FACULTY OF MECHANICAL ENGINEERING
DEPARTMENT OF PROCESS ENGINEERING
Prof. Ing. Tomáš JIROUT, Ph.D.
SUPERVISOR

CTU
CZECH TECHNICAL UNIVERSITY IN PRAGUE

In Prague 12. 7. 2021

Supervisor evaluation

Student: Ing. Mehmet Ayas

Ing. Mehmet Ayas has been enrolled in a doctoral study program at the Department of Process Engineering, FME CTU in Prague in 2015. Currently, He has been employed in the position of research engineer in the same department. With respect to the excellent results of his research and development work, teaching, and other activities he will continue with his research career at our department. The department expects continuous cooperation with Ing. Ayas in form of a working position dealing with CFD simulations and mathematical modeling of processes and equipment.

His doctoral study is oriented upon to theory of flow and agitation of pure viscous non-Newtonian fluids in the laminar flow regime. This theory is applied to the investigation of the specific fluid flow in industry apparatuses, mainly on the non-circular channels and mixing stator-rotor apparatuses. At first, Ing. Mehmet reviewed the theory about non-Newtonian flow in rectangular channels. During his investigation of theory and experiments from literature survey and by his own models and calculations he observed interested founding. He founded out that the intersection location of all curves representing dependency of correction coefficients on power-law model flow index is in number one in a wide range of aspect ratio of the rectangular channel. This correction factor for calculation of flow characteristic (pressure drop vs. flow-rate) of power-law model fluid in the channel is used for non-circular cross-section. The correction factor depends on empirical parameters obtained by experiments defined in the literature. This phenomenon hasn't been published so far. Then He started to found out the semi-empirical mathematical expression of this phenomenon. Finally, he defined expression which simplified the dependency of correction factor on flow index. This simplification can be used for rapid engineering calculation with advance and with the accuracy of 5 % from experimental results published in the literature. The simplicity and more the geniality of the simplification is one parameter dependency. Moreover, this parameter is nothing new, it is just and only well-known and already published geometrical parameter for the flow of Newtonian fluid flow in non-circular channels. Before publishing these results, the years of investigation, evaluation and cross-checking were spent. The new formula was tested for different shapes of non-circular channels, because it is valid not only for rectangular channels but also for concentric annulus, isosceles triangle, elliptical channel, symmetrical L-shape channel, and eccentric annulus channel.

To find other applications of this expression He further investigates the agitation of viscoplastic fluid in an in-line rotor-stator mixer. Due to laminar flow and the narrow gap between the developed rotor and stator of the mixer the investigation of applicability can be done. The new construction of the rotor-stator mixer has been developed. The mixer has been built up. Experiments with viscoplastic material have been carried out on this device. The integral

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characteristics of the process were measured. Also, CFD simulations of this device were performed by Ing. Ayas to achieve a detailed view inside the flow characteristic and for comparison and validation of the model with experimental data. The new power number for such devices has been established. It consists of power number for overcome yield stress and power number of sheared flow as well as the efficiency of mixing process was defined. Investigations were performed for the different gap between rotor and stator parts and for the different revolutions of the rotor. Metzner-Otto coefficient was found out for investigated geometry as well as dimensionless power number dependency on Reynolds number.

Besides these topics, he has been collaborated on other basic and applied research and also on cooperation with industry partners. His main specialization is CFD simulation of fluid single and multiphase flow in process apparatuses and construction optimization. He was involved in the cooperation with industry partners for the development of a new mixer for viscoplastic material or the design of a new agitator for honey production. The projects of MPO, OPPI Development of new technologies firing lightweight, CZ.01.1.02/0.0/0.0/16_084/0009975, Internal projects of SGS were successfully solved with his contribution. Nowadays he is participating in the project of TACR, Trend, Hybrid Diesel-Electric powertrain for mining suspended monorail locomotive, FW01010484.

The results of his research work are regularly published and presented on international scientific platforms. He is the main author of several articles in impacted journals and journals indexed in databases WoS and Scopus.

Ing. Ayas has been also involved in the teaching activities in the magister study program. Currently, he is a teacher of the subject of Numerical analysis of processes and Modelling, control and analysis of processes. He is also the supervisor of students' semester works on these subjects.

The scientific career of Ing. Ayas is more oriented toward theoretical study and CFD analysis. In terms of access to his research, it is necessary to appreciate his deep theoretical knowledge and overview of publications on the topic, independence at work, and a wide range of scientific directions.

Prof. Ing. Tomáš Jirout, Ph.D.
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