Skoltech
Skolkovo Institute of Science and Technology

# Jury Member Report – Doctor of Philosophy thesis.

**Name of Candidate:** Maksim Zhmaev

**PhD Program:** Petroleum Engineering

**Title of Thesis:** Experimental evaluation of filtration properties of cryolithozone rocks under conditions of formation and decomposition of gas hydrates

**Supervisor:** Dr. Evgeny Chuvilin

**Name of the Reviewer: Yongwon Seo**

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| I confirm the absence of any conflict of interest<br><br>(Alternatively, Reviewer can formulate a possible conflict) | **Date: 16-11-202** |

*The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense.*

*If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.*

**Reviewer's Report**

Reviewers report should contain the following items:

- Brief evaluation of the thesis quality and overall structure of the dissertation.
- The relevance of the topic of dissertation work to its actual content
- The relevance of the methods used in the dissertation
- The scientific significance of the results obtained and their compliance with the international level and current state of the art
- The relevance of the obtained results to applications (if applicable)
- The quality of publications

The summary of issues to be addressed before/during the thesis defense

The candidate conducted numerous experiments, accumulated substantial experimental data, and derived meaningful conclusions. I commend the candidate for his significant efforts in preparing this doctoral thesis. Below are several minor comments that may be helpful to improve the thesis:

1. In Chapter 4, the candidate should specify the rationale for using a CO2 (55%) + N2 (45%) gas mixture to simulate flue gas. Typically, the CO2 concentration in flue gas ranges from 10 to 20 %.
2. P123, in eq (21), how did the candidate determine "compressibility factor" Z? Was it calculated using equation of states or obtained from data tables?
3. P124, the candidate used a density of 0.794 g/cm3 for CH4 hydrate and 0.788 g/cm3 for CO2 hydrate. However, these values are significantly lower than those reported in the literature. While density values can vary slightly depending on temperature, pressure, and the degree of cage occupancy, the typical density of CH4 hydrate is 0.91 g/cm3, and that of CO2 hydrate is 1.11 g/cm3.
4. In Chapter 6, for CH4-CO2 replacement, given that the initial saturation of the hydrate sample is relatively low, the impact of additional CO2 hydrate formation from residual water appears to outweigh the effect of actual guest replacement on gas permeability. If feasible, it would be beneficial to evaluate these two factors (additional CO2 hydrate formation and actual guest replacement) separately by comparing and analyzing hydrate saturation (Sh) values before and after CO2 injection.

**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*