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# Sieve Shaker Data for Obtaining Proper Well Completion Method

Mahmood Bataee, Methaq Mohammed Moqbel Nasr Alqaisi, Babak Moradi, Babak Shahbazi, Zakaria Hamdi, Atefeh Zamani

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***Abstract***

The sand accumulates at the well leads to increase in sand production resulting in lost production and increased well maintenance cost. The main objective of this research is to evaluate sand produced from the field and to propose a suitable prevention sand method.Four samples of sand with different mass size are prepared for the test and then placed in a sieve shaker with openings in the decreasing order of sieve size. Sieves of sizes 2000, 1000, 500, 250, 125, 36 microns and a no sieve pan were used to sample the sand. Granular particles are accumulated on different sieves, which give the particle size distribution of the samples.From sieving analysis, the results showed that for well one the majority of the sand material is retained on the 500-size sieve. While, for the second sample the results showed that the percentage of sand accumulated on the 125 micron is the highest, which indicates that the sample consists of fine particles. Further, the highest percent weight retained of this sample is reported at mesh size of 125 micron. Further, the sieve analysis for the rest of samples indicated that maximum of the particles of the sand sample belong to the large category of particle size classification.This can be justified as the highest percent weight retained of both samples are reported at the larger micron size mesh particularly at 2000 and 1000 micron mesh sizes. Based on tiffin Criteria, the results elaborated that well one can use standalone screen or wire-wrapped screen and for the well two must use mesh screen. While for well three and well four, it is suggested to use gravel pack that can utilize slotted liner since these types of sand are non-uniform sand.

***Keywords:*** *Sand prevention, Sieve shaker equipment, Sand analysis, Tiffin criteria.*

## 1. Introduction

The petroleum industry like other industries is affected by numerous challenges. These challenges increase the cost of production and heighten the capital intensiveness of the industry. One of the major challenges faced by the petroleum industry is sand production. According to the analysis of the previous studies conducted by (Procyk, et al., 2015), (Bellarby, 2009) and (Foidaş & Ştefãnescu, 2017), that the major challenge in the well completion industry can be taken into consideration in term of how to effectively integrate intelligent-well technologies with modern sand-control strategies.

Sand production can severely affect the well productivity and damage the downhole equipment and surface facilities (Alawad et al., 2009). Therefore, reservoirs requiring sand control have a major challenge for selection of a suitable completion method. Further, the forecast of sanding risk is the initial step in a development of horizontal wells, and sand management is best achieved when the sand production mechanisms are understood. Commonly there are two manners for approaching the sand production problem, the first one is prevention and the second one is reduction. In the first case, after identifying a sanding risk, the wells completion must include the use of sand control technologies that may prevent the onset of sand (Ohita et al., 2007). The second case, if the problem could not be predicted at the initial development, is to look for options that reduce the production of sand.

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In brief, the prime goal of this study is to analyze the produced sand that can be obtained from the well based on criteria. In depth, the author intended to investigate the available sand prevention techniques that could be used to prevent the sand from production proposing a suitable sand prevention method that can prevent the sand generating inside the well.

## 2. Materials and Methods

### Chemicals and Equipment

Four types of sand varied in mass for different well are taken from the laboratory. Their mass are represented respectively as 431.981 g, 26.497 g, 23.6 g and 12.6 g. The sieve investigation is an awesome quality control and quality acknowledgment apparatus. The examples are gauged and set at the highest point of a heap of sieves with continuously littler work size. Mechanical assembly is vibrated to isolate grains-littler ones to go through the sieves, the particles littler than the littlest sieve are gathered in a dish and weight of test held by each sieve is estimated and aggregate weight percent is plotted on a semi-log plot.

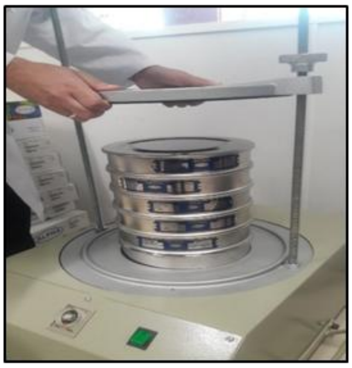

**Figure 1:** Sieve Shaker

**Table 1:**Sieve Weights and Mesh Sizes

| Sieve [µm] | Sieve weight (g) |
|---|---|
| 2000 | 406 |
| 1000 | 342.175 |
| 500 | 306.994 |
| 250 | 287.899 |
| 125 | 270.272 |
| 63 | 273.942 |
| Pan | 270 |

The proposed process is described graphically in Figure (2). The flow chart explains the principle working of sieve analysis device, by showing each step of how it is working.

