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***Comments on the doctoral dissertation***

Author: **Ing. Aleš Vávra**

Title: **Alkali catalysed transesterification of rapeseed oil**

The doctoral thesis by Ing. Aleš Vávra is based on 5 fundamental papers in impacted journals, and also in several related conference presentations concerning investigation of a very attractive theme for an industrial application which is transesterification of rapeseed oil in the presence of heterogeneous and/or homogeneous alkali catalysts. The crucial point of this process development inspired the serious investigation of fatty acids methyl- and/or butyl- esters syntheses which represents key components of bio-diesel. In the beginning it should be stressed that the author's papers published in *Renewable Energy* and *Journal of Cleaner Production* containing main results of the dissertation thesis, belongs without any doubt to the group of top journals in the fields. It should be stressed that all results the thesis were particularly reviewed before their publication.

Ing. Aleš Vávra presents himself by the doctoral dissertation manuscript as a skilled researcher. He summarized in the thesis many important results and very original data of both scientific and practical importance.

First of all, author of the thesis focussed his attention to detailed search of engineering and technology aspects of the tri-acyl-glycerols of rapeseed oil transesterification process. He described very detailed experimental equipments, materials used and methods of their characterization, etc.

Next, author's attention was paid to kinetics of transesterification of rapeseed oil by methanol and butanol catalysed using homogeneous potassium hydroxide catalyst in laboratory batch reactor. He tested the application of heterogeneous catalysts in the form of mixed magnesium-alumina and/or magnesia ferric oxides for the transesterification process using pilot plant fixed bed reactor as well. In this case the long-term catalyst test of catalyst stability was successfully carried out (300h).

Later on, Ing. Vávra investigated the importance of the rate controlling parameters which are: temperature, pH value and electric conductivity of the reaction mixture. Using the last two parameters for the FFA concentration control by an addition of calcium hydroxide or

by stopping the reaction has been verified in the thesis. Special attention he paid to the removal of the FFA from methyl ester and separation improving by inorganic acids addition to the final reaction mixture.

Finally, author's attention was focussed to the importance of successful ester and glycerol phases separation.

It is obvious that the author of thesis has mastered knowledge in broad fields of catalysis, chemical technology, chemical reaction engineering and his own experimental data statistically evaluation.

The achieved results of thesis are clearly demonstrated both in graphical and written forms. It is possible confirm the high quality of research and skills of Ing. Aleš Vávra. The thesis of his doctoral dissertation can be classified the first class from a fundamental point of view. The formulated ideas are original ones and should stimulate much further research in the directions defined in scale up of the esterification process. The only limitation of the results follows from the fact that all experiments have been done in a laboratory or pilot plant scales.

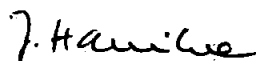
The following question could be discussed in front of the defence committee: Which parameters knowledge, subsequent experimental and process model simulation data, dimensionless parameters and/or simplexes could be proposed for successful transesterification process scale-up, which experiments could be very necessary and important in future research?

In order to conclude, it is possible to express that Ing. Aleš Vávra made a significant progress in studied topics. Concerning the quality of the performed research I would like to underline that from my point of view already the high level publications itself represents sufficient and the most valid prove.

Doctoral thesis of Mr. Vávra and his papers collection are in all aspects comparable to the high standard which is in the Faculty of Chemical Technology, University Pardubice respected. In short, the author has brilliantly completed an outstanding work that is already recognized by chemical technology community.

**Thus, I would like to recommend submitted doctoral thesis of Ing. Aleš Vávra: both to the defence committee and to the Faculty of Chemical Technology, University Pardubice to accept thesis as the doctoral dissertation.**

Prague, 3th November 2019



Prof. Ing. Jiří Hanika, DrSc., dr. h. c.