Research Title:

Effect of Salinity and Acidity of Well Water and Desalinated Water on Local Uses in Ibri

Coducted by:

Zulfi Ahmed Alwaeli & Sheikha Hafez Almaamari

Ibri School for Basic Education (5-9)

Supervised by:

Ms. Sheikha Mubarak Al-Sawafi & Ms. Tarfa Hamid Al-Sukaiti

September 2024

Contents:

the page	Subject
3	Acknowledgements
4-5	Study Summary
6	Research Questions
6	Introduction and literature review
7-8-9	Research methods 1.Research Plan
10	Research methods 2.Study Site
11-14	Research methods Data collection and analysis.1
15-16	Discussion of results
17	The bottom line
18	Recommendations
19	References
20-22	Supplements

Acknowledgements

We extend our sincere thanks and gratitude to everyone who contributed with us in putting his mark to complete this research, especially Eng. Walid Al-Sawafi, Senior Production Engineer at Namaa Company , Ms. Munira Rashid Al-Abri, Environmental Affairs Specialist , Eng. Hamdan Al-Waeli , Building Contractor, Ms. Tarfa Al-Sukaiti, and the administration of Ibri School , and thanks are extended to our parents who had the most important role in completing this scientific research.

"Effect of Salinity and Acidity of Well Water and Desalinated Water on Local Uses in Ibri"

Preparation of the two students:

Zulfi Ahmed Suleiman Alwaeli & Sheikha Hafez Mayouf Almaamari

Supervision of the professor:

Sheikha Mubarak Al-Sawafi

Tarfa Hamid Al-Sukaiti

Ibri School for Basic Education (5-9)

Sultanate of Oman / Al Dhahirah Governorate / Ibri Wilayat

Study Summary:

This study aims to determine the impact of salinity and ph on local uses in Ibri by addressing the following question:

1- What is the effect of well water and desalinated water salinity on drinking, agriculture, and construction?

2- How does desalinated water quality compare to well water in terms of salinity and acidity?

To answer these questions, the investigative scientific research method was applied, where we used two samples of Sohar desalination plant water that are distributed to residential areas in the state of Ibri, the first area is Kawas, the second region is Al-Nahda, and the third region is AlGhuwail (Al-Salif), and a sample of water was taken from its well, and sent to the Agricultural Research Center in Barka for analysis and to know the levels of salinity and acidity in each sample. The water protocol was applied to a sample of well water and desalination water in terms of (salinity and pH) to determine its effect on local uses. We examined the two samples using GLOBE instruments to find out the chemical properties of this water and compare it with the characteristics of the well water sample.

The presence of salinity and acidity in well water and groundwater used locally in Oman is a problem as a result of its use extensively in agriculture and building construction." Our knowledge of global patterns in water measurements depends on sampling at a few specific sites." (1)

Interviews were conducted with: Eng.Waleed Al-Sawafi (Senior Production Engineer, Nama Water services).

Discussed desalination water safety, treatment requirements, and the impact of salinity on household equipment. Ms. Munira Al-Abri (Environmental Agency)-Explained how high acidity in irrigation water affects soil composition and nutrient absorption.

Eng. Hamdan ALWaeli(Construction Expert)-Highlighted how excessive salinity and acidity in water weaken concrete and corrode iron reinforcements in buildings.

A questionnaire was applied to a sample of the community on the problem of the effect of high salinity and acidity of water used for different local uses.

Key terms:

Salinity: It is the salt content dissolved in water.

pH: is the negative decimal logarithm of the concentration of a hydrogen ion in a solution and indicates the pH of that solution

(1) Water Research Protocol GLOBE program

Research Questions:

Through our research, we tried to answer the following questions:

1- What is the impact of the salinity of well water and desalinated water on local uses (drinking, agriculture, construction concrete and iron)?

2-How does the quality of desalination water differ compared to well water in terms of salinity and acidity?

Introduction and literature review:

Water is the most important resource for life and human development, especially in arid and semiarid areas such as the Wilayat of Ibri in Oman, which rely on well water and desalinated water to meet their local needs.

