

Drinking Water Treatment: pH Adjustment Using Natural Physical Field

Hesham Mohamed Abdal-Salam Yehia, Said Mahmoud Said

Department of Biotechnology, HST Company, Cairo, Egypt

Email: hyehia@hlogicgroup.com

How to cite this paper: Yehia, H.M.A.-S. and Said, S.M. (2021) Drinking Water Treatment: pH Adjustment Using Natural Physical Field. *Journal of Biosciences and Medicines*, 9, 55-66.

<https://doi.org/10.4236/jbm.2021.96005>

Received: May 4, 2021

Accepted: June 4, 2021

Published: June 7, 2021

Copyright © 2021 by author(s) and Scientific Research Publishing Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Water has a pH of around (7.0), making it neither alkaline nor acidic. Alkaline is defined as a pH value greater than (7.0). The power of water to neutralize acids is measured by its alkalinity. The pH scale ranges from (pH = 0 to 14), with anything above (pH = 7.0) being alkaline, and anything below (7.0) being acidic. Much of the research up to now has been investigating the effect of adding alkaline substances to the water to increase the pH levels. Recent evidence suggests that using baking soda (sodium bicarbonate), which is an alkaline substance with a pH of about (9). While studies have shown that adding soda to water increases its alkalinity, it has a number of negative health consequences. For instance, Hypokalemia, Hypochloremia, High levels of sodium in the blood, Worsening kidney disease, Worsening heart failure, Muscle weakness and spasm, and Increased stomach acid production. The main aim of this study is to investigate a natural substance consisting of environmental elements *i.e.*, it is derived from silica by the thermal fusion method (prepared by the authors) that raises the pH of water with a physical field of 80 cm without adding any components to the water. The results showed the effectiveness of this natural substance in its solid and liquid forms in raising the pH of water to reach 8.5 from a distance range = 80 cm, without any side effects on human health.

Keywords

Alkaline, Acidic, Water, pH Value, Biotechnology, Physical Field

1. Introduction

Water is known as a key component of the life of any living organism, but this source of life can be a curse in some cases and drinking water becomes a danger to people's health [1]. In details, Loss *et al.*, 2017 explained a report published by

the *Soil and Tillage Research*, a specialist in which they said that some people suffer from many health problems due to drinking water [2]. Their study report attributed these problems to the fact that many people do not realize the value of what is called the “pH” of the water they drink, as the pH determines the concentration of hydrogen ions in the water, which determines the “acidity” of the water, which can cause problems. Many if it is high or low, depending on the health condition. Researchers warn that a low pH turns water into a toxic solution, and it is also more attractive to heavy metals in the human body.

The pH is lower, may cause digestive problems for some people, if the person suffers from high acidity in the stomach. This explains the increase in the popularity of potable alkaline water in the recent period, which leads to the neutralization of acids in the digestive system, and makes the person feel more comfortable. Alkaline water helps the body become more alkaline, which treats many diseases including cancer [3] [4]. Also, drinking alkaline water leads to an equalization of the pH of the mouth, digestive system, and urine, so its continued intake leads to an equalization of the pH of the whole human body. In turn, a study indicated that the use of alkaline water with a degree of 8.8 can disrupt the work of an enzyme in the body, which plays a dangerous role in heartburn, and reduces its annoying symptoms. She explained that alkaline water, which has a pH between 8.5 and 10 degrees, is beneficial for people with irritable bowel syndrome. It is noteworthy that the human body has a “fine natural regulator” of acidity levels, which cause changes in the pH of the blood, such as that which solve serious problems in the organs and tissues [5].

2. Literature Review

The pH of water indicates whether it is acidic or alkaline. The pH scale ranges from 0 to 14, with 7 indicating neutral. The pH of drinking water should be between 6 and 8.5. If the water is acidic, this treatment process is used (low pH) [6]. When pumped into a water system, soda ash (sodium carbonate) and sodium hydroxide increase the pH of the water to near neutral. They do not cause hardness problems in treated water, unlike neutralizing filters [7]. Baking soda’s pH cannot be measured since it is a dry powder. Since pH is determined by the relative amounts of free hydrogen and hydroxyl ions in a water-based solution, an aqueous solution is needed.

