ISSN (ONLINE):2456-5717
International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)
Vol.4, Issue.4, April 2018

Characterization of Sand Formation from a Crude Oilfield

[1]A. Sivasakthi, [2]T. Nagalakshmi
[1]Ph.D. Research Scholar, Department of Petroleum Engineering, AMET University, Chennai- 603112, India.
[2]Professor & Head of the Department,Department of Petroleum Engineering, AMET University, Chennai-603112, India.

Abstract - **In this research article, sand formation was investigated by collecting the sand sample from the crude oilfield of western India. The sand formation was observed in the shallow type of crude oil reservoirs. The predominant mineral present in the sand is quartz and the characterization of sand was carried out through the determination of soil textural test, moisture content, bulk density, particle density, porosity and sieve analysis. The soil in the oilfield contains about 92 % of sand, 6 % of silt and 2 % of clay. The moisture content present in the sand sample was about 4%. The bulk density, particle density and porosity of sand were found to be 1.1587 g/cm^3, 1.8829 g/cm^3 and 30 %. The sieve analysis was useful in determining the size distribution of the particles in the collected sand sample.**

Keywords – Bulk density, Quartz, Particle density, Porosity, Sand and Sieve analysis

I. INTRODUCTION

Sand is an asymmetrical material composed of various homogenous or heterogeneous minerals particles. By the action of several geological, geochemical and geophysical mechanisms along with any of the rocks namely sedimentary, igneous and metamorphic rocks go through changes which in turn form the sand particles. In the soil, the textures are divided into three types namely sand, silt and clay. In common, soil contains about 86 % of sand particles. The key mineral in the sand is Quartz, which is chemically referred to as silicon dioxide. Quartz mineral can be either a monocrystalline or polycrystalline depending upon the rock particles and the mineral particles also have a better resistance to the effect of extreme weathering and abrasion. The sand particles are classified as coarse, medium and fine sand particles respectively. Table 1. Shows the classification of sand particles along with their grain size distribution.

TABLE 1. CLASSIFICATION OF SAND PARTICLES

SI.No.	Classes of sand particles	Grain size distribution (mm)	Void space
1.	Coarse sand	2 – 0.6	Small
2.	Medium sand	0.6 – 0.2	Small
3.	Fine sand	0.2 – 0.06	Very small

The sand particle size may vary depending upon the environmental conditions and geological effects. The sand particle is one of the main components in the formation of sandstone. The sandstone has the oil bearing capacity and a type of sedimentary rock composed of consolidated sand along with the cement particles. The main mineral components in the sandstone are Quartz, feldspar and rock fragment besides some amount of impurities may also be present. The impurities present in the sandstone gives various colours to the rocks. Sandstone is formed by the geological and cementing action of clay or silica induced on the quartz, feldspar and rock fragments crafted the clastic sedimentary rocks formation. Sandstone has a small void space compared to the uncemented sand particles. Similar to sand formation, the sandstone mineral composition, colour, void space and texture may different by their domain origin.

In this research article, the sand samplewas characterized by the determination of different classes of texture and porosity. Colour of the sand and sandstone was observed visually. The porosity of the sand was calculated from the bulk density and particle density, which was obtained beforehand from experiments. The sieve analysis was carried out to differentiate the particle distribution of the collected sand sample.

II. MATERIALS AND METHODS

A. Materials Required

The sand sample was collected from a crude oil field of western India for the experimental studies. The hot air oven was used in order to find the dry weight of sand sample. Sieve trays with ASTM No. were arranged for the particle size distribution of the collected sand sample.

B. Methodology

- Determination of sand content

The sand sample obtained from the oilfield was taken in a 500 ml beaker. 50 ml of 1 % NaCl solution was added to the beaker and then the sand sample was added on top of the NaCl solution, till the water reaches the 100 ml in the beaker. Once again, the 1 % NaCl solution was poured into the beaker up to the level of 150 ml. Now, the mixture in the beaker is completely agitated and placed in the isolation for settling. After 24 hours, the total depth of the sediment was noted and stirrer the sand sample one more time. After a minute, note the depth of sand settled at the bottom. After 2 hours, the depth of silt was calculated and finally the remaining amount of clay was determined from the difference in the total depth of sediment to the sum of the depth of sand and silt.

% Sand content	= (Sand depth / Total depth)	×	100
% Silt content	= (Silt depth / Total depth)	×	100
% Clay content	= (Clay depth / Total depth)	×	100

- Determination of moisture content

The moisture content of the sand sample was determined by the ratio of weight of the sand sample to the dry weight of the sand sample heated at 105 ˚C for 24 hours.

