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Mixing of drilling mud used in oil field (Soroush) with nanoscale materials and its impact on oil extraction

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Drilling mud, Oil extraction, Soroush oilfield

Abstract:

Today various Nano materials have been used to oil recovery enhancement that one of them include of poly acrylamide based Nano composite gels. This material is prepared using specific monomer copolymerization by networking factors. This material absorbs significant amount of water. To produce networks with specific properties, various co monomers or network structure modifications could be used. Inflation test had been performed to produced hydrogels by various. Amount of clay Nano particles in pure water and salty water solutions that shows significant results. According to results, Nano composite hydrogel including 2 % clay, absorb more water. Comparing to hydrogel without Nano particles of clay, we can see 180% more water absorption, this results have been achieved to salty water but balance time to absorb water would be increased. Also to evaluate the effect of using Nano particles and hydrogel on excavation mud, viscosity have been studied. Results show increase of post decrease viscosity of hydrogels including Nano composite materials compared to common types.

Introduction:

According to estimations, world demand to energy would be increased. Although using other energies as nuclear and recycled energies would be increased at future but compared to fossil energy, it would be at low level and during two future decades, these types of energies would be complementary energies. As most of country reservoirs pass second half of life cycles and passing the time, recovery would be more problematic, better and more effective methods would be required.

It is necessary to say that among oil recovery enhancement, the best method based on economic and practical aspects should be selected. By this, Nano sciences with goal of reviewing material to production process and production and exploitation optimization include of this potential to challenge all technologies as hydrocarbon resource exploitation generally Nano science is effective tool to improve various properties as effective surface, stability, economic aspects to use consumable materials through control material structure based on atomic dimensions and creating optimized structure to materials. As durability, stability and equipment dimensions are very important to oil and gas industry, using Nano technology, significant modifications may be achieved. Based on new published paper, it is expected to increase would oil recovery coefficient as 10 % using Nano technology, while using hydrogel to oil recovery enhancement is very important and with combination of Nano science and hydrogel oil recovery would be increased (Makuuchi, 2017).

Said networks are sensitive against various environmental factors as PH, temperature and solution ionic structure. According to said properties, hydrogels include of various applications to agriculture, injection, drug delivery, micro fluid, systems, contact lenz and water treatment industries. Also specifications of hydrogels may be determined based on final capacity to absorb liquids (thermo dynamic inflation), the ratio of liquid absorption among them (kinetics inflation) and their mechanical properties as hydrated or wet materials (humidity resistance) (Xinming, 2017).

Acrylamide-based hydrogels, due to their high absorption capacity (due to water-loving amid groups), have high mechanical stability of swollen hydrogels and more suitable environmental properties than other hydrogels. But these gels are heavily water-proof, vulnerable. Because the formation of water because of its high amount of single and double-volume ions, reduces the strength and destruction of the structure of these materials. For this reason, nowadays, by adding clay to the polymer structure (composite), it improves its thermal and thermal properties, and because the use of Nanoparticles due to

its very small dimensions and the very high contact surfaces in the loading rate, improves the properties desired for drilling mud and Hydro gel has been reported and problems associated with common boosters, such as weight gain, surface defects and process ability problems, are less common (Chang, 2017).
Due to the similar viscosity of the water, these types of polymers are usually injected into the reservoirs and, by reaching the desired location, become a solid mass and play their role as a pathway or blocker. In this method, due to the similarity of water viscosity and polymer gels, the cost of injection into wells is much lower than other methods, as well as the depth of penetration of these gels due to structural similarity with water is much more than cement; on the other hand, the strength and durability This type of gel is more than ten times as much as conventional gels and in similar conditions. It should also be noted that these types of gels are not permanent and, if injected incorrectly, they can be neutralized by another chemical agent. Therefore, the use of hydrogels containing Nano materials is considered as the next-generation technology used in drilling mud (Fig. 1) (Gupta, 2017).

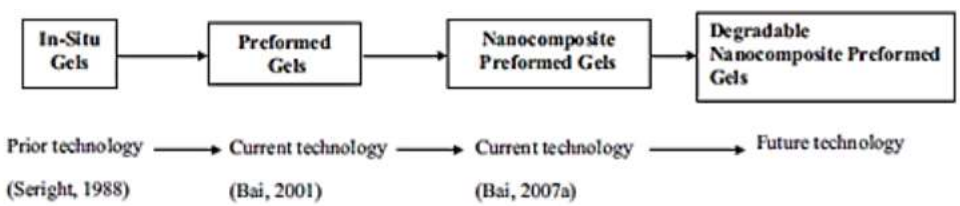

Figure 1: The advancement of technology in the process of using hydrogels in the exploitation of reservoirs (Sahiner, 2017)

Hydraulic base and oil base drilling flowers are the most common flowers used in various drilling operations. Among these flowers, blue-flowered flowers are the most common types of flowers, so that they are used in almost 80% of wells, and the use of these flowers is more economical compared to oily flower bases and other flowers. (Frutos, 2016).

