Drilling Fluids, Inc.

KlayCon

New mud systems appear from time to time. Recent advancements in the drilling industry have provided several environmentally friendly fluids that replace oil in oil based muds or chrome in water based muds. These new fluids are typically much more expensive, more difficult to maintain and provide less reliable hole stability. They can only be justified in areas with very stringent discharge limits, such as the North Sea.

A new mud system is being used in the drilling scene in western U.S. It goes by a variety of names, most commonly Acid Mud because of the fact that it is unique among muds in its use of acid as a major ingredient to control pH. Actually, it is no more an Acid Mud than a mud with a salinity of 1000 ppm is a Salt Mud. Rather, it is a polyacrylate (Cypan/DMA) mud, with the pH level controlled at 6.0 to 7.0 by adding a variety of acids to the mud system. Supplemental treatments of GEO's CFR lubricant or a comparable surfactant is also recommended to enhance lubricity and to further minimize clay packing.

GEO's Acid Mud system is called KlayCon and is designed to retard hydration of highly reactive mud-making clays along with helping to stabilize pH and water sensitive shales. The overall mud cost of this system is generally 30% higher than a normal Cypan/DMA mud. However, this increase in costs is more than offset by a reduction in rig time spent on clay related problems such as excessive wiper trips, clay pack off and tight hole. Reduced rig time also results in less mud maintenance as well as all the associated rig costs.

KlayCon is not Oil Based Mud (OBM) and does not have the absolute inhibiting properties of that system, however, it is an economical alternative to achieve a degree of inhibition without adding salt which compromises fluid loss or using OBM which raises the mud costs geometrically on a shallow to moderate depth well (1,000' to 10,000').

There are several questions about any new mud systems that an operator might ask before he is willing to try it.

GEO Drilling Fluids, Inc.
1431 Union Avenue
Bakersfield, CA 93305
1-800-GETSGEO
(661)325-5919
geodf@geodf.com

For more info visit:
geodf.com

GEO
Drilling Fluids, Inc.

1. Will it work to drill the kind of well I am planning? In preparing a mud program for each new drilling project, GEO technicians and admi nistrative experts evaluate the potential drilling problems and cost effectiveness of various mud systems before making recommendations. In many cases KlayCon is recommended. Recaps and well histories of relevant wells are then included in the proposal to substantiate the program recommendations.

2. Will it provide a corrosion or safety concern to the rig, tubular goods, pumps, or crews? Is the mud system hazardous or are any of the components hazardous? KlayCon is not a strong acid. In fact, the following chart shows just how the mildly acidic the 6-7 pH of KlayCon is when compared to some common fluids.

Liquid	pH
Milk	6.7
KlayCon	6.0-7.0
Orange Juice	4.1
RC Cola	2.4

The pH is maintained at a slightly acidic to neutral level with the addition of various acids into the mud system. While many products are available for this purpose, GEO primarily uses Citric Acid. This is fairly weak organic acid, which coincidentally acts as a mud thinner as well as imparting the particular inhibition of KlayCon.

The other acid most commonly used is Phosphoric Acid. Utilizing a small injection pump to control the rate of addition minimizes handling of Phosphoric Acid. Phosphoric Acid comes in a variety of strengths from 25-40% solution. The stronger the solution of acid is, the more hazardous. While none of it is especially hazardous, it does require additional Personal Protective Equipment (PPE).

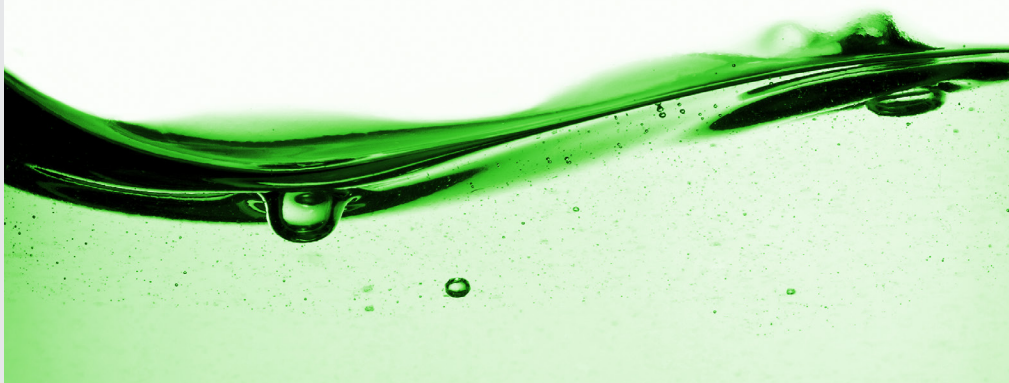
3. How does it work? Can you explain the chemistry and/or physics that make this mud system better than the alternatives? Initially we ran this mud system without an exact understanding of how it worked. There were some vague theories about Hydrogen acting as an inhibitor, but the problem with that is that Hydrogen is a tiny, weak Cation, much weaker than Sodium and therefore unable to reduce the amount of water a clay platelet would absorb. Hydrogen bonding, however, is a significant force in polymer chains, polymer bonding, surfactant, and other processes at work in the mud system.