Researchers attempted to evaluate the impact of physically activated carbon to remove natural organic matter in drinking water purification process. Korotta-Gamage and Sathasivan (2017) highlighted that physically activated carbon (BAC) removes low molecular weight in natural organic matter (NOM). They also concluded that treatment with BAC is slow, and the effluent can contain soluble microbial products and microbes [8]. On the other hand, a great deal of previous research has focused on removing some compounds from the water, especially groundwater, in order to raise the pH of the water, making it alkaline. Bora and Dutta (2019) set up a series of experiments using a new technic to re-

move of metals (Pb, Cd, Cu, Cr, Ni, and Co) from drinking water by oxidation-coagulation-absorption at optimized pH. In fact, the removal of certain metals, such as Cd, Pb, Ni, Cr, Cu, and Co, from groundwater using the oxidation-coagulation-adsorption at optimised pH (OCOP) process, which is an effective and low-cost method for simultaneous removal of As, Fe, and Mn. In their study the process has been found to remove the selected metals from an initial concentration of 2 mg/L in the following order: Cd (79.0 percent), Co (94.8 percent), Ni (94.4 percent), Cu (98.0 percent), Cr (98.3 percent), and Pb (98.3 percent) (99.5 percent). The heavy metals adsorb on the surface of coagulates according to atomic adsorption spectrophotometer, energy distributed X-ray spectrophotometer, and powder X-ray diffraction analyses [9].

Hashim *et al.*, (2019) demonstrated that the use of an electrocoagulation (EC) reactor with aluminium electrodes is used to investigate the effect of the initial pH on the removal of reactive black 5 dye (RB5) from water. In their study several sets of continuous flow experiments were started at five different initial pH values (4, 5, 6, 7, and 8) while keeping the current density, inter-electrode size, and RB5 concentration constant at 2 mA/cm², 4 mm, and 25 mg/L, respectively. The most obvious finding to emerge from this study is that the removal efficiency increased steadily as the initial pH increased from 4 to 6, reaching a maximum of 96% at the neutral pH range, before decreasing to 74% as the initial pH increased to 8 pH value [10].

Not only drinking water needs to raise pH levels, but also fish farming water needs to raise pH levels, and this is what we find in a study by Martins *et al.*, (2017) as sodium bicarbonate (NaHCO₃), calcium carbonate (CaCO₃), and calcium hydroxide (Ca(OH)₂) were used to test alkalinity and pH maintenance on BFT during a Nile tilapia (*Oreochromis niloticus*) nursery. The findings show that using sodium bicarbonate, hydroxide, or calcium carbonate to change alkalinity and pH in the final proportions of 14.64, 0.49, 7.18, 0.32, and 24.09, 2.32 percent in relation to feed consumption, respectively, is accurate [11].

It is now well established from a variety of studies it becomes clear to us beyond a reasonable doubt that there is no scientific study that has carried out the process of raising the pH in a physical field without chemical intervention. Therefore, this study tries to test the effect of the biosphere for heat treated silica under certain conditions in raising the pH of drinking water and helping to remove harmful bacteria in it.

3. Research Methodology

The amount of hydrogen ions present in water is measured by the pH of the water. It decides whether the water is acidic or alkaline. The term pH refers to the hydrogen potential. The pH of water should be between 6.5 and 8.5, according to the World Health Organization (WHO). pH can be determined using the following formula: $\text{pH} = -\log [\text{H}^+]$. Experimentally, the water indicates that the number of H⁺ and OH⁻ ions is equal. It has also been established that the prod-

uct of the two concentrations equals a constant 'K.' This constant's value was discovered to be between 10 and 14.



As **Figure 1** shown, pH ranges from 0 to 14, with 7 being neutral. pHs less than 7 are acidic while pHs greater than 7 are alkaline (basic).

3.1. Na_2SiO_3 Sample

The initial sample consisted of a natural material of silica SiO_2 with a micro-thermal fusion technology, which works to generate a bio-field of up to 80 cm. *Our research is concentrating about the physical effect on oxonium ions in any matrix and thru this Field we make change into alkaline state due to the active bride which have been created between silica and sodium atoms.* This contribution helping to raise the pH of water to up to 8. In order to obtain a higher purity, more powerful acids such as hydrofluoric acid can be used in addition to thermal shocks. After the refining process the sand is dry, and some applications require it to be milled to produce very thin materials, called silica flour as depicted in **Figure 2**.

