Journal of Coal Chemistry 2026 No1 pages 18-24 *ISSN 1681-309X*
DOI: 10.31081/1681-309X-2026-0-1-18-24 Specialty G1(161). U.D.C.: 662.7

COMPARATIVE STUDY OF INTERFACIAL DESTABILIZATION MECHANISMS IN EMULSIONS TREATED WITH DEMULSIFIERS

© V.V. Savchenko[1]

National Technical University "Kharkiv Polytechnic Institute" (NTU KhPI), 61002, Kharkiv, Kyrpychova St., 2, Ukraine

K.O. Doroshenko[2]

STATE ENTERPRISE 'UKRAINIAN STATE RESEARCH INSTITUTE FOR CARBOCHEMISTRY (UKHIN)', 61023, Kharkiv, 7 Vesnina St., Ukraine

[1] Savchenko Vitalii Volodymyrovich, Postgraduate Student of the Department of Oil, Gas and Solid Fuel Processing Technologies, ORCID: 0009-0006-0333-1253, e-mail: korbinity@gmail.com
[3] Doroshenko Kristina Olexadrivna, junior researcher of the Chemical Department, ORCID: 0009-0005-1683-4346, e-mail: xo@ukhin.org.ua

The article describes the results of digital image analysis of emulsion samples obtained using a ToupTech device and processed with ToupView software. Direct observation and documentation of emulsion breakdown dynamics in real time were carried out, making it possible to visually track structural changes, in particular the reduction in the number and size of droplets of the aqueous phase. The study analyzes the features of the action of two demulsifiers ("E" and "PM-1441") on the structure and kinetics of the breakdown of water-in-oil emulsions. It is shown that the reagents exhibit fundamentally different mechanisms of influence on the interfacial surface and the aggregative stability of the dispersed system. Demulsifier "E" acts as an active interfacial film breaker, intensifying droplet coalescence and promoting rapid growth of the dispersed phase, followed by efficient gravitational phase separation. However, excessively rapid coalescence may lead to the formation of intermediate layers and partial entrainment of the organic phase into the aqueous phase. In contrast, "PM-1441" predominantly exhibits a flocculating effect, promoting the aggregation of droplets into clusters without complete coalescence. As a result, a metastable flocculated structure is formed, characterized by limited particle growth and a tendency toward secondary dispersion under shear stress. This mechanism is milder and more suitable for systems with a high content of dispersed solid impurities, but it requires a longer settling time. It was established that the efficiency of each reagent is largely determined by hydrodynamic conditions of injection, contact time, and temperature regime. For "E," moderate mixing, subsequent heating, and a shorter contact time are optimal, whereas for "PM-1441," intensive initial mixing, preheating, and prolonged conditioning are required to form stable flocs.

Keywords: demulsifier; interfacial film; emulsion; petroleum products; coking products; microscopy.

Corresponding author: K.O. Doroshenko, e-mail: xo@ukhin.org.ua
Manuscript received 2026/02/26
Accepted for publication 2026/03/30
Published 2026/04/17

How to Cite:
1. Savchenko V.V. Porivniania mekhanizmiv mizhfaznoi destabilizatsii v emulsiiakh, obroblenykh deemulhatoramy / V.V. Savchenko, K.O. Doroshenko // Vuhlekhimichnyi zhurnal. – 2026. – № 1. – S. 18-24. https://doi.org/10.31081/1681-309X-2026-0-1-18-24
2. Savchenko, V. V., & Doroshenko, K. O. (2026). Porivniannia mekhanizmiv mizhfaznoi destabilizatsii v emulsiiakh, obroblenykh deemulhatoramy. *Vuhlekhimichnyi Zhurnal*, (1), 18–24. https://doi.org/10.31081/1681-309X-2026-0-1-18-24

How to obtain the full text of the article:
- within 2 years from the date of publication – upon request by e-mail: post@ukhin.org.ua
- after 2 years from the date of publication – free access in the database "Scientific Periodicals of Ukraine" of the Vernadsky National Library of Ukraine by the link:
http://www.irbis-nbuv.gov.ua/cgi-bin/irbis_nbuv/cgiirbis_64.exe?Z21ID=&I21DBN=UJRN&P21DBN=UJRN&S21STN=1&S21REF=10&S21FMT=juu_all&C21COM=S&S21CNR=20&S21P01=0&S21P02=0&S21P03=PREF=&S21COLORTERMS=0&S21STR=ukhj

