Title (the shorter the better, include key words)

Team Member Names

Faculty Advisor(s): (their name/s), Dept. of ____, Florida Institute of Technology

INSTRUCTIONS

- **Do not use a color background**
- **Keep all content within the gold lines and blue and crimson bars (other than title block and icons)**
- **Do not change the size of the poster**
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- **Ensure that all images are at least 300 dpi**
- **The name of any faculty should be put in as "Dr. [First Name] [Middle Initial]. [Last Name], Dept. Of [name of department], [name of institution]**
- **Names of any sponsors, mentors, volunteers, helpers, etc. can be put in the acknowledgements section. Put in text only. Do not put in any additional logos in the poster other than the ones already in the template.**

***Your Poster file should be named as follows*:**

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Note: The project name should be exactly as the registered project name.

***If this is an individual project, please place the title of your project instead of the team name**

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****delete this text box, arrow and the example symbols****

Research on Methods to Decrease Emissions in Jet Engines

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Faculty Advisors: Dr.Douglas Willard, Dept. of Aerospace, Florida Institute of Technology
Dr.Darshan G. Pahinkar, Dept. Of Mechanical and Civil, Florida Institute of Technology

Introduction

The aviation industry contributes over 915 million metric tons of CO2 and NOx annually. In response, this project aims to develop a biofuel mix and carbon capture system to significantly reduce these emissions, while maintaining engine efficiency.

Biofuel Design

The test stand is a GE J85 Jet Engine, which runs off Jet fuel type A. Overall, 1kg of Jet A produces 3.16kg of CO2 and 0.3kg of NOx.

- Need to Decrease both CO2 and NOx
- CO2 and NOx display inverse relationships

To combat this, the biofuel must increase CO2 & decrease NOx. A separate system will decrease the CO2.

- Utilize biofuel to lower NOx & Increase CO2
- Use a Carbon Capture device to deplete CO2

Jet A is comprised of Kerosene-hydrodesulfurized & Kerosene (petroleum), which alters its chemical properties by increasing NOx. To reduce NOx, a 20% alteration (B20) is needed:

- 13.5% Kerosene (unadulterated) & 6.5% Ethanol (biofuel) displacement
- B20 will decrease both NOx by 12% & CO2 by 5.9%

Capture Design

The carbon capture system was designed to both withstand and utilize the extreme conditions of jet exhaust (~650°C). The Carbon Capture pipe system is made of 304 Stainless Steel, which has advantages including: High melting point, availability, low cost, and rigidity. For this project, Calcium Carbonate Looping was chosen which uses the high temperature of the exhaust to convert Carbon Dioxide into a stable Calcium compound. The calcium oxide is introduced into the flow where it reacts and bonds with the carbon dioxide at high temperature causing a solid sequestration of the carbon dioxide.

Experimental Setup

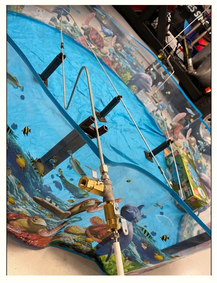
Three separate tests are performed to test the effectiveness of the fuel and carbon capture:

1. Jet-A without Carbon Capture
2. Jet-A with Carbon Capture
3. Biofuel mixture with Carbon Capture

Data Gained from each test include:

- Gas Composition
- Pressure
- Temperature

Testing Apparatus



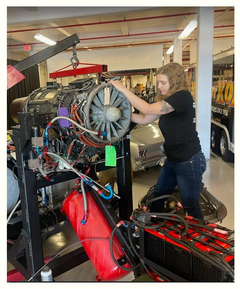


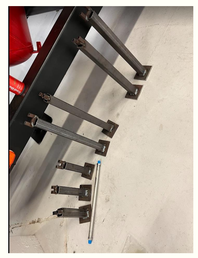
The testing Setup used for this projected included the use of Larsen Motorsport's Biofuel Test Stand. Pictured above is the full exhaust and carbon capture design built by this team attached to the test cell. The collection design is made to attached to an EGP outlet which is placed in the flow of the exiting exhaust. From this pressure couple on the engine, we were able to collect pure exhaust samples for testing. This pure exhaust sample is then passed through the carbon capture, heat exchanger, and exhaust collection bags.

Manufacturing

Manufacturing was completed with:

- Welding stands
- Threading Pipes for Fittings
- Bending Pipes
- Flaring pipe ends for JIC fittings
- Chemical Mixing Fuels

Data Analysis Methods

Comparing the Gas Composition Data from each test, the effectiveness of the carbon capture can be validated. The pressure and temperature data are used to calculate other performance characteristics of each fuel. In addition, the residual Calcium Compounds from tests 2 and 3 are examined using Mass-Spectroscopy to confirm that the Calcium has reacted.

Acknowledgements

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Advisor Acknowledgments:
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