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Research Paper

Investigating Rock and Fluid Parameters in Choosing the Most Appropriate Nanocomposites Concentration in Sandstone Reservoirs

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1. ABSTRACT

This study investigates the effect of new nanocomposites (ZnO/SiO_2/Xanthan) for the most appropriate selection of nanocomposites concentration in sandstone porous media. This research has been done for the first time in sandstone reservoir. First, the morphology of nanocomposites was investigated using XRD, SEM tests. Then, the effect of nanocomposite on changes in wettability, surface tension, viscosity, zeta potential, pH, and density in different concentrations of nanocomposite in tank conditions was investigated. Based on the results of this study, the optimal concentration was selected for fluid dynamic tests. The optimum choice of fluid can reduce many problems, such as reducing oil recovery due to blocking the pores and throat of rocks. According to the lowest contact angle (36°), highest zeta potential (-49.68 mV) in the presence of nanocomposites, 40 ppm was chosen as the optimum concentration.

Keywords: Sandstone, nanocomposites, interfacial tension, Xanthan, Silica

2. INTRODUCTION

Due to the reduction of oil production in fields, new advanced oil recovery methods with high efficiency and low cost have been developed among various researchers [1-2]. In order to achieve the best results during enhanced oil recovery, nanofluids are widely used due to their small size and high efficiency. The two main mechanisms of increasing oil recovery in the use of nanofluids are changes in wettability and surface tension [3-5]. It has also been observed that the use of pomegranate seeds containing bioactive substances and phytochemicals has been useful for the production of nanoparticles stabilizing particles and changing the effective mechanisms in porous environments. Although, many experiments have been conducted in the presence of ZnO/SiO2, but so far no attempt has been made to obtain the best in reservoir and static conditions in the presence of this nanocomposite. Accordingly, in this study, the best was selected based on the static tests of pH, density, zeta potential, interfacial tension, wettability and viscosity.

3. MATERIALS AND METHODS

One of the Iran's sandstone and crude oil reservoirs has been used for static and dynamic tests. At the reservoir temperature of 60 degrees Celsius, the density, API and viscosity of crude oil are 0.846 cm^3/g, 28 and 9.9 cP, respectively. Also, calcium chloride, sodium chloride, magnesium chloride hexahydrate and potassium chloride salts were purchased from Merck, Germany.

Pomegranate seeds are dried at room temperature and extracted after dewatering. Then, sodium metasilicate (5 g) and zinc chloride (2 g) were mixed with 200 ml of the solution extracted from the previous step [two hours at 850 rpm and 80 °C]. After placing the mixture in a dark place and stirring, an oven was used to remove impurities [temperature set at 600°C]. Finally, 10 grams of xanthan was added to the resulting mixture for 2 hours and the system was allowed to dry completely. To prepare nanofluids, salt water solutions with the

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concentration of magnesium chloride: 28.56 ppm, calcium chloride: 40287 ppm, potassium chloride: 800 ppm and sodium chloride: 40316 ppm in the salt water solution at the nanoparticle concentration in question and the solutions obtained for 1 day to To obtain a uniform solution, they were mixed by ultrasonication.

4. RESULTS AND DISCUSSION

Based on the Zeta potential and contact angle tests as shown in Figures 1 and 2, respectively, 40 ppm was selected for performing dynamic tests. At this point, Minimum contact angle and highest contact angle results were seen.