Dyrania and Polialia from methylcellulose and poly (vinyl alcohol) to investigate the properties of drilling mud. The results showed that flower stability increased. Van et al. Utilized microinjection micro injection 4 inversions to make a copolymer composed of various water-soluble monomers such as acrylamide, acrylic acid, and sodium 4-styrene sulfonate. They used this copolymer as an additive in drilling mud and their results showed that the properties of drilling mud, thermal stability and salt resistance have improved. Sadiq Al-Wade and Sabaghi studied the effect of titanium dioxide / polyacrylamide Nano composite on drilling mud properties. The results showed that the addition of Nano composite to the drill mud increases rheological properties such as plastic viscosity, turbo point, compatibility index, and loss of flower (Siddaramaiah, 2016).

In a comprehensive study, Alhellian and Ramezani studied the effect of acrylamide-based hydrogels on drilling mud. For this purpose, they used two thermal methods with the presence of a primer and transverse connector and a gamma radiation method without the use of any primer and fastener. Their reports indicate that the use of gamma radiation method increases the water-friendliness and hydrogel inflation, which, if added to drilling mud, increases the water absorption of reservoirs by this hydrogel it is possible. Also, by studying the properties of this hydrogel, it was found that the samples produced by irradiation have a higher inflation and higher than heat ratio. They also carried out research on the use of polymers in drilling fluids. In their research, it was discovered that the addition of polymer would increase the viscosity, wetting point and strength of the gels of the drilling mud system. Also, a decrease in fluid loss and a thickening of the laminate layer was observed (Zhang, 2016).

In this study, we studied and studied the acrylamide-based synthesized hydrogel, which was used for its preparation in primer, monomer and unique grid maker. Also, by combining the desired hydrogel with clay Nanoparticles, its role in drilling mud and its effect on increasing the removal of reservoirs (increased swelling strength) has also been analyzed. In this regard, the effect of these hydrogels on the rheological properties of drilling mud and the provision of optimum amounts of materials for the preparation of suitable hydrogels is presented (Kabiri, 2016).

2. Methods and stages of research

2.1. Materials and Devices

The materials used in this paper are acrylamide (AM) and acrylic acid (AA) (both of which have a purity of up to 99% and manufactured by MERCK Germany) were used as base monomers and were completely soluble in water. Polyethylene glycol (PEG) (manufactured by MERCK, Germany) was used as a core grinder, N, N'-methylene-acrylamide (MBA) with a purity up to 99% (manufactured by MERCK Germany). Also, XLG Laponite clay Nanoparticles were used to add Nanoparticles. Potassium Persulfate (KPS) with a purity of 99% (made by Sigma-Aldrich) as the initiator of polymerization process, N, N, N ', N'-TEtra Methyl Ethylen Diamine (TEMED) with a purity up to 99% (manufactured by MERCK Germany) were used as accelerators of polymerization process.

Montgomeryonite (Bentonite) made by Sigma-Aldrich of the United States was used as a flower base. In this study, the Viscometer Bath 6KV Visanometer-SETA Viscometer Bath was used to measure the viscosity of the flowers. Also, Hamilton Beach was used to mix flowers and hydrogels.

2-2. Nano composite hydrogel preparation method

The method of preparing hydrogels has been thermally and soluble polymerization. First, 30 g of acrylamide solution was mixed in 100 g of distilled water in a reactor. They were then completely stirred for 10 minutes in a magnetic stirrer. Then, 0.2% of the XLG Laponite clay Nanoparticles were added to the mixture and completely mixed for 24 hours to make the Nanoparticles well homogenized in the mixture. Then, 250 ppm of PEG were added to the mixture and stirred for 10 minutes. The final mixture was then washed with nitrogen gas for 10 minutes before adding 100 ppm of KPS as a primer.

