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Utilization Of Beshr Silica In Filtration

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Abstract: Due to the environmental regulations and scarcity of water resources, it's important to find ways for wastewater treatment for reusing in different purposes. Sand and media filtration is a commonly applied technology for the removal of suspended substances from water and is frequently used for drinking and process water production. In this research the silica sand deposits from Besher-Libya location were physically and chemically characterized as a prelim study to investigate its suitability as a wastewater-filter, the properties studied are; porosity, permeability, specific gravity, grain size distribution and chemical analysis. The obtained results were compared with the standard specifications according to Manvile (1986) and concluded that the results are promising and could be used as a wastewater-filter.

Keywords: (filtration, grain size, silica, wastewater)

Introduction

With the pace of life accelerating, filtration has become a part of daily life. We deal with filtration, filters and its equipment permanently in homes, factories and various government facilities. Filters, in addition to being barriers that remove solids from wastewater, help in obtaining a uniform flow of runoff. This changes the nature of the water and makes it suitable for drinking, Agriculture, boiling or cooling make-up. Moreover, wastewater filtration helps users meet the requirements of more stringent environmental restrictions in discharge. Although filtration, considered as a simple mechanical process, in fact it includes the mechanisms of adsorption (physical and chemical), straining, sedimentation, interception, diffusion, and inertial impaction [1]. Sand media filters are one of the most popular filters used in micro-irrigation systems, especially for filtering water with big amounts of organic impurities [2]. Silica and industrial sand are used in filtration processes of drinking water, wastewater treatment and water production from wells. Uniform grain shapes and grain size distributions are the most physical characteristics control the filter efficiency, which are responsible of producing efficient filtration bed operation in removal of contaminants from potable and wastewater. The filter bed is graded by size and density which are describes the type of filters to "multilayer", "in-depth", and "mixed media". The used technique is to put light coarse particles at the top of the filter bed and fine denser particles are at the bottom [1]. Fortunately silica is chemically inactive and will not react with acids, pollutants, volatile organics or solvents. Coarse silica is used as packing material in deep-water wells to increase yield from the aquifer because it's preventing the infiltration of fine particles from the formation and so expanding the permeability around the well screen [2]. Moreover,

the mechanical strength of silica sand makes it a high durable material and that will ensure the filter media will be long lasting, even under high pressure in pressure filter, and lowering maintenance costs. The aim of this paper is to investigate the characterization of Besher sand deposits as a filter media according to Manvile 1986.

Location of study area

The area where the sample had been taken is located in the Centre part of Libya beside the coastal road close to the Brega oil port (Beshr soil).

Experimental and methodology

During the geological survey in the sedimentary basin of Central Libya, several samples of Beshr soil deposits were collected. The material expected to be chemically and mineralogical homogeneous throughout the area, therefore four samples about 20 kg were collected from distal parts of the basin. The samples were low in density, friable, and white to yellowish in color in spatial distribution, as shown in figure (1).

Fig. 1: Beshr soil samples

Raw materials used in this paper which obtained from the Beshr site were dried for 24 hour at 105^{o} C, and weighted in dry room condition [3], samples were tested to obtain some physical properties; density, specific gravity, porosity, permeability and Grain size analysis which have been carried out according to American Society for Testing and Materials "ASTM". To determine the size distribution of the sample's particles, a sieve analysis test was carried out. Moreover, a loss of Ignition test was performed to measure the organic content in the soil.

Results and discussion

1. Physical Properties:

Porosity is defined as volume fraction of voids within the silica sand's layer and can be determined easily by weight measurement [4]; the sample's mean porosity was 1.085%. The apparent density is the mass per total volume, the bulk density of soil depends greatly on the mineral make up of soil and

the degree of compaction, the average of bulk density for the samples studied were 2.4 g/cm^3. Specific Gravity of sand is the ratio of the density or mass of sand to the density or mass of a reference substance at a fixed temperature and the volume should be the same, the middle specific gravity of the target samples were 2.054. Soil permeability is the property of the soil to transmit water and air, the samples show permeability of 0.0625 cm/sec.

2. Grain size analysis:

The grain size analysis test is done to determine the percentage of each size of grains contained within a soil sample as shown in table (1), then the results of the test are used to draw the grain size distribution curve as shown in figure (2).

Table 1: Grain size analysis results

Sieve No.	Diameter mm	Weight%	Cumulative oversize %	Cumulative Undersize%
4	4.75	6.66	6.5	93.5
10	2	9.44	15.8	84.2
20	0.850	24.02	39.4	60.6
40	0.425	23.19	62.2	37.8
60	0.250	13.68	75.6	24.4
100	0.150	10.13	85.6	14.4
200	0.075	9.02	94.5	5.5
pan	-			-

The grain-size distribution of the soil sample obtained by plotting the percent finer with the corresponding sieve on semi-log graph paper, as shown above which is used to calculate the uniformity coefficient of the sample. From the grain size distribution curve, the values of D10, D30, and D60, which are the diameters that correspond to the percent finer of 10%, 30%, and 60%, respectively can be determined [5], [6].