Quartz can also be converted to crystallite in a rotary kiln operating at elevated temperatures, with the inclusion of catalysts. Also, some applications require that quartz be melted in electric arc furnaces to be cooled and then milled to produce silica magma the results of this sample coined in **Table 1**.

4. Evaluation Methodology and Results

The solution was then assayed for increasing the pH value using the ASTM E70-Standard test method. This standard was applied for calibration of our instrument, and pH of aqueous solution measurement. The test environment was at 20°C, 73% humidity [12].

4.1. Evaluation Procedure

To assess whether the pH values are increased and received, the evaluation criteria

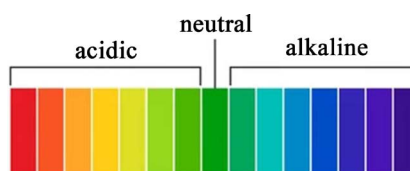


Figure 1. pH Scale.



Figure 2. The forms of Na_2SiO_3 Sample used in this investigation.

Table 1. Properties of Na_2SiO_3 .

Na_2SiO_3 Properties	
Name	Silicon dioxide
Also Known as	Silica, Silic acid and Silic acid anhydride
Appearance	Transparent solid (amorphous) White (sand/powder)
Molecular Formula	SiO_2
Melting Point	Around 1400°C 1700°C
Boiling Point	2230°C
Density	2.65 g/cm^3 (α -quartz) 2.196 g/cm^3 (amorphous)
Molar Mass	60.08 g/mol

If not otherwise stated, the above data are given in the standard case (at 25°C and 100 kPa)

were as follows:

- 1) In a 100 mL beaker, 50 mL of tap water was put and sealed with a stretch cover.
- 2) Our pH-meter was calibrated with buffers before each measurement of pH value (4, 7.02, and 10 pH unit).
- 3) The water temperature was measured as well as the pH value.
- 4) The 100 mL beaker containing the 50 mL water was placed on the samples in **Figure 2** to measure the effect of the physical field on raising the pH value.
- 5) The temperature of the water and the pH was measured every hour (The beaker is re-covered with stretch material after each measurement) without any interference in the water except that it is installed on the base that contains the manufactured material in this study, the result of this experiment is shown in **Figure 3**.

The experiment lasted about five hours. Both the temperature and the pH at the beginning and until the end of the experiment were measured accurately, as shown in **Figure 3**, to ensure the neutrality of the measurements was carried out through the National Institute for Standard in the Arab Republic of Egypt (**Appendix A**).

To ensure the validity of the results, the tests were repeated according to the previous conditions in the laboratories of the Drinking Water and Wastewater Authority, Egypt (**Appendix B**). The results showed that the pH levels increased by using the substance in a physical field, as shown in **Figure 4**.

Through the previous results, we find that the pH levels of water have increased from the neutral position 7 to the alkaline state 8 and this is through a vital field without direct intervention on the water, and these results are unique in the field of improving water quality, and they have direct applications on agriculture and improving the quality Drinking water and fish farming.

4.2. Radiation Evaluation

To indicate whether the manufactured material (Silica SiO_2) contains radioactive or null elements. The evaluation method and procedures are summarized in **Table 2**.

