CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

A quantitative description of immiscible oil displacement by flooding processes in porous media is one of the importance requests for high quality EOR techniques. The Centric Scan SPRITE MRI technique is an effective tool for the direct visualization and quantitative evaluation of flooding processes in porous media. By directly monitoring the images of fluid distributions and residual oil saturation profiles from MRI, this technique allows a better understanding of dynamic mechanisms for waterflooding, polymer flooding and in-situ permeability modification in porous media. Fundamental characteristics of flooding processes such as displacement front, oil recovery profiles, mobility control, and phase trapping also can be observed using this technique. Unfavorable displacements such as fingering and/or channeling of the displacing fluid were detected and directly visualized through MRI during waterflooding and at low polymer concentration. In contrast, ideal piston-like displacement was visualized at high polymer concentration due to the favorable mobility ratio of the injected polymer solution to the oil bank. Sand wettability also affected the residual oil saturation and characteristic of flooding test. For oil-wet sand experiment, the oil will occupy the small pores and contact the majority of the sand surface, this leads to less oil recovery compared with oil recovery in water-wet sand. Trapped nonwetting phases in the channel were visualized. The capillary force in the channel required to mobilize an oil drop was higher than that of an air drop since the oil phase wetted a glass surface better than the air. A weak polyacrylamide gel helped control displacing fluid channeling and improved amounts of oil recovery.

Moreover, the experimental findings show a close agreement between material balance and fluid saturations determined from MRI in unconsolidated porous media. All of these ideas are applicable to consolidated porous media (reservoir core samples).

6.2 Recommendations

It would be worthwhile and interesting to develop the Centric Scan SPRITE MRI technique for more realistic applications. In terms of sample models, consolidated rocks could be introduced as the porous media instead of the sand pack samples. Homogeneous rocks are recommended as the preliminary step. Reservoir core rocks could also be investigated. A better image resolution and variety of different 2D slices of the sample (different planes of the images across the sample) would allow a better understanding of the rock structures and dynamic microscopic processes. The accuracy of quantitative evaluations in rock core samples for both material balance measurement and MRI techniques needs to be improved. In terms of the oil phase, oil more representative of crude oil in the reservoir should be employed since the polarity of fluorine element affects the interaction between fluids and porous media. Moreover, the modification of the experimental setup is necessary for supporting other inquiries; for example, installing a pressure gauge to measure the pressure drop across the sample. First, this helps to calculate the pressure required to overcome the nonwetting phase trapped in the channel or the Jamin effect in the channel system. Second, the other properties such as relative permeability can be calculated. In addition, realistic reservoir conditions should be considered. MRI measurements under high pressure and temperature should also be investigated in the future.