What Would Happen if We Ran our Engines on Alternative Fuels?
Engine Test Bed Project

Introduction

One facet of the Advanced Power & Energy Program (APEP) at UCI investigates the efficiency, performance, and pollutant emissions of various power systems. Until now, little research has been done within APEP on the emissions of reciprocating engines when using alternative gaseous fuels. Our senior design project involves the study of a natural gas reciprocating engine/generator system and its resulting exhaust composition and pollutants in order to shed new light on how it impacts the environment while running on alternative gaseous fuels. We are especially interested in the effects that these fuels have on particulate matter (PM2.5) emissions since these particles (< 2.5 microns) can cause serious respiratory problems. We hope this test bed will help to clarify the formation and emission of criteria pollutants like PM2.5, carbon monoxide (CO), and NOx in reciprocating engines.

Purpose / Goals

By measuring the emission levels (NO2, CO, PM2.5) produced by the engine when operated on conventional and alternative gaseous fuels, we will be able to determine which fuel(s) work best with the system that we have, obtain a better understanding of the pollutant formation mechanisms and assess the potential feasibility of alternative gas use in reciprocating engines. This enables future researchers to build upon the conclusions from our experiment and perhaps to measure the emissions data for other generator/engine test beds with similar fuel sets.

Requirements

In order to make this engine test bed a reality, the following requirements have been established:

- We have an operating reciprocating engine and generating head set-up.
- To assess the conditions necessary for the engine to operate on different gaseous fuels.
- Precise, reliable and relevant measurement equipment
- Intuitive and effective user manual for future generations of students and researchers to make use of the test bed and perform research on it.
- Each quarter milestone is met.

Fall Quarter 2014: Engine diagnostics and repair
- Setting up workspace
- Determine state of engine
- Replace malfunctioning parts: Battery and Pressure regulator
- Engine turnover and compression check
- Analyzing results from compression checks
- Final component overlook
- Run engine

Winter Quarter 2015: Design and implement analyzing equipment
- Determining measurement points
- Calculations of flows
- Designing measurement equipment
- Manufacturing of measurement equipment
- Implementing measurement equipment

Spring Quarter 2015: Testing and analyzing engine
- Determining fuel combustions for testing
- Run tests
- Analyze results
- Present conclusions

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Purpose / Goals

Today, reciprocating engines are widely used for a variety of applications, one of which is stationary power generation. Natural gas is a common source of energy for such engines. Thus far, research on reciprocating engines in APEP is primarily focused on gasoline and diesel based fuels. If this project is successful, it opens up the opportunity to research the trends and causes of emissions like PM 2.5 from natural gas and renewable gaseous fuels and the possibility of finding a solution to minimize them. Obtaining a better understanding of the factors governing efficiency and air pollutants will open up for greener and more effective electricity and power generation. The results of the research done on our test bed may even show potential for extrapolation to car motors, since the engine component is a GM 5.7L V8.

Looking Towards the Future

Research area where the finished test bed will be installed

Project participants

From left to right: Vince McDonell – Advisor, Katie Leong – Team Lead, Daniella Lopez, Richard Hack – Chief Engineer, Ivan Anagno West, Christopher Ferro