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T h e R e v i e w

of Doctoral Thesis

Ing. Václav Novotný : *Absorption Power Cycle with Aqueous Salt Solution for Low Temperature Heat Utilization*, Czech Technical University in Prague, Faculty of Mechanical Engineering, Prague, 2022.

The submitted Doctoral Thesis contains 282 pages of text with title page, Acknowledgements, Highlights, Declaration, editorial page, Abstracts in English, Czech and Chinese languages, Contents, List of Figures, List of Tables, Bibliography, list of Author´s publications related to the thesis, Nomenclature, nine Appendices and list of Author´s Scopus/WoS publications.
The topic of the Doctoral Thesis is investigation and creation of absorption power and cooling cycle. Experimental absorption power unit was designed and built. Obtained operation data are analysed and discussed.
Introduction describes waste heat as a field with notable benefits to power engineering of decentralized systems.
In Chapter 2 concepts of absorption power cycles are summarized. Various working fluids for absorption power cycles and for absorption combined power and cooling cycles are described. Overview of experimental and commercial cycles is shown.
Chapter 3 presents a review of major components of absorption power cycles. They are heat exchangers, absorbers, separators, pumps.
In Chapter 4 considerations on expanders and on additive manufacturing technologies are summarized.
Chapter 5 introduces the goals of the Doctoral Thesis.
Theoretical investigations of absorption power cycles are described in Chapter 6. Thermodynamic models are proposed. Important performance quantities are introduced and described. Achieved results from solution of parameters of the lithium-bromide-based cycles are compared with available data from literature. General analysis of utilization of heat source is performed and presented. Analysis of sensitivity of cycle parameters is performed.
Chapter 7 describes configurations and design of two absorption power systems for experimental investigation. Operation of both experimental rigs is analysed. Measurement uncertainties are evaluated.
Chapter 8 presents concept and design of turbo-expander for absorption power system. Testing and evaluation methods are summarized. Performance results of air and steam turbines are experimentally determined and discussed from point of recommendations for further development of turbo-expanders for absorption power systems.
Chapter 9 summarizes conclusions of the Doctoral Thesis. Theoretical investigation was focussed on thermodynamic model for absorption power system working with aqueous salt solutions. Performance and results have shown the overall technical feasibility of designed and built experimental absorption power system.
Numerical models, tables of computational results, design details of both test rigs, uncertainty evaluations, axial turbine design and evaluation of isentropic efficiency of air turbines are presented in Appendixes.

Assessment

Theory of heat cycles is significant for preparation of conceptions and design of power engineering units and for analysis of their performance. Components of heat cycles have to be

thoroughly investigated for reliable and efficient operation of power engineering units. The author turned his research activity to absorption power cycles working namely with lithium bromide aqueous solutions. He chose three main goals : to find theoretical benefits and range of prospective applications of absorption power cycle, to prove technical feasibility of the absorption power cycle (by its designing and building, by its demonstration, by its component operability, and by comparison theoretical and real operation), and to suggest actual range of its applicability for future development of salt solution of absorption power cycles. Extensive theoretical analyses of heat cycles have different criteria from which the author of the Doctoral Thesis derives lithium bromide aqueous solutions to be best candidates of proposed absorption system. His approach is based on the system of balance equations for solution of performance parameters. The reviewer highly appreciates the author´s experimental investigation of absorption power systems. The author of the Doctoral Thesis designed and built two test absorption power cycle units with lithium bromide aqueous solutions. His achieved results are valuable for further development of absorption systems for waste heat utilization. Namely values of measured efficiencies of the system and its components give an impetus for significant improvement in future designs. It is possible to state that the goals proposed by the author of the Doctoral Thesis were achieved.

The submitted Doctoral Thesis is topical contribution to investigation, design and operation of power engineering systems with working fluids namely aqueous salt solutions. Undoubtedly, further research and technical projects with low temperature heat sources will follow this achieved experience and knowledge. The author proved his good knowledge in the field of power engineering and his experimental skills. Results of performed analysis of uncertainties of measurements are interesting.

The reviewed Doctoral Thesis has logical structure. The Thesis is understandable. Many figures have so small letters that the reviewer had to use electronic version of the Thesis to apply zoom to magnify them. The reviewer found misprints, inconsistencies in the Thesis. This note does not affect outstanding achieved results.

The reviewer has following questions :

1st Why are data in many Tables (for instance pp. 57, 62, 66,74, 81, 86, 91) in the Chapter 6 Theoretical Cycle Investigations called “Boundary conditions”? Are there differential equations in the author´s theoretical model?

2nd Absorption and desorption processes are crucial for design and operation of absorption power cycles. Has the author of Doctoral Thesis some experience with possibility to affect them for their control and intensification?

Conclusion

Submitted Doctoral Thesis is on very good level and contributes to research and design in the field of power engineering. The author fulfilled proposed goals. The author performed theoretical analysis for application of absorption power cycle in utilization of waste heat. The author designed and built two test absorption power cycle units. He achieved valuable results for further investigations of utilization of low temperature heat sources. The author proved his creative capacities and his very good professional knowledge. The reviewer

recommends Doctoral Thesis by Mr. Václav Novotný for defence

before the Committee for Defence of PhD. Thesis in the study field Power Engineering. After successful defence it is recommended to award a degree

Philosophiae Doctor (PhD.)

to Mr. Václav Novotný.

Prague April 18th, 2022