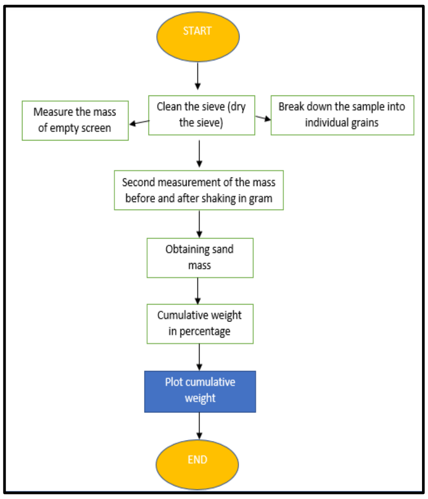


**Figure 2:** Research Methodology Flow Chart

## 3. Results and Discussion

### Sand Control Sequences in a Completion Well

Sand generating is considered as one of the prime obstacles associated with well completion system. For this concern, utilizing of well completion components can significantly contribute to the management and deprivation of sand generating while maximizing hydrocarbon productivity. According to (Andrews, et al., 2015), the initial step in sand control is to make sure about the formation stability issues. In case the stability criterion is achieved, then the sand management procedure can be adopted. Otherwise, the process of completion should go for further stimulation of the formation.

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According to(Fattahpour, et al., 2016), and (Mahmoudi & Roostaei, 2016), the sand management procedure can be generally classified into either two ways as it is done by implementing a completion system, which will monitor and control the flow rate or in other way, it will allow the sand to come in production and then disposed. Using Gravel pack or maintaining the flow velocity below critical point can be the most effective strategy of sand exclusions in a well. Although formation solids are not always sand, in the petroleum industry, the production of any solids from a well is generally called sand production. It is not often anticipated that, produced solids can accumulate in the well or in subsea or surface flow lines, destroy a downhole pump, or erode various well hardware including slotted liners or screens, gas-lift valves, the surface choke, or any bends in surface pipe.

**Sieving Analysis**

Four sorts of sand tests with various mass size were burdened an advanced gauge balance. The example materials arranged for the test were then set in a sieve shaker with openings in the diminishing request of sieve size. Sieves of sizes 2000, 1000, 500, 250, 125, 36 microns and a no sieve dish were utilized to test the sand. Granular particles are amassed on various sieves, which give the molecule size appropriation of the examples. It is expected that no misfortunes were caused during the entire run of the analysis for example the entirety of the loads of the totals collected on singular sieves give the all out weight of the example taken. As a rule, a littler example will give a progressively exact investigation. Be careful, in any case, that the more you split, the more prominent the possibility of blunder. Testing sieves are a go or no go check; if the example is too huge it won't allow every one of the particles a chance to introduce themselves to the screen surface. Frequently the constraining component for lessening the example size is the exactness of the gauging gadget used to decide the measure of material held on the sieve. The accompanying Equations are utilized in estimation so as to pick up consistency in the units for better correlation:

$$\Phi = \frac{\log 10\ d}{\log 10\ 2}$$

Where,

Φ =called Φ unit, dimensionless

d = diameter of the sieve opening, mm

The weight of the material on the sieve can be calculated using the equation:

$$\mathbf{W_m = W_{ms} - W_s}$$

Where,

$W_m$ = weight of material on the sie ve, gm

W ms = weight of sieve and material, gm

W s = weight of the sieve, gm

The percent weight retained on each sieve can also be given by the equation:

$$\boldsymbol{W}rs = \frac{\boldsymbol{W}mr}{\mathbf{W}m}$$

Where,

W rs = percent weight retained on each sieve, %

W mr = weight of material retained, gm

W m = total weight of material, gm

**Tiffin criteria**

Percentage fines content where fines are those that can pass through 44 microns gravel particles pore size:

- $S_C$<10, use standalone screen

- $U_C$<3 and fines <2% use wire wrapped screen
- 3<$U_C < 5$ and 2% fines <5%, use mesh screen
- $S_C$>10 or $S_C > 5$ or fine >5%, use gravel pack, can utilize the slotted liner.

