Expert Opinion of PhD dissertation entitled

"Study on polydimethylsiloxane membrane contactors to recover dissolved gases (CH_4, CO_2) from anaerobic effluents"

written by **Merve Visnyei**

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1) Novelty, Subject and Significance

The topic of the dissertation is highly relevant, timely, and aligned with the current global focus on sustainable energy production and greenhouse gas mitigation. The recovery of dissolved methane and carbon dioxide from anaerobic effluents represents a significant scientific and environmental challenge. The candidate's approach – applying *polydimethylsiloxane (PDMS) membrane contactors* – introduces a novel and technologically promising solution that advances both the theory and practice of wastewater treatment and biogas utilization. The study contributes to the circular economy concept by integrating material and energy recovery within anaerobic processes, thereby improving energy efficiency and reducing fugitive emissions. Its outcomes are of both scientific and social importance, with clear implications for environmental protection and sustainable industrial development.

2) Substantial Aspects

The dissertation provides an extensive and well-structured literature review that covers the fundamental aspects of anaerobic digestion, biogas generation, and gas–liquid membrane separation. The Author demonstrates a deep understanding of the physicochemical principles of gas transfer through membranes. The Candidate critically discusses the most relevant studies and identifies the gaps in existing research, particularly the limited understanding of simultaneous CH_4 and CO_2 removal from real anaerobic effluents. This analytical approach effectively supports the formulation of the research objectives. Overall, the literature review is comprehensive, critical, and scientifically sound.

The experimental design is methodologically correct, modern, and well suited to the stated objectives. The use of non-porous PDMS hollow-fibre membrane contactors in both synthetic and real anaerobic effluents demonstrates a progressive experimental approach. The series of experiments – covering model, synthetic, and real effluents – reflects logical progression and thoughtful planning. The experimental apparatus, analytical methods, and parameter selection are appropriate, reproducible, and in line with contemporary practices in chemical engineering research. The work demonstrates technical competence and precision.

The experimental results are presented in a clear and logically organized manner, supported by well-designed figures and tables. The statistical and mathematical treatment of the data is appropriate, and the interpretations are well justified. The

previously criticized statements related to Figs. 23 and 24 were aligned with equations, and now all of them are clear and informative.

The discussion compares the Candidate's findings with literature data, revealing good consistency with previous studies and identifying the unique contributions of her work. The conclusions are valid and logically derived from the results. The research findings provide new insights into the optimization of membrane-based degassing technologies. The references are accurate and up to date and now showing the same format.

All my remarks and comments have been considered and the dissertation has been revised accordingly.

3) Structure, Presentation and Language

The dissertation is well structured and coherent, with clear chapter organization following academic conventions. A short Introduction has been inserted at the beginning, which I missed in the previous version. Figures and tables are informative, clear, and properly referenced. In general, the formatting of the dissertation is very impressive, formulations of sentences, expressions reflect the elevated level of English language, and the whole work is written in fluent English. The writing style is professional, and scientifically precise. The layout, formatting, and overall appearance of the dissertation meet the high standards expected of a doctoral work.

4) Publication Requirements Scientific Contribution

Merve Visnyei published four first-author-papers: all of them are original works. Out of the four articles, three are written in English, one is in Hungarian, and two have very high impact factors (11.4 and 5.5,) which are very attractive. The Candidate fulfils the requirement of publishing two original first-author papers.

The Candidate participated at four conferences, out of which one was international: a joint conference of 48th International Conference of the Slovak Society of Chemical Engineering SSCHE 2022 and Membrane Conference PERMEA 2022. She also presented her results at two national conferences, namely, 50th Chemical Engineering Days and Water and Wastewater Treatment in the Industry 2022 Conference.These contributions represent original scientific results that advance the field of biogas upgrading and membrane-based degassing. The candidate's results are suitable for publication in high-quality scientific journals.

5) Thesis Point and Overall Assessment

The Candidate formulated four thesis points, including sub thesis points. In the previous version I aimed for some minor clarifications, which have been performed in the final version of the dissertation. Now the thesis points meet the scientific standards, and express standalone statements. I accept all the four thesis points with all subpoints in their current form.

The dissertation written by **Merve Visnyei** represents a valuable and original contribution to the field of chemical and environmental engineering. It demonstrates the candidate's ability to conduct independent, high-quality research and to interpret and discuss results in a scientifically meaningful way.

The work combines technical innovation with environmental relevance, contributing to the development of sustainable wastewater treatment and energy recovery systems.

Based on the scientific quality, novelty, methodological rigor, and overall presentation, **I recommend the acceptance of the dissertation and the awarding of the PhD degree to Merve Visnyei.**

The doctoral thesis submitted by Merve Visnyei contributes to the field of Bio-, Environmental- and Chemical Engineering Sciences and fulfills the requirements for a PhD dissertation. Therefore, I propose the acceptance of the thesis.

After a successful defense I recommend the Candidate to be awarded the degree of Doctor of Philosophy (PhD).

Budapest, 5 November 2025.

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