However, these resources

Faces significant challenges related to high salinity levels and high pH

This can directly affect every day uses, such as agriculture, human consumption, building concrete and iron. Concern is growing about water quality and its impact on human health and agricultural production, as high salinity may reduce soil and crop productivity, while excess acidity may corrode pipes and water infrastructure, in addition to its health impact.

"According to the Joint Programme (JMP) report, 97% of Oman's water is pollution-free and the entire population has access to water [1]". "Moreover, 91% of the population has immediate access to piped water, which means that only 9% have to wait for water to arrive by tanker. [2] "Protecting existing aquifers from depletion and pollution, preventing unregulated water use, and protecting agricultural lands from fragmentation, urbanization, erosion and salinization are important solutions to improve the contribution of environmental resources to food production in the Sultanate, in addition to reducing the current deficit in water resources and achieving a balance between water uses and renewable water in the various governorates of the Sultanate in order to provide water for all uses." [3]

Hence, this study came to explore these challenges and analyze the effects of salinity and acidity of water on local uses in the state of Ibri, with a focus on providing practical and appropriate solutions to improve water quality and ensure its sustainability.

]1[Joint Monitoring Programme (JMP) report, 2017, 'Progress on Drinking Water, Sanitation and Hygiene: 2017 Update . United Nations Children's Fund and the World Health Organization، and Sustainable Development Goal Baselines'

[2] Available at: http://www.timesofoman.com/article/120055 . Accessed on 11/4/2018.

[3] Oman Food Systems Report, UN Food Systems Summit, Ministry of Agriculture, Fisheries and Water Resources, September 2021

Hypothesis:

We expect that solutions can be found to the salinity and pH of well water and desalinated water by reducing water pollution and using devices to purify it from salinity and acidity because it affects and harms nature and local uses.

Research Limitations:

Spatial boundaries: This research was applied to the Kawas and Nahda regions.

Time limits: Information and analysis collected from 20/9/2424 to 10/12/2024

Research methods

First, the research plan:

Scheduling the research plan

Table (1) shows the chronology of the research plan

Month	Task Description
September 2024	Identify research topic, select study areas and collect samples
October 2024	Analyze water samples and interpret results
November 2024	Draft research findings and preliminary conclusions
December2024	Conduct interviews, distribute quesstionnaires, and finalize research writing.
January2025	Upload research to the GLOBE website

Table (2) shows the steps of work in the research

Execution time	The student	executing Work
September 2024	Zulfi Ahmed Alwaeli	Bringing samples for study from different regions, namely: Kawas, Al-Ghuwail and AlNahda, and then we transferred them to the Agricultural Research
October 2024	Sheikha Al Maamari	Center and the municipal laboratory for analysis
		Analysis of search results And start writing the research
November December 2024		We conducted interviews with specialists, distributed the questionnaire and conducted sample analyzes using Globe devices.

- Gather information from online sources, articles, and books.

-Collect three water samples: one from the Sohar desalination plant and two from different regions in Ibri.

-Send samples to the Agricultural and Animal Research Laboratories in Barka and Ibri Municipality laboratory for analysis.

-Measure water properties (salinity, Ph) using GLOBE instruments.

- Conduct interviews with experts in water quality and environmental impact.

Write a research report.

-Analyze collected data, organize it in tables, and present it graphically.

-Enter findings into the GLOBE database.

Study Tools:

1- water samples from three location in the Ibri (Al-Ghwell, Al-Nahda, Kawas).

2- Special containers for water collection.

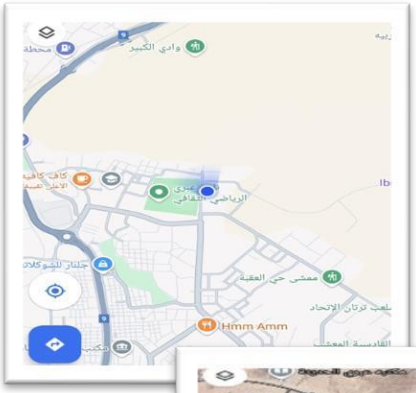
3- GLOBE analysis instruments.