We were able to identify a significant difference between the pH of the filtrate and the pH of the mud. Lab experiments with various clays indicate that the hydrogen ions are associating with the clays. Solid particles have what is called Zeta Potential. This is the ability of a particle to hold a film of water only a few molecules thick. As we know, it takes water to wet Barite. This water remains with the Barite particle and is not free to move about and act as a thinning agent. Barite is basically inert and has a very small Zeta potential. Gel, on the other hand, is very active and has a very large Zeta potential. The result is that the clays not only absorb water into their matrix, they also adsorb water onto their surfaces. Drilled solids and native clays have a smaller Zeta potential than commercial clay, depending on their activity, and to some degree, in proportion to their Cation exchange capacity (CEC).

The effect of Zeta potential helps explain why muds appear "dehydrated" after a trip when, in fact, they still have just as much water. A portion of what was free water before is now tied to the newly added solids, or to solids that have been broken into smaller pieces and are exposing more surface area.

GEO Drilling Fluids, Inc.
1431 Union Avenue
Bakersfield, CA 93305
1-800-GETSGEO
(661)325-5919
geodf@geodf.com

For more info visit:
geodf.com



GEO
Drilling Fluids, Inc.

In the KlayCon mud acid is added to provide an abundance of hydrogen ions. At a neutral pH (7.0) there are equal numbers of hydrogen Ions (H+) and hydroxyl Ions (OH-). When acid is added, the balance tips toward the H+ and when we check the pH of the mud it will be below 7.0. However, the H+ is attracted to the clays, which have a slightly negative charge, and some of them end up concentrated in the water adsorbed onto the clays because of the Zeta potential. This makes the clays slightly inhibited by means of what is called mass action. Mass action is a process which occurs when an abundance of ions (Cations or Anions) are attracted to an active solid. By their very presence in such massive numbers, they prevent water from reaching the matrix and causing swelling. This effect is somewhat short lived, especially is comparison to Cation exchange and the inhibiting effect of Potassium or calcium. The bonding is very weak (Hydrogen bonding) and that leaves the ions free to effect the pH measurements of the mud.

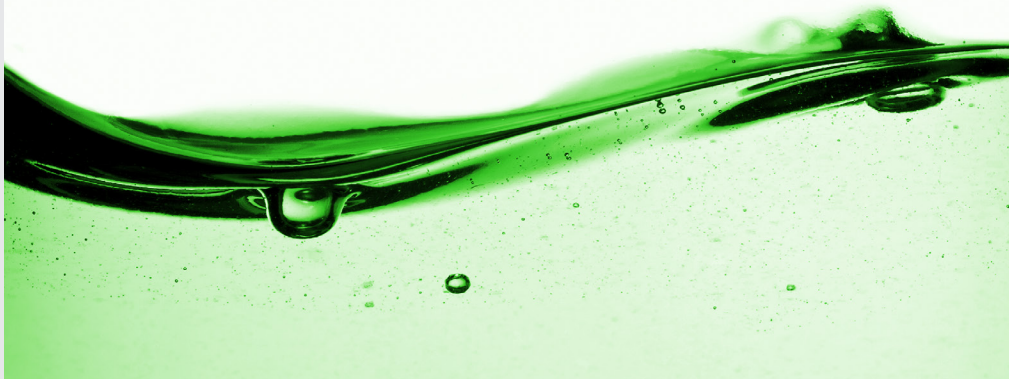
When the mud is filtered, the adsorbed water remains with the clays of the filter cake. The filtrate, lacking the lost H+ (but with the same amount of OH-) has a more basic (higher) pH. In fact the filtrate almost always has a 7.0+ pH. This means that the pipe, pumps and well bore only see the neutral pH fluid. This answers the question of potential corrosion. But it still doesn't explain how this fluid can change the dynamics of the well bore clays.

The mass action of H+ covering the clay particle satisfies the exposed negative charges along broken platelet edges. Without the negative charge, the platelet and pieces of clay are no longer attracted to other clays, since they all have positive charges, either from the massed H+, or from the Cations (Sodium, Calcium or Potassium) arrayed on their faces. This reduces Yield Point and Gel Strengths. Additionally, the clay cuttings undergo the same transformation as they start up the well bore, preventing them from being attracted to the clays exposed on the well bore itself which have also been inhibited. This keeps the hole clean, reducing drag, and the likelihood of pack off.