Uniformity coefficient

$U_C$=$D_{40}/D_{90}$

Sorting coefficient

$S_C = D_{10}/D_{95}$

Fine particles

%fine ($< 44\mu m$)

**Sieving Analysis for Well One**

For a 431.981 g of sand, the sieve analysis for well one is shown in Table (2).

**Table 2:** Sieve Analysis for well one

| Sieve [μm] | Φ unit (dimensionless) | Sieve weight (g) | Sieve + sand (g) | Weight sand Retained (g) | Percent Weight Retained (%) | Total Percent Weight Retained (%) |
|---|---|---|---|---|---|---|
| **2000** | 1 | 406 | 837.981 | 0 | 0 | 0 |
| **1000** | 0 | 342.175 | 774.981 | 1.927 | 0.446 | 0.446 |
| **500** | 1 | 306.994 | 738.971 | 319.393 | 73.936 | 74.382 |
| **250** | 2 | 287.899 | 719.88 | 104.568 | 24.206 | 98.584 |
| **125** | 3 | 270.272 | 702.253 | 5.288 | 1.224 | 99.808 |
| **63** | 3.988 | 273.942 | 705.253 | 0.524 | 0.121 | 99.936 |
| **Pan** | 0 | 270 | 701.981 | 0.20 | 0.046 | 100 |

The sieving analysis results are utilized for the construction of normal and cumulative distribution curves which are based on weight percent and sieve sizes as can be shown in Figure (2) and Figure (3).

**Figure 3:** Normal Distribution of Sand on various sieves

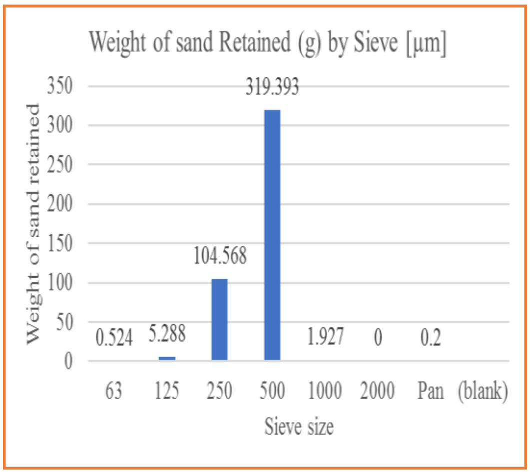
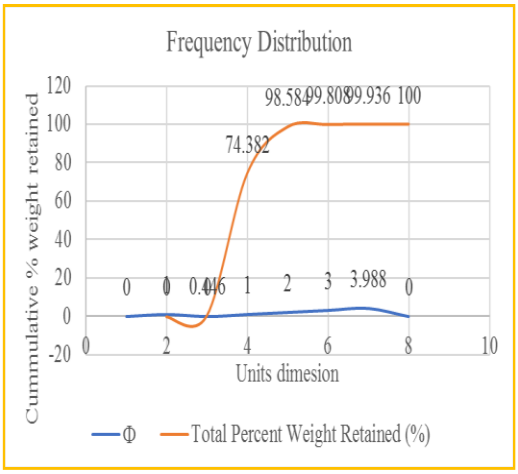



**Figure 4:** Frequency Distribution of Sand on various sieves



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With a swift glance to both graphs, it very well may be demonstrated that greater part of the sand material is held on the 500 size sieve. Along these lines, the particles of this size are named halfway ones. At or more half combined weight, the general level of better particles (perusing on the X - pivot to one side of the bend) is more in this example. This suggests the sand test tends to be suspended in the well culmination and structure a channel cake and keep away from any liquid misfortune into the development.

### Sieving Analysis for Well Two

The amount of sand is reduced to 26.497 g. The sieving analysis is shown in Table (3).

