

## Adsorption of asphaltenes in porous media: experimentation and modeling

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Asphaltene adsorption on minerals induces wettability alteration in oil bearing formations which in turn affects formation capillary pressure, relative permeability, electrical properties, and residual oil saturations. The majority of existing work addresses the adsorption of asphaltenes of reservoir minerals in static set-ups where adsorption isotherms are measured and modeled. On the other hand, very little work currently exists on the adsorption kinetics of asphaltenes under dynamic regimes which would be more representative of petroleum reservoirs under production.

In this study, we propose to investigate the adsorption of different asphaltenes on various minerals using UV/Vis spectroscopy. The experimental set-up consists of a core holder containing crushed minerals with comparable mesh size. Asphaltene solutions in toluene are flown through the mineral pack with a constant flow rate of 0.5 ml/min and their concentrations recorded at the outlet with time. Preliminary results indicate that adsorption is largely controlled by the type of mineral rather than the asphaltene itself. The highest adsorption amounts per unit area are found on calcite mineral. The effect of several parameters such as asphaltene concentration and composition is analyzed.

The theory of activated adsorption/desorption approach - TAAD is incorporated into a convection/dispersion equation to model the flow of asphaltenes inside the porous medium. [1] The resulting equation is then solved numerically by Barakat-Clark finite difference technique. [2] We find that kinetic, not equilibrium, governs asphaltene adsorption in laboratory scale experiments. Levenberg-Marquardt's optimization algorithm is used to derive kinetic parameters such as  $\Gamma_{max}$ ,  $k_a$ , and  $k_d$ . Once these concentration-independent parameters are found, the model is able to predict with reasonable accuracy the effect of concentration on asphaltene adsorption in porous media.

### References

- [1] Rudzinski, W., Plazinski W. (2007) J. Phys. Chem. C. 111, 15100-15110.
- [2] Satter, A., Shum, Y. M., Adams, W. T., Davis, L. A. (1980) SPE J. 20, 129-138..