Hydrogen often acts as a trivalent cat ion in solutions. As such it provides the inhibition associated with divalent (Ca+) and trivalent (Al+++) ions. In addition it helps bond the polymer to the clay particles decreasing imbibition of water into the clay matrix.

GEO Drilling Fluids, Inc.
1431 Union Avenue
Bakersfield, CA 93305
1-800-GETSGEO
(661)325-5919
geodf@geodf.com

For more info visit:
geodf.com



4. Is it expensive? Will the benefits outweigh the added costs? As mentioned previously, the KlayCon system is generally 30% more expensive than a conventional Cypan/DMA mud system. Over the past five years, GEO Drilling Fluids, Inc. has drilled many wells with this new mud type, accumulating experience and formulating procedures. While not every well drilled with KlayCon has been trouble free, on the whole these wells have had fewer clay related problems and have therefore been cheaper to drill than comparable wells drilled with the conventional Cypan/DMA mud. Savings in mud costs are derived from a reduction in drilling days, less frequent and troublesome wiper trips and thus fewer Tour treatments. The savings in rig time and associated drilling costs more than offsets the increased mud costs.

5. Solids Control Equipment A commitment to optimum solids control equipment is essential to the success of the KlayCon system. As with all drilling fluids, proper solids control is key to maintaining good hole conditions and keeping mud costs in line. Allowing for an excess build up of drill solids results in significantly higher material consumption, water dilution and disposal costs.

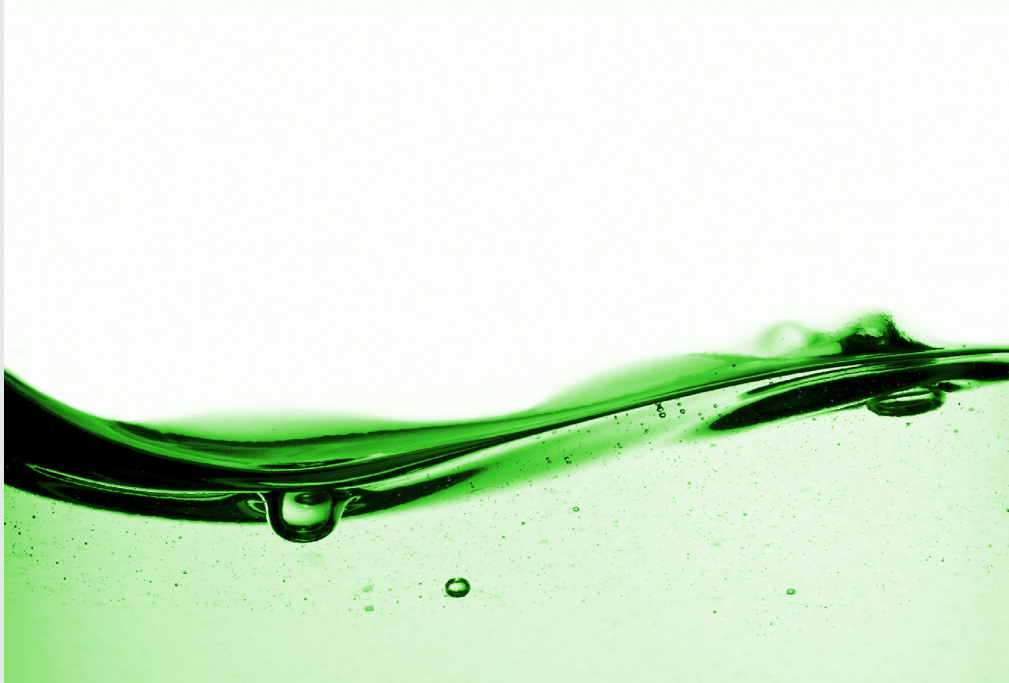
Normally recommended equipment includes a mud cleaner capable of processing 120% of the circulating volume and a centrifuge.

CONCLUSIONS

KlayCon has been successfully run all over western U.S. and is particularly suitable for areas with highly Bentonitic Clays. This system is as environmentally friendly as a regular Cypan/DMA mud, both as a finished product and each of the constituents individually.

The cost of running KlayCon is increased by the amount of Acid used, as it requires just as much Cypan, Omnipol II and CFR as a normal well. Some of the additional cost of Acid is offset by a reduction in drilling and rig time.

The KlayCon mud acts as a moderate clay inhibitor. While less effective than brines or oil, it is cheaper and easier to run. GEO's KlayCon system is the new alternative to these expensive options.



GEO Drilling Fluids, Inc.
1431 Union Avenue
Bakersfield, CA 93305
1-800-GETSGEO
(661)325-5919
geodf@geodf.com

For more info visit:
geodf.com