

Doctoral Dissertation Thesis Review

The title of the Ph.D. thesis:

„The preparation of methyl esters and their application in epoxidation“

Name of Ph.D. Candidate: Ing. David Kocián

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Study program: Physical Chemistry

Supervisor: **doc. Ing. Martin Hájek, Ph.D.**

Opponent: **doc. Ing. Tomáš Soták, PhD.**

The submitted doctoral thesis focuses on studying the preparation of methyl esters from vegetable oils and their further application in epoxidation. The results of the experimental section are divided into two major parts. The first part is focused on the preparation of methyl esters preparation via homogeneous and heterogeneous transesterification reactions. In this part, in the case of homogeneous transesterification (using KOH as a catalyst), the loss of yield of methyl esters due to their transfer across the phase boundary into the glycerol phase was studied. For heterogeneous transesterification (MgAl mixed oxides as catalysts), the influence of residual sodium compounds after catalyst synthesis on the properties of mixed oxides, and also the yield of methyl esters, was studied in detail. In the second part of the experimental section of the thesis, the application of methyl esters obtained from *Camelina Sativa* (non-edible oil) in epoxidation was studied. The dissertation contains a large amount of valuable data and interesting results.

The doctoral candidate Ing. David Kocián has published the results of his scientific research as an author in 8 peer-reviewed journals with high impact factors (in 1 of them as first author, in others as co-author). 6 of them are in the commented set of this dissertation thesis, the other 2 publications were published during the doctoral study, but were not included in the doctoral thesis. He also contributed as a co-author to another high-impact publication, at present time under review. His research findings were also presented at several international conferences (Italy, Croatia, Cyprus, Prague, and Mikulov) through oral presentations and posters. All the results of his research were presented in English.

I found the dissertation to be well-executed overall, and I particularly appreciate the impressive amount of original experimental data it contains. The quality of the written text is very good, with only a minimal number of typographical errors. Overall, the thesis was prepared with care and attention to detail.

As the dissertation thesis is structured in the form of a commented set of published CC papers, which have already undergone peer review, I will just limit myself to a few questions and comments that in no way diminish from the overall quality of the work:

To ME(s) preparation via the transesterification process:

1. Have you tried to repeat the experiment with the best achieved results? If so, how reproducible were the results?
2. Why did you choose the temperature of 450 °C for the mixed-oxide catalyst preparation?
3. Have you tested the reproducibility of the mixed-oxide catalyst preparation? What results did you achieve?

To the epoxidation process:

4. How are the prepared epoxides produced on an industrial scale?
5. Can a different oxidizing agent be used in the epoxidation process? Do you have a plan to use other types of these agents for the reaction?
6. Did you also try to test other types of heterogeneous catalysts? What types of catalysts could be suitable for your process?
7. Have you tried to repeat the experiment with the best achieved results? If so, how reproducible were the results?

General questions:

8. What was the error in the determination of products using the GC/HPLC method in both processes?
9. Considering the extensive amount of experimental data, what was the doctoral candidate's contribution to the experimental data presented in the dissertation and to their interpretation? Which activities did you carry out independently?
10. What are your future research ideas, if you plan to continue your research?

In conclusion, I can state that the submitted dissertation by *Ing. David Kocián* fulfills the requirements for obtaining a Ph.D. degree in the study program of Physical Chemistry.

I recommend the submitted dissertation thesis for defense.

In Bratislava, 8.9.2025

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Product development - Polyolefin R&D



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