IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Characterizing Core-Annular Flow of Emulsions**	
Project Number	**IMURA0661 (1)**	
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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

Transport of high viscosity fluids (oils, emulsions) in pipes requires large pressure drops. One strategy to reduce this pressure drop is to inject a low-viscosity fluid at the periphery of the pipes, leading to what is known as "core-annular flow" (CAF). In this work, we will experimentally study the relationship between the rheology of emulsions and the flow characteristics of the CAF in emulsion is the core fluid.

Project aims

We will specifically:

1. Study the characteristics of the interfacial waves in CAF for different types of emulsions/oils. These waves are responsible for the net pressure drop in the core fluid.
2. Characterize pressure drop in the limit of very low flow rates in the annulus, where the core starts to foul the pipe walls. Does the injected water manage to form a thin film near the pipe wall, or does it get mixed into the emulsion/oil ?
3. Understand the mechanisms by which the core manages to “levitate” in the pipe for horizontal CAF. These mechanisms may be different for emulsions with high and low yield stress.
4. Study CAF of emulsion in coiled pipes
5. Carefully characterize the interfacial rheology of water-in-oil emulsions. This may play a crucial role in determining the yield stress of emulsions.

Expected outcomes

1. Generation of data related to pressure drop, interface shapes in CAF and interfacial rheology of emulsion
2. A semi-empirical model on how the rheology of emulsions play a role in their transport as CAF

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

Transport of high internal phase emulsions in pipes is seen in the mining industry, where the explosives are in the form of HIPE emulsions. CAF may be used to reduce pressure drop for transporting such emulsions. CAF is also used to transport crude oil over very large distances.

Capabilities and Degrees Required

B.Tech/B.S. or M.Tech/M.S. in Mechanical Engg or Chemical Engg. Candidate should have had some prior experience in developing an experimental setup. Candidate should be strong in mathematical analysis, fluid mechanics, computer aided design and Chemistry. Prior experience in MATLAB is a plus.

Potential Collaborators

Rico Tabor, rico.tabor@monash.edu

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

Fluid Mechanics, Rheology, Emulsions