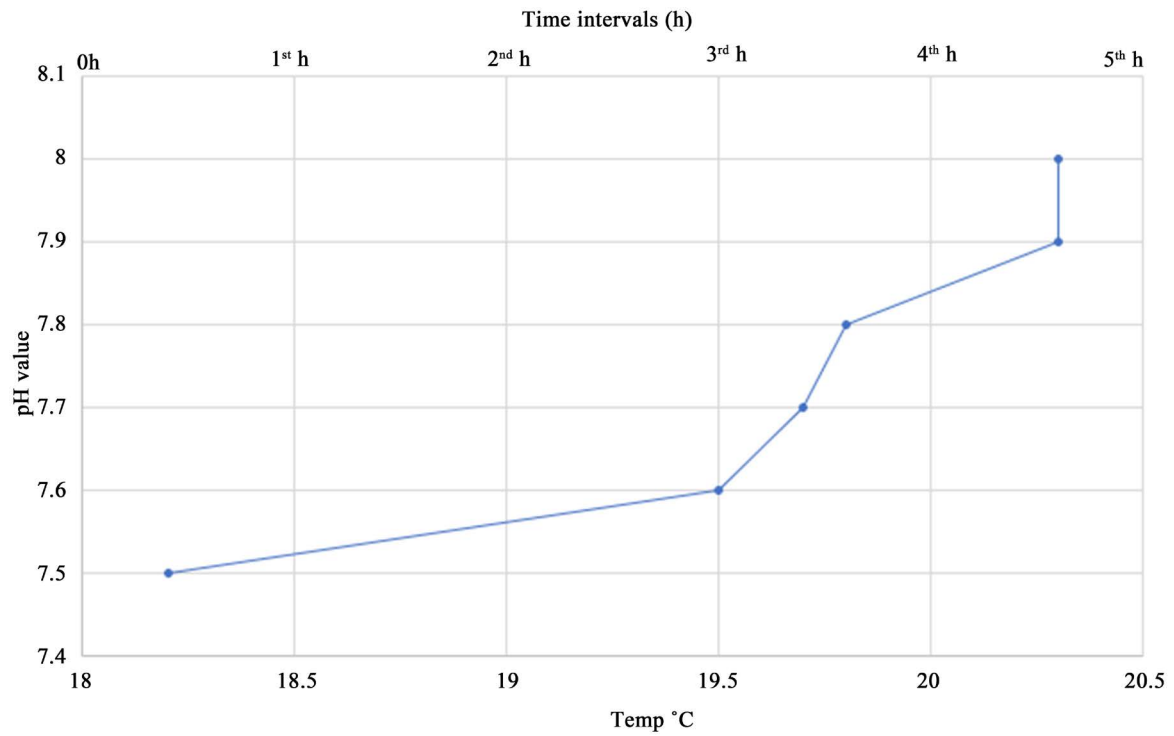


Figure 3. The results of the pH value over time (first experiment).

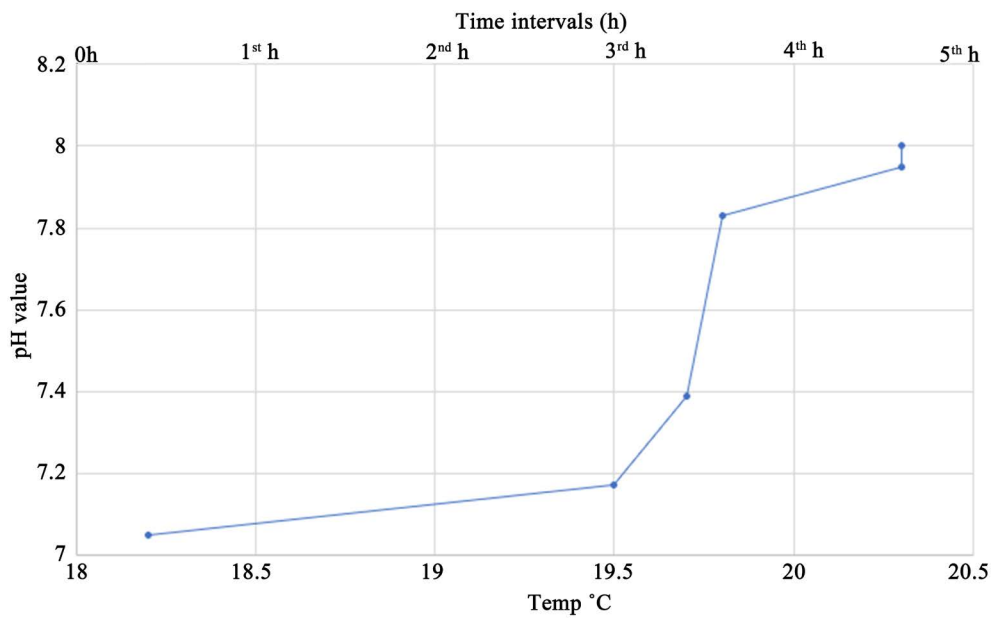


Figure 4. The results of the pH value over time (Second experiment).

Table 2. Radiation evaluation method and procedures.

<i>Device Name</i>	<i>Type</i>	<i>Manufacturer</i>
Detector	Nal (TI) Scintillation detector 3” * 3”	Canberra
Analyzer	Multi-channel analyzer	Ortec
Detector	Contamination monitor LB122	Berthold

The results from the previous analysis, which was carried out by an independent and charitable body at the National Institute for Standard in Egypt, indicated that the manufactured material does not contain any radioactive elements as shown in **Appendix C**.