Research methods

Second, the location of the study:

The study was conducted in the Wilayat of Ibri,AL Dhahirah Governorate, Oman, covering ALGhweil (Salif Village), Kawas, and ALNahda.

Data collection occurred between September and November 2024, during the seasonal transition From summer to winter when temperatures were lower.



Al-Ghuwail

(salif)

Kawas

ALNahda

Research methods

III. Data collection and analysis

Information and data related to the first question were collected through the application of the investigative scientific research method, where the questionnaire was applied to a sample of the community to find out the impact of salinity of well water and desalinated water on local uses (drinking, agriculture, cement concrete and iron for buildings)

- An interview was conducted with specialists in the field of water, health, building construction and the environment.

-Scientific measurements were made to obtain numerical data on the properties of salinity, acidity and conductivity of water samples taken from the well of Mazraat Al-Ghuwail (Al-Salif) and a sample of house water using GLOBE devices



The images show (collecting samples of desalinated water in the connection to homes and a sample of water from a well)

Application of water protocol to



Table (1) shows the pH, salinity and conductivity of a house water sample sourced from the Sohar desalination plant

Record water data using globe devices

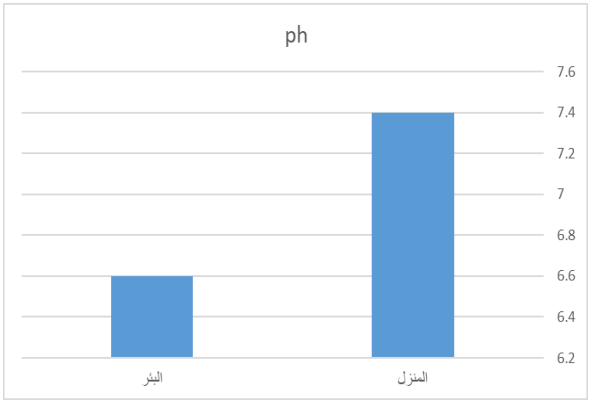
Conductivity (ms)	Acidity(PH)	Salinity(ppm)
815	7.4	533

Table (2) shows the pH, salinity and conductivity of a well water sample

(MS Conductivty	Acidity (ph)	(Salinity PPM)
6.48	6.6	4.55

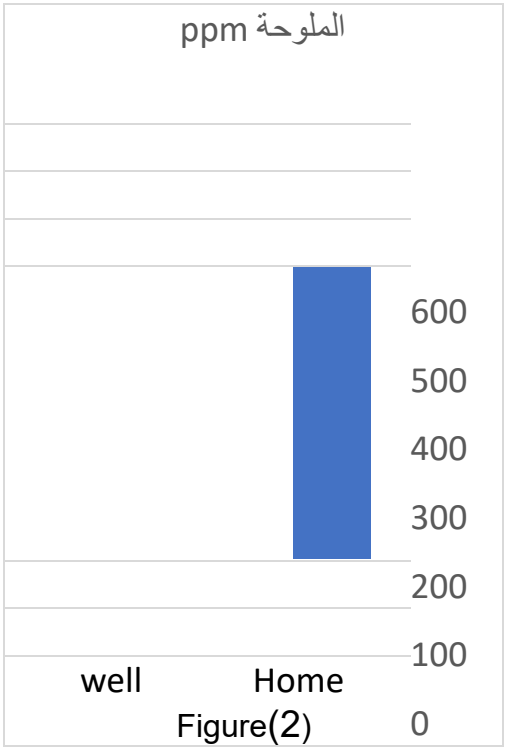
Graphical representation of data

Figure (1) shows a comparison of pH between the well water sample and the house water sample.



Figure(1)

(Figure 2 shows the salinity of the water sample taken from a house and the degree of salinity of A water sample taken from a well)



Figure(2)

Figure 3 shows the degree of conductivity between the samples of house water and well water.

