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Prevention of the Factors Affecting Electrical Conductivity of Conducting Material with Use in Chemically Hostile Environment

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Abstract: A steel armored cable connects the downhole electronic equipment present in the well with a surface panel which provides power and different electrical commands during wireline logging operations. This steel armored cable gets corroded by the chemicals and hydrogen sulfide gas present in the well. After corrosion, the chemical reaches the insulation of the cable and starts degrading it. After corrosion and degradation, there is a failure in the conduction electrical signals and electrical power. Failure in the conduction of electrical signals and electrical power supply affects the wireline logging operations. To prevent corrosion and degradation the cable must be washed. Sometimes washing of cable is prohibited at the well site because of water falling into the well and changes the chemical properties of the chemical present in the well. A technique is adopted in which water is used for washing the cable and same water is also prevented from falling into the well.

Keywords*:* Borehole drilling, well logging, chemical washing, protection of instruments.

Introduction

Wireline logging operation consists of a surface panel, down hole electronic equipment and a steel armored cable (Fig. 1). The cable and down hole electronic equipment is present in the well during logging operations. This cable is affected by different chemicals present in the well. During the drilling of a well, different chemicals are added to mud to acquire the desired chemical composition such as the weight of the mud, specific thickness of the mud, specific gravity of the mud. This chemical based mud is present in the well all the time and is circulated to bring the formation cutting to the surface for geological analysis. Circulation of the mud also keeps the drilling bit cool (Geehan and Mckee, 1989).The oil and gas present in the down hole geological formation have a very high pressure and it tries to come out of the well. Once it comes out, it is uncontrollable and is called blowout. To prevent blowout there must be some weight or pressure on the oil and gas that must be greater than the oil and gas pressure. Mud weight creates a pressure on the oil and gas. One factor causing blowout is the loss of mud into the formation. As mud has its weight and if the mud is lost in the porous formation and carvings then the overall weight of the mud will be less than the pressure of the oil and gas in the well. If the pressure of oil and gas in the well is greater than the weight of the mud then it will come out of the well and cause blowout. Some formations have pores and carvings in it. The mud gets lost in the pores and the carvings. Bentonite is added in mud to acquire a thick jell. This jell fills the pores in the porous formation of oil exploration well and also forms a mud cake on the wall of the well to cover carvings. Once the pores are filled with jell and carvings are covered then the mud will remain in the well (Layman's Guide, 2017). Another factor may also cause blowout is the lack of weighting agent in the mud. During drilling into the zone where oil and gas are present, the pressure of the oil and gas of the well tries to push oil and gas to come out of the well. As the drilling reaches the oil and gas zone, the downhole pressure automatically increases. Mud engineers present at the well site monitor the downhole pressure. If it is greater than the mud weight then he must add some weighting agent in the mud to increase the mud weight. Signs of blowout are constantly monitored by mud engineers. Salt and barite are added to increase the weight of the mud and the downhole pressure increases (Tarr and Flak, 1992). The cable used for logging operations is a steel armored cable. The chemicals added to mud causes corrosion on the surface of the steel armor of the cable (Banbin and Sarian, 2015*)*.These chemicals in the mud affect the cable, which is used for logging operations. These chemicals first corrode the armor of the cable then it degrades the insulation of the cable (Fernandes, 2014) (Fig. 2). There is hydrogen sulfide gas also present in the well, which also corrodes the steel armor. Once the armor is destroyed then the hydrogen sulfide gas and other chemicals start degrading the insulation of the cable (Quality wireline and Cable In., 2008) (Fig. 3). To avoid corrosion of the armor of the cable and degradation of the insulation of the cable, the cable must be washed after every logging operation. Cable washer is used to wash the cable. Cable washer is a tube having a diameter little bit larger than the diameter of the cable. The cable passes through the cable washer. There are

water injection nozzles which allow the pressurised water to wash the cable (Fig. 4). There is a problem that sometime washing of cable is prohibited as the water fell into the well and changes the chemical properties of the chemicals based mud. This change in chemical properties causes the loss of liquid of the well into the carvings in the well.

