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PERFORMANCE AND EFFICIENCY OF A BI-FUEL BIO METHANE/GASOLINE VEHICLE

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Abstract Compressed natural gas (CNG) vehicles have been utilized in fleet applications in the United States for decades. However, vehicles capable of running on both gasoline and CNG are uncommon, with very few applications intending to use bio methane instead of CNG. This paper discusses the conversion of a production vehicle running on gasoline, CNG, and bio methane, the product of upgraded biogas. The technology used in this application allows the vehicle to switch instantaneously between the liquid and gaseous fuels without affecting drivability. The CNG tank is mounted in the bed of the truck and is plumbed to the engine bay, where the fuel is injected into the engine via natural gas fuel injectors. The vehicle is tested for exhaust gas emissions (CO, CH_4, CO_2, NO_x, and HC). This article will present a detailed description of the bi-fuel vehicle, the CNG fuel system, the test procedures followed, the aforementioned test data, analysis of the test results, and a comparison of the results for CNG and gasoline as fuels.

Key Words

Natural Gas Vehicle, Bi-Fuel, Biogas, Emissions

1. Introduction

Kettering University (formerly GMI Engineering & Management Institute) is a fully cooperative private institution that offers degree programs in engineering, sciences and business. In 2010, Kettering University received a research grant from the United States Department of Energy (DOE) through the Michigan Economic Development Corporation (MEDC) to verify and improve process parameters for the production of biogas at the Flint, Michigan Wastewater Treatment Plant (WWTP) and to determine the feasibility of utilizing biogas in transportation and power generation applications. This project involved the selection and outfitting of a vehicle with a bi-fuel CNG kit. After investigating various vehicles and conversion technologies, a 2009 Chevrolet 2500 HD gasoline truck and a bi-fuel CNG conversion kit were purchased, and the conversion was completed at Kettering University (Figure 1).

Figure 1 - Bio Methane Truck

While biogas produced through anaerobic digestion at the Flint Wastewater Treatment Plant is indeed a combustible fuel, it must be upgraded to bio methane before it can be used in an internal combustion engine. Biogas is about 62% methane, 37% carbon dioxide, and may have small amounts of chemical compounds (specifically hydrogen sulfide) that can be harmful to the metal in an internal combustion engine. Thus, it must be upgraded to bio methane, a fuel that is 95% (or greater) methane and has a reduced hydrogen sulfide content. The