | | | | °C | | 25.00 | |
| Turbidity | EPA 180.1 | | 1 | | | NTU | 0.02 | 2.81 | OOS |
| Inorganics (Titration) | | | | | | | | | |
| Bicarbonate Alkalinity as CaCO3 | EPA 150.1 | | | | | mg/L | | 136.80 | |
| *Calcium as Ca++ | EPA 150.1 | | | | | mg/L | | 50.39 | |
| Calcium Hardness as CaCO3 | EPA 150.1 | | | | | mg/L | | 227.40 | |
| Carbonate Alkalinity as CaCO3 | EPA 150.1 | | | | | mg/L | | 31.60 | |
| Carbonate Hardness as CaCO3 | EPA 150.1 | | | | | mg/L | | 168.40 | |
| Chloride as Cl- | EPA 150.1 | | 250 | | | mg/L | | 418.47 | OOS |
| Hydroxide Alkalinity as CaCO3 | EPA 150.1 | | | | | mg/L | | 0.00 | |
| *Magnesium as Mg++ | EPA 150.1 | | | | | mg/L | | 36.50 | |
| Methylene Orange Alkalinity as CaCO3 | EPA 150.1 | | | | | mg/L | | 168.40 | |
| Non Carbonate Hardness | EPA 150.1 | | | | | mg/L | | 219.40 | |
| Phenolphthalein Alkalinity as CaCO3 | EPA 150.1 | | | | | mg/L | | 15.80 | |
| Total Hardness as CaCO3 | EPA 150.1 | | 200 | | | mg/L | | 387.80 | OOS |

This analytical report relates to the sample(s) as received by the laboratory, if sampling was not done by laboratory Report shall not be reproduced (except in full) without written approval of lab authority

Normal Filter(2)

| TEST PARAMETERS | | METHOD OF TESTING | | OMAN STD No. 8/2012 | | UNIT | LOQ | RESULTS | REMARKS |
|--------------------------------------|-------------|-------------------|------|---------------------|--|-------|------|----------|---------|
| | | MIN | MAX | | | | | | |
| On Site Tests | | | | | | | | | |
| Appearance | APHA 2110 | | | | | n/a | | Pass | |
| Odour | APHA 2150 A | | | | | n/a | | Pass | |
| Taste | APHA 2160 | | | | | n/a | | Pass | |
| Temperature | EPA 150.1 | | | | | °C | | 25.00 | |
| Physical Chemistry | | | | | | | | | |
| Colour | APHA 2120 B | | | | | n/a | | Negative | |
| *Electrical Conductivity | EPA 120.1 | | | | | µS/cm | 10 | 2095.00 | |
| *pH | EPA 150.1 | 6.50 | 9 | | | | 1 | 8.23 | |
| TDS | EPA 120.1 | | 1000 | | | mg/L | n/a | 1322.35 | OOS |
| Temperature | EPA 150.1 | | | | | °C | | 25.00 | |
| Turbidity | EPA 180.1 | | 5 | | | NTU | 0.02 | 3.88 | |
| Inorganics (Titration) | | | | | | | | | |
| Bicarbonate Alkalinity as CaCO3 | APHA 2320B | | | | | mg/L | | 166.40 | |
| *Calcium as Ca++ | APHA 2320B | | | | | mg/L | | 97.88 | |
| Calcium Hardness as CaCO3 | APHA 2320B | | | | | mg/L | | 244.60 | |
| Carbonate Alkalinity as CaCO3 | APHA 2320B | | | | | mg/L | | 0.00 | |
| Carbonate Hardness as CaCO3 | APHA 2320B | | | | | mg/L | | 166.40 | |
| Chloride as Cl- | APHA 2320B | | 600 | | | mg/L | | 412.33 | |
| Hydroxide Alkalinity as CaCO3 | APHA 2320B | | | | | mg/L | | 0.00 | |
| *Magnesium as Mg++ | APHA 2320B | | | | | mg/L | | 33.70 | |
| Methylene Orange Alkalinity as CaCO3 | APHA 2320B | | | | | mg/L | | 166.40 | |
| Non Carbonate Hardness | APHA 2320B | | | | | mg/L | | 218.60 | |
| Phenolphthalein Alkalinity as CaCO3 | APHA 2320B | | | | | mg/L | | 0.00 | |
| Total Hardness as CaCO3 | APHA 2320B | | 500 | | | mg/L | | 385.00 | |

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Top Tank(1)

| TEST PARAMETERS | | METHOD OF TESTING | | OMAN STD No. 8/2012 | | UNIT | LOQ | RESULTS | REMARKS |
|--------------------------------------|-------------|-------------------|------|---------------------|--|-------|------|----------|---------|
| | | MIN | MAX | | | | | | |
| On Site Tests | | | | | | | | | |
| Appearance | APHA 2110 | | | | | n/a | | Pass | |
| Odour | APHA 2150 A | | | | | n/a | | Pass | |
| Taste | APHA 2160 | | | | | n/a | | Pass | |
| Temperature | EPA 150.1 | | | | | °C | | 25.00 | |
| Physical Chemistry | | | | | | | | | |
| Colour | APHA 2120 B | | | | | n/a | | Negative | |
| *Electrical Conductivity | EPA 120.1 | | | | | µS/cm | 10 | 430.00 | |
| *pH | EPA 150.1 | 6.50 | 9 | | | | 1 | 7.24 | |
| TDS | EPA 120.1 | | 1000 | | | mg/L | n/a | 279.50 | |
| Temperature | EPA 150.1 | | | | | °C | | 25.00 | |
| Turbidity | EPA 180.1 | | 5 | | | NTU | 0.02 | 0.33 | |
| Inorganics (Titration) | | | | | | | | | |
| Bicarbonate Alkalinity as CaCO3 | APHA 2320B | | | | | mg/L | | 50.60 | |
| *Calcium as Ca++ | APHA 2320B | | | | | mg/L | | 13.70 | |
| Calcium Hardness as CaCO3 | APHA 2320B | | | | | mg/L | | 38.00 | |
| Carbonate Alkalinity as CaCO3 | APHA 2320B | | | | | mg/L | | 0.00 | |
| Carbonate Hardness as CaCO3 | APHA 2320B | | | | | mg/L | | 50.60 | |
| Chloride as Cl- | APHA 2320B | | 600 | | | mg/L | | 112.05 | |
| Hydroxide Alkalinity as CaCO3 | APHA 2320B | | | | | mg/L | | 0.00 | |
| *Magnesium as Mg++ | APHA 2320B | | | | | mg/L | | 11.28 | |
| Methylene Orange Alkalinity as CaCO3 | APHA 2320B | | | | | mg/L | | 50.60 | |
| Non Carbonate Hardness | APHA 2320B | | | | | mg/L | | 34.40 | |
| Phenolphthalein Alkalinity as CaCO3 | APHA 2320B | | | | | mg/L | | 0.00 | |
| Total Hardness as CaCO3 | APHA 2320B | | 500 | | | mg/L | | 85.00 | |

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Electric Filter (3)