International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 05
April 2017

# Determination of Spontaneous Potential of Borewell

[1]Akash K S, [1]Anandhu Mohan, [1]Nikhil Krishna, [1]Sachin, [2]*Rajesh Kanna,

[1]Undergraduate student, Department of Petroleum Engineering, Lords Institute of Engineering, Hyderabad, Telangana
[2]Professor & Head, Department of Petroleum Engineering, Lords Institute of Engineering, Hyderabad, Telangana
* Corresponding author email: rajeshkanna@lords.ac.in

***ABSTRACT: -*** *The purpose of this experiment is to study the potential differentiation characteristics of an open well in the state of Telangana, India. This determination will be accomplished by using an electrical resistivity meter. The potential of borewell surface varies with depth at different areas; by finding out the potential difference using electric resistivity meter we can f ind out the nature of formation evaluation of soil.*

.

***Keywords: -*** *Probes,Winches,Consolidated Rocks,Capillary Soil, Shale*

## 1. INTRODUCTION

### 1.1 Spontaneous potential:

Spontaneous potential (SP), also called self-potential, is a naturally occurring electric potential difference in the Earth, measured by an electrode relative to a fixed reference electrode. Spontaneous potentials are often measured down boreholes for formation evaluation in the oil and gas industry, and they can also be measured along the Earth's surface for mineral exploration or groundwater investigation. The phenomenon and its application to geology was first recognized by Conrad Schlumberger, Marcel Schlumberger, and E.G. Leonardon in 1931, and the first published examples were from Romanian oil fields.

Spontaneous potentials (SP) are usually caused by charge separation in clay or other minerals, due to presence of semi-permeable interface impeding the diffusion of ions through the pore space of rocks, or by natural flow of a conducting fluid through the rocks.

The most useful SP component is the electrochemical potential, since it can cause a significant deflection opposite permeable beds. The magnitude of the deflection depends mainly on the salinity contrast between borehole and formation fluid, and the clay content of the permeable bed. The SP log is therefore useful in detecting permeable beds and to estimate formation water salinity and formation clay content. Due to the nature of the electric current, SP can only be recorded in conductive mud. [3]

### 1.2. Spontaneous Potential Log

The spontaneous potential log, commonly called the self-potential log or SP log, is a passive measurement taken by oil

industry well loggers to characterise rock formation properties. The log works by measuring small electric potentials (measured in millivolts) between depths in the borehole and a grounded electrode at the surface.

Conductive bore hole fluids are necessary to create a SP response, so the SP log cannot be used in nonconductive drilling muds (e.g. oil-based mud) or air filled holes. [2] The change in voltage through the well bore is caused by a buildup of charge on the well bore walls. Clays and shales (which are composed predominantly of clays) will generate one charge and permeable formations such as sandstone will generate an opposite one. Spontaneous potentials occur when two aqueous solutions with different gionic concentrations are placed in contact through a porous, semi-permeable membrane. In nature, ions tend to migrate from high to low ionic concentrations. In the case of SP logging, the two aqueous solutions are the well bore fluid (drilling mud) and the formation water (connate water). The potential opposite shales is called the baseline, and typically shifts only slowly over the depth of the borehole.

The relative salinity of the mud and the formation water will determine the way the SP curve will deflect opposite a permeable formation. Generally if the ionic concentration of the well bore fluid is less than the formation fluid then the SP reading will be more negative (usually plotted as a deflection to the left). If the formation fluid has an ionic concentration less than the well bore fluid, the voltage deflection will be positive (usually plotted as an excursion to the right). The amplitudes of the line made by the changing SP will vary from formation to formation and will not give a definitive answer to how permeable or the porosity of the formation that it is logging. The presence of hydrocarbons (e.g. oil, natural gas, and condensate) will reduce the response on an SP log because the interstitial water contact with the well bore fluid is reduced. [3]

## 2. EQUIPMENT USED

Fig 1. Electrical Resistivity Meter along with Winches and Probes.

### *2.1 Electrical resistivity meter*

Electrical resistivity meter is a device used for geophysical exploration methods. The basic parts of resistivity measurement system includes a source of electrical current,a voltage measuring system and cables to connect these components to the electrodes

International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 05
April 2017

*Fig 2.Electrical resistivity meter*

*2.2 Winches*

*Fig.3 Winch*

A Winch is a mechanical device used to pull in or let out or adjust the tension of a wire or a rope in its simplest form it consist of a spool and attached hand crank.

2.3 *Probes*

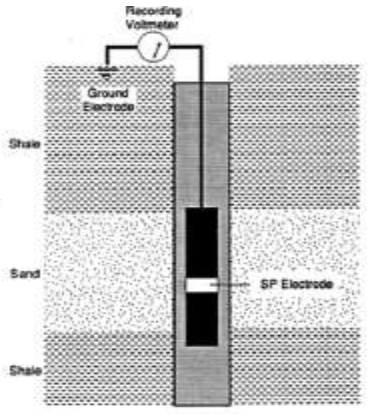
It is usually an iron rod with a pointed metal tip for making electrical contact with a circuit element being checked. In SP Logging we use a ground probe and a surface probe inorder to check the potential difference.

*Fig.3 Probe*

## 3. EXPERIMENTAL PROCEDURE

Set up the configuration for well logging properly. One probe of voltmeter is placed 4-5m away from borewell surface. Second probe is dipped into the borewell by connecting it with winches.

