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Electrohydrodynamic phenomena in the water-oil system in an electromagnetic pulsed electric field

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The work examines the electrohydrodynamic process of movement in a system of two immiscible liquids – conducting water and transformer oil, under the influence of a pulsed electric field oriented perpendicular to the interface. It has been shown that with pulsed action there is a more intense movement of conductive water, which leads to its penetration into a layer of lighter oil located above the water. This movement causes a cone of water in the oil to form and grow. The height of the cone depends on the amplitude and duration of the applied voltage pulse. As a result of experiments and modeling, the characteristic time for the water cone to reach the upper potential electrode was determined. The simulation results are in good agreement with the experimental results.

Keywords: conductive water, transformer oil, pulsed electric field, water cone, EHD flows.

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REFERENCES

1. Sun C., Ohodnicki P. R. and Stewart E. M., IEEE Sens. J. **17** (18), 5786–5806 (2017).
2. Ushakov V. Ya., Klimkin V. F. and Korobeynikov S. M., Impulse Breakdown of Liquids, New York, Springer Berlin Heidelberg, 2007.
3. Lesaint O., J. Phys. D: Appl. Phys. **49** (14) 144001 (2016).
4. Chng T. L., Brisset A., Jeanney P., Starikovskaia S. M., Adamovich I. V. and Tardiveau P., Plasma Sources Sci. Technol. **28** (9), 09LT02 (2019).
5. Ding C., Khomenko A. Y., Shcherbanev S. A. and Starikovskaia S. M., Plasma Sources Sci. Technol. **28** (8), 085005 (2019).
6. Kosarev I. N., Starikovskiy A. Y. and Aleksandrov N. L., Plasma Sources Sci. Technol. **28** (1), 015005 (2019).
7. Liu Z., Hara K. and Shneider M. N., Phys. Fluids. **35** (4), 042101 (2023).
8. Shneider M. N. and Pekker M., Liquid Dielectrics in an Inhomogeneous Pulsed Electric Field, Institute of Physics Publishing, 2019.
9. Olsson E. and Kreiss G., J. Comput. Phys. **210** (1), 225–246 (2005).
10. Starikovskiy A. Y. and Aleksandrov N. L., Plasma Sources Sci. Technol. **28** (9), 095022 (2019).
11. Starikovskiy A. Y. and Aleksandrov N. L., Plasma Sources Sci. Technol. **29** (7), 075004 (2020).
12. Starikovskiy A. Y., Aleksandrov N. L. and Shneider M. N., Phys. Rev. E. **103** (6), 063201 (2021).
13. Starikovskiy A. Y., Bazelyan E. M. and Aleksandrov N. L., Plasma Sources Sci. Technol. **31** (11), 114009 (2022).
14. Aleksandrov G. N., Ivanov V. L., Kadomskaya K. P., Kozyrev N. A., Kostenko M. V., Kuchinskij G. S., Polovoj I. F., Ryabov B. M. and Hoberg V. A., Tekhnika vysokih napryazhenij, Moscow, Vysshaya shkola, 1973 [in Russian].
15. Panov V. A., Vasilyak L. M., Vetchinin S. P., Pecherkin V. Ya. and Saveliev A. S., Plasm. Phys. Rep. **44** (9), 882–885 (2018).
16. Panov V. A., Vasilyak L. M., Vetchinin S. P., Pecherkin V. Ya. and Son E. E., Plasm. Phys. Rep. **42**, 1074 (2016).
17. Panov V. A., Pecherkin V. Ya., Vasilyak L. M., Vetchinin S. P. and Saveliev A. S., Plasm. Phys. Rep. **47**, 623 (2020).
18. Panov V. A., Pecherkin V. Ya., Vasilyak L. M., Kulikov Yu. M., Vetchinin S. P. and Saveliev A. S., Applied Physics, № 5, 32–37 (2021) [in Russian].
19. Landau L. D., Lifshitz E. M. and Pitaevskii L. P., Electrodynamics of Continuous Media: Vol. 8, Butterworth-Heinemann, 1984.
20. Panov V. A., Vasilyak L. M., Vetchinin S. P., Pecherkin V. Ya. and Son E. E., J. Phys. D: Appl. Phys. **49**, 385202 (2016).