
Partitioning of Binary Solvents on Charged Expandable Clays

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Abstract: The present paper represents an extension of recent work that considered the partitioning response of binary solvents placed into contact with charged, expandable clays. Previous theoretical work yielded a model of partitioning by performing a thermodynamic analysis, involving the work of polarization, on a binary solvent, treated as a continuum and residing within the interlayer space of a layered aluminosilicate clay. Partitioning, or the tendency for sorbed and bulk phases to have different compositions, was shown to be sensitive to the dielectric properties of the 2 solvents of the binary mixture and to the surface charge density on the clay, among other factors. Although previous experimental work has helped to validate the theory, additional work is reported here that looks at hysteresis effects, the role of the exchangeable cation (usually organic), the prediction of adsorption isotherms and the contribution that partitioning, or sorption, makes to the disjoining pressure that develops in binary solvent systems. In this current study, 3 different organo-clays were considered: Cetyltrimethylammonium (CTMA), Isopropanolammonium (IPA), and Benzylammonium (BA) montmorillonite. Solvent systems under study included: acetone/chloroform (a-c), acetone/quadricyclane (a-q) and acetonitrile/chloroform (an-c). While partitioning of the a-c system on CTMA-clay follows theory quite well, theory tends to over-predict partitioning for the a-q system on the same clay and under-predict partitioning for the an-c system on all clays. Predicted adsorption isotherms range from highly nonlinear to nearly linear. Finally, the delamination and subsequent swelling processes of BA-clay in a water/acetonitrile binary solvent system are very sensitive to composition, a result that is directly linked to the partitioning process.

Key Words: Clays • Isotherms • Partitioning • Solvents • Swelling

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