Make sure the probe touches the inner surface of borewell. Potential readings are shown in the resistivity meter when it touches the surface. The potential value at ground level is null. Take the potential readings for each 2m depth in millivolts. Respective potential values are measured according to the depth.



International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 05
April 2017

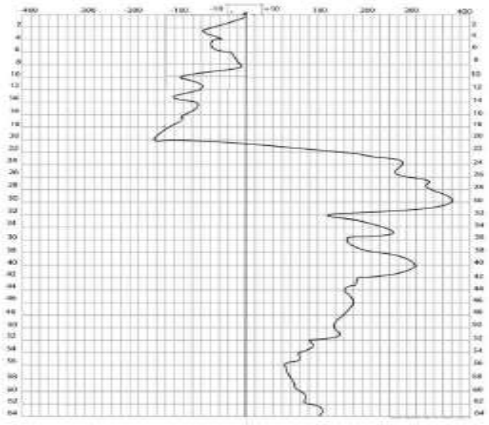
*Fig.4 SP Log Configuration*

## 4. OBSERVATION

**Table 1. SP log readings**

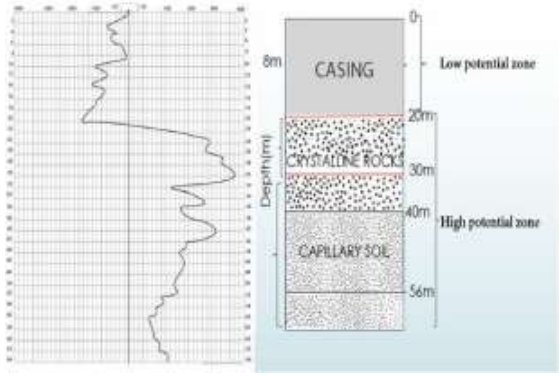
| Depth(m) | Voltage(mV) |
|---|---|
| 2 | -80 |
| 4 | -20 |
| 6 | -30 |
| 8 | -10 |
| 10 | -100 |
| 12 | -80 |
| 14 | -90 |
| 16 | -50 |
| 18 | -70 |
| 20 | -100 |
| 22 | 260 |
| 24 | 280 |
| 26 | 301 |
| 28 | 322 |
| 30 | 333 |
| 32 | 398 |
| 34 | 100 |
| 36 | 211 |
| 38 | 155 |
| 40 | 316 |
| 42 | 318 |
| 44 | 212 |
| 46 | 111 |
| 48 | 155 |
| 50 | 160 |
| 52 | 144 |
| 54 | 132 |
| 56 | 123 |
| 58 | 115 |
| 60 | 130 |
| 62 | 144 |
| 64 | 127 |
| 66 | 138 |
| 68 | 140 |

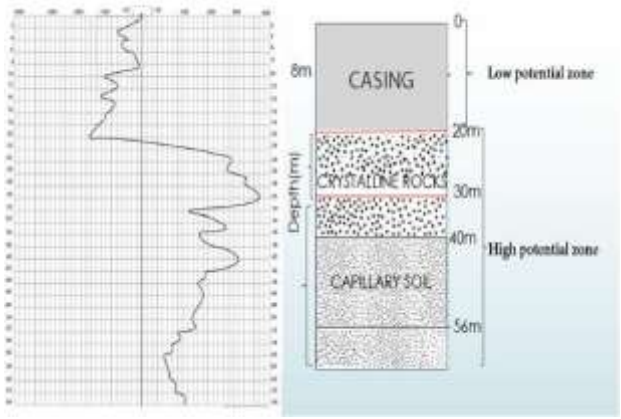
## 5. GRAPHICAL INTERPOLATION



The graph shows graphical representation of potential vs depth. X axis shows the spontaneous potential in millivolts. Y axis shows depth in metres. Graph shows the relation between potential vs the depth of bore well. It gives the details of formation evaluation in the bore well.

## 6. CORRELATION




### *5.1 Observation*

From the above graph the observed dry well is having low potential values at initial depths.

On reaching 8m low potential takes a deflection. From 14m onwards low potential value gradually increases till 20m. From 20m graph takes a huge deflection to high potential values
Potential values take a decrease at 30m but remains in positive zone. On reaching 36m potential increases but falls after it. Ongoing down the potential values become less but remains in high potential zone.

### *5.2 Assumption*

Initial potential readings are in low potential zone, so there may be presence of mud and the surface is saturated and highly conductive.
In high potential zones, there may be presence of hard bedrocks, consolidated rocks without saturation.

## 6. CONCLUSION

It is concluded that the dry well observed in L.I.E.T may have the presence of Consolidated, crystalline rocks without saturation.

***REFERENCES***

*[1]https://en.wikipedia.org/wiki/spontaneouspotential*

.

*[2] Fakhry A. Assaad (26 September 2008). Field Methods for Petroleum Geologists: A Guide to Computerized Lithostratigraphic Correlation Charts Case Study: Northern Africa. Springer Science & Business Media. pp. 45 ISBN 978-3-540-78837-9. Specific log types such as SP, resistivity, porosity, and gamma ray logs are discussed in detail by Asquith and Gibson (1982). ... A spontaneous potential log is a record of direct current (DC) voltage differences between the naturally occurring...*

*[3] The Australian Drilling (10 June 1997). Drilling: The Manual of Methods, Applications, and Management. CRC Press. pp. 1363–. ISBN 978-1-56670-242-3.*