ADSORPTION OF SURFACTANTS IOS 1518, C25A, AND T15 ON DOLOMITE POWDER IN DI WATER

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Surfactant-stabilized $C0_2$-water emulsions may be used to flush oil out of a reservoir. A surfactant with low adsorptivity on porous rock is necessary to reduce surfactant loss. The adsorptions of surfactants IOS 1518, C25A, and T15 in mg (surfactant)/m^2 (surface area) are tested in this study by preparing by weight a mixture of surfactant solution and dolomite powder, filtrating the mixture, and titrating the liquid by two-phase titration to determine residual surfactant concentration. Each surfactant will have a maximum/plateau adsorption, which occurs when further increase of surfactant concentration in the mixture does not result in increased adsorption. The purpose of this study is to identify surfactants with low plateau values. Further work will test the adsorptivities in conditions with higher temperatures, pressures, acidity or salinity in order to predict how the surfactant will perform in reservoir conditions.

Determination IOS 1518 and C25A Adsorption for Surfactant Enhanced Oil Recovery

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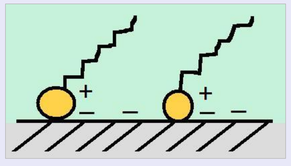
Adsorption and Surfactant Enhanced Oil Recovery (EOR)

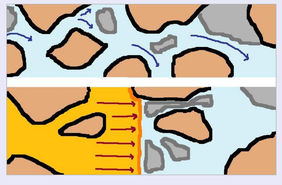
What is adsorption?
- Adherence of molecules in a fluid to a solid surface.
- An equilibrium that may be reversed.
- Dependant on polarity
- Monolayer or multi-layer

What is surfactant EOR?
- increase oil recovery from a reservoir that has lost its natural pressure.
- inject CO_2/H_2O/surfactant foam to force oil from porous rock.
- Surfactant must be chosen to stabilize foam well and to minimize loss (low adsorption).

Goal: Measure the adsorptions of IOS 1518 and C25A.



Adsorption



Injection of water and foam

Langmuir-Type Isotherm

Original Langmuir Isotherm
- Assumes:
  - Gas phase
  - Monolayer
  - Simple molecules
- Solution to PDE for flow in porous media
- Satisfies equilibrium relationship.
- Linear and plateau region

Langmuir-Type Isotherm
- Empirical data matches original Langmuir isotherm curve.
- Liquid phase, possibly multilayer, large molecules
- Parameters for use in simulation obtained by fitting curve to data.

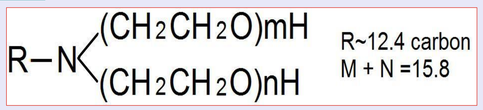
Adsorption Measurement

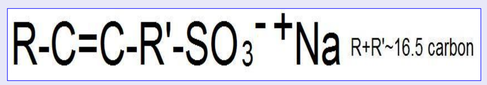
Sample Preparation:
- Dolomite powder and surfactant solution mixed for 24 hours.
- Di water, ~21ºC, 1 atm, unadjusted pH.

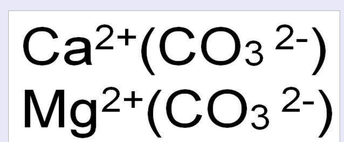
The ratio of powder to surfactant was varied to produce a range of residual concentrations.

Adsorption (units of mg/m^2) calculated by mass balance.

A Langmuir-type isotherm is generated, at the plateau of which the dolomite is saturated with surfactant.







Chemical formulas of C25A, IOS 1518, and dolomite, respectively.

Methylene Blue Two Phase Titration

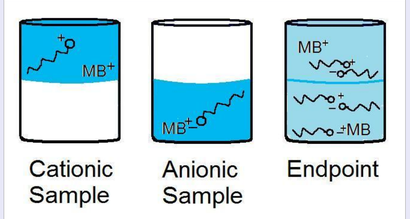
Residual surfactant concentration is determined by this titration.

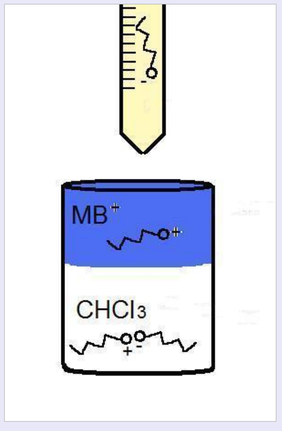
Sample surfactant forms pairs with titrant molecules.

Once all sample molecules form pairs, titrant forms pairs with MB. MB pairs enter the chloro-form/organic phase.

Titration is stopped when both phases are same shade of blue.

Correct for titrant that pairs with MB.



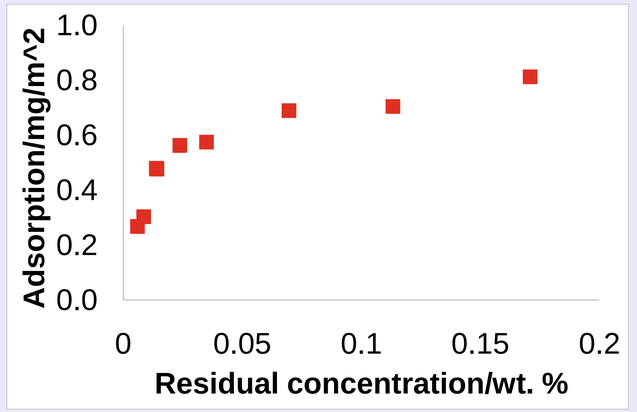


Titrant
- Surfactant of opposite charge to sample

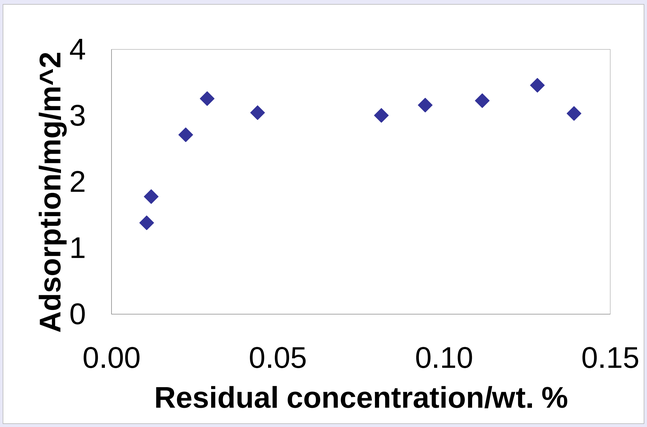
Aqueous phase
- MB^+ (low concentration)
- Surfactant solution of unknown concentration
- pH=2 buffer

Organic phase
- Chloroform

Results



C25A adsorption plateau: 0.697 mg/m^2 , the average of the second and third points from right. The far right point had a small concentration difference and a high percent error.



IOS 1518 adsorption plateau: 3.18 mg/m^2 .

Conclusion

C25A and IOS 1518 have adsorption plateaus of 0.697 mg/m^2 and 3.18 mg/m^2, respectively. Less surfactant loss would occur with use of C25A.

Anionic surfactant adsorption is higher because of attraction to positively charged dolomite surface. Cationic surfactants are more promising for EOR use because they minimize loss.

The adsorption at these conditions will be used in a simulation at reservoir conditions, which are hard to achieve in lab.

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