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Determination of the Hardness Level of Underground Water in Khost City, Afghanistan

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Abstract:- The dominant reasons of water hardness are due to the exit of calcium and magnesium ions in the water. It is noteworthy to mention that hardness of water increases the cost of industrial and living activities. In many developed countries the hardness of water is deeply and broadly investigated. In developing countries such as Afghanistan, limited studies are available that have investigated this issue. Therefore, this study aims to investigate the hardness of water from deep wells as well as gully in different regions of Khost city, Afghanistan. We have collected data from 8 deep water wells and a gully located in different areas. It was observed that the permanent hardness of water was small; hence it was not considered in this study. Then we focused on investigation of temporary hardness of water from the above-mentioned sites.

Keywords:- *Hardness, Water, Afghanistan, Deep Water Wells, Gully*

I. INTRODUCTION

The amount of salt in underground water depends on the structure of land strata. In other words, the amount of calcium and magnesium exist in the land strata that are touched with underground water play vital role in hardness level of water [1]. Water generally has two types (permanent and temporary) hardness. The temporary hardness of water is the existence of dissolved calcium hydrogen carbonate in the water while the existence of calcium sulfate in water caused permanent hardness. In recent time the terms "temporary hardness" and "permanent hardness" are replaced by alkaline and non-alkaline hardness respectively. Temporary hardness can be removed by boiling the water, while the permanent hardness cannot be removed with this process [2]. Several kitchens, bath and laundry problems occur due to the temporary hardness of water. For instance, the salt dissolved in water caused precipitation from hot water flowing and storing in pipes as well as boiling water in dishes for cooking purposes which reduce the life span and disturb normal functioning of the above-mentioned elements [3]. There are four types of water in term of the amount of salt dissolved in water (see table 1) [4].

No	Types of water	Amount of salt (ppm)	gr/lit
1	Soft water	0 -1000	0-1
2	Salty water	1000 -10,000	1-10
3	High salty water	10,000 -35,000	10-35
4	River water	>35,000	>35

Table 1:- Types of water in term of dissolved salt

Generally, the natural water that has high hardness level is not proper for drinking, agriculture and industrial purposes. Therefore, it is recommended to reduce the amount of salt to 0-1 gr/lit for using of water for the above-mentioned purposes [5,6]. The World Health Organization (WHO) recommended the amount of salt to be 0.5-1.5 gr/lit in soft water [1]. In addition, not only hardness of water but the amount of suspended materials, biological characteristics and materials that caused rusting of metallic materials is to be considered for use of water in industrial purpose. There are several methods applicable for removing temporary hardness of water such as lime soda process, ion exchange, distillation, electro dialysis, and reverse osmosis and freezing. Among these methods, the lime soda process in the one of the convenient and economical method for softening natural water [2]. Prior to apply the water hardness removal techniques it is essential to identify types of hardness (e.g. temporary and permanent or both of them) of the water. Researchers and practitioners in developed countries have made several attempts to identify the amount of hardness of water; however, limited studies have investigated this issue in developing countries. Particularly, we found no any research attempts in order to investigate the water hardness in the city of Khost, Afghanistan. Hence, this research focuses on the following objectives:

- Conducting research in order to investigate underground water hardness in developing countries, especially in the city of Khost, Afghanistan.
- Investigating water hardness of deep wells as well as gully in different areas of Khost cities.

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This research is composited from introduction explained in section 1 followed by methodology in section 2. The result and recommendations are addressed in section 3 and section 4 respectively.

II. METHODOLOGY

In order to achieve the above-mentioned objectives, we collected data from 8 deep wells and a gully in the city of Khost, Afghanistan in June 2019. For collecting data sample, we collected the sample from the five deep wells and a gully from central district while the rest three deep wells were located in the adjacent district (Tani and Ismaielkhail-Mandozi). The collected samples were then sent to the water laboratory of Kabul polytechnic university located in Kabul, the capital city of Afghanistan. Usually, the following two (soap solution and ethylene diamine tetra acetic acid (EDTA)) methods have been used for determination of water hardness. It is important to mention that the accuracy of EDTA method is higher than "soap solution method" [2]. Hence, we have used EDTA method in this study. The procedure of EDTA method has been addressed in a textbook of Engineering Chemistry [2].

III. RESULT AND DISCUSSION

In this study, we have collected water samples from different regions of Khost city, Afghanistan. Then the collected samples were analyzed using EDTA methods in order to determine temporary hardness of deep water wells as well as a gully. The obtained result of the analysis is shown in table 2. As stated earlier, the water with hardness smaller than 1.5gr/lit is called soft water and appropriate for domestic, agriculture and industrial usage. The result presented in the table also shown that the hardness of water from all sample are smaller than 1gr/liter which is called soft water (as the range is stated in table 1). Hence, we can conclude that the groundwater from the studied regions is naturally appropriate for domestic, agriculture and industrial purposes. From the result we can also conclude that the hardness of water of deep well is larger than that of gully water (e.g. hardness of deep well water in region Lakan 1 is larger than hardness of gully water in region Lakan 2).

No	Site name	Region	Water source	Hardness (gr/lit)
1	Murdekhil	Khost city central region	Deep well	0.310
2	Landi Kalai-Shamal		Deep well	0.455
3	Matoon		Deep well	0.408
4	Ustadan Families		Deep well	0.255
5	Lakan 1		Deep well	0.428
6	Lakan 2		Gully	0.462
7	Tani	Local districts	Deep well	0.285
8	Mandozi		Deep well	0.478
9	Haidarkhail		Deep well	0.472

Table 2:- Water Hardness of Different Area

IV. CONCLUSION

In this study, we focused on the analyzing hardness of water of different regions in the city of Khost, Afghanistan. The samples were collected from eight water wells and a gully located in different regions of the study area. We obtained from the analysis that the hardness of the tested samples were in the range of soft water (e.g. smaller than 1gr/lit). Thus we can conclude that the water is appropriate for use in different purposes such as domestic, agriculture and industrial. Our study has some limitations, for instance, the data was collected from limited areas. Hence, it is recommended to collect and test the hardness of the water from different regions.

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