ISSN 2542-2049

Saint Petersburg State University

22nd International School-Conference

Magnetic resonance and its applications

proceedings

Spinus

31 March — 4 April 2025

Saint Petersburg, Russia

Magnetic Resonance and its Applications. Spinus – 2025.
Proceedings. Saint Petersburg State University, **2025**. 267 pp.
Volume 22
ISSN 2542-2049

Reviewer of Proceedings: Vasily T. Lebedev, Doctor of Physics and Mathematics, Head of Laboratory of Neutron Physicochemical Research, PNPI RAS

NMR diffusometry and micellar solubilization using biological surfactants

Daria L. Melnikova, Artem S. Alexandrov, Ruslan V. Arkhipov, Victor P. Arkhipov*
Molecular physics department, Institute of Physics, Kazan Federal University
E-mail: general_zh@mail.ru
** Department of Physics, Kazan National Research Technological University,*
E-mail: vikarch@mail.ru

The micellar extraction method uses the property of micelles and vesicles of surfactants, formed at concentrations above the critical micelle concentration, to solubilize organic compounds, aliphatic, aromatic and polycyclic hydrocarbons, metals and other pollutants. However, the use of synthetic surfactants in itself has a negative impact on the environment due to their toxicity and low biodegradability. Bio-surfactants produced by living microorganisms are used for environmental restoration, bioremediation and soil washing, biodegradation of hydrophobic organic compounds, in food production, cosmetics, pharmaceuticals and are a promising "green" alternative to synthetic surfactants.

An effective method for studying micellar solubilization is the NMR diffusometry method. Selective measurements of the self-diffusion coefficients (SDC) of all components in an aqueous solution of surfactant + solubilizate make it possible to find the distribution of the solubilizate between the bound (in micelles) and free (in water) states within the two-state model. Solubilization of hydrocarbon molecules by surfactant micelles is manifested, and its efficiency can be calculated from changes in the SDC of hydrocarbon molecules with a change in the concentration of surfactant in the solution. In the absence of solubilization, the SDC values of hydrocarbon molecules should not depend on the presence of micelles in the solution, and a possible decrease in the SDC can only be associated with changes in the dynamic viscosity of the solution with an increase in the concentration of rhamnolipid. In the presence of solubilization, one should expect a decrease in the SDC values of hydrocarbon molecules and their convergence with the SDC values of the surfactant with an increase in its concentration in the solution, and, finally, equality of the SDC values of hydrocarbons and rhamnolipid with complete solubilization.

The work summarizes and analyzes the results of studies [1-3] of micellar solubilization from aqueous solutions of substances of the BTEX group (benzene, toluene, ethylbenzene, xylene), phenol, and naphthalene, carried out by the NMR diffusometry method using rhamnolipid as a bio-surfactant.

Acknowledgements

This work was funded by the subsidy allocated to Kazan Federal University for the state assignment in the sphere of scientific activities number FZSM-2023-0016.

References

1. Arkhipov V. P., Arkhipov R. V., Petrova E. V., Filippov A. Magn. Reson. Chem., 61, 345−355. (2023) doi: 10.1002/mrc.5337
2. Arkhipov V. P., Arkhipov R. V., Filippov A. Magn. Reson. Chem., 62, 712–717, (2024) doi: 10.1002/mrc.5468
3. Arkhipov V. P., Arkhipov R. V., Filippov A. ACS Omega, 8, 30646-30654, (2023) doi.org/10.1021/acsomega.3c04367