IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Investigations on CCP-enhanced carbon dioxide uptake in aqueous media during flue gas scrubbing**
Project Number	**IMURA0301**
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Research Academy Themes:

Highlight which of the Academy's Theme(s) this project will address?

(*Feel free to nominate more than one. For more information, see www.iitbmonash.org)*

1. Advanced computational engineering, simulation and manufacture
2. Infrastructure Engineering
3. **Clean Energy**
4. Water
5. Nanotechnology
6. Biotechnology and Stem Cell Research

The research problem

Define the problem

Over 2 billion tons of carbon dioxide (CO_2) is emitted from steel production globally. While new technologies for steel production will reduce this emission somewhat, there is a need to capture the emitted CO_2 from the production process. Amine and ammonia based systems are currently at the forefront of development for CO_2 capture from flue gas in power generation processes. In efforts aimed at reducing the costs associated with carbon capture and sequestration, absorption in brines augmented with combustion products such as fly ash have shown some promise. Through a combination of laboratory scale experiments and associated process and thermodynamic modelling, this project will identify the relevant key issues and establish the extent of enhancement of CO_2 capture using water and brine, by particulate products of coal combustion, such as flyash.

Project aims

Define the aims of the project

Fly ash, depending on the coal used, contains varying amounts of alkalinity which can be usefully employed in capturing CO_2. This can be done either in a two-stage process in which the alkalinity is first leached into the water/brine solvent which is then used to scrub the flue gas, or in a single stage process in which the leaching and carbon dioxide capture proceed simultaneously in the solvent slurried with fly ash. The major aim of this project is to (a) first establish the feasibility of such a process, and identify the flyash characteristics of importance by determining the capacity of the solvent as a function of fly ash loading for different sources of flyash, and detailing the physicochemical characteristics of the flyash, and (b) identify the transport and kinetic issues related to a commercially realizable implementation of the concept, in contactors such as slurry reactors and packed beds.

Expected outcomes

Highlight the expected outcomes of the project

- A brief review of CO2 capture using water/brine as a solvent and the effect of coal combustion products (CCP) on capacity and rate in such applications
- Identification of fly ash characteristics conducive to augmentation of the absorptive capacity/rate of brine carbonation
- Fundamental understanding of the absorptive carbonation augmented with CCP, and components of such products which are effective in enhancing the capacity and/or rate
- Extent of CO2 fixation, and conditions required to optimise the fixation of CO2
- Test results on industrial type contactors based on proof of concept from thermodynamic studies
- Mathematical models to explain the test results, and hence, identification of scale-up procedures

How will the project address the Goals of the above Themes?

Describe how the project will address the goals of one or more of the 6 Themes listed above.

The project falls under the Clean Energy theme. It will address the theme by lowering the net CO2 emission from steel manufacturing process.

Capabilities and Degrees Required

List the ideal set of capabilities that a student should have for this project. Feel free to be as specific or as general as you like. These capabilities will be input into the online application form and students who opt for this project will be required to show that they can demonstrate these capabilities.

A degree in Chemistry, Chemical Engineering or Materials Engineering.

Familiarity with analytical/characterization instruments and mathematical modelling will be an advantage.