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# Characterization of Emissions from the Combustion of a Selected Surrogate for Aviation Fuels

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## Abstract

In this study, emissions from a surrogate of aviation fuel components have been characterized. The proposed surrogate includes n-dodecane and m-xylene with 75% and 25% by liquid volume, respectively. The combustion was investigated behind reflected shock waves to obtain ignition delay times and quantify yields of a range of stable combustion products including volatile gases, PAHs (polycyclic aromatic hydrocarbons) and soot. The experimental conditions covered a temperature range of ~980-1500 K, at pressures of 18 atm, at an equivalence ratio of 3, using argon as the diluent (93 % vol). In all experiments, dwell times were kept in the range of 7.55-7.85 ms by using a suitable argon-helium mixture as the driver gas. The collected gas samples from shock tube experiments were analyzed using GC-TCD for light gases and GC-MS was used for semi-volatiles. The mass of the collected particulate matter (PM) was determined via the temperature programmed oxidation (TPO)/carbon burn-off method. The present work provides comprehensive emissions characterization data for the validation of combustion kinetic models, and valuable comparisons for selecting future alternate jet fuels based on their emissions

## Background and Motivation

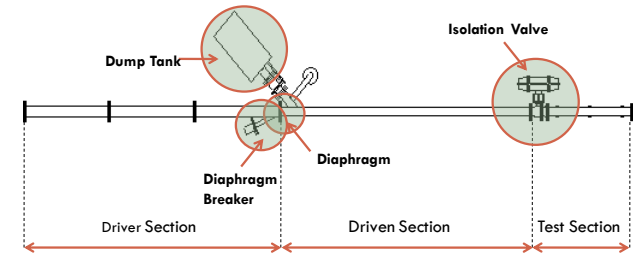
The transportation sector, particularly aviation industry, has been identified as the largest consumer of fossil fuels. Recently, energy and environmental issues related to internal combustion and jet engine operations have been the focus of many researches whose efforts are aimed at better understanding the combustion mechanisms of transportation fuels. These fuels are composed of hundreds, if not thousands, of different hydrocarbons including paraffins (normal and branched), cycloparaffins and aromatics.

A detailed combustion modeling of transportation fuels is currently unfeasible due to their complex composition. In order to reduce the modeling effort, selecting appropriate surrogates to replace the real fuel is currently the most accepted solution.

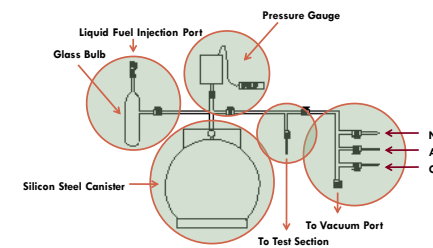
A surrogate fuel can always be reproduced based on its pure compounds as the composition is well known. As a result, any potential effects on combustion processes due to the differences in composition can be avoided leading to a more appropriate interpretation of the results.

## Experimental

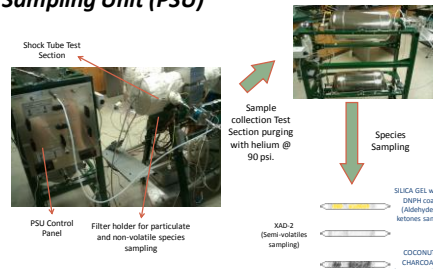
### UDRI Shock tube Facility



### Sample Preparation Unit (SPU)



### Product Sampling Unit (PSU)



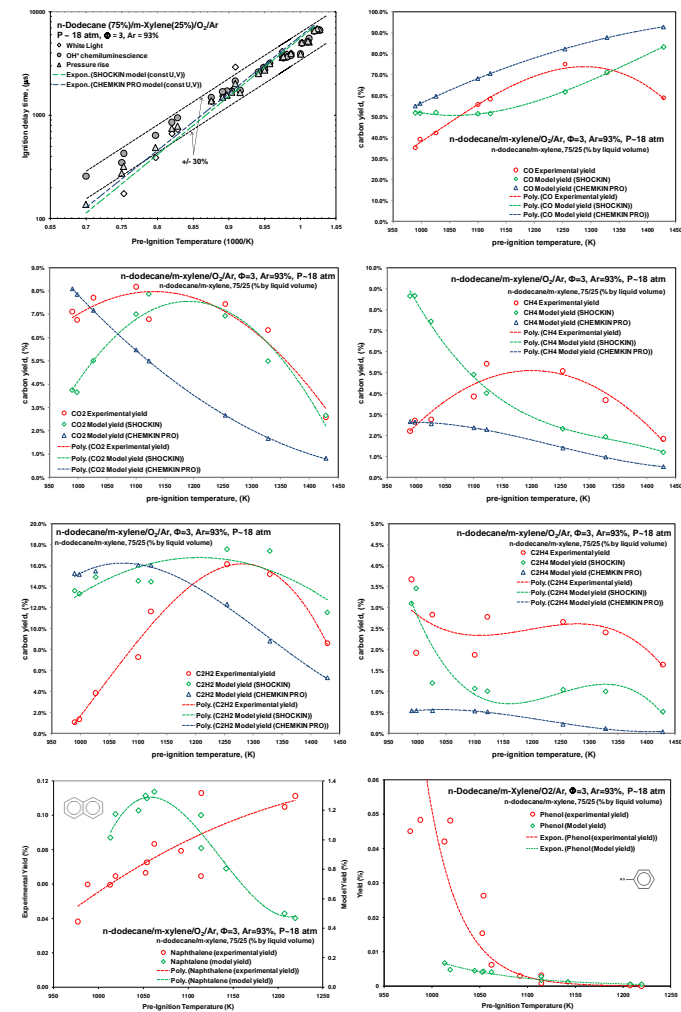
### Experimental Conditions

Pressure	~18 atm
Temperature range	970 – 1250 K
Dwell time	7.5 ± 0.2 ms

### Modeling Approaches

SHOCKKIN	CHEMKIN
0D	0D
Cantera library (MATLAB® code)	Close Homogeneous Batch Reactor
Computations based on the shock tube experimental pressure profiles (the non-ideal effects associated to shock tube experiments are taken into account during the chemical kinetic computation).	Computations based on the initial pre-ignition conditions only (initial gas phase composition, temperature and pressure).
Constant volume and internal energy assumption	Constant volume and internal energy assumption

## Results



## Acknowledgments

The present work was supported by the Strategic Environmental Research and Development Program (SERDP), and from the University of Dayton Graduate School Summer Fellowship 2012 (GSSF).