

IPID4all Senior Research Exchange with Carl von Ossietzky University of Oldenburg

Feedback report

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Home supervisor

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Exchange period

2017.01.06-2017.08.26

Exchange topic

*Hydrogen purification using pressure swing
adsorption with Aspen platform*

Host university

Carl von Ossietzky University of Oldenburg

Host research group

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Host supervisor

Prof. Michael Wark

Introduction

With the help of the programme "IPID4all - Mobile Doctorates in System Integration of Renewable Energy", it is helpful to strengthen technical cooperation of renewable resources. It provides a good way to share the information and exchange ideas and experiences for renewable energy even the new energy vehicles. What's more, it is helpful to deepen research cooperation and exchange between Carl von Ossietzky University of Oldenburg and Wuhan University of Technology. On the basis of what I learned I am studying on hydrogen production and purification using pressure swing adsorption and doing simulation with Aspen platform. Its destination is in agreement with the ambition of the host institutions towards hydrogen production and purification. It can not only promote the research of doing different process simulations with Aspen platform, but also exchange ideas and experiences for obtain high purity hydrogen safely and effectively. Thanks to Dr. Alexandra Pehlken to introduce my home supervisor Prof. Jinsheng Xiao and myself to my host supervisor Prof. Michael Wark.

Research Undertaken

Pressure swing adsorption (PSA) is a widely-used technology to purify hydrogen from industrial hydrogen-rich exhausted gas. Metal Organic Frameworks (MOFs), such as Cu-BTC, have the characteristics of structure diversity, high pore volume, large specific surface area and strong selectivity, which are considered as a new adsorbent in the field of PSA. Aspen Adsorption is an engineering software to implement the multicomponent adsorption, heat and mass transfer model for predicting breakthrough curves and PSA cycle performance of hydrogen gas mixture. The model is validated by experimental data, then parametric studies are conducted to investigate the influence of adsorption pressure, feed time and flow rate on breakthrough curves and PSA cycle performance.

Personal Experience/Activities

During my stay in University of Oldenburg, I have got a lot of unforgettable experience. In this process, I had many discusses with my colleagues and got a lot of new thoughts from them, it was very kind of them to help me, and I also enhanced the ability of communication and reading English literatures. In addition, I also talked with the other students in the laboratory, not only enhanced the understanding of the cultural atmosphere, but also realized the academic rigour and professionalism from the people in the university, which was stemmed from their love for their work. Here are my main activities during this period.

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- Got a certificate after taking the course “Chemical Process Development” which was taught by Prof. Jürgen Rarey and had many discussions with the classmates not only German but also Thai.
- Gave the presentation of “Optimization of Pressure Swing Adsorption Cycles for Hydrogen Purification Using Cu-BTC” to Prof. Michael Wark and his students.
- Attended the weekly seminar held by Prof. Michael Wark and learnt a lot from the students in this group.
- Visited the laboratories in Institute of Chemistry and understood the use of each experimental instrument.
- Discuss with the PhD student Pascal Böwer on process simulation on Aspen platform and learn something new about purification methods from him.

Conclusions

Based on the previous work performed in Wuhan University of Technology, during the period of the visiting in Carl von Ossietzky University of Oldenburg, I made further progresses on the following points:

- A multicomponent adsorption, heat and mass transfer model development for hydrogen purification system and implemented on Aspen Adsorption platform.
- The model validation by the experimental data from the reference, which shows good agreement in both breakthrough curves and PSA cycles.
- Simulations under three different pressure and gas feed rate in breakthrough curves, the results show that lower pressure and faster gas feed rate induces earlier breakthrough points.
- Parametric studies showing that, within a certain range, higher adsorption pressure, shorter feed time and lower feed rate lead to higher hydrogen purity, but lower recovery and productivity.

With the study exchange at the Carl von Ossietzky University of Oldenburg, I not only did some work there, but also experienced the Germany culture. It's very helpful for me to improve my English and make many friends from all over the world. I love this period of foreign study and life and it will be the most valuable in my whole life.

Outlook

- We planned to publish a joint paper on the topic “Parametric Study of Hydrogen Purification Performance by Pressure Swing Adsorption on Activated Carbon Multi-beds”.
- The student exchange will also be planned between Institute of Chemistry at Carl von Ossietzky University of Oldenburg and my group, the Hydrogen Energy Research Group at Wuhan University of Technology, through the DAAD funded programme IPID4all.



- Fig.1 Joined the course “Chemical Process Development” which was taught by Prof. Jürgen Rarey

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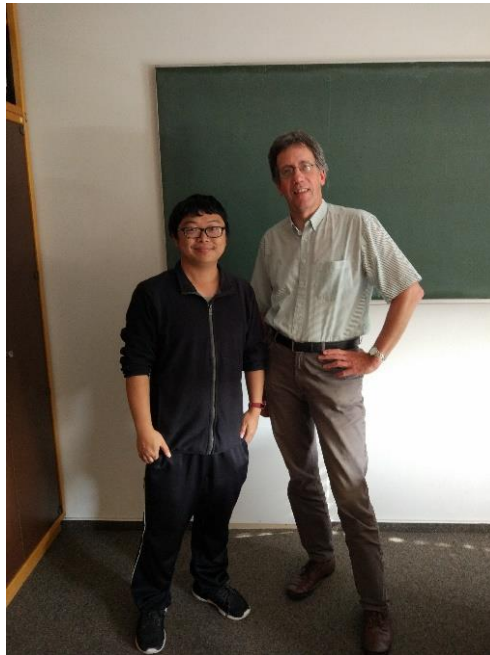


Fig.2 Discussed the joint paper with Prof. Michael Wark in his office.



Fig.3 Discussed with Pascal Böwer on process simulation on Aspen platform

Acknowledgement

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