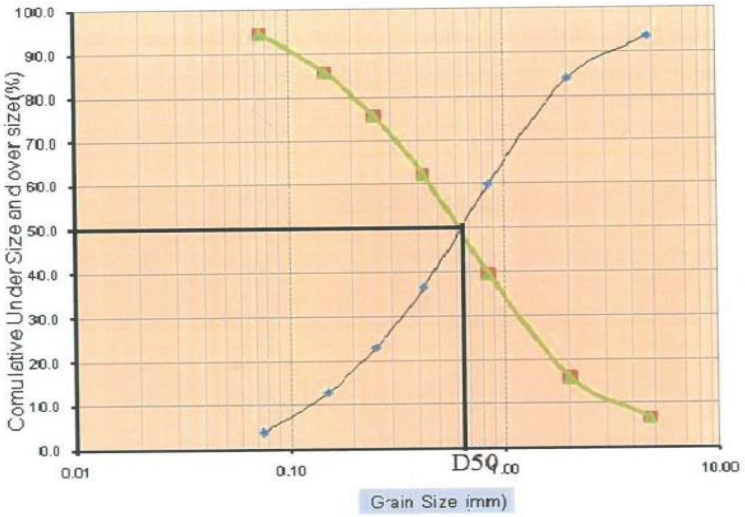

Fig. 2: Grain size distribution curve

The values of the uniformity coefficient Cu and the coefficient of gradation Cc can be calculated using the following equations:

Cu = D60÷D10= 0.85÷0.26= 3.27

$Cc=(D30)^2(D10\times D60)=(0.32)^2(0.26\times 0.85)=0.463$

3. Loss of Ignition (LOI):

This test is designed to measure the amount of moisture or impurities Lost when the sample is ignited under the conditions specified in the individual monograph. Then, the difference of weight is divided by the original weight. The results of samples's loss of ignition are presented in table (2) below.

Table 2: Loss of ignition results

Sa. No.	LOI
R5-1	0.44
R5-2	0.30
R5-3	0.37
R5-4	0.34
R5-5	0.34

4. Chemical analysis:

The chemical analysis of the bulk samples was done in Zleten cement factory and the results shown in the Table (3).

Table 3: Chemical analysis results

Sa. No.	R5-1	R5-2	R5-3	R5-4	R5-5
Na_2O %	0.14	0.13	0.11	0.12	0.12
MgO %	1.15	1.16	1.11	1.11	1.14
SiO_2 %	74.17	74.24	74.24	74.09	74.4
Fe_2O_3%	3.74	3.49	3.45	3.34	3.41
Al_2O_3 %	5.80	5.82	5.77	5.76	5.81
K_2O %	0.44	0.45	0.44	0.44	0.44
CaO %	14.78	14.67	14.8	15.11	14.65

Silica, alumina, iron oxide Were the main constituents of the samples. The Sio_2 content corresponds to related aluminum silicate minerals present in the sample and the existence of Al_2O_3, Fe_2O_3 to the high amount of chlorite and vermiculite present in the sample. The contents of CaO and MgO are slightly high due to the existence of carbonate minerals, the loss of ignitions (LOI) of the sample is mainly attributed to loss of H_2O contained in clay minerals, the sodium oxide (Na_2O) and potassium oxide (K_2O) are mainly attributed to the presence of feldspar, illite and clay mineral.

5. The XRD analysis:

X-ray powder diffraction (XRD) is a rapid analytical technique used for phase identification of a crystalline material. The samples are finely ground, homogenized, and average bulk composition is determined. The samples are characterized as clay-silica deposits as these minerals are composed of amorphous silica (SiO_2nH_2O) which has biological origin.