Moisture content of the sand sample = (wt. of the sand sample / dry wt. of the sand sample) ×100

- Determination of bulk density, particle density and porosity

Bulk density is the ratio of weight of the oven-dry sand sample to the volume of sand solids and pores. Particle density is the ratio of weight of the oven-dry sand sample to the volume of sand solids. Porosity is the measure of void space in a material. The bulk density was calculated by measuring the volume of sand taken and the oven dry weight of sand at 105 ˚C for 24 hours. The particle density was calculated by adding an exact volume of water to the measured amount of sand sample and stirred vigorously to remove air from the void space. Now, measure the volume of sand particles alone and porosity was calculated from the fractional air space.

- Sieve analysis

Sieve analysis helps in the particle size distribution of the sand sample. It gives the idea of how the particles were dispersed in the different size range of gravel, sand, slit and clay. The sieve trays were arranged in the ascending No. of sieve and mechanically agitated to separate the particle to their respective sieve sizes. Before conducting the sieve analysis test, the sand sample was dried in the hot air oven at 105 ˚C for a time period of 24 hours and the large lump particles were broken down to get accurate results. The dry weight of the sand sample (W_I) was 50 g before applying sieve test. Calculations were carried out with the retained weight of sand particles in each sieve.

Percentage of each sieve, Rn = (weight retained (W_R) / initial weight (W_I)) ×100.

Percentage finer = 100 – (cumulative percentage retained (ΣRn))

III. RESULTS AND DISCUSSION

A. Determination of sand content

The sand, silt and clay content were separated and the volume of the individuals was calculated accordingly. Table 2.shows the different sediment along with the grain size distribution was displayed and explains that the particles of clay < silt < sand and therefore the settling time of clay > silt > sand particles respectively. In the oilfield, the soil/ sand sample is always mixed with the crude oil and while conducting the experiments the organic/ crude oil layer floats on the top of the water. The organic/ crude oil layer does not affects the experiment

and the floating of crude oil shows that the density of water is greater than the density of crude oil present in the sand sediment.

TABLE 2. CLASSIFICATION OF SEDIMENTS

SI.No.	Classes of sediments	Grain size distribution (mm)	Void space
1.	Sand	2 – 0.06	Small
2.	Silt	0.06 – 0.02	Very Small
3.	Clay	< 0.002	Extremely small

Fig. 1.represents the distribution of sediments from the collected sand sample of the oilfield. The bottom layer is the sand sediment, the silt content is present at the middle layer and clay content is settled as the top layer on the silt content. The percentage of sand, silt and clay content was found to be 92 %, 6 % and 2 %.

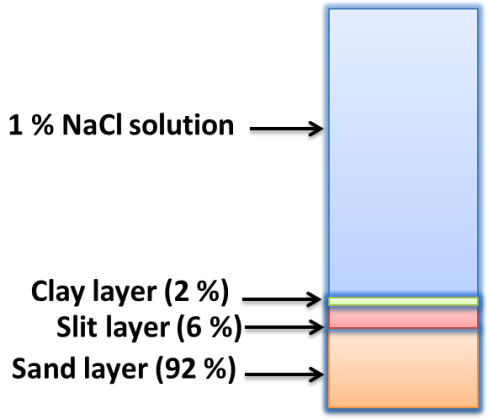

Fig. 1. Distribution of sediments in the 1 % Nacl solution

B. Visual colour observation

Colour of the sand was visually observed and the sand was grey in colour. Due to the grey colour, the sand is completely made up of quartz. Quartz is a clear and transparent mineral particle, which is composed of silicon dioxide. The grey colour of the sand indicates the absences of other coloured mineral particles except quartz and presence of some impurities. Colour of the sand mainly comes from the historical and geological action of the environment.

C. Determination of moisture content and porosity

The moisture content in the collected sand sample was found to be 4%. The bulk density and particle density of the sand sample were observed to be 1.1587 g/cm^3 and 1.8829 g/cm^3. Porosity of the sand was obtained from the percentage volume of sand or original volume of sand occupied by air between these grains and the value was 30 %. Sand particle has high porosity compared to silt and clay which are finer and the pore space will also be smallerin nature.

Moreover, sand particles are non-sticky and loosed granulated particles except clay particles which are sticky and very tightly packed together.

D. Sieve analysis

Sieve No. such as 6, 8, 10, 12, 14, 20, 30 and 200 were used in the investigation of sand sample. Table 3. Shows the calculated values of percentage passing through the sieve are also called as % finer from the obtained weight retained values of the sand in each sieve tray. The collected sand particles falls mainly in the category of medium and fine sands along with some amount of silt content which was shown in the Fig. 2.