Through the previous results, I find that Na_2SiO_3 can raise the pH levels and These results are consistent with Joni *et al.* (2018; 2020) [13] [14] as they concluded that “Precipitated silica scale-up can be produced by optimizing the sodium silicate (Na_2SiO_3) precursor with additional HCl as precipitant by direct mixing method at pH 7 at temperature 25°C .” This, in turn, helps to raise the pH of adding it to the water.

The current results of our study are unique in that they raise the pH physically without direct interference with water, which helps protect the water from any chemical effects.

5. Conclusion

The pH value will be used as a standard to measure the properties of water. It is a measure of the concentration of hydrogen ions in a solution, which is the negative logarithm of the actual hydrogen ion concentration, meaning that the hydrogen ion concentration decreases with increasing the pH, and that the difference of one acidity unit indicates a difference of ten times the hydrogen ion concentration. The aim of the present research was to examine a natural substance of environmental elements, extracted from silica using the thermal fusion method (developed by the authors) to increase the pH of water with an 80 cm physical field without adding any components to the water. Our research is concentrating about the physical effect on oxonium aion in any matrix and thru this field we make change into alkaline state due to the active bride which has been created between silica and sodium atoms. The solution was then assayed for increasing the pH value using the ASTM E70-Standard test method and Nal (TI) Scintillation detector 3×3 for radiation values. The laboratory results in two independent agencies showed an increase in the pH rates of water within five hours to reach 8, and this confirms the validity of the hypothesis based on this study, which is that the vital field of the material manufactured by the authors raises the pH rates of water from a distance. The second major finding was that the used material does not contain any radioactive elements.

Acknowledgements

The researchers extend their thanks and appreciation to Mr. Major General Sherif Fares, head of the Drinking Water Company in Sharkia Governorate, Arab Republic of Egypt, for his full support and assistance in conducting the necessary analyzes and testing. We are also pleased to thank the National Research Center and the National Institute for Standardization for conducting the necessary checks to ensure the effectiveness of the manufactured material in raising pH rates in water.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Couto, R.D.R., Comin, J.J., Soares, C.R.F.S., Belli Filho, P., Benedet, L., Moraes, M.P.D., Brunetto, G. and Beber, C.L. (2013) Microphysical and Chemical Attributes of a Hapludalf Soil with Swine Manure Fertilization. *Pesquisa Agropecuária Brasileira*, **48**, 774-782. <https://doi.org/10.1590/S0100-204X2013000700010>
- [2] Loss, A., Lourenzi, C.R., dos Santos Junior, E., Junior, C.A.M., Benedet, L., Pereira, M.G., Comin, J.J., *et al.* (2017) Carbon, Nitrogen and Natural Abundance of ¹³C and ¹⁵N in Biogenic and Physicogenic Aggregates in a Soil with 10 Years of Pig Manure Application. *Soil and Tillage Research*, **166**, 52-58. <https://doi.org/10.1016/j.still.2016.10.007>
- [3] Zalvan, C.H., Hu, S., Greenberg, B. and Geliebter, J. (2017) A Comparison of Alkaline Water and Mediterranean Diet vs Proton Pump Inhibition for Treatment of Laryngopharyngeal Reflux. *JAMA Otolaryngology: Head & Neck Surgery*, **143**, 1023-1029. <https://doi.org/10.1001/jamaoto.2017.1454>
- [4] Li, S.J., Lv, W.Y., Du, H., Li, Y.J., Zhang, W.B., Che, G.W. and Liu, L.X. (2019) Albumin-to-Alkaline Phosphatase Ratio as a Novel Prognostic Indicator for Patients Undergoing Minimally Invasive Lung Cancer Surgery: Propensity Score Matching Analysis Using a Prospective Database. *International Journal of Surgery*, **69**, 32-42. <https://doi.org/10.1016/j.ijssu.2019.07.008>
- [5] Tan, Y., Zhu, Y., Zhao, Y., Wen, L., Meng, T., Liu, X., Hu, F., *et al.* (2018) Mitochondrial Alkaline pH-Responsive Drug Release Mediated by Celastrol Loaded Glycolipid-Like Micelles for Cancer Therapy. *Biomaterials*, **154**, 169-181. <https://doi.org/10.1016/j.biomaterials.2017.07.036>
- [6] Sun, Y., Hou, S., Song, S., Zhang, B., Ai, C., Chen, X. and Liu, N. (2018). Impact of Acidic, Water and Alkaline Extraction on Structural Features, Antioxidant Activities of Laminaria Japonica Polysaccharides. *International Journal of Physical Macromolecules*, **112**, 985-995. <https://doi.org/10.1016/j.ijbiomac.2018.02.066>
- [7] Vidaković, D., Krizmanić, J., Dojčinović, B.P., Pantelić, A., Gavrilović, B., Živanović, M., Ćirić, M., *et al.* (2019) Alkaline Soda Lake Velika Rusanda (Serbia): The First Insight into Diatom Diversity of This Extreme Saline Lake. *Extremophiles*, **23**, 347-357. <https://doi.org/10.1007/s00792-019-01088-6>
- [8] Korotta-Gamage, S.M. and Sathasivan, A. (2017) A Review: Potential and Challenges of Physically Activated Carbon to Remove Natural Organic Matter in Drinking Water Purification Process. *Chemosphere*, **167**, 120-138. <https://doi.org/10.1016/j.chemosphere.2016.09.097>
- [9] Bora, A.J. and Dutta, R.K. (2019). Removal of Metals (Pb, Cd, Cu, Cr, Ni, and Co) from Drinking Water by Oxidation-Coagulation-Absorption at Optimized pH. *Journal of Water Process Engineering*, **31**, Article No. 100839. <https://doi.org/10.1016/j.jwpe.2019.100839>
- [10] Hashim, K.S., Hussein, A.H., Zubaidi, S.L., Kot, P., Kraidi, L., Alkhaddar, R., Alwash, R., *et al.* (2019) Effect of Initial pH Value on the Removal of Reactive Black Dye from Water by Electrocoagulation (EC) Method. *Journal of Physics: Conference Series*, **1294**, Article No. 072017. <https://doi.org/10.1088/1742-6596/1294/7/072017>