**Table 3:** Sieve Analysis for well Tow

| Sieve [µm] | Φ unit (dimensionless) | Sieve weight (g) | Sieve + sand (g) | Weight sand Retained (g) | Percent Weight Retained (%) | Total Percent Weight Retained (%) |
|---|---|---|---|---|---|---|
| **2000** | 1 | 406 | 432.497 | 5.177 | 19.543 | 19.543 |
| **1000** | 0 | 342.175 | 368.672 | 2.427 | 9.162 | 28.705 |
| **500** | 1 | 306.994 | 333.491 | 1.743 | 6.579 | 35.284 |
| **250** | 2 | 287.899 | 314.396 | 5.813 | 21.944 | 57.228 |
| **125** | 3 | 270.272 | 296.741 | 6.758 | 26.511 | 83.739 |
| **63** | 3.988 | 273.942 | 300.439 | 3.179 | 12.00 | 95.73 |
| **Pan** | 0 | 270 | 296.497 | 1.066 | 4.025 | 100 |

The normal and frequency distribution curves of the sand sample are shown in Figure (5) and Figure (6).

**Figure 5:** Normal Distribution of Sand on various sieves

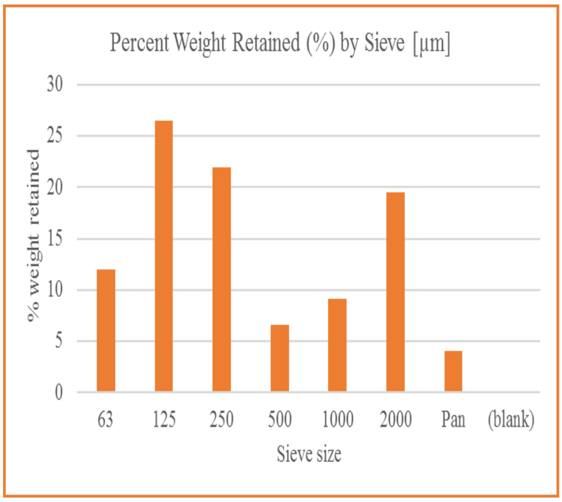
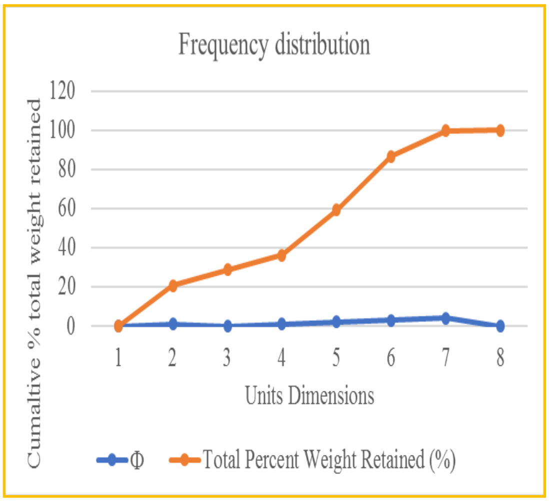



**Figure 6:** Frequency Distribution of Sand on various sieves



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The graphs show that the percentage of sand accumulated on the 125 micron is the highest, which indicates that the sample consists of fine particles. From the frequency distribution curve of sand sample in well two analysis, at and above 50% cumulative weight, the relative percentage of finer particles is the highest. The author suggests that the size of sand particles at this level can be treated as a possible ingredient in a newly devised drilling fluid, which will help maintaining a firm mud cake to prevent invasion of the mud into the formation.

### Sieving Analysis for Well Three

For third sample type of sand, the result analysis varies significantly from the type 1 and type 2 samples of sand. The sieving analysis for this type 3 of sand with mas of 23.6 g is shown in Table (4).

**Table 4:** Sieve Analysis for well Three

| Sieve [µm] | Φ unit (dimensionless) | Sieve weight (g) | Sieve + sand (g) | Weight sand Retained (g) | Percent Weight Retained (%) | Total Percent Weight Retained (%) |
|---|---|---|---|---|---|---|
| **2000** | 1 | 406 | 429.6 | 7.481 | 31.699 | 31.699 |
| **1000** | 0 | 342.175 | 365.775 | 5.101 | 21.6144 | 53.313 |
| **500** | 1 | 306.994 | 330.594 | 2.649 | 11.23 | 64.543 |
| **250** | 2 | 287.899 | 311.489 | 2.962 | 12.56 | 77.103 |
| **125** | 3 | 270.272 | 293.872 | 2.224 | 9.424 | 86.527 |
| **63** | 3.988 | 273.942 | 297.542 | 1.645 | 6.98 | 95.73 |
| **Pan** | 0 | 270 | 293.6 | 0.947 | 4.0127 | 100 |

The data used in the construction of the normal and frequency curves. The results showed that the highest percentage of weight retained was on the 2000-micron sieve.

