



Study of the effect of using plant tissue(xylem) as bacterial filter for polluted well water

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The supervision:

Siham Rabee AL-Hasania

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(Abstract):

Considering that wells are one of the main sources of fresh water in the Sultanate of Oman and as a result of the impact of some of these wells on sewage water, which made them unfit for human use.

Therefore, this research aims to study the possibility of using simple and inexpensive methods to purify this polluted water by using natural techniques that do not have long-term harm, which is the use of (plant xylem) as bacterial filters. To achieve this goal, the following research questions were developed

1-What is the impact of well water on waste water?

2- How effective is the use of wood tissue as a bacterial filter for polluted well water?

3- To what extent are water properties affected as a result of using wood texture for purification?

We took three water samples from wells close to residential areas to study the extent of their contamination with sewage, and the hydrosphere protocol of the GLOBE program was applied.

(Temperature - salinity - pH - the amount of dissolved oxygen) and conducting a bacterial examination of the samples in cooperation with the Omani Water and Wastewater Company in South Al Sharqiyah Governorate.

It was confirmed through the examination that the wells were contaminated with sewage water, where high percentages of bacteria and a lack of dissolved oxygen were found. When using wood tissue, we concluded that it is very effective, as a significant decrease in the amount of bacteria and an increase in the amount of dissolved oxygen was observed.

The study recommends companies to use effective techniques to purify polluted water in inexpensive ways and available to everyone to make it suitable for human use and to manufacture a sophisticated device based on wood texture in purification

Key terms

Xylem: It is a vascular tissue (sieve) that transports water and minerals from the roots to the various parts of the plant

Bacterial examination: it is the analysis of water to estimate the number and type of bacteria present in it

Coliform bacteria: a type of intestinal bacteria that are found in the colon and large intestine of humans and animals

E. coli: It is one of the most important types of bacteria that live in the intestines of mammals and can cause bloody diarrhea, stomach cramps, nausea, vomiting, and kidney failure

Research questions:

- 1- To what extent is well water affected and polluted by sewage water?
- 2- How effective is the use of wood tissue as a bacterial filter for polluted well water?
- 3- To what extent are water properties affected as a result of using wood texture for purification?

Introduction and literature review

The inner parts of trees contain succulent, soft wood lined with straw-like channels known as xylem which draw water through the tree trunk and branches. The xylem channels are connected to each other by thin membranes that act as natural sieves and filters, filtering .bubbles of water and sap



On February 28, 2014, in the 32nd session of the Regional Conference of the Food and Agriculture Organization of the United Nations, it was confirmed that the per capita share of fresh water in the Middle East and North Africa region has declined by two-thirds over the past forty years, and is expected to decrease by .50% by 2050

The research aims to study the possibility of using the xylem in the plant in the purification and filtering of polluted well water, as it acts as a natural filter for .bacteria

In an article, engineers from the Massachusetts Institute of Technology said fabric filters could be manufactured that eliminate pathogens such as E. coli and .rotavirus and could remove bacteria from polluted springs and groundwater

Softwood filters can be widely used, especially in areas where contaminated drinking water is a major cause of illness and death, such as India and Africa. Karnick's team published a study in the journal Plus One in late February 2014 showing that the woody tissue of some plants can effectively purify bacteria .from water

search methods:

First, the research plan

We carried out a set of procedures to answer the research questions, which are:

1- Taking three samples from polluted wells (close to residential areas).

2- Application of the hydrosphere protocol for GLOBE

Measuring [temperature - salinity - pH - dissolved oxygen].

3- Conducting a bacterial examination of the samples in cooperation with the company

Omani Water and Wastewater in South Al Sharqiyah Governorate.

4- Making a filter device using wood texture.

