PROJECT FACTS

UNIVERSITY OF KENTUCKY CENTER FOR APPLIED ENERGY RESEARCH

POWER GENERATION & UTILITY FUELS

Development of an Integrated Process to Convert Glycerin to Green Power in a Biodiesel Plant

Biodiesel is an alternative fuel which can be substituted for diesel fuel. It also can be used in power generation as a replacement fuel for fuel oil. Biodiesel is made primarily of vegetable oils, which are extracted from biomass. As a result, this fuel is plant-based, renewable and adds no net CO_2 to the atmosphere. However, a by-product of making biodiesel is glycerin. Historically, many people have struggled with how to deal with the glycerin by-product, due to its low heating value, low volatility, high oxygen, high alkali and ash content.

In a bio-diesel plant with an annual production capacity of 8 million gallons, the glycerin by-product at 10% of total bio-diesel, would provide power in the range of 700-1000kWe. Unfortunately, in this range, using the steam cycle (boiler + steam turbine + generator) is cost prohibitive. From the available technologies, one alternative is co-generating electricity in a small gas turbine (mini-turbine) without a steam cycle.

In this research project, the utilization of glycerol for power production in a combustion turbine application was investigated. Raw glycerol, as produced from a typical biodiesel operation, presents many challenges for use in combustion applications. Fuel specifications for firing in a combustion turbine are very stringent regarding the ash content. Unrefined biodiesel-derived glycerol contains up to 5 wt% of alkali from the base catalyst. In addition, the viscosity and low vapor pressure of glycerol limit the degree of atomization within the turbine combustion chamber, resulting in products of incomplete combustion. A process was developed and demonstrated that could effectively lower the ash content of the raw glycerol below 0.5 wt% with a single flash distillation stage. A bulk sample of refined glycerol was prepared and tested in a combustor designed to simulate the combustion chamber of a small gas turbine generator. Comparison combustion tests were performed with crude glycerol.

A simple flash distillation using a single vacuum stage was successfully demonstrated to produce a low ash (less than 0.5 wt%) glycerol stream. The resulting glycerol product was refined, but not considered to be a high-quality industrial material suitable for resale. However, the ash content was lowered such that it could potentially be used in a combustion turbine facility.

The application of small-scale power production from glycerol may be limited; however, the crude glycerol has shown potential for use as a combustion catalyst. One possible opportunity is the use of crude glycerol as a fuel additive for coal. Added to coal, glycerol would also function as a dust suppressant in addition to increasing the combustion efficiency.

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