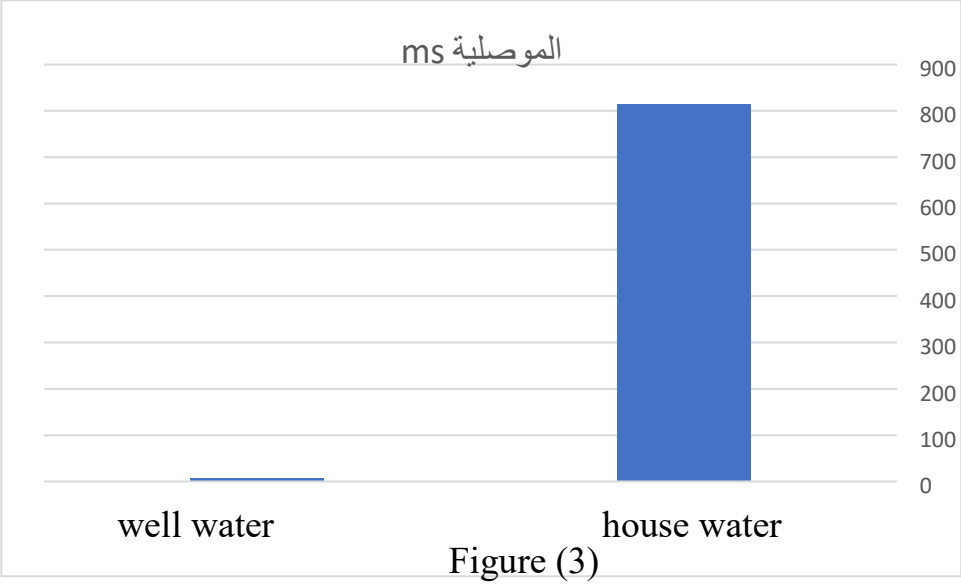


Figure (3)

Some responses to the questionnaire applied to a sample of the population

As for the answer to the second question:

How does the quality of desalination water differ compared to well water in terms of salinity and acidity?

The second question was answered by analyzing the water samples collected in the laboratory of Ibri Municipality and the Agricultural and Animal Research Center in Barka; to know the physical and chemical properties of the three samples by knowing (salinity, acidity), and analyzing the answers to a set of questions in the questionnaire, as well as by answering the first and second questions in the interview with the competent engineer.

Discussion of the results:

To answer the first question, it was clear through the questionnaire that 69% of respondents use desalinated water for washing and drinking, 30% use water for irrigation, with concerns about its effect on soil quality. and 1% use it for drinking only, and it turned out that all members of the sample agree that the high salinity of the water used affects the concrete and iron of buildings. One of the construction contractors explained that the high levels of salts in the water affect the strength and durability of concrete, and increase the risk of corrosion of rebar, as he explained that The level of salts in the water used in the concrete mixture should not exceed 500mg/L. He explained that the high level of acidity (pH) in the reinforcing water means the presence of sulfuric acid, which attacks iron, causing rust, as dissolved sulfur reacts with cement, which leads to poor durability of concrete and thus cracking and fragmentation of its parts.

Engineer Walid Al-Sawafi from Nama Water Services Company explained that desalinated water can be used directly in drinking and needs a single filter only to purify impurities coming from the main line until productivity continues in the coming periods. He also explained that high acidity and high level of salts in water cause increased lime, which affects household equipment such as water heaters and pipes and explained that the increase in salts greatly affects the growth of agricultural crops, slows their growth and delays flowering. He also explained that there is no difficulty at the present time in using water for daily purposes such as: washing and cleaning.

Ms. Munira Al-Abri, an environmental affairs specialist from the Environment Agency, explained that irrigating crops with high acidic water leads to a decrease in the pH of the soil, which may lead to the decomposition of some nutrients faster, affecting the plant's ability to absorb these elements.

