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2nd **IRIS** POSTGRADUATE STUDENTS CONFERENCE:

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A simulation model to improve the energy efficiency of post combustion carbon capture process in coal power plant

Rasel Mahamud, PhD candidate, PELM

Carbon capture and storage (CCS) is considered as a promising option to reduce carbon dioxide (CO₂) emissions by power plants that use fossil fuels. However, it consumes significant amount of energy raising the cost of power generation, hence CCS technology may not be a long term viable option for reducing CO₂ emissions. Reducing energy penalty through process integration has significant importance for CCS adoption by the power generation industry.

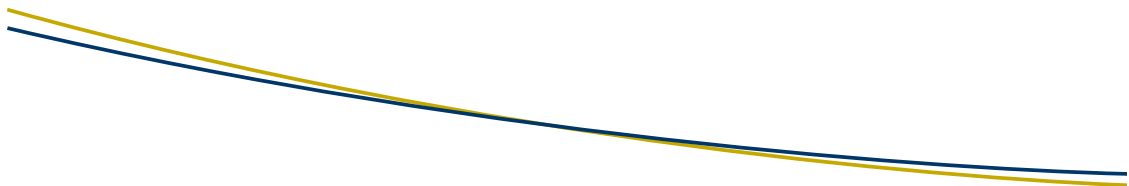
Pinch technology is being used for process integration analysing overall process energy requirements to find economically optimal design. Exergy analysis, on the contrary, can reveal the major causes of thermodynamic imperfection of the processes and thus provides more insights for effective thermodynamic process design. Combining the strengths of both methods, this project will develop a simulation model to improve the process energy efficiency of post combustion carbon capture process in coal power plant.

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A rotating parallel disc device for flow-accelerated corrosion research

Ian McNeilly, PhD candidate, PELM

In industry high fluid flow rates are a major cause of enhanced corrosion damage to exposed metal surfaces. With inherent difficulties in the monitoring of corrosion in plant environments, there is often a need to resort to small scale laboratory systems and attempt correlation of corrosion rates between the two systems by using conditions of similarity based on parameters such as mass transfer coefficients or wall shear rates. Currently available simple geometries include rotating electrode geometries such as the rotating disc electrode (RDE) and the rotating cylinder electrode (RCE). While hydrodynamic flow and mass transfer attributes remain well defined over a wide range of fluid velocities, these geometries are limited to modelling plant corrosion rates for comparatively mild flows up to a maximum shear rate of about 380 s⁻¹. Industrial plant wall shear rates can be as high as 105 or 107 s⁻¹ and other larger scale geometries such as the flow loop and the jet impingement cell are able to model turbulent plant flows



at comparable wall shear rates. However turbulent and unpredictable fluid flow characteristics of these systems make the collection of meaningful electrochemical measurements difficult. Therefore, correlation to plant environments through conditions of similarity can also be complex.

This presentation introduces a novel Parallel Disc Device (PDD) that is capable of generating very high wall shear rates at the surface of a metal electrode under flow conditions that are presumed laminar. The device has been electrochemically characterised by studying, as a function of both gap distance and top disc rotation, the diffusion limited reduction of hexacyanoferrate(III) at a nickel working electrode and the diffusion limited reduction of dissolved oxygen at a copper electrode.

Mass transfer data recorded for these electrochemical reaction systems have been used to validate an empirical mass transfer model for the PDD in terms of the Sherwood number (Sh), Reynolds number (Re), and Schmidt number (Sc) dimensionless variables. This model is valid for PDD gap sizes ranging from 0.250 mm to 1.00 millimetres up to a maximum wall shear rate of 30,000 s⁻¹.

Harmonic Mitigation Methodology in Low Voltage Distribution Networks

Pubudu Padmaharsha Warusamanna, MEng Candidate, PERG

Harmonic distortion, one of the most important aspects of power quality, is generated by equipment which does not draw linear currents. Since the introduction of many modern electrical appliances and industrial equipment, harmonic distortion has become an increasing problem for utilities. It is necessary that harmonic distortion limits in power systems be kept below compatibility levels to stop equipment failure or malfunction, to ensure equipment operate within ratings and to minimise adverse impact on the life expectancy of connected equipment.

With more disturbing loads and distributed generation being connected to the low voltage distribution network, the industrial partner of this research project Ergon Energy expects that it will need to resort to harmonic mitigation methods to ensure that harmonics in the distribution network remain within acceptable limits.