5- Comparing the results of the hydrosphere protocol measurements and the results of the bacterial examination before using the device and after using it to obtain research results

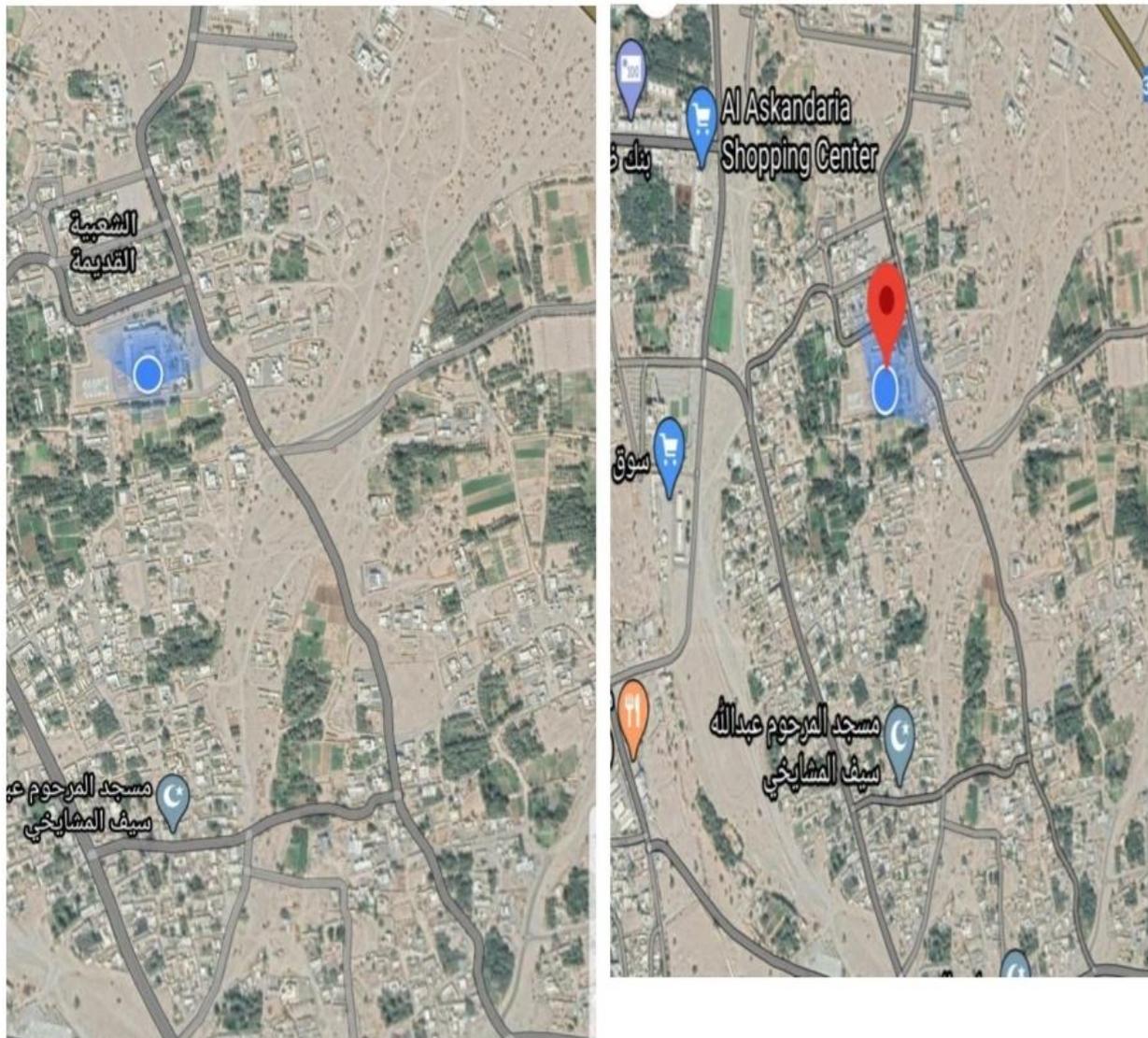


Timetable for the implementation of the
research plan

Time period	executors	Step
20/12/2022	GLOBE team	Information and data collection
9/2/2022	GLOBEteam	Sample collection
12/1/2022	Fajr AL-Mataani	Making a filter
25/1/2022	Fajr AL-Sawai ,Reem AL-Mataani	Hydrosphere protocol application
9/2/2022	Oman Water and Wastwater Company	Bacterial examination of samples
22/2/2022	GLOBE team	Entering data into the site GLOBE

Second: The location of the study

Sultanate of Oman (South Al Sharqiah Governorate) Wilayat Jalan Bani Bu Hassan February. The weather is moderate (22 Celsius) The hydrosphere protocol was used



Data collection and analysis:

***A bacterial examination of the samples was conducted in cooperation with the Omani Water and Wastewater Company, in order to answer the first research question: How is well water affected by sewage?**



***The filter was designed using wood texture and applying the hydrosphere protocol of the GLOBE program**

And a measurement of [temperature - pH - salinity - dissolved oxygen] in order to answer the second research question: How effective is the use of wood tissue as a filtering technique for polluted well water? And the third question: To what extent are the properties of well water affected as a result of the use of wood texture?



