

Prague, 19th May 2023

## The Supervisor's Letter of Evaluation

**Student:** Ing. Andrey KUTSAY

**Student ID:** 371318

**Doctoral Study Programme:** Mechanical Engineering

**Study Field:** Design and Process Engineering

**The Title of the Thesis:** Technology and equipment for lignocellulosic waste conversion to biofuels and bioproducts with high added value

**Supervisor:** Prof. Ing. Tomáš Jirout, Ph.D.

**Co-Supervisor:** Assoc. Prof. Ing. Lukáš Krátký, Ph.D.

PhD studies of Mr Kutsay were professionally scoped to waste-to-X conversion technologies. He profoundly and critically assessed the potential of lignocellulosic waste treatment in a biogas plant to produce biofuels and biochemicals with added value.

Regarding the study block of a PhD programme, his theoretical background was deeply enriched by studies of theoretical subjects (*Momentum, heat and mass transfer – special tasks; Selected topics from diffusion separation processes; Partial differential equations*) and applied courses (*Technology of biogas and biohydrogen production; Energy production of biomass*). The study block gave him core knowledge to perform a multidisciplinary biotechnological, chemical and mechanical engineering transfer to design a biogas plant facility in original biorefinery concepts. The state exam finished his study block with distinctions.

His R&D task scoped to confirm or disprove the hypothesis that lignocellulosic waste treatment in biogas biorefinery producing bioproducts and biofuels simultaneously can meet industrial attractivity independent of green subsidies. He created the original parametric biogas plant model that allows combining several pretreatment steps (*mechanical size reduction, hydrothermal pretreatment*) and promising product processing techniques (*cellulosic fibre production, biogas cogeneration, biogas upgrade to biomethane, CO<sub>2</sub> to microalgae*). Experimental data and published information calibrated the model. He proposed seven original pathways deeply defined in PFD schemes, material and energy balances expressed by mutually interconnected physical or semi-empirical modelling equations, followed by basic equipment design, economic and sensitivity analysis. Regarding the technical maturity of waste-to-X and

investing attractivity with no green subsidies, Mr Kutsay stated that the biogas plant with mechanical size reduction of lignocellulosic biomass and biogas upgrade to biomethane was the profitable solution for lignocellulosic waste treatment.

Mr Kutsay worked with the tiny support of supervisors. He showed great effort and ambitions to work independently on supervisor help, whose role was only as mentor support. He was competent in understanding the topic, critical thinking about mutual processing steps from a mechanical engineering point of view, creating unique technological pathways as blockchains in a complex parametric model, identifying suitable processing chains at TRL>7 with economic attractivity and presenting all the gained results in impacted journals, international and national conferences. He published 3x impacted articles in the WoS database, 3x conference papers in the Scopus database, and 4x papers or abstracts. He participated in 6x international and 1x national conference. He lectured on "Biogas Biorefinery: Techno-economic Analysis" at the International Conference on Engineering for Waste and Biomass Valorisation in 2018. A deep factual discussion with plenty of participants followed that. He reached the H-index with the value of 2 (dated 12.4.2023).

Grant Agency of the Czech Technical University in Prague endorsed his research and development activities, grant No. SGS15/067, SGS16/149, SGS18/129. All the project activities and gained results became the backbone to submit the project dealing with the excellent research "Research Centre for Low-carbon Energy Technologies" that was supported was supported by the Ministry of Education, Youth and Sports of the Czech Republic under OP RDE grant number CZ.02.1.01/0.0/0.0/16\_019/0000753.

He has been employed in the Casale Project in different positions (mechanical engineer, construction manager, project manager) since 2019. As a result, he reached several industrial realizations, e.g. JSC TOGLIATTI AZOT (Urea Plant, 2200 MTD, Tolyatti, Russia), JSC NAVOIYAZOT (nitric acid production plant, 1500 MTD, Navoiy, Uzbekistan).

*Assoc. Prof. Ing. Lukáš Krátký, PhD.*

*Co-Supervisor*

*Prof. Ing. Tomáš Jirout, PhD.*

*Supervisor*