Different companies have different methods to wash the cable (Alden et al., 2004). A cable brush cleaner is also used by some companies to clean the cable surface after logging operations. Cable auto spray oiling system is another tool used to lubricate the cable after logging operation. Some other oiling systems are used to lubricate and wash the cable to avoid corrosion and degradation, which cause failure in the conduction of electrical signals (Borehole Research Group, 2002). A well-known company has a cable washer which is sealed compartment through which the cable passes. In this compartment, they wash and lubricate the cable. A high-pressure water motor is attached to the compartment. There is an outlet from where the water is sucked by another motor. After washing another motor pumps oil to lubricate the wire clean and lubricated wire comes out of this compartment (Borehole Research Group, 2002; Forum Energy Technologies, 2010). The problem in the simple cable washer is that the cable is washed but the water fell into the well as there is no control to keep water away from the well. This water in the well changes the chemical properties of the chemicals based mud causing the loss of liquid of the well into the carvings in the well and also decreasing the weight of the mud (Abduo et al., 2015) (Fig. 5). In the present investigation we practice two units; with washing and without washing. Both units were used for the same number of analysis. After the specified time the physical condition of both units were compared. After the comparison the conclusion has been made that what is the effect of the washing on the performance and physical condition of the unit.

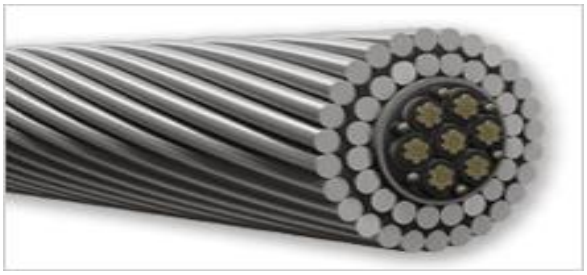

Fig. 1 Wireline logging cable with steel armor around it.

Fig. 2 Steel armor destroyed by chemicals and gas in the well.

Fig. 3 Steel armor destroyed by the chemicals and gas in the well

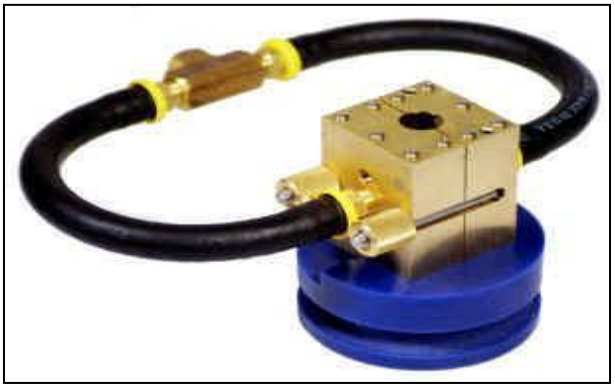

Fig. 4 Simple cable cleaner.

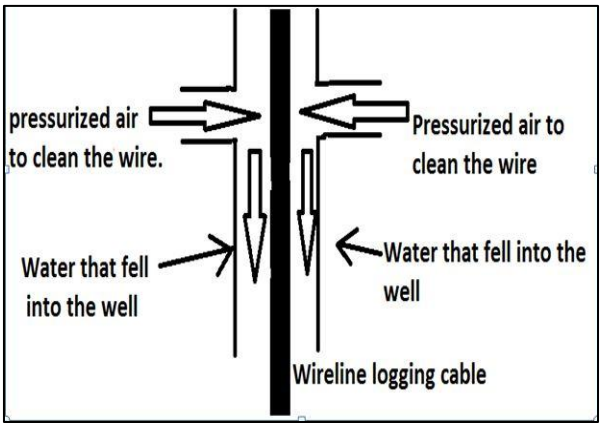

Fig. 5 Simple cable cleaner in which water cannot be prevented from falling in the well.

Materials and Methods

Cable washing at the well site is tired by a disc having a hole in between it. The disc is to fit into the well hole. After the passage of electronic devices and cable through the disc, a rubber having a special shape is placed on the disc hole. The rubber is not fixed in the disc (Fig. 6). By this pressurised water was used to wash the cable and the rubber keeps the water away from the well. While pulling the cable out of the well the rubber was always found displaced from its required position. That's why this technique is failed (Fig.7). Washing of the cable is very important to increase the life after pulling the cable out of the well. The logging cable is very expensive. The cost of the

cable is $25,000. If we manage to increase the life of the cable then we can save the revenue. One more problem is that there are few companies selling such cables. If our cable fails on the well site so it is a big problem to contact such company and place an order. All other companies providing wireline logging operation services manufacture their own equipment and cables. To keep the business in their hand they do not sell their equipment and cable to other companies.