- [11] Martins, G.B., Tarouco, F., Rosa, C.E. and Robaldo, R.B. (2017) The Utilization of Sodium Bicarbonate, Calcium Carbonate or Hydroxide in Biofloc System: Water Quality, Growth Performance and Oxidative Stress of Nile Tilapia (*Oreochromis niloticus*). *Aquaculture*, **468**, 10-17.
<https://doi.org/10.1016/j.aquaculture.2016.09.046>
- [12] Ixchel, R.H.M. and de la Luz, P.R.M. (2021) Characterization of Mine Tailings in Their Natural State and Stabilized with Cement, Focused on Construction Caracterización de residuos mineros en estado natural y estabilizados con cemento, enfocada a construcción. *Ingeniería Investigación y Tecnología*, **22**, 1-9.
<https://doi.org/10.22201/ii.25940732e.2021.22.2.010>
- [13] Joni, I.M., Rukiah and Panatarani, C. (2020) Synthesis of Silica Particles by Precipitation Method of Sodium Silicate: Effect of Temperature, pH and Mixing Technique. *AIP Conference Proceedings*, **2219**, Article No. 080018.
<https://doi.org/10.1063/5.0003074>
- [14] Joni, I.M., Nulhakim, L., Vanitha, M. and Panatarani, C. (2018) Characteristics of Crystalline Silica (SiO₂) Particles Prepared by Simple Solution Method Using Sodium Silicate (Na₂SiO₃) Precursor. *Journal of Physics: Conference Series*, **1080**, Article No. 012006. <https://doi.org/10.1088/1742-6596/1080/1/012006>

Appendix A

Ministry of Higher Education & Scientific Research
National Institute for Standards
www.nis.sci.eg

وزارة التعليم العالي والبحث العلمي
المعهد القومي للمعايرة

El- Sadat (Tersa) St., El Haram, Giza, Egypt - P.O.Box 136 Giza - Code 12211 - Tel. / Fax: +202 - 33867452 - NIS Tel +202 - 37401113

Report No: 7/43/2021

Test Method:
ASTM E70- Standard Test Method for pH of Aqueous Solutions with the Glass Electrodes.
This standard was applied for calibration of our instrument: and pH of aqueous solution measurement.

Environmental conditions:
Temperature: 20°C, and Humidity: 73%.