The final mixture was placed in a hot bath at 40 ° C for 10 hours in order to complete the final hydrogel formation process. The formed hydrogel is then divided into small pieces and placed in deionised water for 72 hours to remove the unreactive materials from the hydrogel. The hydrogel is then dehydrated and dried at 60 ° C for 12 hours. Finally, by breaking down the final hydrogel and sieving them from a mesh of 180 to 250 µm mesh, an acrylic acid based Nano-composite hydrogel was prepared and ready to be added to the drill mud.

2-3. Study of Kinetic Influence of Nano composite Hydrogel

To calculate the percentage of kinetic inflation of hydrogels, samples consisting of 1% hydrogel solution made with dipping of 0.25 g of dry hydrogel in 24.25 g of sodium chloride solution and 75.27 g of distilled water were prepared. . Then, it was placed in distilled water at 40 ° C for several hours (to reach the equilibrium value of inflation). Then the weight of the hydrogels is measured and the inflation percentage is calculated from the following equation:

$$Q = \frac{w_{wet} - w_{dry}}{w_{dry}} \times 100$$

In formula (1), the weight of the hydrogel is swollen and the weight of the hydrogel is dry.

2-4. Study of the Effect of Nano composite Hydrogel on Water Absorption

In order to study the effect of using clay Nanoparticles in the preparation of hydrogel based on water-solubility and water absorption properties, different amounts of clay Nanoparticles were added to acrylamide-based hydrogel to compare the results with the state without using Nanoparticles. Hydrogels containing 0.02%, 6.0% and 3% by weight of XLG Laponite Nanoparticles were prepared and placed in both solutions of water and brine containing 1% sodium chloride separately.

3. Presentation and analysis of results

According to the results in Fig. 2, the percentage of hydrogels inflation increased over time, reaching its equilibrium value at about 140 minutes, and then did not change. The percentage of inflation at this time for the hydrogel containing 0.2% by weight of the XLG Nanoparticles is the highest and for the hydrogel without the Nanoparticle is the least, so that the hydrogel containing optimum Nanoparticles is about 180% more than the water absorbing hydrogel and has more ability to increase the oil recovery Will have. Also, these results indicate that by increasing the amount of Nanoparticles, the ability to absorb water in hydrogels decreases and the amount of added Nanoparticles should be optimized to bring the maximum water absorption. Figure 3 shows the results of this study for salt water, which is inferential as in Fig. 2, suggesting an optimum of 0.2% for clay Nanoparticles. However, the time required to achieve equilibrium in this state (salt water absorption) is greater than pure water.

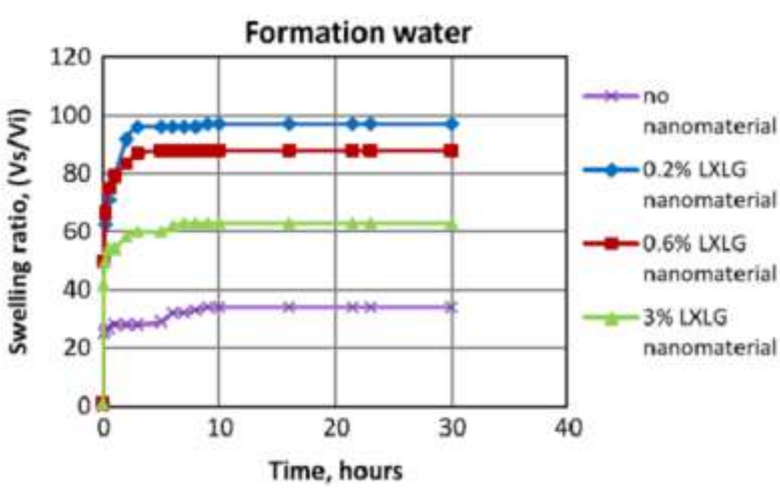

Figure 2: Changes in the percentage of inflation of time-produced hydrogels for pure water

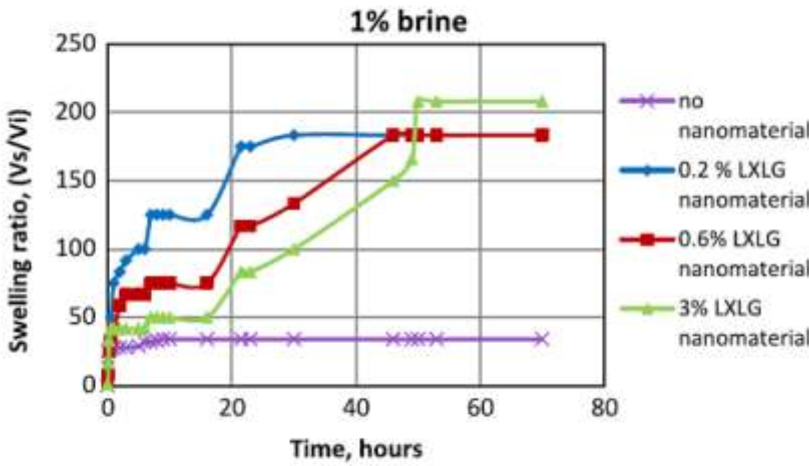

Figure 3: Changes in the percentage of inflation of hydrogels made with time for salt water 1%

