

EPT-M-2010-5

## MASTER THESIS

for

Stud.techn. Ole Kristoffer Abrahamsen

Spring 2010

*Hydrogen storage: Thermophysical data and flow properties for some porous media*  
*Hydrogenlagring: Termofysikalske data og strømningssegenskaper for noen porøse medier*

### Background and objective.

Hydrogen on-board storage is a critical matter for development and commercialization of hydrogen based vehicles. However, the hydrogen storage systems presently available do not meet standards imposed by the U.S. Department of Energy and the automobile industry and needs improvements. Sorption type materials have been identified as a viable option. They are characterized by high porosity and surface area. However, the thermal effects that occur during the filling and discharging of a storage system play an important role in the utilization of the hydrogen adsorption storage systems.

The objective of the project is to design experimental test rigs and perform experiments for the characterization of thermal properties of some adsorption type storage materials.

The work is a continuation of the project work.

### The following questions should be considered in the project work:

1. Permeability:
  - a. A test rig for the measurement of permeability in porous materials shall be designed and documented. Required instrumentation and measurement accuracies shall be specified. The experimental uncertainty shall be evaluated.
  - b. An experimental program for the determination of permeability of selected porous materials shall be performed. The materials shall be described, and measurement results shall be analyzed, discussed and presented. A comparison to relevant literature data shall be made, if possible.
2. Thermal conductivity:
  - a. Based on the results of the project work, a complete setup for the measurement of thermal conductivity on porous materials shall be designed. All required equipment specifications and instrument accuracies shall be determined, and suitable equipment shall be selected. A complete experimental uncertainty analysis shall be performed. Additionally, numerical analyses shall be performed in order to assess the temperature and heat flow distributions in the test setup.

- b. Experiments shall be performed on the test setup. Materials and material combinations for analysis shall be selected in cooperation with the Department. The experimental results shall be analyzed, presented and discussed. A comparison with available literature models shall be performed and the results discussed.
3. Suggestions for further work shall be presented and discussed.

Within 14 days of receiving the written text on the diploma thesis, the candidate shall submit a research plan for his project to the department.

When the thesis is evaluated, emphasis is put on processing of the results, and that they are presented in tabular and/or graphic form in a clear manner, and that they are analyzed carefully.

The thesis should be formulated as a research report with summary both in English and Norwegian, conclusion, literature references, table of contents etc. During the preparation of the text, the candidate should make an effort to produce a well-structured and easily readable report. In order to ease the evaluation of the thesis, it is important that the cross-references are correct. In the making of the report, strong emphasis should be placed on both a thorough discussion of the results and an orderly presentation.

The candidate is requested to initiate and keep close contact with his/her academic supervisor(s) throughout the working period. The candidate must follow the rules and regulations of NTNU as well as passive directions given by the Department of Energy and Process Engineering.

Pursuant to "Regulations concerning the supplementary provisions to the technology study program/Master of Science" at NTNU §20, the Department reserves the permission to utilize all the results and data for teaching and research purposes as well as in future publications.

One – 1 complete original of the thesis shall be submitted to the authority that handed out the set subject. (A short summary including the author's name and the title of the thesis should also be submitted, for use as reference in journals (max. 1 page with double spacing)).

Two – 2 – copies of the thesis shall be submitted to the Department. Upon request, additional copies shall be submitted directly to research advisors/companies. A CD-ROM (Word format or corresponding) containing the thesis, and including the short summary, must also be submitted to the Department of Energy and Process Engineering

Department of Energy and Process Engineering, 12. January 2010



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