***Measurements of samples are compared before using the filter device and after using the device to know the effectiveness of wood texture as a filter material**



Results

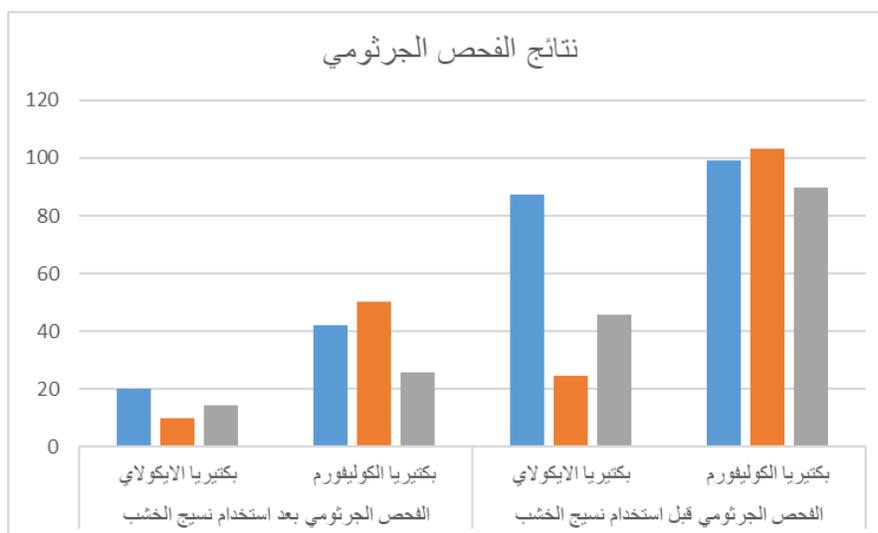
The results shown in the following tables were obtained:

The results of the bacterial examination of the sample

-1

Bacterial examination after using xylem		Bacterial examination before using xylem		Sample number
Coli bacteria	Coliform bacteria	Coli bacteria	Coliform bacteria	
20	42	87.4	99.2	1
10	50.2	24.5	103.3	2
14.2	25.6	45.6	89.8	3

Schedule(1)



Shape(1)

**Results of the application of the hydrosphere
protocol to the program**

-2

GLOBE

after using xylem				before using xylem				Sample number
The amount of dissolved oxygen	PH	temperature PPM	temperature	The amount of dissolved oxygen	pH	salinity PPM	temperature	
10	7.02	301	22	6	6.70	304	22	1
12	7.30	448	23	5	7.35	455	23	2
11	7.52	509	21	5	7.58	513	22	3

Schedule(2)

Discuss the results:

Through the previous results, we can answer the research questions:

The first question: To what extent is well water affected and polluted by sewage water?

*Table (1) indicates that the wells contain a percentage of fecal bacteria, and it is assumed that the amount of coliform bacteria in the water does not exceed 10 according to the Omani standard specifications for water.

*Table (2) indicates that the salinity and pH conform to the Omani standards for water, but the amount of dissolved oxygen decreased in the samples, which indicates the presence of organic substances or microorganisms that consume dissolved oxygen.

This indicates that the wells have been contaminated with sewage water. There is a previous Arab study dealing with the impact of sewage water on the amount of dissolved oxygen as one of the indicators of sewage pollution.

The second question: How effective is the use of wood tissue as a bacterial filter for polluted well water?

*Table (1): Refers to a significant decrease in the amount of bacteria in polluted well water after using wood tissue, and this is a clear evidence of the effectiveness of wood tissue as a bacterial filter for polluted water.

*Table (2): Refers to an increase in the amount of dissolved oxygen in water after using xylem, and this indicates a decrease in the amount of organic matter or microorganisms that were consuming oxygen.

These results are strong evidence that xylem is able to effectively purify contaminated water from bacteria.

The third question:- To what extent are the properties of water affected as a result of using wood texture for purification

*Table (2): indicates that the properties of water such as salinity, temperature and pH were not affected much after using the wood texture and indicate that they conform to the Omani standard specifications.

Conclusion:

Through our application of the hydrosphere protocol for the program

GLOBE(Salinity - pH - temperature - dissolved oxygen) on samples from wells and in cooperation with the Omani Water and Wastewater Company Through bacteriological examination of the samples, we found that some wells were affected by sewage water, as we found that coliform and E. coli bacteria are present in high rates in the water These wells however After using the xylem purification, we noticed a significant decrease in the amount of bacteria and an increase in the amount of dissolved oxygen in them.

These results are considered important because they show us the possibility of using xylem as effective bacterial filters to purify polluted water.

* The strengths of the research were: obtaining effective results in the bacterial examination and effective results when using wood tissue as a bacterial filter.

The research can be expanded by using more than one type of wood tissue for different local plants to find out the most efficient tissue as a bacterial filter.

Weaknesses: No previous local studies for comparison.

Thanks and appreciation:

We are pleased to extend our sincere thanks and appreciation to the program

GLOBE

To open new scientific horizons for us, we thank Professor Siham Al-Hasani, the program supervisor at Al-Rafa School, for the efforts made in helping us to accomplish this research, and Mr. Ghafail Salem Al-Maamari, Head of the Quality Department of the Omani Water and Wastewater Company.

the reviewer:

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Entering data into the site GLOBE:

The GLOBE Program Science Data Entry

model

1*

Dissolved Oxygen

mg/L

2*

Dissolved Oxygen

mg/L

Remove

3*

Dissolved Oxygen

mg/L

Remove

Salinity

ppt

The GLOBE Program Science Data Entry

Dissolved Oxygen Kit

manufacturer

model

1*

Dissolved Oxygen

mg/L

2*

Dissolved Oxygen

mg/L

Remove

3*

Dissolved Oxygen

mg/L

Remove

The GLOBE Program
Science Data Entry

pH Paper

pH Meter

1 *

If salt added, conductivity

$\mu\text{S}/\text{cm}$

pH

2 *

If salt added, conductivity

$\mu\text{S}/\text{cm}$

pH

Remove

3 *

If salt added, conductivity

$\mu\text{S}/\text{cm}$

pH

Remove



The GLOBE Program
Science Data Entry

pH Paper

pH Meter

1 *

If salt added, conductivity

$\mu\text{S}/\text{cm}$

pH

2 *

If salt added, conductivity

$\mu\text{S}/\text{cm}$

pH

Remove

3 *

If salt added, conductivity

$\mu\text{S}/\text{cm}$

pH

Remove



The GLOBE Program
Science Data Entry



Water

— Expand/Collapse | ✕ Remove

Temperature

Measured with: Probe *

Alcohol-filled Thermometer

Probe

1 *

Temperature

22

°C

2 *

Temperature

23

°C

Remove

3 *

Temperature

24

°C



Supplements



سلطنة عمان
وزارة التربية والتعليم
المديرية العامة للتربية والتعليم
للمحافظة الشرقية (جنوب)

التاريخ: ٢٠٢٢/٢/٢١ م مدرسة: الرفعة للتعليم الأساسي (٩-٥)

المحترم الفاضل/ غفيل بن سالم المعمرى
رئيس قسم الجودة بالشركة العمانية للمياه ومياه الصرف الصحي بمحافظة جنوب الشرقية

السلام عليكم ورحمة الله وبركاته وبعد:-
الموضوع/ طلب فحص عينات المياه

في إطار التعاون بين المؤسسات الحكومية والمؤسسات الخاصة وفيما يخدم برنامج (GLOBE) البيئي .تقدم اليكم بطلب فحص عينات مياه التي ستخضع للتقييم الخاص بالبحث العلمي الخاص بالبرنامج .

وتفضلوا بقبول فائق الاحترام والتقدير

يعتمد مدير المدرسة
جواهر بنت حمد الجاسر المشايخه

الختم



بإدارة العامة للتربية والتعليم بمحافظة جنوب شرقية - سكب الإشراف التربوي بجعلان - جعلان بني بو حسن مدرسة/الرفعة للتعليم الأساسي (٩-٥) - هاتف وفاكس: ٢٥٥٥٠٦٧٠