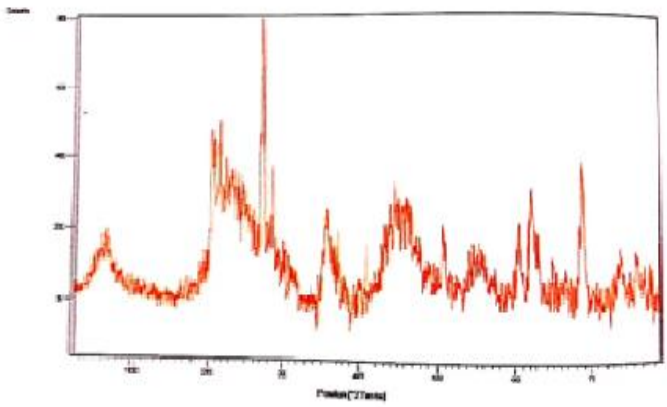

Fig. 3 (a): XRD analysis of sample 1

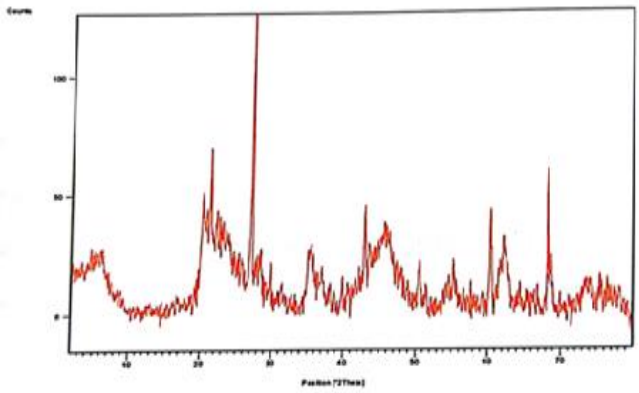

Fig. 3 (b): XRD analysis of sample 2

The XRD analysis of the four bulk samples are presented in figure (3. a,b,c,d). Referring to the XRD analysis, other clay minerals such as chlorite $(MgFe)_3$,(Si Al)4010(OH) and illite are also present in variable amounts and smectite (Ca,Mg,Na).

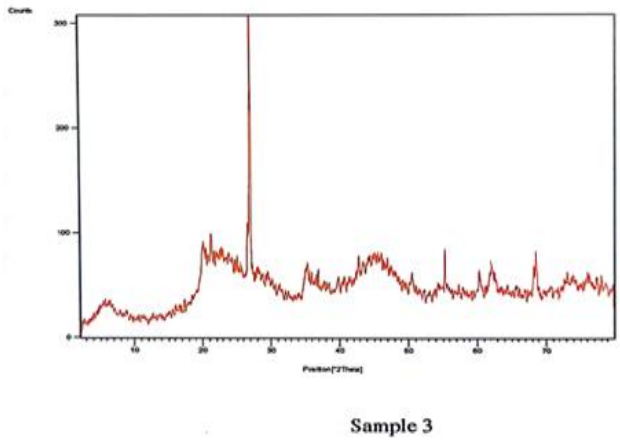

Fig. 3 (c): XRD analysis of sample 3

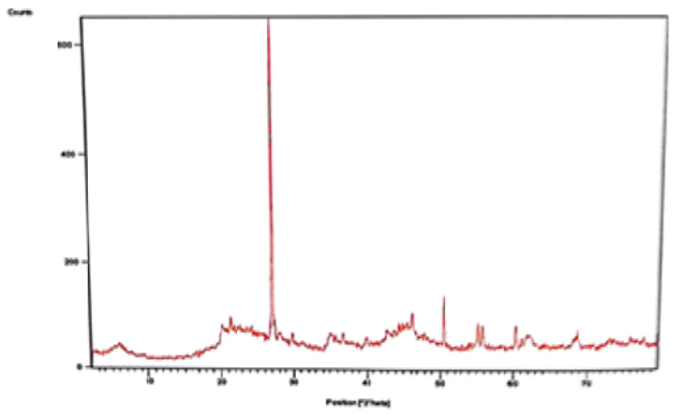

Fig. 3 (d): XRD analysis of sample 4

The results show the contents of the samples are different phases of silicate minerals i.e Quartz, Cristobalite, Tridymite, accompanied to the feldspar (microline) and vermiculite.

Conclusion

In this research some physical and chemical properties of Besher silica were studied to investigate its possibility to use in water filtration, these properties are permeability, porosity, specific gravity, grain size distribution. The results compared with standard specification of filtration according to Manvile 1986 and concluded that the results are promising and in line with standard specifications.

Acknowledgment

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References

[1] H. Barka, Applicability of Besher Silica in Filtration Process, Bachelor's project, Tripoli University, Libya 2016.

[2] M. Elbana, F. Ramírez de Cartagena, J. Puig-Bargués, (August, 2012), Effectiveness of sand media filters for removing turbidity and recovering dissolved oxygen from a reclaimed effluent used for micro-irrigation, Agricultural Water Management, 111, 27-33, DOI:10.1016

[3] MD Sahadat Hossain, Ph.D., P.E.; Md Azijul Islam; Faria Fahim Badhon, (2018). Network, [online], Available at: https://uta.pressbooks.pub/soilmechanics/open/download?type=xhtml

[4] F. G. Bell, Engineering geology and geotechnics. Newnes Butterworths, London, 1980, pp. 11-93.

[5] L. Mazogy, Studying the possibility of using silica sand in the Abu Ghailan region for the glass industry, Bachelor's project, Tripoli University, Libya 2009.

[4] John T. Germaine, Amy V. Germaine, (2009, May 20). Network, (2nd ed.) [online]. Available at: https://www.google.com.ly/books/edition/Geotechnical_Laboratory_Measurements_for/Ln5EpwZooPQC?hl=en&gbpv=1