**Figure 6:** Normal Distribution of Sand on various sieves

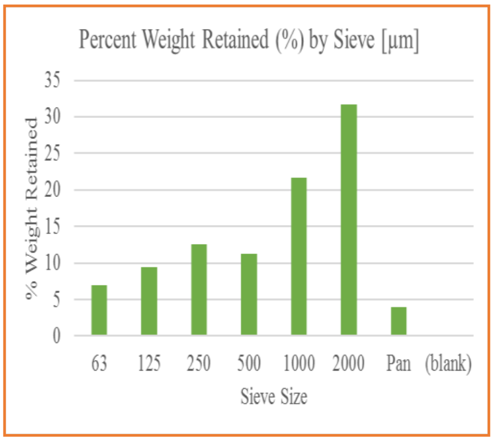
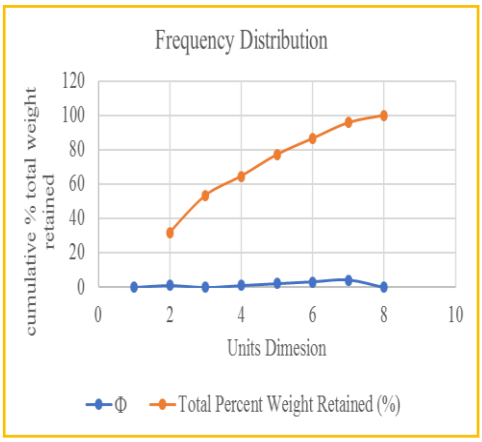



**Figure 7:** Frequency Distribution of Sand on various sieves



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From the graphs, the results indicates that maximum of the particles of the sand type 3 sample belong to the large category of particle size classification. This type of sand may assist in formation of mud cake and then lead to stability problems in well completion system.

**Sieving Analysis for Well Four**

For the last type of sand with a mass of 12.6 g, the sieving analysis is shown in Table (5).

**Table 5:** Sieve Analysis for well Four

| Sieve [µm] | Φ unit (dimensionless) | Sieve weight (g) | Sieve + sand (g) | Weight sand Retained (g) | Percent Weight Retained (%) | Total Percent Weight Retained (%) |
|---|---|---|---|---|---|---|
| **2000** | 1 | 406 | 418.6 | 4.413 | 35.023 | 35.023 |
| **1000** | 0 | 342.175 | 354.775 | 1.659 | 13.166 | 48.189 |
| **500** | 1 | 306.994 | 319.594 | 1.481 | 11.754 | 59.943 |
| **250** | 2 | 287.899 | 300.499 | 0.567 | 4.50 | 64.45 |
| **125** | 3 | 270.272 | 282.872 | 1.123 | 8.912 | 73.355 |
| **63** | 3.988 | 273.942 | 286.542 | 0.552 | 4.381 | 77.736 |
| **Pan** | 0 | 270 | 282.6 | 0.507 | 4.024 | 81.76 |

The results is expressed graphically in Figure (8) and Figure (9).