TABLE 3. SIEVE ANALYSIS OF SAND SAMPLE

Sieve No.	Sieve size (mm)	Wt. of sand retained, W_R (g)	% of sand on each sieve, Rn	Cumulative % retained, ΣRn	% Finer
6	3.35	0	0	0	100
8	2.36	0	0	0	100
10	2	0	0	0	100
12	1.7	0.12	0.24	0.24	99.76
14	1.4	0.16	0.32	0.56	99.44
20	0.85	1.69	3.38	3.94	96.06
30	0.60	2.89	5.78	9.72	90.28
200	0.075	44.19	88.38	98.1	1.9

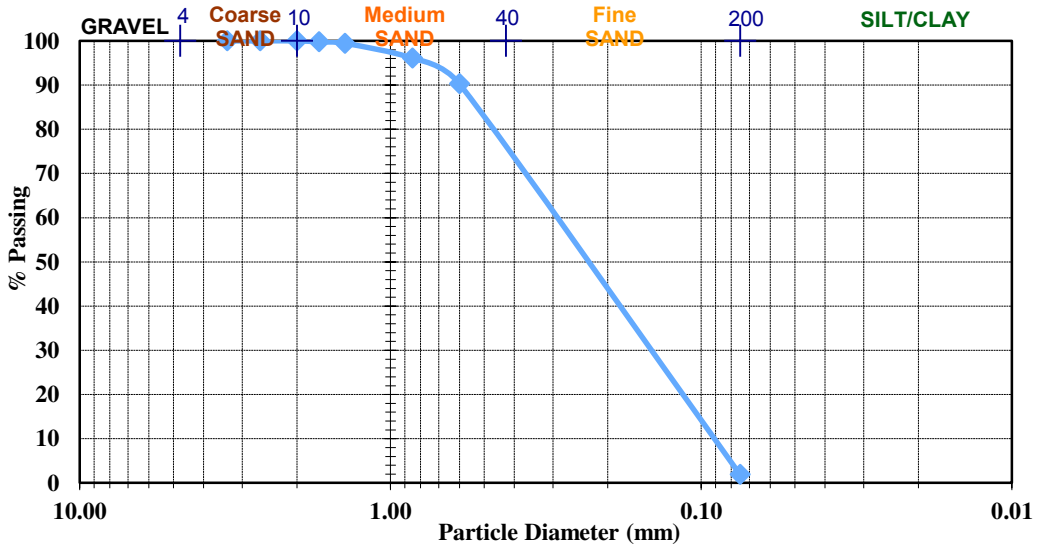

Fig. 2. Particle size distribution of the collected sand sample

IV. CONCLUSION

The sand formation characterization of crude oil field is useful in the recovery and refining process of crude oil. The characterization of sand helps in the recovery of crude oil by knowing the specific details such as porosity, density and grain size distribution gives the idea of what type of recovery methods are suitable in this particular formation. In the refining section of the crude oil, the determination of density and porosity of sand will be valuable for the separation of crude oil from the sand content.

The sand formation in any crude oil reservoir was made up from the geological, geophysical and geochemical action. The sand sample collected from a specific crude oil field was characterized with the aid of soil textural test and sieve analysis test. The soil/ sand sample has about 92 % of sand and remaining 8 % of silt and clay content. Colour of the sand was visually observed to be grey due to the presences of prevalent amount of Quartz minerals. Total moisture content in the sand sample was around 4% and the porosity of sand was found to be 30 %. Bulk density and particle density of the collected sand sample were 1.1587 g/cm^{3}and 1.8829 g/cm^3. The sieve analysis of sand assigns the particle of sand according to their size.The range of sand particles from the collected sample was found to be concerning medium and fine sand particles along with small amount of silt content.

REFERENCE

[1] Steven E. Wilson Lansing and Michigan, “An Michigan’s Study of Coastal Sand Dune Mining in Michigan”, 2000, *Geological survey division,* Pamplet 7.
[2] Robert R. Berg, “Reservoir Sandstones”, 1986, published by Prentice-Hall, Inc., New Jersey 07632.
[3] www.leovanrijn-sediment.com.
[4] SKAT, “Quality control guidelines for fibre or micro concrete tiles”, 1992, pp 67.
[5] Lin, W.R., Tadai, O., Takahashi, M., Sato, D., Hirose, T., Tanikawa, W., Hamada, Y. and Hatakeda, K. (2015) “An Experimental Study on Measurement Methods of Bulk Density and Porosity of Rock Samples”. *Journal of Geoscience and Environment Protection*, 3, 72-79.
[6] Crawford, KacyMackenzey, "DETERMINATION OF BULK DENSITY OF ROCK CORE USING STANDARD INDUSTRY METHODS", Master's report, Michigan Technological University, 2013.
[7] Muhammad siddiqueshakir, Anwar-ul-hassan and Abdul razzar, “Effect of salts on bulk density, particle density and porosity of different soil series” *Asian Journal of Plant Sciences*, Vol. 1. No. 1: 5-6, 2002.

AUTHOR'S BIOGRAPHY

A.Sivasakthiis the Ph.D., Research Scholar in the Department of Petroleum Engineering at AMET University, Chennai, India.

Dr.T.Nagalakshmiis the Associate Professor in the Department of Petroleum Engineering at AMET University, Chennai, India. She has the 14 years of experience in the field of educating the students from the AMET University.