

Performance, fuel-flexibility and emissions characteristics of a 4.97cc Wankel rotary engine for portable power

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The small scale, fuel-flexible engine system presented in this paper intends to convert liquid chemical energy (in the form of liquid hydrocarbons) into electrical energy by means of a small-scale rotary engine. This system is intended to serve as generator for use during disaster relief and military efforts providing fuel flexibility and highly portable power for communication. This paper illustrates not only the fuel-flexibility of a 4.97cc O.S. Graupner Wankel engine and its performance: power output and efficiency, but also introduces fuel-flexible emissions trends. The power and emissions characteristics of this engine are obtained via a custom built dynamometer and a Lujan auto emissions data collection system, respectively. Emission trends have been collected for methanol and gasoline and will be collected for diesel, a kerosene-like heavy fuel and biofuel (ethanol, butanol, or any other available biofuel). With further testing, best and worst case emissions profiles for various fuels and blends can be determined in addition to methodologies to reduce such emissions.

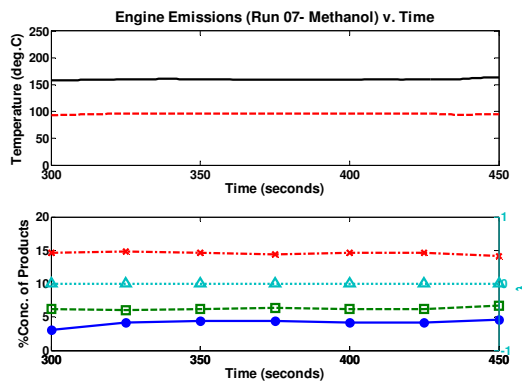


Figure 3. Emissions and their dependence on temperature. Top: Engine temperature is plotted with a light dashed line and the exhaust temperature is plotted with a dark solid line. Bottom left y-axis: %O₂: light dash-dot line with 'x' markers, CO₂: dark dashed line with square markers: %CO: dark solid line with solid dot markers, Bottom right y-axis: λ: dotted line with triangle markers, .

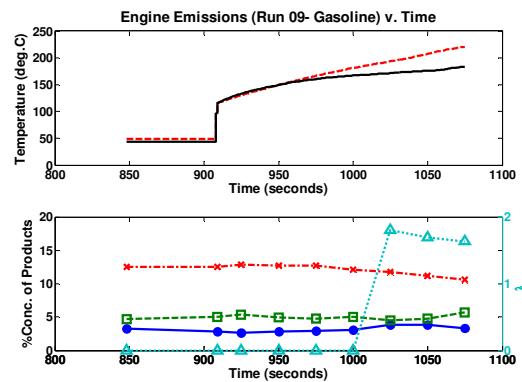


Figure 4. Emissions characteristics of Gasoline in response to exhaust and engine temperature changes. Plotted lines are similarly defined as in Fig. 3.

The demand for ultra-portable, fuel-flexible power on the 100-1000W (light bulbs to hairdryers) continues to grow as technologies increasingly require some form of battery, engine, or alternative energy source to function.

Small-scale, 4.97cc Wankel rotary engines are fuel flexible and can produce power up to 300W [1]. Unlike most engines, the Wankel can be made fuel-flexible, deriving power from a multitude of fuels such as alcohol, gasoline, diesel, and biofuels (Figure 3). To enable fuel-flexibility, advanced control of the combustion event such as spark timing, engine temperature, fuel-to-air ratio and dynamic compression ratio [2], glow plug energy and integration of sensors and actuators for active feedback control are necessary.

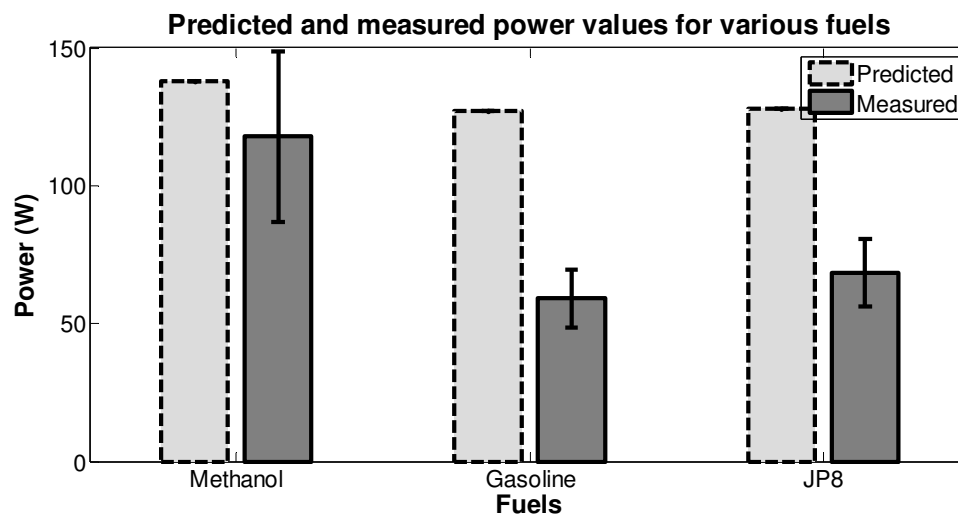


Figure 5. Measured and estimated power predictions for methanol, gasoline and JP8 at approximately 9K RPM. Predictions for gasoline and JP8 are overestimated due to engine's capability to vaporize and combust all fuel given that these air-to-fuel ratios differ largely compared to methanol. This data was measured within a 95% confidence interval.

References

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