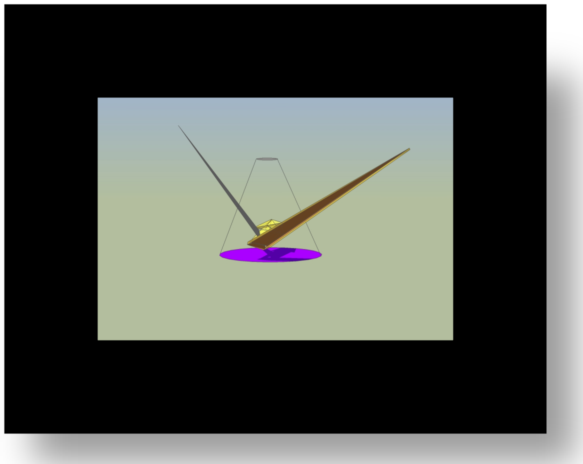
UNIQUE DRILLING FLUIDS, INC.

TECHNICAL DIVISION



PARTIALLY HYDROLYZED POLYACRYLAMIDE

Chemistry

The chemistry of PHPA relies on the neutralization of ionic polymers (anionic or cationic), resulting in a conformation change of a random shaped molecule to that of a rigid rod. The increase in the length of the molecule contributes to increasing viscosity, which relates to the ionic groups present. The ratio of monomer and initiator [M]/ [I] is directly proportional to the molecular weight of the polymer. Addition of salts such as NaCl, allow ionic grouped chains to return to their random conformation and subsequently a decrease in viscosity is apparent.

PHPA's polymerize in several ways, for instance a proton (carbocation) is used as an initiator for cationic polymerizations and act as electron donors, whereas anionic polymerizations, which are more common, take place in the presence of electron withdrawing groups (carboanions). Polymerization with complex coordination catalysts is another method employed. Organometallics such as titanium chloride react with monomers at the titanium atom allowing propagation at the compounds corners. The benefit of this method is specific in that it allows more stereoregulation or larger chains are formed without interference from other atoms and their electrons, hence less steric hindrance (less repulsion) and in turn longer chain growth.

Applications

The chemistry aforementioned gives a brief overview of the science behind PHPA chain growth. The application of PHPA's for our purposes correspond to field conditions such as high salinity, temperature, shale inhibition, fluid loss control and clay extenders. Anionic, cationic, and nonionic configurations of PHPA's have specific applications and to be effective are often dependent on molecular weight. For example, if a client's need is to extend the half life of his bentonite then a low molecular weight and very high anionic PHPA is recommended. Conversely, if a well has troublesome shale that is In need of inhibition, then a high molecular weight PHPA is recommended. Further investigation (shale reactivity) would need to be known before one is to decide on the ionic nature of the polymer (anionic, cationic, nonionic). Salinity problems can be severe and as mentioned before can reduce the viscosity of the PHPA. Special carriers are manufactured for PHPA's to combat salinity issues and this helps to preserve the viscosity and coating properties of the PHPA's. As we all know temperature can be a nuisance in the well and for that purpose molecular weight is critical when confronted with high temperatures. For example, a mud company recommended a high molecular weight PHPA to a client whose formation temperature was quite high when in fact they should have recommended a low molecular weight PHPA. The chemistry can be explained as such; high molecular weight PHPA's are more readily broken down due to the length of their carbon chains, whereas lower molecular weight PHPA's do quite well because there is less to destroy and in turn the shorter chain changes its configuration and binds easier to its target.

Fluid control agents use very low molecular weight and anionic polymers. This makes sense considering the end users purpose is to have cake permeability as thin as possible. The big picture here is to know the client's shale reactivity and environment. This will increase the probability of making an intelligent decision when choosing the right product for your client. If one has a good understanding of PHPA's and their chemistry solving shale problems (inhibiting) are trivial.