One of the important points that can be deduced from the above diagrams is that although it may appear that in increasing appearance of Nanoparticles, we should see an increase in inflation and the amount of water absorbed, but this is not the case, and with the increase in the volume and weight of the Nanoparticles and Addition of them along the grid and other materials, the density of the hydrogel is increased and causes no water to penetrate into the polymer. According to the results of the study, the effect of hydrogel on the rheological properties of drilling mud was increased by adding gel to flower, increasing the viscosity of the flower, which, however, was higher in the lower concentrations of the hydrogel, due to the unsaturation of the system in concentrations are low. The initial viscosity (without the addition of hydrogel) was 7.27 cm. At a concentration of 100 ppm of hydrogel, this value reached about 154.7 cm, with an increase of about 580%, while the viscosity of the flower Concentrations of 200 and 300 ppm of hydrogels were 7.158 and 3.19 cm, respectively, increasing by about 2.5% and 24% relative to the viscosity of 15.47 cm. Figure 4 shows the results of this study. This increase in the viscosity of the flower, as well as in the very low concentration of hydrogel, is very important.

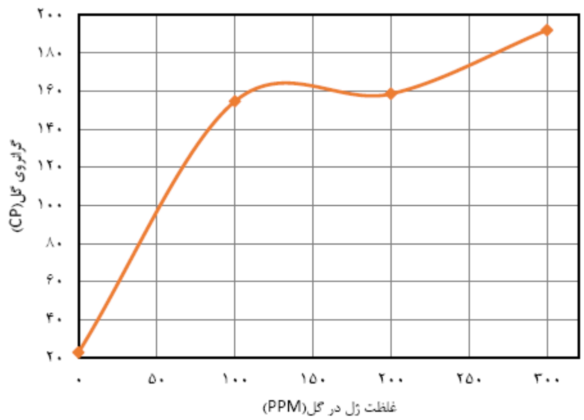

Figure 4: Changes in flower viscosity with hydrogel concentration in flower

The other section that has been considered in this article is a stellar increase in the residual viscosity of a polymeric hydrogel solution that linearly contains 170 cm for a hydrogel containing 0.3% PPG and without a Nanoparticle of 4437 cubic feet for the hydrogel containing 0.6% LXLG with the Nanoparticle which in turn can be interesting.

4. Results

In the present study, the feasibility and the feasibility of using clay Nanoparticles to increase the mechanical and thermal resistance of acrylamide-based hydrogel was investigated and evaluated. The results of the study showed that hydrogels without Nanoparticles can absorb water by about 8 hours for about 2 hours, which is a significant amount. But if you can make a hydrogel that can overcome the fluidization problems that occur when drilling mud and oil reservoirs, it can be easily used. Therefore, in the present paper, different quantities of clay Nanoparticles with specific dimensions were used which were selected based on the experimental design. The results showed that during the construction of this hydrogel, by changing the amount of added Nanoparticles to the hydrogel, there was a decrease in the percentage of swelling, so that the least amount of adsorption was related to the use of a hydrogel containing 3% Nanoparticles and the highest absorption was related to the hydrogel containing the Nanoparticle 2%, which can absorb water by about 180% more than ordinary hydrogels and without using Nanoparticles. At the same time, by increasing the mechanical and thermal resistance of the hydrogel, not only the hydrogel viscosity reduction after reduction would be improved, but by increasing it, the water absorption was much higher than that of the normal hydrogels and can be determined by determining The optimal amounts of these Nanoparticles that can be different and different, with the change in the formulation of drilling mud, have yielded favorable results. Also, the effect of hydrogel made by solvent polymerization process on the viscosity of drilling mud was investigated, which resulted in increasing the viscosity of the flower with the concentration of hydrogel. This property can be used to increase the harvest. Adding hydrogel to drilling mud increases the viscosity of drilling mud and decreases the relative permeability of water reservoirs into crude oil. In this way, water reservoirs are separated by drilling mud and oil recovery occurs.

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