To answer the second question through the analysis of water samples at the Agricultural and Animal Research Center and the laboratory of Ibri Municipality, it was found that the salinity level in desalinated water ranges from 435 mg/L to 481 mg/L, which means that it is within the permissible limits in the salinity level of drinking water, which ranges from 120 to 1000 mg/L, as

it is considered safe to drink. As for the pH level:8.2 to 9.2, which may contribute to iron corrosion and affect building materials. The acidity level of desalination water is 8 according to the municipal laboratory in Ibri, and 8.6 according to the Agricultural and Animal Research Center.

This means that the acidity level of desalinated water and most well water falls within internationally permissible limits for drinking water.

Eng. Waleed Al-Sawafi also explained that the desalination water arriving at Ibri from Sohar has a salinity of less than 600 mg/L. It is within the permissible range of less than 1200 mg/L. He explained that the pH level of desalination water is within the standards applicable for local use.

The survey revealed that 59% of the sample used filters to purify water, and 30% believed that desalinated water is safer than other water sources. 86% believe further testing is required to ensure water safety. 76% of the samples are satisfied with the quality of desalinated water reaching their homes. 63% prefer well water for drinking, while 21% find desalinated water more suitable.

The bottom line:

By discussing the results of the research, it was found that the levels of salinity, acidity of well water, and desalination water are within the permissible range in the fields of drinking and agriculture, but some negative effects appear in the long term such as (rust and corrosion of pipes, the appearance of lime in pipes, water taps and heaters) and some negative effects on the structure of cement buildings appear if methods are not used to reduce salinity and acidity levels, as explained by one of the building contractors.

In general, the acidity level of desalination water was slightly lower than that of well water, and the salinity of desalination water was within the permissible limits.

And that most users of this type of water are satisfied with its quality. The subject needs further studies and research to confirm the validity of the results and conclusions.

Recommendations:

The study confirms that both well and desalinated water in Ibri meet general safety standards for drinking and agriculture. further ascertain its suitability for local uses, especially well water, some of which have high salinity, which affects agricultural productivity in the state.

We also recommend the Ministry of Agriculture, Livestock and Water Resources to conduct studies on the water of some aflaj in the state, such as Falaj Al-Driz, which our colleague researcher Sarah Al-Gharibi conducted research on the impact of traditional aflaj water on the characteristics of the soil, where she found through the analysis of soil samples the high level of salinity in it, as it was proven that the farm from which the study sample was taken is watered with water Falaj Al-Driz in which the salinity is high, which comes from well water. We can also benefit from the project carried out by our colleagues from the school's scientific innovation team on using algae to reduce the salinity of well water, as they conducted experiments on the possibility of aquarium algae to reduce the salinity of well water and make it suitable for irrigation of crops and adopted and developed the project.

We also recommend directing farmers and homeowners with high salinity water sources to use strategies that reduce or help reduce salinity.

References

[1] Water Research Protocol, GLOBE program

[2] Joint Monitoring Programme (JMP) report, 2017, Progress on Drinking Water, Sanitation and United Nations Children's ،Hygiene: 2017 Update and Sustainable Development Goal Baselines' Fund and the World Health Organization.

[3] Available at: http://www.timesofoman.com/article/120055 . Accessed on 11/4/2018

[4] Oman Food Systems Report, UN Food Systems Summit, Ministry of Agriculture, Fisheries and Water Resources, September2021

Supplements

Results of Water Samples Analysis at the Agricultural and Animal Research Center

Registration : 0
Order No : 1328
Order Date : 2024-10-20

رقم القيد : 0
رقم الطلب : 1328
تاريخ الطلب : 20-10-2024

المديرية العامة للبحوث الزراعية والحيوانية
مركز بحوث التربة والمياه - قسم بحوث التربة

Samples Analysis Result نتائج تحليل عينات

Applicant Details : بيانات مقدم الطلب :

Name :	مدرسة عبري للتعليم الاساسي	الاسم :
Address :	محافظة الظاهرة - ولاية عبري -	العنوان :

