IITB-Monash Research Academy

An Indian-Australian research partnership

Indian Institute of Technology Bombay | MONASH University

Project Title:	**Robust design and operation of thermochemical processing of municipal solid waste**
Project Number	**IMURA0364**

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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

Municipal solid waste (MSW) is a major environmental and health concern in most of the medium to large cities in the developed as well as developing countries. Safe and sustainable disposal of the waste is necessary. Moreover, the recovery of any value added commodities as part of the waste disposal processes is also highly desirable. Thermochemical treatment of MSW, which includes processes from simple incineration to large scale gasification, have been proposed and also implemented at various places. However, one of the major challenges faced by these processes is the inherent variability in the supply of MSW for processing, due to different supply sources, changing weather, and storage methods. This variability can manifest itself in the form of the total quantity received, as well as the quality of each batch received. These variations, which can be quite large, have significant negative impact on the process performance, which leads to lower efficiency, higher energy wastage, and overall reduction in the cost-competitiveness. The design and operation of these processes must, therefore, be carried out by systematically considering the input uncertainties.

Project aims

The goal of the proposed research is to perform the robust design and operation of the biomass conversion processes. The work will develop models for the thermochemical processes of biomass and quantify their performance assuming deterministic feedstock properties. We will use models already published in the literature and enhance those to enable stochastic simulations (simulations under uncertainty) later in the project. We will also quantify the compositional variability in MSW. We will do this by collecting samples from various places in and around Mumbai and analysing them for their composition. The analysis will be classified as per the category of waste, such as waste from gardens, household, restaurants, and industry. We will also estimate the total production of each category of waste. We will then conduct stochastic simulations to quantify the impact of uncertainty on the operation of the thermochemical processes. The results will be compared with those for the deterministic case. We also aim to perform the validation of the results by doing experiments with the collected wastes. Such validation will be highly desirable.

Expected outcomes

This research is expected to lead to the following outcomes:

- Develop reliable models for thermochemical processing of MSW
- Quantify the compositional variations of the MSW in various categories
- Identify model parameters that have a significant impact on process performance
- Validate the model and results using experiments

Provide recommendations of technology, scale, design, and operation to local agencies and municipal corporations.

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

This project will fall under multiple themes mentioned above. The main thrust of the work will be in the area of advanced computational engineering and simulation. However, the municipal solid waste is a biological material and therefore may be used as a feedstock for biotechnological applications. The compositional analysis we do, therefore, will make important contributions in that area. Further, the thermochemical treatment can be used for energy production, which makes this project relevant within the clean energy theme. We therefore feel that the project will fit quite well within the overall goals of the IITB-Monash Research Academy.

Capabilities and Degrees Required

- Chemical/process engineering
- Computational modeling
- Multi-disciplinary interests in application, environmental issues and policy making