

An Indian-Australian research partnership

Project Title: **Chemical Looping – Metal Oxide Development & Hydrodynamics**

Project Number **IMURA0618**

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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
7. Humanities and Social Sciences

The research problem

Define the problem

IITB-Monash Academy has developed a new process for the production of Ammonium Nitrate from ammonia based on chemical looping of the metal oxide. Operation of the process is hampered by the hydrodynamics of the metal oxide powder at high temperature. Further development is required to obtain a suitable metal oxide that can operate in a circulating reactor system at the required temperature without sintering. Prior work has demonstrated several metal oxides are capable of performing the reaction.

Project aims

Define the aims of the project

1. Design of a laboratory scale flow reactor system (both hot and cold system)
2. CFD modeling of the flow reactor system (hot and cold) to predict the space velocities and contact time between metal oxides and gases
3. Develop a suitable way to manufacture the metal oxides with the appropriate particle size resistant to sintering at the reaction temperature in an ammonia atmosphere
4. Investigate mixed metal oxide systems for NO formation and establish mechanism of oxygen transfer
5. Assess sintering/agglomeration propensity of the metal oxides

Expected outcomes

Highlight the expected outcomes of the project

1. A laboratory scale flow reactor system which can demonstrate the chemical looping process (cold without reaction) (*Work completed at IITB*)
2. An understanding of the underlying hydrodynamics of the reactor system and the Residence Time Distributions (RTDs) of metal oxides and gases. (*Work completed at Monash and IITB*)
3. Development of a suitable metal oxide which is resistant to sintering at the reaction temperature in an ammonia atmosphere. This could be a mixed metal oxide. (*Work completed at IITB*)

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 is an advanced manufacturing process. This is one of the first works which proposes to use chemical looping for the manufacture of a chemical. It will also use advanced modelling and simulation in developing the flow reactor system.

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.

Chemical Engineering, Mechanical Engineer, Materials Engineering, Energy Engineering
Bachelor or Masters Degree

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

Please provide a few key words relating to this project to make it easier for the students to apply.

Chemical Looping, Oxygen Carriers, NH₃ oxidation, Ostwald Process