



# IFPRI Project Abstract

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## **Spray characterization at industrially relevant conditions**

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### ***Project Objective:***

The present work is a continuation of our research on the atomization of high viscosity and polymeric fluids. The currently available models do not correctly predict the droplet sizes generated by swirl nozzle when using high viscosity and polymeric fluids. Therefore, our objective was to develop a new model that can well predict such sprays.

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### ***Approach:***

Identify the issues with the current models. These were: (i) current models assume a constant sheet instability wavelength, (ii) they do not consider the sheet perforation process that is observed experimentally, and (iii) they do not consider the ligament stretching and thinning, which is an important aspect of the atomization process in high viscosity and polymeric fluids.

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### ***Recent Results:***

This year we developed a model for the atomization process of a liquid sheet and its resulting droplet sizes and size distributions. Based on the images taken at near nozzle region from pressure swirl nozzles, the liquid sheet is found to break up due to a combination of growth of surface waves and formation of perforations. It is found that the liquid sheet form large scale wavelength at the breakup position and considering the boundary layer in the ambient gas is important to predict the wavelength correctly. The wavelength is found to have a much larger magnitude and scales with sheet velocity  $U$  at  $U^{-16/15}$  for inviscid liquid sheets and  $U^{-37/30}$  for viscous sheets. It is also found that the surface waves generate alternating thick and thin regions on the liquid sheet. The thin region perforates when its thickness reaches the order of  $1 \mu m$  as the sheet expands, and the growth of the perforation results in the disintegration of liquid sheet into filaments. Based on the geometric relationship, two characteristic sizes of filaments are identified and the resulting drop size distribution is found to be a mixture of two Gamma distributions resulting from each characteristic filament sizes.

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### ***Next Steps:***

We have completed the planned project. However, we are currently analyzing our experimental results on a flapping liquid jet. This will be completed within the next few months.

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