

Hydrogeological analysis of abandon hydrocarbon wells

Faizan-ur-Rehman Qaiser, Syed Tallataf Hussain and Nangyal Ghani Khan
COMSATS Institute of Information Technology Abbottabad

A new method for hydro geological analysis of hydrocarbon well is done in this project. There are many hydrocarbon wells drilled all over the world and ratio of success to failure is 3:10. It means, only 30% of them turn over to a successful production and rest the rest are plugged and abandoned. Among these abandon well most of them are located in such places where the major problem is water. If these well are used as water wells then it will be very effective for the local peoples. But either this water which comes to the surface from a formation which is proved to be a good reservoir is sufficient enough to use for drinking or agricultural purposes. For this purpose one should know the amount of Total Dissolved Solvents (TDS) (mg/l) in the water.

Spontaneous Potential Log and Deep Resistivity Log are used to find the resistivity of formation water and formation water saturation. The resistivity of formation water at formation temperature is calculated by using Bateman & Konen formula of calculating R_w at formation temperature.

$$R_w \text{ at formation temperature} = R_w \text{ at } 75^\circ \times 81.77 / (T_f + 6.77)$$

This resistivity is then converted into conductivity and used in a formula to convert into TDS (mg/l).

$$\text{TDS (mg/l)} = \text{Conductivity } \mu\text{S/cm} \times 0.67$$

It is found that the formation water has a TDS in the range of 400mg/l which is suitable for drinking purposes to 1800mg/l which is suitable for agricultural purposes. Now the next step is that whether the formation have sufficient amount of water present in it or not. So formation water saturation is found from Archie (1942) formula.

$$S_w = [(a/\phi^m) \times (R_w/R_t)]^{1/n}$$

From here it is clear that in many abandon hydrocarbon wells, formation water is present in huge amount and at high pressure. According to geology in an average reservoir one third of the pore is filled with hydrocarbon and remaining is with water. If no hydrocarbon is found there then the whole pore is filled with water. As the well is drilled to 2000m to 3000m then due to the over burden pressure, naturally water come to the surface by its self.

This whole theme is applied on Dhamraki-01 with the help of well data and seismic reflection survey analysis. Following assumption has been made: Dhamraki-01 is a dry well and its current status is P&A (plug and abandon). It has four different layers of sandstone which are alternatively separated by impervious layers of shale and all of these sandstones are completely sandwich between Upper shale of Goru formation and Talhar shale from bottom. This will act as confined aquifer. By using above discussed method in Dhamraki-01 well TDS (mg/l) is found to be in the range of 400mg/l to 1800mg/l.

This TDS of formation water lies in the range of drinking and for agriculture purposes. The chances of presence of carcinogenic compounds in sand are very low, and in shale and clay are high. If volume of shale in this formation increases than chances of carcinogenic compounds will increase in this formation water, but it has been found that this formation has very low values of volume of shale which is 15% to 20% so carcinogenic compound may not be presence. For further detail it can be found by the help of core sample analysis of Goru Sand.

So if these plugged well are reopen just for public use than the huge amount of money which have been spent on this abandon well would not be completely lost.