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Title of doctoral dissertation:

ADSORPTION PROCESES IN ATMOSPHERIC AIR SEPARATION TECHNOLOGY

Thesis supervisor: **prof. dr hab. inż. Maciej Chorowski**

Summary of dissertation

The purpose of the dissertation is the theoretical and experimental analysis of the possibilities of usage of adsorptive methods of air separation to create oxygen for thermal power engineering, especially connected with implementation of oxyfuel combustion technology as a method of carbon capture and storage. The methods of producing oxygen for power engineering must characterize itself with high performance, oxygen purity level higher than 95% and possibly low energy consumption.
The scope of the dissertation includes:

- analysis of adsorptive methods of air separation
- project and build of testing apparatus for adsorptive methods of air separation
- conducting of PSA, VPSA and PTSA methods study
- energy consumption optimization for air separation using PSA and VPSA methods
- analysis of the possibilities of coupling power unit with an adsorptive installation of air separation.

As a result of theoretical analysis, thermodynamic cycles of air separation technology using PSA, VPSA, TSA and PTSA methods have been created. For the purposes of the research, oxygen extraction system using PSA technology has been designed and build. The system allows to examine procedures for oxygen separation for the purpose of laboratory installation of oxyfuel combustion and to examine the influence of pressure and temperature change on the performance of oxygen separation process.
During the examination of PSA technology, the influence of process variables on air separation key parameters has been defined. Laboratory research allowed to establish new start sequences for adsorptive oxygen generators. It has been proved that energy consumption decreases with increasing of their performance.
After the PSA and VPSA technology research lab equipment for the adsorptive oxygen generator has been adopted to work in PTSA technology. The PTSA technology has provided information about possibilities of heat usage in adsorptive oxygen separation process.
Methods of coupling adsorptive oxygen generator and power unit have been proposed. It has been proved that for the purposes of oxyfuel combustion in low-power units, the adsorptive oxygen separation installations are competitive in comparison to cryogenic ones.

The dissertation has been prepared in partnership with The National Centre for Research and Development as a part of a strategic program of scientific research and development *"Advanced Technologies for Energy Generation"* - research task No. 2 *"Developing a technology of oxyfuel combustion for pulverized fuel and fluidized-bed furnaces integrated with CO_2 capture system"*.

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