

Physicochemical characteristics of Algerian Sahara sand dunes used for Bechar wastewater pretreatment

A. Maazouzi^{1*}, A. Badri¹, A. Kettab², D. Ait Baaziz¹

¹LCSE, Laboratory of Chemistry and Environmental Sciences, University of TAHRI
Mohamed-Bechar, P.O. Box 417, Bechar 08000, Algeria

²Water Science Research Laboratory (LRS-EAU)EL HARACHE Algiers 16000, Algeria

*Corresponding author: maazdz@yahoo.fr; kettab@yahoo.fr;

ARTICLE INFO

Article History:

Received : 13/12/2016
Accepted : 25/12/2017

Key Words:

Dune sand (western Erg).
physicochemical
characteristics. (Beni abbes)
Algeria

ABSTRACT/RESUME

Abstract: This work aims at the characterization of dune sand (Beni abbes), which is found in considerable quantity in Algeria Sahara; In order to make, a chemical analysis of the porous environment studied summer so as to provide us with a qualitative and a quantitative information about the chemical composition of the sample, the results obtained show that the quartz (97%) is the most represented mineral, the oxides of aluminium, potassium, iron, chromium and manganese, identified by the chemical analysis, probably enter in the clayey phase, the granular analysis permitted us to determine some parameters as the uniformity coefficient (CU) and equivalent diameter, a comparison of the IR spectrum of the sand (washed and non washed) was achieved, observations to the Scanning Electron Microscopy (SEM) and the X-Ray analysis are achieved also. A part of this work is devoted to the follow-up of the absorbance of the filtrate at different lengths of waves. Erg sand of Beni abbes presents favorable features for its use as being bed filtering in pretreatment.

I. Introduction

The Western Erg in the Algerian South West is a site that spreads on the right strands (East) of the Zousfanas river and Saouras, Southbound, it becomes attached at the west to the erg El Atchane, that links up more at the west to the erg El Raoui in the region of the Daoura river on its turn and until the Algerian-Moroccan border, close to the anti-Atlas. More to the south, these are Ergs less accessible to the different national roads and spread until the Algerian Mauritanian and Malian borders, these are: the Chech erg and the Iguidi erg (fig.1). Geologically these Ergs are dated of the Pliouaternaires, this spread on big surfaces and seem to be an obstacle in the infrastructure of the urban development of the regions of the Sahara as well as a named ecological gate the desertification. Because of the advantages and potentialities waited, the survey, the exploitation and the valorization of the dune sand very extensively studied [1-5] is the objective of this work.



Figure 1. Localization of Western Erg [6]

II. Materials and methods

The sand was also physically (Table 1) and chemically (Table 2) characterized. Mean diameter, uniformity coefficient, porosity and permeability were considered for the physical characterization. In addition to pH and conductivity, oxides: Cr₂O₃, Fe₂O₃, Al₂O₃, K₂O, MnO, Na₂O, MgO and SiO₂ contents were determined to characterize chemically sand of dune used.

III. Results and discussion

Physicochemical characterization of the dune sand

The sand used in this work, is the one of Beniabbes that comes directly from the dune of the Erg Western (Tables 1 and 2). Their characterization confirmed their potential to be used as filtration media, since the equivalent diameter, the uniformity coefficient, the porosity and the permeability were in the ranges 0,22 mm, 1,39, 41% and 0,983 10⁻⁴ m/s respectively, saltiness is very weak represented by the conductivity that is of 98,2µS/cm, the insoluble matter rate is of about 97% (composed essentially of quartz), the weak organic matters and the granular analysis shows that it is about one soil very uniform, showing that sand size

can be characterized as thin to medium. Physical (Table 1) and chemical (Table 2) characterization of the sand of dunes showed that the characteristics of sand used is close to those reported in the available literature [1,7].

The sand belongs to the category fine sand it is confirmed well by the weak porosity, 41%; this character more or less thin of the sands can be quantified also by the equivalent diameter observed to the Scanning Electron Microscopy (SEM) fig 2 and valued by the granular analysis. As in remark in the table 1 the uniformity coefficient is well lower to 2, by convention, so of CU is consisted between 1 and 2, the granulometry is said uniform [8-10].

The results gotten table 2 shows that quartz is the mineral the more represented. The presence of the oxides of iron and aluminum can be an indicator of the presence of FeO (OH); Fe₂O₃; Al(OH)₃... who are recognized like being of the minerals of strong reactivity and oneself a strong power adsorbent on the phosphor [11]. The oxide of calcium very probably presents the concentrations due to the presence of the calcite (CaCO₃) recognized like soluble and that can conditioned the presence of Ca⁺² in water.

