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ABSTRACT

Lost Circulation (LC) remains one of the most severe problems in drilling a Geothermal Well. The costs associated with LC often accounts for over 20% of the total costs of drilling for steam. Many of the conventional materials used in the oil and gas industries have been tried in geothermal wells but have been mostly unsuccessful because of the hostile well bore environment. Temperatures can far exceed the tolerance level of commonly used cellulosic and fibrous materials. Also common in geothermal drilling are the vugular, cavernous zones that are very difficult to seal with the standard wood fibers, etc...

A simple common sense approach to the problem may supersede all of the other exotic cures for LC in geothermal drilling, but only if the proper procedures are followed.

Introduction

So often in the past operators and drillers have not taken the time or the initiative to preplan and premix the LC pills. It has been the practice in the past to vicariously start throwing pallets of LCM down hole at different time intervals with no regard for spotting an effective pill or allowing it the time to set and heal the losses. The run and shoot tactics of trying to catch up to the root of the problem have forced operators to go to very expensive alternatives such as spotting cement pills. The expense incurred here costs hours in mob and demob of cementing units and even more time in waiting on the cement to cure.

What the industry needs is to simply determine a methodology, not just a product, for blanketing large fracture zones. The problem with this theory is how do you blanket or carpet large fractures. Based on past studies and more recent case histories there is a product that when used in conjunction with an array of other pre selected materials can provide an interwoven, fabric-like framework that serves to ‘blanket’ the troublesome theft zone. Another advantage of the rock wool for use in the Geothermal Industry is that it is thermally stable at temperatures up to 1800°F.

In selecting what the other components of the pill should consist of, one must consider several variables.

What is the severity of losses…seepage losses, partial losses or total losses with no returns? If for instance you are drilling with no returns at the flow line and temperatures below 400°F, ground rock wool (30 #/bbl), blended with wood fibers (5#/bbl), cellophane (5#/bbl), etc…would all be good candidates. Boart Longyear version of this type of blend in a 40 # bag is Fabric Seal. Below is Rock Wool blended in smaller concentrations with various other fibers. Plotted in Figure 1 shows that a significant improvement in filtrate loss when adding Rock Wool (RW) with other flakes and particles sizes. Imagine the sealing effect if used in larger quantities.

Figure 1. API test cell results showing the effects of increasing quantities of rock wool with various particle sizes.
2) Predetermine the proper formulation of mineral fiber and other LCM products before mixing pill. Preconditions such as protecting the production zone, temperature issues, drilling with mud motors or steering tools, etc… need to be considered.

3) Determine the number of strokes to LC zone and begin pumping premixed pill directly into the suction line. Having at least one jet removed from a Tricone bit would probably relieve some pump pressure and avoid any possibility of plugging the bit.

4) Begin displacing and spot completed mineral fiber pill @ LC area. Pull pipe above pill or into casing if possible. Let hole set static for an hour or so to allow the fibrous pill to begin matting itself to the matrix of the theft zone. This downtime is critical since oftentimes the fracturing of under pressured formations can be induced by normal drilling operations. The rock wool and other LCM additives will begin weaving its fibers into a carpet like covering thus bridging off the theft zone.

5) Upon circulating returns at flow line, you can by pass shakers and return the pill back to the isolated pill tank for reuse.

Demonstration

- In an attempt to simulate the sealing capabilities of ground rock wool mixed with other fibrous constituents, a simple apparatus consisting of a 4” x 8’ transparent acrylic pipe, 3/8 inch mesh sieve, a CO2 bottle, etc… were assembled. The unit is mounted and set up to receive limited pressure at the top of the apparatus.

- A drilling fluid mixed with Fabric Seal is introduced into the cylinder at the top. It is then sealed and prepared for applying some pressure. Upon pressurization, the filtrate from the fluid is then forced thru a 3/8” sieve placed on the bottom of the apparatus.

- Within minutes the escaping filtrate is completely sealed off. Upon bleeding off the remaining drilling fluid and dismantling the cylinder, a final interwoven cloth like fabric can be removed from the sieve and viewed.

Conclusion

Conquering a Loss Circulation problem in the Geothermal Industry is not only dependent on finding the right product it is about developing the right process. Providing a well thought out set of procedures in conjunction with using the right equipment and picking the right base products are all critical in getting ahead of the game.

References


