The Sedimentation Behavior of Two Commercial Bentonites with the Additives of Polymers and Water Qualities: Used for Drilling Fluids

Shamima Akther, Jinyeon Hwang and Hyomin Lee
Department of Geology, Pusan National University, Busan 609-735, Korea

GeoConvention 2012:Vision

Abstract

Bentonite, which mainly consists of Montmorillonite, is a major component of drilling fluids. The sedimentation behavior of bentonite is a major concern in performance of drilling fluid. In the present study, the sedimentation behavior of two commercial bentonites in solutions pH (pH 2, 7 and 12) and NaCl (1, 3.5, and 10%) were studied. The bentonites are Montigel-F (Sud-Chemie Korea Co.) and Wyoming bentonite (BPM Minerals LLC. USA). The effect of different polymers and polymer concentration on the same solution conditions was also examined. The polymers are Carboxyl Methyl Cellulose (anionic), Partially Hydrolyzed Polyacrylamide (anionic), Xanthan Gum (anionic), and Polyvinyl Pyrrolidone (cationic).

The dispersion and sedimentation behaviors of bentonites were measured by light scattering methods (Turbiscan MA 2000). Light scattering method allows estimating the floc diameter and flocculation rate (velocity). The changes in the viscosity as well as water loss (fluid loss) of bentonite suspensions in such solutions were also investigated as major rheological properties of drilling fluid.

The sedimentation behavior is strongly controlled by solutions of pH, types of polymer, concentration of polymer and concentration of NaCl.

The fluids are stable (disperse) at ≥ pH 7 and unstable (flocculate) at low pH condition. The sedimentation rate and floc diameter are increased with decreasing solutions pH.

For anionic polymer treated samples, the stability of the fluid is increased with increasing concentrations of polymer. The increased addition of anionic polymer results in stable fluid even in acidic condition. In contrast, cationic polymer treated samples are relatively unstable in all pH conditions.

The sedimentation rate varies with concentration of polymers and NaCl. In NaCl solution, flocculation (sedimentation) is generally dominant process and the flocculation (sedimentation) rate is increased with increasing concentration of NaCl and/or with decreasing concentration of anionic polymers. The floc diameter of the sample is increased with increasing concentration of NaCl. Bentonites treated with higher concentration of anionic polymer showed good dispersion in 1% NaCl. However, the cationic polymer is not effective in all NaCl solutions.

The bentonites with fast sedimentation (flocculation) behavior showed low viscosity. The viscosity of the samples increased while increasing polymer concentration and polymer molecular weight. The cationic polymer treated samples showed significantly low viscosity at all pH conditions although the viscosity tends to slightly increase with increasing solution pH. In NaCl solutions, the viscosity of the samples decreased with increasing concentration of NaCl. Bentonites treated with Xanthan gum (anionic polymer) showed best dispersion stability in strong acid and high NaCl concentration. Therefore, this anionic polymer can be used to increase dispersion stability of drilling fluids in specific environmental conditions.

The results obtained from sedimentation experimental works with considering various factor such as type of bentonite, pH, NaCl concentration and types and concentration of polymers will be very helpful data in applying bentonite suspensions to drilling fluids, paper industry, etc.

KEY WORDS: bentonites, drilling fluids, anionic polymer, cationic polymer, pH, NaCl, dispersion, sedimentation/flocculation, viscosity.