COLLEGE OF ENGINEERING
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

Honors Capstone Research (HCR) Summer Program 2020

Plasma Jet Flow Characterization via Computational Modeling

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Introduction

-Atmospheric Pressure Plasma Jets (APPJs) can perform various biological and material treatments due to plasma generated chemistry
-Recently[1], an APPJ at UAH was experimentally characterized across varied operating conditions
-However, the APPJ has yet to be modeled, which allows further characterization
-Here we model the flow structure of the APPJ and compare to similar results[2]

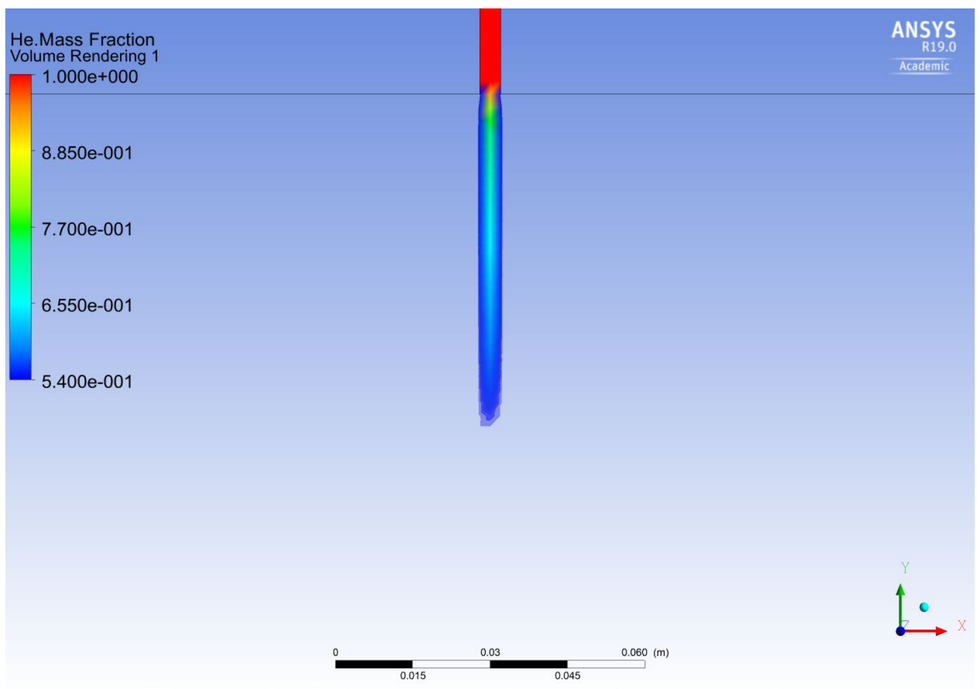

Figure 1: Jet as seen in post-processing, 3.98 m/s flow rate

Model

-We employ ANSYS Fluent, a commercial Computational Fluid Dynamics software to model the 2D flow of the jet
-For turbulence modeling, we use the RNG k-epsilon model as it is a robust turbulence model that accounts for small scale mixing that is important in APPJ behavior
-To model the interactions between the flowing helium and ambient air we use the Species Transport model without chemical reactions

References
1. DOI: 10.1109/TPS.2019.2942576
2. DOI: 10.1088/0022-3727/43/15/155202

Results

-We determine the minimum helium mass and mole fractions needed for jet propagation
-Then we plot the minimum values against inlet flow rate, as seen in Figures 2 and 3
-The trend agrees with the results found in[2] and is explained by additional mass at higher flow rates