We have adopted a technique with the help of our department and are still in use in which the same simple cable washer is modified (Fig. 8). Right below the water injection nozzles air injection nozzles are introduced. This allows very high pressurised air to flow through the air nozzles and throw the water upward. The water thrown upward is collected in a tray and with the help of a channel in the tray the water is taken away from the well (Fig. 9). By this technique, cable is washed and water is kept away from falling into the well. After washing, when the cable is spooled on the cable which is lubricated. By this technique, our goal is achieved by washing the cable and keeping water away from the well. Washing the cable helps to double the life of the cable.

Fig. 6 Disc with a rubber tried to wash the cable and keeping water away from the well.

Fig. 7 Disc with a rubber tried to wash the cable and keeping water away from the well.

Fig. 8 A modified cable washer to wash the cable by introducing air injection nozzles.

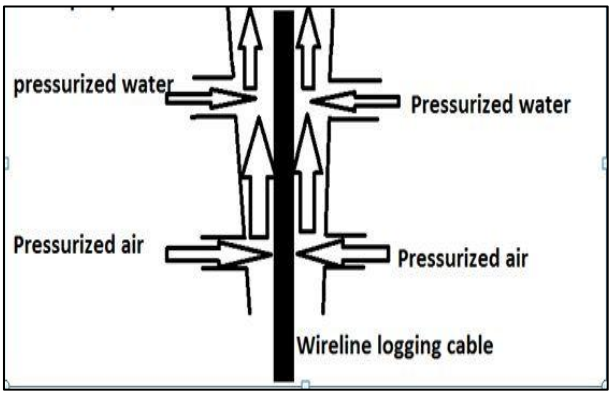

Fig. 9 A modified cable washer to wash the cable by introducing air injection nozzles.

Results and Discussion

Two logging units were used to check whether washing of cable increases the life of the cable or not? Both of the units were having a new spool of wireline logging cables. Both of the logging units had same number of logging operations. One logging unit had cable washing facility with modified cable washer in which water was used to wash the cable and water was kept away from the well with the help of air injection nozzles and a channel to keep water away from the well. The other unit was without cable washing facility as it was a normal practice. After every six months, the condition of the wireline logging cable used for logging operation at different wells was evaluated.

It was found that the cable used for logging operation without washing was getting damaged more rapidly as compared to the cable which was washed with water.

In 2011 both logging units had new cable spools for logging operations. So both of the cables were graded 10 out of 10.

In 2012, both cables were checked and it was found that the cable which was washed after logging operations was in much better condition than the cable which was not washed after logging operations.

Washed cable was graded 7.5 out of 10 and unwashed cable after logging operation was graded 5 out of 10. In 2013 the cable which was not washed after logging operation was graded 1 out of 10 and was changed because it was completely damaged. The cable which was washed after logging operations was graded 5 out of 10. In 2014 the cable which was washed after logging operation was graded 3 out of 10. In 2015 the cable which was washed after logging operation was graded 2 out of 10 and now it was damaged and replaced.

Conclusion

The life of very expensive cable can be increased by washing the cable after every logging operation. Different companies have different techniques to wash their cables. For this purpose, different companies were consulted. Many of them refused to sell their equipment. A company agreed to sell the cable washer and demanded an amount of $ 5, 000. Instead of paying the amount of $ 5, 000, the existing simple cable washer was modified which gave the required results. The modification cost of existing cable washer was not more than $10. Hence, an amount of $ 4, 990 was saved by this method. We have 3 logging units in operational condition. They all have a spool of logging cables. So a total of $14,970 was saved. Every 2 years later the spool of cable has to be replaced by new one if the logging cable is not washed. Each spool costs about $ 250, 000. Hence, for 3 logging units, the cables cost around $ 750, 000 after every 2 years. If the cable is washed then the cost of logging cable will be $ 375, 000 after 2 years.

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