Rocketry employs cryogenic refrigeration to increase the density of propellants, such as oxygen, and stores the propellant as a liquid. In addition to propellant liquefaction, cryogenic refrigeration can also conserve propellant and provide propellant subcooling and densification. Previous studies analyzed vapor conditioning of a cryogenic propellant, which occurred by either a heat exchanger positioned in the vapor or by using the vapor as the working fluid in a refrigeration cycle. This study analyzes the refrigeration effects of a heat exchanger located beneath the vapor-liquid interface of liquid oxygen.

This study predicts the mass liquefaction rate and heat transfer coefficient for liquid oxygen using two different models, a Kinetic Theory Model and a Cold Plate Model, and compares both models to experimental data. The Kinetic Theory Model overestimated the liquefaction rate and heat transfer coefficient by five to six orders of magnitude, while the Cold Plate Model underestimated the liquefaction rate and heat transfer coefficient by one to two orders of magnitude. This study also suggested a model to predict the densification rate of liquid oxygen, while the system is maintained at constant pressure. The densification rate model is based on transient heat conduction analysis and provides reasonable results when compared to experimental data.

Major: Mechanical Engineering

Educational Career:
Bachelor’s of Chemical Engineering, BS, 2003, Tennessee Technological University

Committee in Charge:
Dr. Louis Chow, Chair, MMAE
Dr. Bill Notardonato, Co-Chair, NASA
Dr. Jay Kapat, MMAE
Dr. Alain Kassab, MMAE

Approved for distribution by Dr. Louis Chow, Committee Chair, on January 1, 2010.

The public is welcome to attend.