X-Ray analysis of Beniabbes sand dune

Table 1. Physical characterization of the sand dune

Equivalent diameter mm	Uniformity coefficient (CU)	Permeability 10 ⁻⁴ m/s	Mass volumic kg/m ³	Porosity %
0,22	1,39	0,983	2,63	41

Table 2. Chemical characterization (%) of Beniabbes sand dune: SBL: Beni abbes Sand washed

	Cr ₂ O ₃	Fe ₂ O ₃	Al ₂ O ₃	K ₂ O	Na ₂ O
SBL	0,004	0,18	0,17	0,008	0,008
MnO	CaO	MgO	SiO ₂	pH	Conductivity (µS/cm)
00	1,15	0,015	97,44	6,95	62,4

The described to X-rays used, has allowed us to show that the sand of Beni abbes is composed essentially of quartz (SiO₂). (Fig 3)

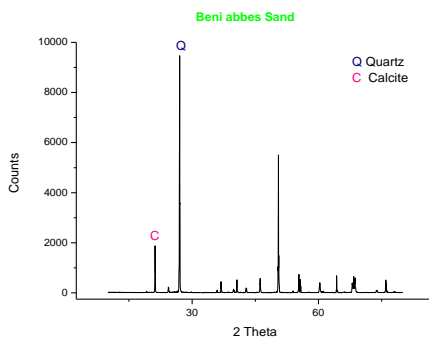


Figure 2. XRD patterns of samples Sand dunes (Beni abbes)

IR spectrum of Beni abbes sand dune

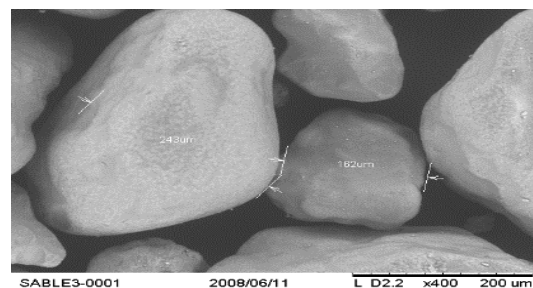


Figure 3. The Scanning Electron Microscopy observation: Sand dune of (Beni abbes)

The IR spectrum have been recorded by means of a spectrophotometer thermo Nicolet AVATAR 320

FT - IRS. The sample has been prepared according to the method of the disks of KBr preserved in dry atmosphere. The exam of the IR spectrum of the raw sand samples and after washing fig 4 shows that some strips in the spectres of raw sample disappear or move after washing and that are bound probably to the presence of the foulness associated to the clay. Of after [12] the strips 467, 698, 1031 cm^{-1} and 755, 789 cm^{-1} and 538 cm^{-1} is respectively characteristic

to the vibration of the link Si-O and Si-O-Al of the kaolinite, and the strip 875 is characteristic to the vibration of CO_3 of the calcite; One essentially discovers; The results gotten by this analytic technique confirm those gotten by chemical analysis, indeed, the present majority phases in the sand of Beniabbes are the calcite (CaCO_3) and the quartz (SiO_2).

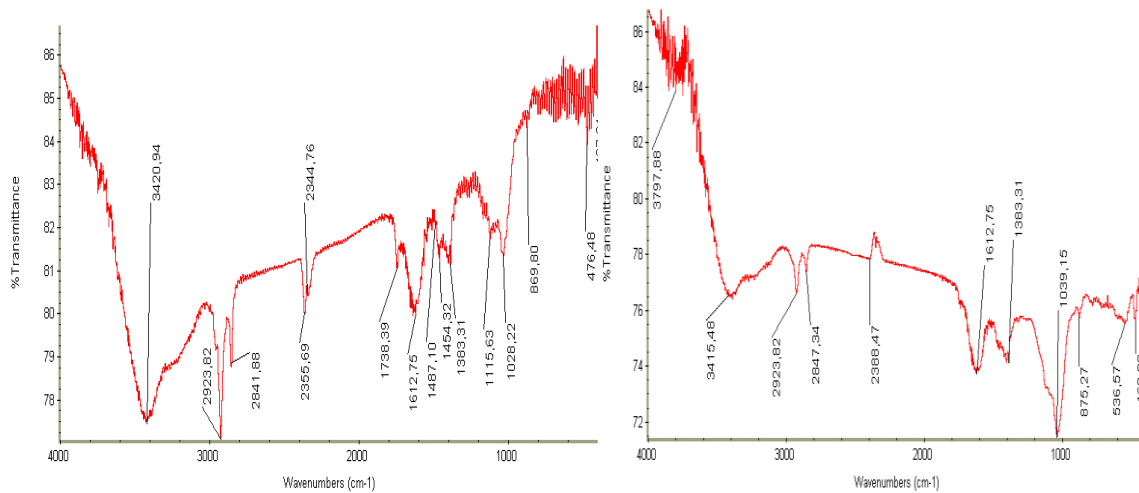


Figure 4. IR spectrum of Beni abbes sand

Absorbance of the filtrates after passage on the filter

For one time of washing that lasted 65 min, the reduction of the absorbance according to the time of washing observe fig. 4 for all wavelength (λ) used, the maximum value of the absorbance it places in the UV domains that been of 0,025 for $\lambda = 254\text{nm}$, a less important absorbance is observed in the domain of the visible 0,017 for $\lambda = 400$ for the first filtrate (AbsF1).

