# CHAPTERV

# CONCLUSION AND RECOMMENDATIONS

## 5.1 Conclusions

The work carried out in this study focused on the effect of pH on adsorption capacity of natural zeolites and the effect of temperature, shear rates, pH and concentration of cellulose derivatives on fracturing fluids and how their degradation were affected by changes in temperature.

Batch tests with four types of water (untreated formation water, treated formation water in site of the field, treated water by natural zeolites and deionized water), two types of zeolite and two types of polymer at various sets of conditions such as pH, temperature, shear rates and concentration gave the following conclusion:

The experimental results confirm the general trend in adsorption capacity Mg, Ca, Na, K and Fe by natural zeolite for oil field produced water, depends on pH, and were assessed at varying pH values from 1 to 9. Generally results obtained from synthetic solutions showed a better metal ions removal at pH 1 for Zn1and Zn 2. Removal about more than 80% for sodium and potassium using produced water samples for same pH . Zeolite 2 has a satisfactory capacity adsorption to remove certain metal ions presents in solutions, and has therefore potential to be used as an adsorbent in the treatment of produced water. While Zn1 has a low capacity adsorption to remove metal ions in solution that may due to be the sticking of presumably iron powder to the magnetic stick could be observed, probably needs more chemical interpretation.The results indicate that treatment of produced water and synthetic solution by natural zeolite is highly dependent on the pH concentration, and zeolite concentration itself.

In the second part of this study, fracturing fluids formulation with four types of water was prepared. Borate and aluminium ion with cellulose derivatives (HEC and CMHEC) in aqueous solution were investigated by using rheological measurements. The evolution of viscoelastic properties of the borate solutions and the ammonium ion mixtures and separately

was characterized, and the crosslinking kinetics was determined.The results indicate that the development of the crosslinking network is highly dependent on the borate concentration, while the cellulose derivatives concentration is relatively unimportant. The effects of pH, temperature, shear rates and cellulose derivatives dosage on fluids formulation were systematically investigated. Optimal reaction conditions for formulation were obtained (pH: 6 and 8; temperature: > 80$^{o}$C and 5g polymer dosage).

## 5.2 Recommendations

Based on the results and conclusions obtained from this study, the following suggestions for future work in the same area are recommended:

1. Some previous studies confirm that Heglig oilfield has fresh water Compared to FAO standards for unrestricted irrigation water. However, need further treatment to heavy metals ($Fe^{+2}$) and some metals ($Ca^{+2}$ and $Mg^{+2}$).
2. Regarding to SRB organism, need their own laboratory in field site because the central field far from the central laboratory to confirm the presence of SRB into produced water so to take suitable additions necessary when re-used.
3. The ability to provide treating produced water by natural zeolite can be reasonable and successful technique.
4. Even if the results of adsorption by natural zeolite are satisfactory, further studies are needed like, ionic effect, flow rate and column length.
5. The ability to provide fracturing fluids with produced formation water can be a successful wastewater management approach and valuable solution for enhancing oil recovery and therefore reducing negative environmental impact due to the usage of large quantities during hydraulic fracturing operations.