**Modelling advanced adsorption processes for post-combustion capture.**

\*\*FULLY FUNDED PROJECT UK/EU ONLY\*\*

Applications are invited for postgraduate research over 3.5 years leading to a PhD degree in Chemical Engineering funded by the Energy Technologies Partnership, Process Systems Enterprise and the University of Edinburgh.

Carbon capture from power stations and industrial sources is an essential pillar in the effort of reducing greenhouse gas emissions in order to achieve the legally binding target set by the 2008 Climate Change Act of 80% reductions by 2050. The current state-of-the-art technologies for post-combustion capture (including retrofit options for existing plants) are based on amine scrubbers, but inherent energy requirements make this an expensive option and significant research is aimed at the development of next generation carbon capture processes that reduce the cost of capital equipment and the energy needed.

Adsorption based processes deliver significant improvements and the US DOE has identified this area as having the potential of achieving a cost of electricity for a pulverised coal plant with carbon capture and CO2 compression that has < 35% cost increase over the plant without capture.

The proposed project builds on the significant adsorption research programme in the carbon capture group at the University of Edinburgh as part of the Scottish Carbon Capture and Storage centre. The student will have access to existing equipment and data. There will be 3 main tasks to the project:

1) In collaboration with Process Systems Enterprise (PSE) we will define base case studies and develop detailed models for rapid thermal swing adsorption and advanced multistage vacuum swing adsorption processes. These will consider initially a pre-dried feed gas stream.

2) Develop a detailed model, with experimental validation, of a hybrid condenser/adsorption process to dry the flue gas.

3) Study the process integration options for case studies (as in 1 above) including both coal and gas fired power plants.

While most current research does address to some extent points 1 and 3, there is very limited fundamental information on point 2. The challenge is to arrive at a reliable process model, but this is particularly difficult since water in adsorbent particles will give rise to a combination of capillary condensation and adsorption in nanopores. This combination is complex since in capillary condensation adsorption and desorption are significantly different, i.e. there will be a hysteresis in the equilibrium curves.

As part of the research activity, a specially designed zero length column cell will be used to measure both adsorbed amounts and temperatures and will allow the development of a reliable model for adsorption and desorption of water in pelletised adsorbents. Further validation will be carried out on a purposely built breakthrough experiment that will include multipoint temperature measurements.

The other key issue that the study will be able to address is the amount of CO2 that will be adsorbed in the drying units, which can in turn affect the overall process recovery. It is worth noting that for carbon capture applications recoveries of 90+% and purities of 95+% are required and therefore to be able to predict the process performance very accurate models are needed.

The modelling framework will allow the direct comparison of adsorbents that require a dry feed gas, which can have very high adsorption capacities, and those that do not loose adsorption capacity in the presence of water, but have typically a lower capacity for CO2.

Further Information:

<http://www.see.ed.ac.uk/carboncapture/>

<http://www.psenterprise.com/>

<http://www.etp-scotland.ac.uk/>

Principal Supervisor:

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Eligibility:

To undertake this research, we are seeking a motivated candidate with a first class degree (or equivalent) in Chemical Engineering or related field.

Experience in process modelling (Unisim, gPROMS) and experimental measurements is beneficial.

Funding:

The PhD scholarship will cover UK/EU tuition fees and an annual stipend of £15,006 over 3.5 years. This PhD project is only funded for UK/EU students – start date 01/10/2014.