Test procedure:

1. 50 mL of tap water were placed in beaker 100 mL and it was covered with stretch cover.
2. Before each measurement for pH-value, our pH –meter was calibrated with buffers (4 ,7.02 and 10 pH unit).
3. The pH and temperature -values of tap water were measured.
4. The 100 mL beaker containing 50 mL tap water was placed on the sample according to the customer requirement.
5. pH and temperature –values were measured at different time intervals (each hour).
6. After each measurement the beaker was covered with stretch cover.
7. The following results were recorded (time, temperature and pH-values).

Results

The results have been tabulated in the following table:

Time intervals (h)	pH-value(pH unit)	Temp (°C) of tap water
At the beginning	7.5	18.2
After 1 st h	7.6	19.5
After 2 nd h	7.7	19.7
After 3 rd h	7.8	19.8
After 4 th h	7.9	20.3
After 5 th h	8	20.3

Cal.Ref.No: 48/3/43/2021
Certif.No.: 7/43/2021

Code: HST-43-2021-02
Date of Test: 10/07/2021

Model:-----
Page Seq.:2/2

Tested by

Chada Abu

Page 2 of 2

Reviewed by

Aksam Abdelkhalik

This certificate is issued in accordance with the laboratory accreditation requirements. It provides traceability of measurement to recognized national standards, and to the units of measurement realized at the NIS or other recognized national standards laboratories. This certificate may not be reproduced other than in full by photographic process. This certificate refers only to the particular item submitted for testing.

Appendix B

شركة مياه الشرب والصرف الصحي بالشرقية
إحدى الشركات التابعة

الشركة القابضة لمياه الشرب والصرف الصحي
المعمل المركزي لمياه الشرب

مرفق رقم ١



اختبار كفاءة مادة السيلكا بتكنولوجيا الاندماج الحرارى في تأثيرها من الناحية الفيزيائية على قيمة pH لمياه الشرب ٢٠٢٠/٢٠٢١/٢٩

الإختبار	مياه الشرب قبل وضع طبقة من المادة تحت الكأس الزجاجية	مياه الشرب بعد ساعة من وضع طبقة من المادة تحت الكأس الزجاجية	مياه الشرب بعد ٢ ساعة من وضع طبقة من المادة تحت الكأس الزجاجية	مياه الشرب بعد ٤ ساعة من وضع طبقة من المادة تحت الكأس الزجاجية	مياه الشرب بعد ٥ ساعة من وضع طبقة من المادة تحت سطح الكأس الزجاجية
pH	7.05	7.17	7.39	7.83	7.95
					8


يختتم

مدير الإدارة العامة للمعمل المركزي

المدير الفني للمعمل الغير عضوى

Appendix C

Ministry of Higher Education
& Scientific Research
National Institute for Standards



المعهد القومي للمعايرة
NIS
National Institute of Standards

وزارة التعليم العالي والبحث العلمي
المعهد القومي للمعايرة


El- Sadat (Tersa) St., El Haram, Giza, Egypt - P.O.Box 136 Giza - Code 12211 - Tel. / Fax: +202 - 33867452 - NIS Tel +202 - 37401113

Standard/Reference / Major Equipment Used:

Name	Type	Manufacturer
Detector	NaI(Tl) Scintillation detector 3"x3"	Canberra Industries, Inc -USA.
Analyzer	Multi-channel analyzer	ortec
Detector	Contamination monitor LB 122	Berthold

Results

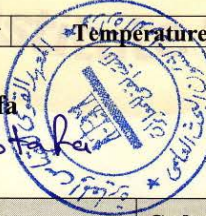
There is no gamma radiation and charged particle detected



Environmental Conditions : -

Pressure: 1005 mbar	Temperature: 22 °C	Humidity: 50 %
---------------------	--------------------	----------------

Tested by: Khaled Mostafa
Khaled Mostafa



Reviewed by:
Dr. Wafaa N. Ahmad

Report No.: 618/31/2020	Code: HST-EC 2020	Model: Energy card
Dev. Des.: Sample for radioactivity detection	Test Date: 15/11/2020	Page Seq.: 2/2

This certificate is issued in accordance with the laboratory accreditation requirements. It provides traceability of measurement to recognized National standards, and to the units of measurement realized at the NIS or other recognized national standards laboratories. This certificate May not be reproduced other than in full by photographic process. This certificate refers only to the particular item submitted for testing