Clay-fines-assisted technologies of oil and gas recovery

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Fines migration, and subsequent reduction in permeability, has been observed to occur during core flood experiments as a result of decreased water salinity, increased flow velocity and altered water pH or temperature. The traditional view of fines migration is that it should be avoided because of its detrimental effect on reservoir permeability and well productivity. However, during waterflooding, an induced reduction in the effective permeability to water in the water-swept zone, caused by fines migration, may be used to provide mobility control to improve the performance of the waterflood. This effect is similar to that of other mobility control techniques such as polymer flooding. Reducing the salinity of the injected water is the most practical method to implement mobility control by induced fines migration as the other parameters that control the release of fines are not easily changed or, in the case of velocity, affect the whole reservoir, not just the water-swept portion. Low salinity water is also often readily available and inexpensive compared to other alternatives.

We also describe several other methods for water blocking and water production decrease during pressure depletion of oil and gas fields:
-short time injection of fresh water into watered-up down-dip wells before their abandonment in oil and gas fields;
-short time injection of fresh water just above the water-oil (water-gas) contact before the production starts;
-short time injection of fresh water below producers during production with high water-cut;
-huff-n-puff short term fresh water injection in producers working with high water-cut.

The presentation includes mathematical model for 2-phase flow with fines. Field cases and modelling show the significant sweep increase during fines-assisted low salinity waterflooding with 5-9% of incremental recovery and 2-3-times reduction in injected and produced water volumes. The above water-production-control methods yield 10-30% increase in oil/gas recovery and 50-200% increase in the well life time.

We also present the analysis of the role of ion exchange for different clays (kaolinite, illite, smectite, montmorillonite) and their potential for fines release and recovery increase.

Notes