

I. IDENTIFICATION DATA

Title:	Thermal-expansory pretreatment of lignocellulosic wastes in industrial scale
Author:	Bc. Andrey Kutsay
Type of thesis:	master
Faculty/department:	Faculty of Mechanical Engineering
Department:	Department of Process Engineering
Supervisor:	Ing. Lukáš Krátký, Ph.D.
Supervisor's place of employment:	FME CTU in Prague, Department of Process Engineering

II. EVALUATION CRITERIONS

Diploma thesis assignment	Challenging
<i>Difficulty evaluation of the diploma thesis assignment.</i>	
Based on experimental result in lab-scale, the main aim of the master thesis was to design and optimize (energy recovery, economical point of view) a model intensified biogas plant by both mechanical disintegration and thermal-expansory pretreatment technology. There was necessary to understand pretreatment and biogas technology and to apply all the knowledge of process engineering to design such an optimized intensified biogas plant and to prove its returnability. There is globally no information about implementation of this pretreatment technology to biogas technology. This topic was therefore very challenging.	

Fulfilment of thesis's assignment	Fulfilled
<i>Evaluate, whether the proposed final work fulfils the assignment. Comment where appropriate, points of reference that were not fully met, or if the work is extended compared to assignment. If the assignment is also not completely fulfilled, try to assess the importance, impact and possibly cause various deficiencies.</i>	
The main tasks of this thesis were to (1) summarize present knowledge of biogas technology, i.e. its principle, suitable process parameters, possibilities of process intensification, (2) to design a flowsheet of non- and intensified biogas plant for a model raw material including mechanical disintegration and thermal-expansory pretreatment, i.e. flowsheet, process parameters, mass and energy balances, process optimization, heat recovery, process economy and overall energy-economic balance, and finally to (3) elaborate an energy-economic feasibility study of non- and intensified biogas technology. All this problematic was discussed in individual chapters and subchapters in detail. The tasks of thesis were therefore fulfilled.	

Activity and independence during thesis's processing	A-Excellent
<i>Evaluate whether the student was active during thesis's processing, whether he respected specific deadlines, if his solution was continuously consulted and whether he was sufficiently prepared for consultations. Consider the student's ability to work independently and creatively.</i>	
The author's approach was very active and I can proclaim that he completely self-fulfilled all the objectives of thesis. Author also regularly discussed a progress in specific objectives during plenty of consultations that were usually held once per week. The student was always well prepared in terms of expertise for consultations.	

Professional level	A-Excellent
<i>Assess the expertise level of thesis, using knowledge gained from the study of scientific literature, documentation and utilization of data obtained from practice.</i>	
Author firstly became familiar with biogas technology and environmental-friendly methods of biomass pretreatment, namely mechanical disintegration and thermal-expansory pretreatment including their effect of process parameters on biogas production and their optimization as for biogas yield. Based on this information, he designed flowsheets of non- and intensified model biogas plant respecting process optimization. He also evaluated process economy and overall-energy economic balances for both model technologies. He proclaimed a high level of skills to transfer a broad theoretical background to design a really brand new biogas technology with full heat recovery. The text of thesis itself and all the performed process calculations therefore confirmed his high professional level and his broad practical knowledge applicable in biofuel technologies.	

Formal and language level**A–Excellent**

Assess formal correctness in the bibliography, the typographical and linguistic aspects of thesis.

Thesis contains all the necessary formal requirements. The text is written clearly, concisely and understandably, it is well readable. I assess this thesis as excellent as for formal and language level.

Bibliography**A–Excellent**

Comment the student's activity during the acquisition and use of learning materials to solve thesis. Characterize the selection of sources. Assess whether the student made use of all relevant sources. Verify that adopted information is properly distinguished from student's results and considerations, whether citation forms correspond with ethics, whether bibliographic citations are complete and finally whether all citations are in accordance with the practices and standards.

Author used relevant 35 references in the text. Citations in the manuscript and their format listed in the bibliography are in accordance with the European Copyright Act No. 121/2000 and even with all the citation practices. Therefore, the work in terms of selection of literature sources and correctness of citations is also excellent.

Other comments

Comment the level achieved major results of the final work, e.g. the level of theoretical results, or the functional level of technical solutions, publication outlets, experimental skills, etc.

The results of this thesis were continuously published as oral presentation at "Studentská tvůrčí činnost 2015", where Mr. Kutsay was placed at 5th position in the competition for the best paper of undergraduate section S2, and as a poster presentation at 23rd European Biomass Conference and Exhibition.

- Kutsay, A. - Krátký, L.: Energy-economic study of thermal-expansive pretreatment for its implementation at biogas plant. In 23rd European Biomass Conference and Exhibition Proceedings. Florence: ETA - Florence, 2015, ISSN 2282-5819. ISBN 978-88-89407-51-6.
- Kutsay, A. - Krátký, L.: Thermal-Expansive Pretreatment of Lignocellulosic Biomass: An Energy Feasibility Study. In Studentská tvůrčí činnost 2015. 2015, ISBN 978-80-01-05727-8.

III. FINAL EVALUATION AND PROPOSAL OF CLASSIFICATION

Summarize aspects of the thesis that most influenced your final evaluation.

Mr. Kutsay firstly became familiar with biogas technology, i.e. with portfolio of processed biomass, technology design and suitable process parameters. Then he studied the possibilities how to intensify biomass biodegradability and how to increase biomethane yield in depth. His scope was primarily devoted to become familiar with environmental-friendly methods of biomass pretreatment, namely mechanical disintegration and thermal-expansive pretreatment including their effect of process parameters on biogas production and their optimization as for biogas yield. Based on this information, he designed a flowsheet of non- and intensified model biogas plant, where wheat straw as a model material was used. These technologies were successfully optimized as for heat recovery, process economy and overall-energy economic balance were estimated. He showed a high level of skills to transfer a broad theoretical background to design a really brand new biogas technology with process optimization as for heat recovery and economical point of view. The main contribution to industrial science, the novelty, is the energy optimized design of intensified biogas technology, where process parameters and process characteristics of individual machines and equipment are summarized. All these calculations were done using Microsoft Excel. There is therefore a possibility to recalculate all these process parameters only by modifications in input and optional data. This software and flowsheet together make the thesis original and high-quality ranking. Based on these outputs, general design of this technology is nowadays ready to be applied in industrial scale.

This thesis fulfilled all the requirements for master thesis. Based on its high-quality, I undersigned Lukas Kratky, I evaluate it as the supervisor by the grade **A – excellent**.

Date: 11.8.2015

Signature: Ing. Lukáš Krátký, Ph.D.