Water sample analysis results نتائج تحليل عينات المياه

Mg PPM	Na PPM	pH -	E.C dS/m	Location	Sample Id Unit	#
-	9 >	6.5-8.4	3 >		Acceptable	
		8.2	4.12	بئر السليف1	1114	1
		8.7	3.57	بئر السليف 2	1115	2
		8.4	1.19	بئر عبري 3	1117	3
		9.2	1.06	بئر عبري 4	1118	4
		8.6	0.81	تحلية صحار (عبري)	1119	5

Soil sample analysis results نتائج تحليل عينات التربة

pH -	E.C1:5 dS/m	E.Ce dS/m	Location -	Type -	Sample Id Unit	#
6.5-7.5	4.0 >	4.0 >			Acceptable	
8.2	1.69	19.88	عينة تربة تسقى بماء فلج الدريز	1	2449	1
8.4	0.30	2.31	عينة تربة تسقى بماء فلج هجار	2	2450	2
8.2	0.86	6.62	عينة تربة تسقى بماء البئر	3	2451	3

الخلاصة :

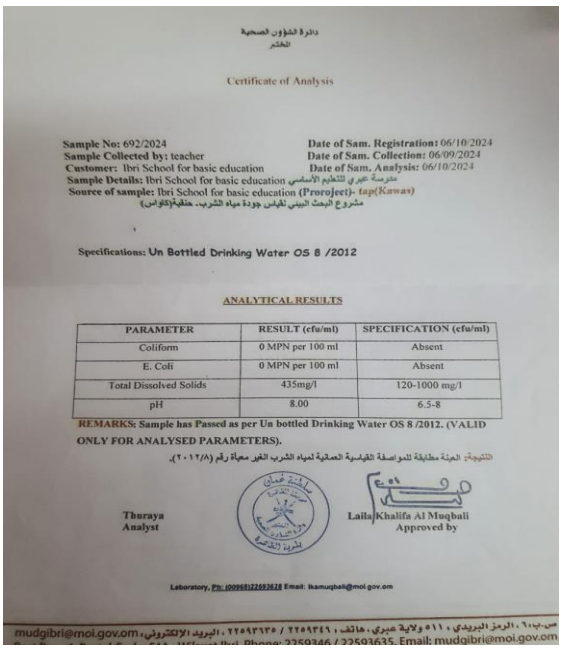
تشير نتائج تحاليل عينات مياه الري الى :بئر السليف(1) وبئر السليف(2) عالية الملوحة (تصلح لري الاعلاف القمح والشعير ونخيل التمر).بئر عبري (3) وبئر عبري (4) وتحلية صحار منخفضة الملوحة وصالحة لري جميع المحاصيل. فيما تشير نتائج تحاليل عينات التربة الى :تربة (1) تها ملوحة عالية جدا وتربة (2) غيرصالحة ، وتربة (3) متوسطة الملوحة. هناك محسنات تربة زراعية تعمل خفض ملوحة التربة مثل : الجبس الزراعي الذي يضاف كل 6 اشهر بمعدل من 500 الى 1000 جراما للمتر المربع و الهيوميك اسيد الذي يضاف شهريا بمعدل 30-40 جراما للمتر المربع ، بالاضافة الى الري الغزير للتربة بمياه عذبة.

Approved by إعتماد
مدير مركز بحوث التربة والمياه

Reviewed by المراجع
رئيس قسم بحوث التربة

Analyzed by المحلل
ماجدة بنت سليمان الزدجالية

Sample Analysis Results Ibri Municipality Laboratory



دائرة الشؤون الصحية
الختم

Certificate of Analysis

Sample No: 692/2024
Sample Collected by: teacher
Customer: Ibri School for basic education
Sample Details: Ibri School for basic education مدرسة عبري للتعليم الأساسي
Source of sample: Ibri School for basic education (Prorojeet)- tap(Kawas)
مشروع البحث البيني لقياس جودة مياه الشرب- منقوا(كواس)

Date of Sam. Registration: 06/10/2024
Date of Sam. Collection: 06/09/2024
Date of Sam. Analysis: 06/10/2024