References

1. Saraiva S. V. Effect of Flow Conditions on the Dynamics of Chemical Demulsification in Highly Viscous Emulsion Flow / S. V. Saraiva, D. O. L. Fontes, D. Bonetti, A. M. F. Fileti, F. V. da Silva // Industrial & Engineering Chemistry Research. – 2025. – Vol. 64. – P. 12323–12336. https://doi.org/10.1021/acs.iecr.5c01009.
2. Sun T. Influence of Demulsifiers of Different Structures on Interfacial Dilational Properties of an Oil–Water Interface Containing Surface-Active Fractions from Crude Oil / T. Sun, L. Zhang, Y. Wang, S. Zhao, B. Peng, M. Li, J. Yu // Journal of Colloid and Interface Science. – 2002. – Vol. 255. – № 2. – P. 241–247. https://doi.org/10.1006/jcis.2002.8661.
3. Meng M. Investigation of the Microscopic Process of the Media Coalescence Treatment of Water-in-Oil Emulsion / M. Meng, Q. Yang // ACS Omega. – 2023. – Vol. 8. – P. 11908–11915. https://doi.org/10.1021/acsomega.2c07274.
4. Savchenko V. V. Analiz tendentsii rozvytku deemulhuvannia naftovykh i kamianovuhilnykh system / V. V. Savchenko, I. O. Lavrova // Vuhlekhimichnyi zhurnal. – 2016. – № 2. – S. 13–18. https://doi.org/10.31081/1681-309X-2025-0-2-13-19.
5. Miroshnichenko D. Study of Hybrid Modification with Humic Acids of Environmentally Safe Biodegradable Hydrogel Films Based on Hydroxypropyl Methylcellulose / D. Miroshnichenko, K. Lebedeva, A. Cherkashina, V. Lebedev, O. Tsereniuk, N. Krygina // MDPI C. – 2022. – Vol. 8. – P. 71. https://doi.org/10.3390/c8040071.
6. Savchenko V. V. Deemulhatory z buroho vuhillia: syntez, vlastyvosti, zastosuvannia / V. V. Savchenko, L. P. Bannikov // Suchasni tekhnolohii pererobky palnykh kopalyn : tezy dop. 8-yi Mizhnar. nauk.-tekhn. konf., 16–17 kvit. 2025 r. / uklad. D. V. Miroshnychenko ; prohr. kom.: I. M. Ryshchenko, O. L. Borysenko, D. V. Miroshnychenko [ta in.] ; Nats. tekhn. un-t «Kharkiv. politekhn. in-t». – Kharkiv : NTU «KhPI», 2025. – S. 67–70.
7. Mchedlov–Petrosian M. O. Koloidna khimiia / M. O. Mchedlov–Petrosian, V. I. Lebid, V. M. Hlazkova. O. V. Lebid. – Kharkiv: KhNU imeni V. N. Karazina, 2012. – 500 s.
8. Huang B. Study on Demulsification-Flocculation Mechanism of Oil-Water Emulsion in Produced Water from Alkali/Surfactant/Polymer Flooding / B. Huang, X. Li, W. Zhang, C. Fu, Y. Wang, S. Fu // Polymers. – 2019. – Vol. 11(3) . – P. 395. https://doi.org/10.3390/polym11030395.
9. Matytsyn V. M., Leitar S. P., Zhurba V. A., Denysiuk A. M., Haliuk B. V., Serediuk B. V., Lytvyn B. L., Nykolyshyn M. M., Ivanochko B. N., Bratychak M. M., Topylnytskyi P. I., Maksymyk V. Ya., Fast O. O. Cposib znevodnennia ta znesolennia naftovykh emulsii : pat. UA 35503 A Ukraina. MPK S10G 33/04; zaiavl. 21.10.1999. opubl. 15.03.2001, Biul. № 2.
10. Tang L. Research Progress of Surfactant Demulsifier / L. Tang, T. Wang, Y. Hu, Y. Li, X. He, A. Yan, P. Tao, G. Chen // Processes. – 2025. – Vol. 13. – P. 2087. https://doi.org/10.3390/pr13072087.
11. Ahmadi S. Petroleum Emulsion Stability and Separation Strategies: A Comprehensive Review / S. Ahmadi, A. Khormali // ChemEngineering. – 2025. – Vol. 9. – P. 113. https://doi.org/10.3390/chemengineering9050113.