Weekly CEAFM Seminar: Spring 2015

JOHNS HOPKINS
Center for Environmental
& Applied Fluid Mechanics

Date: **Friday, April 3, 2015**

Time: 11:00 AM

Location: Gilman Hall # 132

Speaker: **Prof. C. Thomas Avedisian** (Cornell University)

Title: ***"Spherically Symmetric Droplet Combustion: A Simplified Liquid Fuel Burning Configuration for a Complex Combustion Process"***

Abstract

The dwindling supplies of petroleum-based liquid fuels have generated renewed interest in developing alternatives for powering combustion engines. Even after petroleum fuels are gone (in a hundred years according to some projections) there will still continue to be a demand for liquid fuels which may be filled in part by fuels derived from non-food feedstocks (e.g., algae, soybean, camelina, etc.). Developing the understanding of such fuels in the complex environment of a combustion engine is difficult owing to the highly turbulent and swirling flow field and multiphase transport dynamics of sprays that are present. As droplets represent the fine-grid structure of sprays, the combustion dynamics of fuel droplets are examined in an environment that seeks to remove external convective influences to simplify the transport field to promote spherical symmetry in the droplet burning process. The one-dimensional flames and transport dynamics that result are well positioned to reveal the influence of such parameters as droplet size and fuel type on ignition and burning, and to provide data for validating detailed numerical models of droplet burning.

Spherically symmetric droplet burning is promoted using an experimental design that incorporates stationary droplets in a stagnant ambience under low gravity to reduce the influence of forced and natural convection. Results are presented for a wide range of fuel systems (real fuels (jet, diesel, gasoline), biofuels (e.g., derived from algae), alcohols, alkanes, aromatics and surrogates) that show the influence of droplet size and fuel composition on combustion, as well as the unique sooting dynamics that are intrinsic to the one-dimensional droplet flame configuration. An interesting effect of varying droplet diameter is also presented that suggests flame extinction followed by a low temperature combustion regime that is believed to be the result of radiative losses from the droplet flame.