Specifications: Un Bottled Drinking Water OS 8 /2012

ANALYTICAL RESULTS

PARAMETER	RESULT (cfu/ml)	SPECIFICATION (cfu/ml)
Coliform	0 MPN per 100 ml	Absent
E. Coli	0 MPN per 100 ml	Absent
Total Dissolved Solids	435mg/l	120-1000 mg/l
pH	8.00	6.5-8

REMARKS: Sample has Passed as per Un bottled Drinking Water OS 8 /2012. (VALID ONLY FOR ANALYSED PARAMETERS).
النتيجة: العينة مطابقة للمواصفة القياسية الصادرة لمياه الشرب الغير معبأة رقم (٢٠١٢/٨).

Thuraya
Analyst

Laila Khalifa Al Muqbali
Approved by

Laboratory, Ph: (00968)22693628 Email: lkamuqbali@moi.gov.om

mudgibri@moi.gov.om ، البريد الالكتروني ، ٢٢٥٩٣٤٦ / ٢٢٥٩٣٦٣٥ ، هاتف ، ٥١١ ولاية عبري ، ص.ب:٦ ، الرمز البريدي
Post Box: 6, Postal Code: 511 - Wilayat Ibri, Phone: 2259346 / 22593635, Email: mudgibri@moi.gov.om

Al-Dhahira Muncipality

دائرة الشؤون الصحية
الختم

Certificate of Analysis

Sample No: 693/2024
Sample Collected by: teacher
Customer: Ibri School for basic education
Sample Details: Ibri School for basic education مدرسة عبري للتعليم الأساسي
Source of sample: Ibri School for basic education (Prorojeet)- tap(Al Nahda)
مشروع البحث البيني لقياس جودة مياه الشرب- منقوا(حي النهضة)

Date of Sam. Registration: 06/10/2024
Date of Sam. Collection: 06/09/2024
Date of Sam. Analysis: 06/10/2024

Specifications: Un Bottled Drinking Water OS 8 /2012

ANALYTICAL RESULTS

PARAMETER	RESULT (cfu/ml)	SPECIFICATION (cfu/ml)
Coliform	0 MPN per 100 ml	Absent
E. Coli	0 MPN per 100 ml	Absent
Total Dissolved Solids	481 mg/l	120-1000 mg/l
pH	8.00	6.5-8

REMARKS: Sample has Passed as per Un bottled Drinking Water OS 8 /2012. (VALID ONLY FOR ANALYSED PARAMETERS).
النتيجة: العينة مطابقة للمواصفة القياسية الصادرة لمياه الشرب الغير معبأة رقم (٢٠١٢/٨).

Safiya
Analyst

Laila Khalifa Al Muqbali
Approved by

Laboratory, Ph: (00968)22693628 Email: lkamuqbali@moi.gov.om

mudgibri@moi.gov.om ، البريد الالكتروني ، ٢٢٥٩٣٤٦ / ٢٢٥٩٣٦٣٥ ، هاتف ، ٥١١ ولاية عبري ، ص.ب:٦ ، الرمز البريدي
Post Box: 6, Postal Code: 511 - Wilayat Ibri, Phone: 2259346 / 22593635, Email: mudgibri@moi.gov.om

Interview Questions

1-What are the salinity levels (TDS) in well and desalinated water in Ibri?

2- Is the acidity (pH) of well water different from desalinated water? Are there specific criteria for local uses?

3- What is the effect of high salinity on household equipment such as water heaters and pipes? 4-

How does salinity affect the irrigation of agricultural crops in the region?

5- Do families have difficulty using water for everyday purposes such as washing or cleaning due to acidity or salinity?

6- What technologies are used for desalination in Ibri? Are they effective in reducing salinity and acidity?

7- Can desalinated water be used directly for drinking or do you need additional treatments?

8-How does the high salinity in the water used affect the corrosion of concrete and iron in buildings, especially in residential areas in Ibri?

9. Can high pH level in water accelerate the degradation of structural materials such as concrete pipes or bricks used in construction? How can this problem be addressed?

Publish the steps and results of the research on the social networking site x platform