A Demonstration of Fat and Grease as Industrial Boiler Fuel

EXECUTIVE SUMMARY

The University of Georgia (UGA) Engineering Outreach Service (EOS) used fats and grease (chicken fat, yellow grease, choice white grease, and beef tallow) as industrial boiler fuels in the 100,000 lb./hr. No. 2 boiler at the UGA steam plant during January and February 2002. The project was funded by the Fats and Proteins Research Foundation, Inc. and the Poultry Protein & Fat Council of the U.S. Poultry & Egg Association. The objectives of the project were to publicly demonstrate the use of biofuel for industrial steam production and to examine the procedures necessary for its use.

Combustion Test Program Summary

Fuel	No. of Tests
Natural Gas	9
Choice White Grease	10
Choice White Grease - Fuel Oil Blend	12
Tallow	13
Tallow Fuel - Oil Blend	15
Yellow Grease - Fuel Oil Blend	19
Yellow Grease	21
No. 2 Fuel Oil	22
Chicken Fat - Fuel Oil Blend	23
Chicken Fat	29
Total	173

Tests were conducted Jan. 28 thru Mar. 15, 2002.

Biofuels, either singly or blended with No. 2 fuel oil, are technically and economically viable alternatives to No. 2 fuel oil. Biofuels are user friendly and less hazardous than petroleum fuels. The addition of biofuel combustion capability is simple and inexpensive. It is not necessary to replace or compromise the operation of existing fossil fuel systems.

Industrial boiler operators can use these results to economically justify the use of biofuels and to support air emissions permit submittals. Even lower emissions levels may be obtained from boilers employing advanced combustion systems.

Summary of Results:

1. Laboratory analyses showed that the fats and greases tested have high heating value, low ash, negligible sulfur, low moisture, and other physical and chemical properties conducive to their use as boiler fuel. Heating values for the biofuel blends tested are within 95% of the heating value of No. 2 fuel oil.

2. The 100,000 lb./hr. No. 2 boiler at the UGA steam plant was retrofitted to burn biofuels for approximately $31,000, including the cost to add flue gas recirculation (FGR). This amount does not include any expense for the construction of fuel storage facilities, which were not required for the demonstration program. The biofuel heat exchanger was obtained without cost to the project. It was not necessary to replace or modify the boiler fuel train or nozzle for these tests.

3. The tests demonstrated that the biofuels burn cleanly, readily, without odor and without damage to boiler equipment.

4. During this test program, biofuels produced steam within 3.8% to 5.3% of the efficiency of No. 2 fuel oil. Biofuels blended with No. 2 fuel oil were more efficient than unblended biofuels, and can actually produce steam with more efficiency than No. 2 fuel oil. Throughout the tests part load efficiency was greater than maximum load efficiency, and steam production with FGR was more efficient than without FGR.

5. Biofuels are clean burning. They generally produce fewer combustion emissions than No. 2 fuel oil.

6. Flue gas recirculation is an effective way to reduce NO_x emissions for both fossil and biofuels.

Impact of the Research Results relative to the requirements for Boiler No. 2 in the UGA Part 70 Operating (air emissions) Permit ("the Permit"):

1. The Permit prohibits the burning of any fuel whose sulfur content exceeds 1.3% (para. 3.2.1). The maximum sulfur content of any biofuel tested was 0.007%, and 0.13% for any biofuel blended with No. 2 fuel.

2. The Permit limits particulate matter emissions to 0.417 lb/mmBtu (para. 3.4.1). The maximum total particulate (non-condensible and condensible) emission rate of any biofuel was 0.083 lb/mmBtu.

3. The Permit limits visible emissions to 40% opacity (para. 3.4.9). Smokestack opacity ranged between 0% and 11% during the biofuel tests.

Impact of the Research Results relative to the GA Rules for Air Quality Control (the "Rules"):

1. The Rules (Sections (2)(d)2 & 3) limit particulate emissions from all fuel-burning equipment, of any size, to 0.10 lb/mmBtu and opacity to 20%. The maximum total particulate (non-condensible and condensible) emission rate of any biofuel was 0.083 lb/mmBtu. Smokestack opacity ranged between 0% and 11% during the biofuel tests.

2. The Rules (Section (2)(d)4) limit NO_x emissions to 0.3 lb/mmBtu from fuel oil burning equipment, of any size, in an attainment area. The maximum NO_x emission rate of any biofuel tested was 0.23 lb/mmBtu.

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