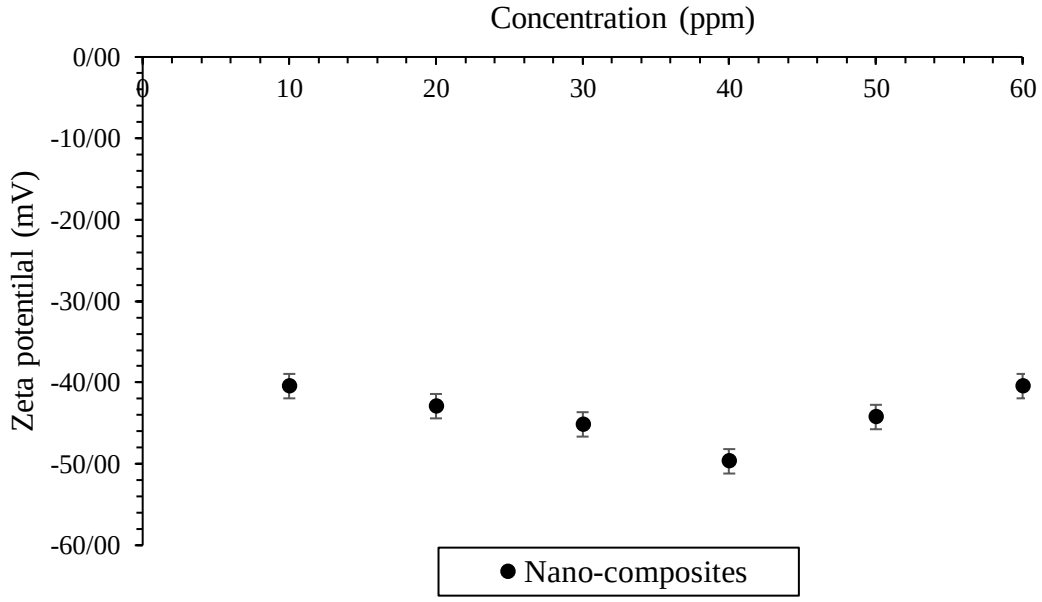

Figure 1. Zeta potential in the presence of nanocomposites

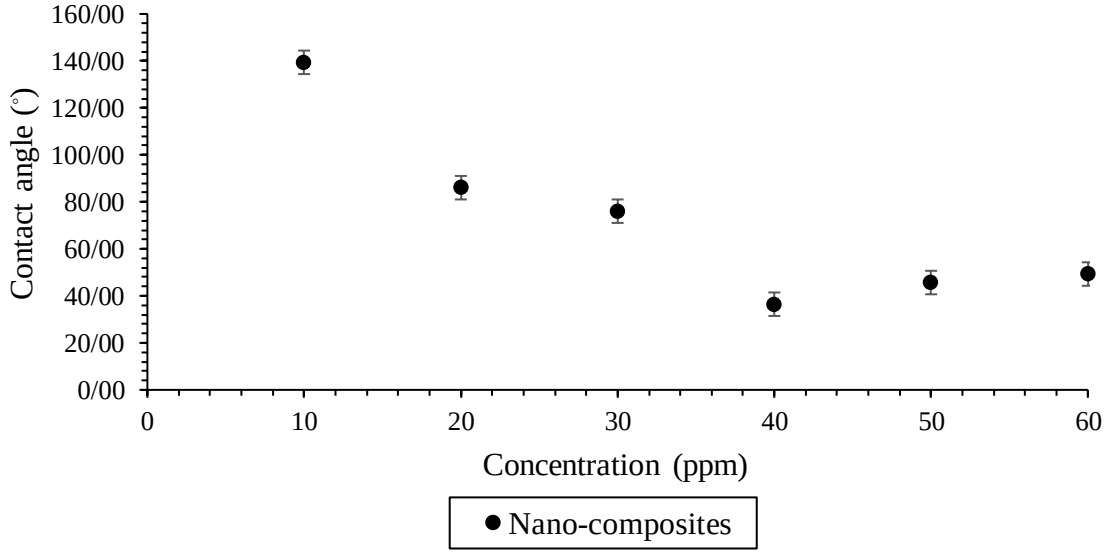

Figure 2. Contact angle in the presence of nanocomposites

5. CONCLUSION

In this article, ZnO-SiO_2 nanocomposites were characterized by X-ray diffraction (XRD) and scanning electron microscopy (SEM). In the present study, various tests of surface tension, contact angle, viscosity, and adulteration potential were performed in the presence of nanocomposites at concentrations of 10, 20, 30, 40, 50, and 60 ppm. Based on the results, 40 ppm was chosen as the optimal concentration. Therefore, this concentration was chosen as an ideal concentration for dynamic testing with the help of nanocomposites. At

40 ppm, surface charge values of -49.68 mV were obtained, which proves the stability of nanofluids. The surface tension at this point has an acceptable decrease and the amount of zeta potential was in a more stable state compared to other concentrations. In this regard, viscosity (μ) and contact angle were the lowest among other concentrations.

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