**Figure 8:** Normal Distribution of Sand on various sieves

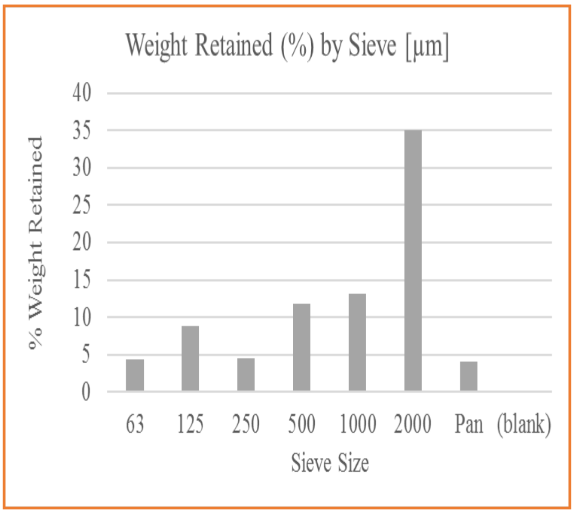
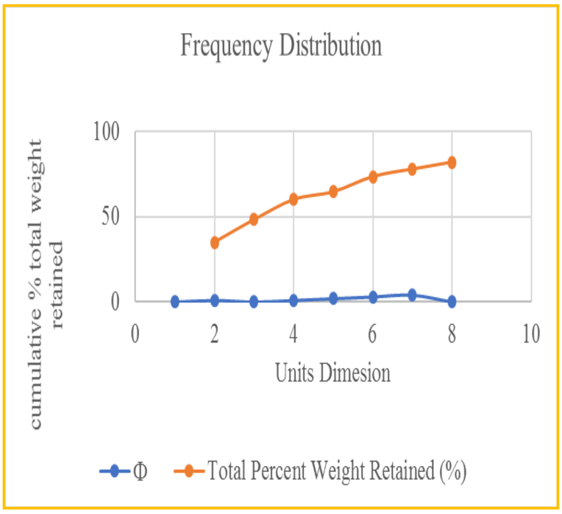



**Figure 9:** Frequency Distribution of Sand on various sieves




From the normal distribution curve of the type four sand sample, the highest percentage of weight retained was on the 2000-micron sieve, which indicates that particle size is large. Similar to type three sand sample, this type of sand may assist in formation of mud cake and then lead to stability problems in well completion system.The frequency distribution curve in Figure (9) of the fourth type sample shows that at and above 50% cumulative weight, the sample consists of finer

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particles that imply that the sand sample used as an additive in the new drilling fluid.

**Choosing the Well Completion Method for Four Wells Using Tiffin Criteria**

To choose the best well completion method, it is an essential to apply Tiffin Criteria for the four well. The sand analysis for well one and well two are shown in the following figures.

**Figure 10:** Sand Analysis for Well One

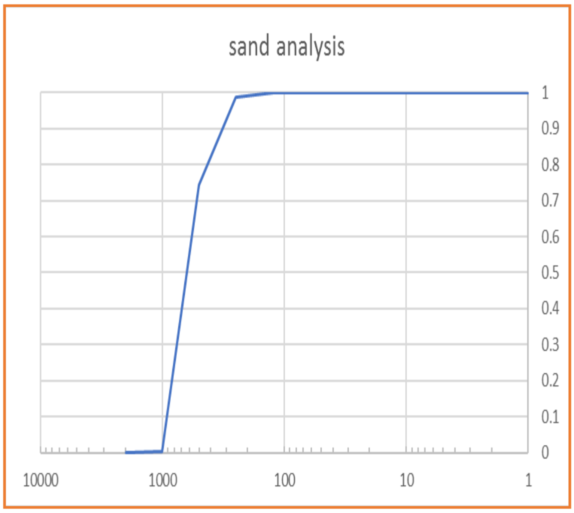
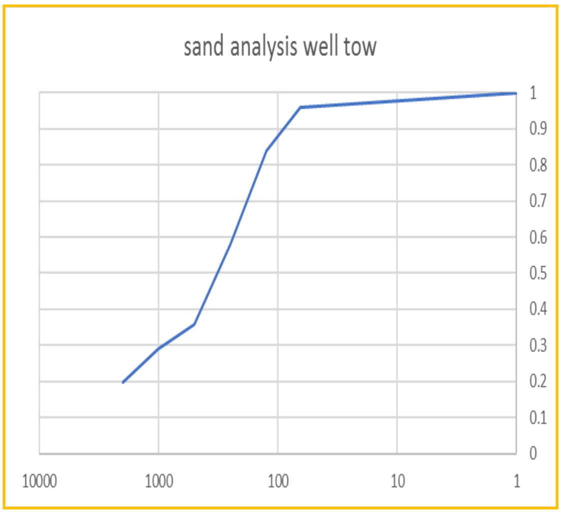



**Figure 11:** Sand Analysis for Well Two




Applying Tiffin Criteria

**For Well One:**

Uniformity coefficient

$U_C = D_{40}/D_{90}$

= 600/300 = 2

Sorting coefficient

$S_C = D_{10}/D_{95}$

=800/270= 2.96

Fine particles

%fine $(< 44\mu m)$

@$44\mu m$ =0%

**For Well Two:**

Uniformity coefficient

$U_C = D_{40}/D_{90}$

= 400/90 =4.4

Sorting coefficient

$S_C = D_{10}/D_{95}$

600/90 = 6.66

Fine particles

%fine $(< 44\mu m)$

1-0.8=0.2 * 100 = 20%

Based on tiffin criteria the well one can use standalone screen or wire-wrapped screen. While, the well two must use mesh screen.