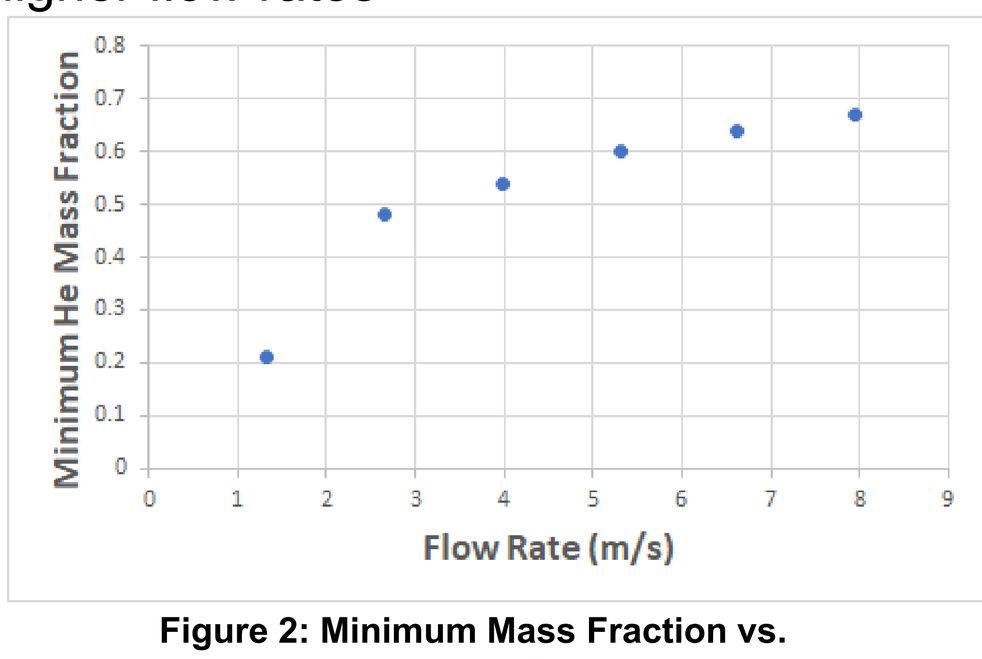

Figure 2: Minimum Mass Fraction vs. Inlet Flow Rate

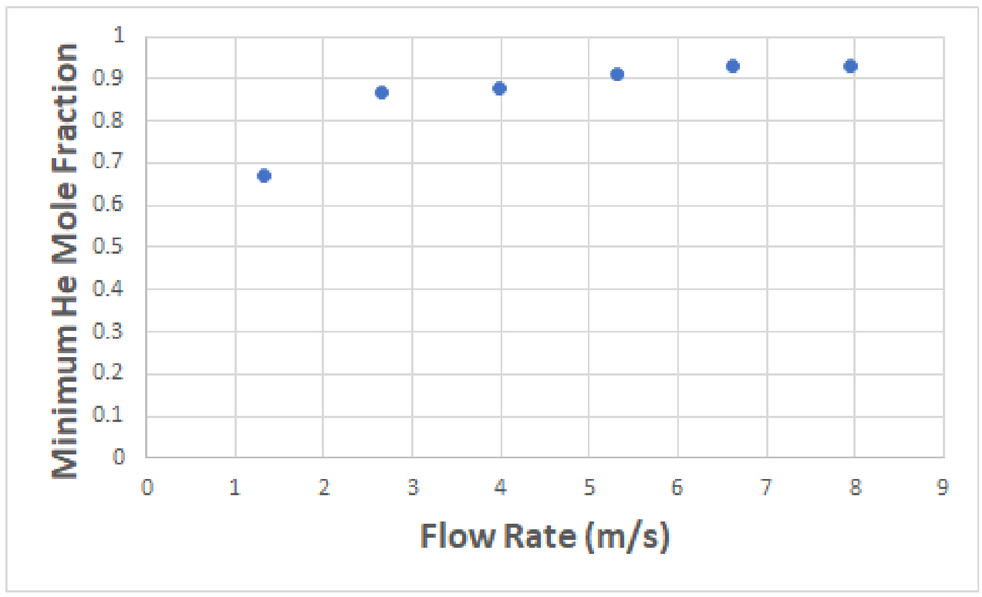

Figure 3: Minimum Mole Fraction vs. Inlet Flow Rate

Future work

-We plan to further model the flow using a Smoothed-Particle-Hydrodynamic (SPH) method rather than Fluent's meshing-based method
-We plan to model the E/M behavior of the APPJ in SPH to characterize its key plasma properties

Acknowledgements

Funding was provided by the Honors summer Capstone Program run by the UAH Honors College. The authors would like to thank Dr. Keith Hollingsworth for providing access to an ANSYS Fluent license. Special thanks to Ryan Gott for detailed descriptions of the experimental setup and relevant discussion of the APPJ.

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