Intelligent Gel as a High-performance Plugging Agent in Deep Wells

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Deep earth exploration plays an important role in studying our planet for more information about geological data and mineral resources,,oil and gas. It is a great challenge to develop geodrilling technology facing a deep well depth, high temperature, great pressure, and complicated geological conditions. Lost circulation is a common and difficult problem especially in deep wells, which costs great loss.

In this paper, a new kind of acrylamide copolymer/phenolic resin gel is introduced. The gel's molecular skeleton is cellulose which graft copolymerized by water-soluble acrylamide monomer. Phenolic resin is a crosslinking agent. The viscosity of the polymer solution is low and shows excellent shear thinning properties, and the solution is easy to be injected into the well and enters into rock fractures and pores. The crosslinking time can be controlled by changing the crosslink ratio and the amount of catalyst. After the gel is crosslinked, it will completely lose mobility, which has a high strength as plugging agent with high temperature (up to 200 °C) and pressure resistance. The polymer gel has good properties of flushing fluid resistance, high salinity brine resistance and crude oil resistance. The sand pack experiments, permeability tests of cores treated with the gel and other tests about plugging material all shows the intelligent gel has good plugging performance. The intelligent gel can be mixed with other solid plugging agents to enhance plugging effects without affecting its properties. It has good application prospect in lost circulation control, workover operation, and water plugging.

Figure 1. 1.5 inch steel pipe and sand pack with intelligent gel.
Intelligent gel is crosslinked in the sand pack which can bear the pressure of 20Mpa at 180 °C with the length of 1.2 meters. This experiment shows that the acrylamide copolymer/phenolic resin gel has excellent plugging performance.