For well three and well four, the sand analysis is shown in Figure (12) and Figure (13).

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**Figure 10:** Sand Analysis for Well One

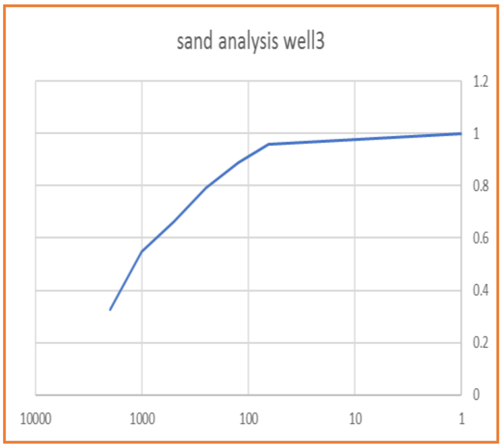
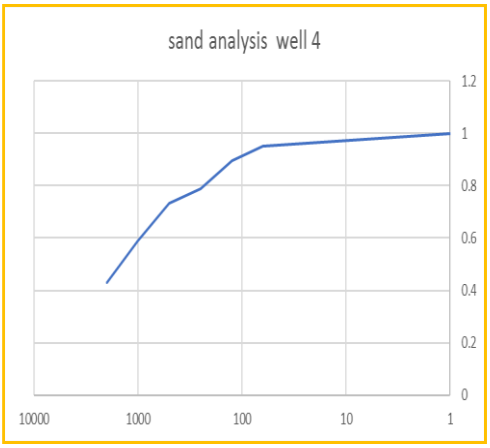



**Figure 11:** Sand Analysis for Well Two




Applying Tiffin Criteria

**For Well Three:**
Uniformity coefficient
$U_C = D_{40}/D_{90}$
=1600/ 120 =13.3
Sorting coefficient
$S_C = D_{10}/D_{95}$
4000/10 =400
Fine particles
%fine ($< 44\mu m$)
1-0.95=0.05*100=5%

**For Well Four:**
Uniformity coefficient
$U_C = D_{40}/D_{90}$
2200/140 =15
Sorting coefficient
$S_C = D_{10}/D_{95}$
5000/140=35.7
Fine particles
%fine ($< 44\mu m$)
1-0.96=0.04*100=4%

Based on tiffin criteria, it is suggested to use gravel pack for well three and well four that can utilize slotted liner since these types of sand are non-uniform sand.

## 4. Conclusion

The study showed the resultant outcome on the construction of normal and cumulative distribution curves which are based on weight percent and sieve sizes. Sieves of sizes 2000, 1000, 500, 250, 125, 36 microns and a no sieve pan were used to sample the sand. For sand type one sieving analysis, it can be inferred from the bar diagram that majority of the sand material is retained on the 500 size sieve. Therefore, the particles of this size are classified as intermediate ones. For the second sample, the results showed that the percentage of sand accumulated on the 125 micron is the highest, which indicates that the sample consists of fine particles. Further, the highest percent weight retained of this sample is reported at mesh size of 125 micron. For sample three and four, the results indicates that maximum of the particles of the sand sample belong to the large category of particle size classification. This type of sand may assist in formation of mud cake and then lead to stability problems in well completion system. This can be justified as the highest percent weight retained of both samples are reported at the larger micron size mesh particularly at 2000 and 1000 micron mesh sizes. in a nutshell, the best normal and frequency

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distributions are determined in the second sample of sand. Hence, this sample is illustrated of not causing a critical threat in well completion and drilling industries. When analysing the sand samples based on tiffin Criteria, the results elaborated that well one can use standalone screen or wire-wrapped screen and for the well two must use mesh screen. While for well three and well four, it is suggested to use gravel pack that can utilize slotted liner since these types of sand are non-uniform sand.

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