The observations to the misses: x 80, fig. 6 of the top of the sand after the passage of the washing water clearly shows that a washing took place.

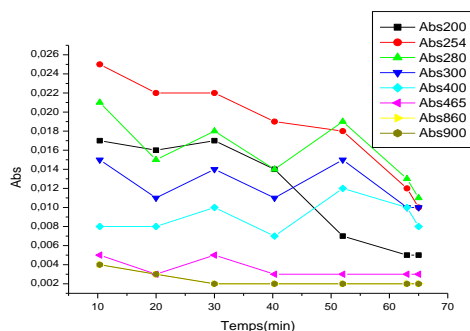


Figure 5. Evolution of the absorbance to different lengths of waves according to the time of washing

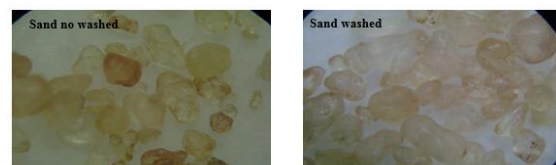


Figure 6. Observations to the misses: x 80, sand washed and no washed

IV. Conclusion

The chemical analysis of the sand to go up that it contains 97,44% of SiO_2 , consider as being the insoluble part and a non negligible part of CaO , Al_2O_3 and Fe_2O_3 , confirmed by analysis FTIR and the X-Ray analysis, the results gotten by this analytic technique confirms those gotten by X fluorescence, indeed, the present majority phases in the sand of Beniabbes are the quartz (SiO_2) and the calcite (CaCO_3).

Erg sand of Beni abbes presents favorable features for its use as being bed filtering in pretreatment, we

dress that a treatment (washing) sand can improve its performances seen the results gotten in this work. The survey of this big extent is to take scientifically in charge in order to discover the economic potentialities that these sites can offer.

V. References

1. Maazouzi.A; Kettab.A et Badri.A; 2007 «Etude de procédés de filtration sur sable de la région de Béchar en pré traitement de l'eau potable» *Desalination* 206 (2007) 358–368
2. Maazouzi.A; Kettab.A et Badri.A; 2008 «Contribution à l'expérimentation de la filtration de l'eau potable en prétraitement dans quelques lits filtrants (sable) de la région de Bechar. » 4ème conférence internationale sur : les Ressources en Eau dans le Bassin Méditerranéen Mars 2008 Alger Watmed4.
3. M.M. Ahammed and M. Chaudhuri, Sand-based filtration/ adsorption media, *Aqua – J. Water Supply: Res. Technol.*, 45 (1996) 67–71.
4. M.F. Hamoda, I. El-Ghusain and N.Z. Al-Mutairi, Sand filtration of wastewater for tertiary treatment and water reuse, *Desalination*, 164 (2004) 203–211.
5. D.H. Mantz and P. Eng, New horizons for slow sand filtration, Proc. 11th Canadian National Conference and Second Policy Forum on Drinking Water and Biennial Conference of the Federal- Provincial-Territorial Committee on Drinking Water, Promoting Public Health Through Safe Drinking Water, Calgary, Alberta, 3–6 April 2004, pp. 682–692.
6. Yann Callot«Histoire d'un massif de dunes, Grand Erg Occidentale (Algérie)»*Géodynamique des milieux continentaux, Sécheresse* 1991,2 :26-39
7. Youcef Touil and all/ Pilot plant for wastewater treatment involving septic pit and biological filtration on sand of dunes of the Algerian Sahara *Desalination and Water Treatment*10 (2009)148-152
8. Gaillard B., 1994. «Les méthodes de traçages pour l'étude des écoulements souterrains. » Cours DESS Hydrogéologie, Université Grenoble I.
9. Molle.P. 2003. «Filtre plantes des roseaux : limites Hydrauliques et rétention du phosphore». Thèse de doctorat, Université de Montpellier II.
10. Ruban G .1996 . «Mesure continue de la pollution par voie optique en assainissement Principe généraux et mise en œuvre, LCPC» : compte rendu de synthèse, ERG2.72.10.6 ,51p.
11. Molle.P. 2003. «Filtre plantes des roseaux : limites Hydrauliques et rétention du phosphore». Thèse de doctorat, Université de Montpellier II.
12. Elouazzani.D.2005«Caractérisation physicochimique et valorisation en bâtiment et TP des cendres issues de l'incinération des boues de papeterie» Thèse de doctorat, Institut des sciences appliquées de Lyon.
13. Maazouzi, A. Kettab, B. Zahraoui, R. Khelfaoui, A. Badri 2009 « Contribution à la mise en place d'un protocole de lavage de lit filtrant de sable pour les eaux potable à l'échelle de laboratoire. » Séminaire Matière Organiques et Environnement. Saint maxime (France).

Please cite this Article as:

Maazouzi A., Badri A., Kettab A., Ait Baaziz, Physicochemical characteristics of Algerian Sahara sand dunes used for Bechar wastewater pretreatment, *Algerian J. Env. Sc. Technology*, 3:3-B (2017) 583-586