Solving Problems & Providing Solutions

FOR FORGE ENERGY

From the perspective of H&J Petroleum

In drilling the surface holes during Forge Energy's San Andres Drilling Campaign, we found ourselves facing Non-Productive Time (NPT) after drilling the surface hole until we reached total depth (TD) and got casing on the bottom. This NPT was typically exacerbated when surface hole drilling took longer than expected, either due to low ROP or some other unexpected event such as a rig repair. NPT related to this formation is quite common with many different types of solutions being offered. When H&J started his project, we also had NPT related to this problematic formation. As we evaluated our experience, we noticed that the longer it took us to get casing to the bottom, the more NPT we experienced. Common suggestions seemed to simply "band-aid" the problem such as adding lease crude to the system or reducing water loss at TD. Industry experts with years of experience told us that the root of this problem lies in the hydroscopic (attraction to water) nature of the clays in the Red Bed formation. This causes the clays to swell, reducing the effective hole size, and ultimately causing mechanical failure of the rock. The most frequent issue we dealt with was the reduction in hole size. Catastrophic failure did not seem to occur except in rare cases where the Red Bed formations were exposed to fresh water over long periods of time. The more typical solutions to this type of problem are to drill with an "inhibitive mud system". These systems work by blocking the chemical reaction caused by the attractive forces due to the difference in polarity of the clays and the water. This is not a typical solution due to the implied cost of building, but more importantly maintaining the system while drilling. The typical volume of cuttings removed from the hole would overwhelm the system with solids unless additional and relatively expensive measures were taken to prevent this from happening. In the absence of such measures, the solution can easily become worse than the original problem.

Problem **Found** & Problem **Solved**

As H&J engineers evaluated this problem, we considered the phenomenon previously described concerning the positive correlation with increase in time the formation is exposed relative to the amount of NPT. In other words, the longer the formation is exposed, the higher the amount of NPT time observed. The surface holes were drilled to the top of the rustler formation with this typically occurring at a depth of 1600' – 1800'. The holes were drilled with a 12 ¼" bit, and 9 5/8" casing was typically run. At the beginning of our program, the average time to drill the holes to this depth was 20 – 24 hours. As we evaluated the NPT time, it was easy to see that reducing the time it took to drill the surface hole had an additional benefit: that of reducing the exposure time the fresh water had with the red beds, thereby reducing the NPT. Next, we spent some time evaluating what was limiting us from drilling faster. We utilized the concepts first learned and now teach on, Mechanical Specific Energy (MSE) and Drilling Dysfunctions. Simply stated, MSE theory says that the ROP is proportional to the amount of energy you put into the bit and the unconfined compressive strength of the rock, as long as you are drilling efficiently (without drilling dysfunctions). While we were drilling on the bottom relatively fast at well over 100' per hour, we also realized that we were drilling in a very low compressive strength formation for most of this hole section. Because of this, we realized there likely was room for significant improvement.