

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Alexandra Scerbacova

PhD Program: Petroleum Engineering

Title of Thesis: Investigation of Alkyl Ether Carboxylate Surfactants Performance in Carbonate Reservoirs

Supervisors:

Professor Alexey Cheremisin, Skoltech

Associate Professor Ahmed Barifcani, Curtin University

Co-supervisor:

Associate Professor Chi Phan, Curtin University

Name of the Reviewer: Mikhail Spasennykh

I confirm the absence of any conflict of interest	 Date: 07-12-2023
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Reviewer's Report

The topic of the PhD thesis by Alexandra Scerbacova is "*Investigation of alkyl ether carboxylate surfactants performance in carbonate reservoirs*" and is attributed to chemical enhanced oil recovery.

The research is focused on investigation of anionic-nonionic surfactants that may be used in reservoirs with harsh conditions (high temperatures and brine salinities).

The main part of work used linear alkyl ether carboxylate (AEC) surfactants with various molecular structures, and the final part described a commercial application of an AEC-based surfactant blend for a carbonate field. Experimental and computational methods were used in the present study. The content of the dissertation fully corresponds to its title.

The thesis is well structured and consists of seven chapters. (1) First part is a literature review that describes main challenges in oil production from carbonate reservoirs and includes problem statement of the PhD project. (2) Second chapter is devoted to experimental investigation of AECs behavior on the oil-water interface. The effect of molecular structure, temperature and salinity was studied on the example of two surfactants. (3) Third chapter presents the molecular dynamics simulation of AECs on water-decane boundary. Application of this technique allowed increasing the number of studied surfactants and determining main parameters that describe the adsorption of surfactants on the interface (compressibility parameter and adsorption limit). (4) Chapter 4 described rock-fluid interactions of AEC surfactants with limestone samples, namely wettability study and adsorption capacity. (5) Based on previously conducted experiments, a surfactant composition was selected and a coreflooding test with in-situ saturation control was performed. (6) The work is concluded with an example of commercial application of an AEC-based chemical composition. (7) Conclusions and future recommendations.

The methods applied in the dissertation are up-to-date and commonly used in scientific and engineering society. The high level of work is proved with 4 papers published in peer-reviewed international journals (three Q1 and one Q3). The outcomes of this study make a contribution in the design of future chemical EOR projects.

Abstract

- Abstract should include general justification of research, objective, general description of methods and results, please check.
- «A gradual decline in oil production...» - please clarify what you mean, there is increase in hydrocarbon production in RF and in the World.
- Please clarify in abstract that research is focused on carbonate reservoirs, containing huge hydrocarbon reserves in RF and in the World

Chapter 1

- “In carbonates, porosity is typically created by the dissolution of the calcium carbonate minerals that make up the rock by acidic fluids, such as groundwater or hydrocarbons” – this is true for secondary porosity, but not for total porosity (page 22)
- «The *main goal* of the present work is to study the effect of molecular structure on performance of alkyl ether carboxylate surfactants in fluid-fluid and rock-fluid interactions that directly influence on surfactant flooding effectiveness». I would say that it is not clear which molecular structure you mean. I would suggest to correct as «The *main goal* of the present work is to study the effect of molecular structure of alkyl ether carboxylate surfactants on their performance in fluid-fluid and rock-fluid interactions that directly influence on surfactant flooding effectiveness» (page 49).
- Research objectives. It would be clearer, if you find a way to formulate objectives as separate tasks which are considered in different chapters of the thesis and published in different publication (page 49).

Chapter 2 - 6

- It would be more logical if you move published results from motivation sections to conclusions in Chapters 2-6.

Chapter 3.

- In my opinion, results of MD simulations are novel and important for understanding of studied phenomena, but I would suggest to mention in conclusion that this method has limits in application for real systems and now cannot replace experimental research.

Chapter 7

- Very good description of conclusion, contribution to knowledge, future recommendations. My recommendation is to slightly expand/detail/highlight opportunities for industrial applications based on obtained results, by adding additional information or points in 7.1.-7.3

Summarizing, I believe that the candidate is definitely qualified for a PhD degree.

Provisional Recommendation

I recommend that the candidate should defend the thesis by means of a formal thesis defense

I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report

The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense