WICHITA STATE UNIVERSITY
COLLEGE OF ENGINEERING
Department of Mechanical Engineering

December 16, 2025

To the Faculty of Chemistry and Chemical Technology
Al-Farabi Kazakh National University, Almaty, Republic of Kazakhstan

RE: Review of the Research Work of Arshyn Zhengis Toward the Doctoral Dissertation

Dear Members of the Committee,
It is my pleasure to provide a review of the doctoral dissertation work of Arshyn Zhengis, which is presented in the form of a series of scientific articles. The submitted works demonstrate a consistent research direction focused on the design, synthesis, and performance evaluation of zwitterionic polymers and their application in advanced membrane technologies. Below, I summarize the main scientific results and publications. Main Scientific Results and Publications:

a) Article 1 — ACS Applied Materials & Interfaces
"Zwitterion–MOF Functional Interface Enabling Robust Ion and Dye Rejection in Water Filtration"
This work reports the development of a PAN–PVP-based nanocomposite membrane incorporating ZIF-8 nanoparticles and sulfobetaine methacrylate (SBMA). The membrane exhibits excellent removal of heavy metal ions and synthetic dyes. Through FTIR, SEM, XRD, XPS, and zeta potential analyses, the structural integrity and functional performance of the membrane were comprehensively established. Furthermore, DFT and MD simulations were employed to elucidate the molecular-level interactions between contaminants and the zwitterion–MOF functional interface, offering mechanistic insight into the observed ion and dye rejection phenomena.

b) Article 2 — Polymer
"Zwitterionic SBMA-based Nanofiltration Membranes: Synthesis Techniques, Antifouling Mechanisms, and Future Perspectives"
This review article provides a systematic overview of SBMA-based nanofiltration membranes. It discusses fabrication techniques, physicochemical characteristics, and antifouling mechanisms associated with sulfobetaine methacrylate. The author emphasizes that the strong hydration capability and electrical neutrality of SBMA contribute significantly to enhanced antifouling performance. The review also outlines promising avenues for future research and application of zwitterionic materials in membrane technologies.

c) Article 3 — Nanomaterials
"Preparation of Zwitterionic Sulfobetaines and Study of Their Thermal Properties and Nanostructured Self-Assembling Features"
In this publication, four types of sulfobetaine-based zwitterionic polymers were synthesized, and their thermal and self-assembly properties were systematically examined. The study demonstrates that variations in the chemical structure—specifically methacrylamide, imidazole, and pyridine functional groups—significantly influence the polymers' thermal stability and their ability to form nanostructured assemblies. These findings highlight the importance of molecular design in tailoring zwitterionic materials for specific applications.

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Overall, the research conducted by Arshyn Zhengis represents original and highly relevant contributions to the fields of materials science and membrane engineering. The body of work demonstrates a strong command of polymer chemistry, membrane fabrication, and advanced characterization methods. Collectively, these studies provide a solid and comprehensive foundation for a doctoral dissertation. Please do not hesitate to contact me if you need further information.

Sincerely,



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