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(54) **METHOD FOR MANUFACTURE AND USE OF THE WASTE STREAM FROM BIODIESEL PRODUCTION (CRUDE GLYCERIN) AS A COMMERCIAL FUEL**

(76) Inventors: **Craig Willam Pech**, Green Bay, WI (US); **John Robert Hopp**, Green Bay, WI (US)

Correspondence Address:
Craig W. Pech
2011 Argonne St.
Green Bay, WI 54304 (US)

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(57) **ABSTRACT**

The biodiesel manufacturing process generates between 10% and 20% crude glycerin as a waste stream. Due to the rapid rise in the production of biodiesel, this waste has become a significant burden to the industry. This patent establishes a method to transform the crude glycerin into a useful fuel in some applications where waste petroleum oil or heavy fuel oil is currently used. A side benefit of this process is that the biodiesel manufacturer can use this fuel as a secondary profit stream.

METHOD FOR MANUFACTURE AND USE OF THE WASTE STREAM FROM BIODIESEL PRODUCTION (CRUDE GLYCERIN) AS A COMMERCIAL FUEL

FIELD OF THE INVENTION

[0001] This invention relates to the processing and use of the waste stream of biodiesel production as a commercial fuel. The invention relates to the processing of this waste stream to prepare it for optimal combustion and its use in a modified fuel burning system.

BACKGROUND OF THE INVENTION

[0002] Due to the rapid expansion of the biodiesel industry, its waste product (crude glycerin) has become a significant disposal issue. This invention solves this problem by allowing the glycerin to be processed into a useful fuel. Since it is renewable and made from vegetable or animal oils, it has a very low sulfur content, very low ash content and a relatively high BTU content of approximately 124,000 BTUs per gallon. It has some significant benefits over petroleum and coal as an industrial energy source. It has a sufficiently high flashpoint to make it stable enough for relatively safe use either as a process fuel either in the biodiesel manufacturing industry itself or as an industrial boiler fuel. By burning crude glycerin, tens of millions of gallons of fuel can be added to the supply chain annually.

SUMMARY OF THE INVENTION

[0003] To successfully produce and use this fuel, five parameters must be met. First, the glycerin must be properly filtered to remove particles that could interfere with the passages in the burner equipment. Second, an accelerant (typically the alcohol used in the biodiesel manufacturing process itself) must be added (or maintained if methanol is not recovered in the biodiesel process) in a proportion that improves combustion, but maintains safety. Third, the fuel must be raised to a temperature close to its native flashpoint (145 degrees F. in the case of methanol) to improve combustion. Fourth, all applicable governmental regulations must be met. Fifth, some equipment modifications may need to be made to protect equipment from its inherent high ph level.

[0004] Previous attempts to use crude glycerin as a fuel have not included any of the above parameters, nor has reliable combustion been accomplished in a publicly documented commercial operation.

DETAILED DESCRIPTION OF THE INVENTION

[0005] Crude glycerin has different characteristics than a typical fuel oil and they must be accounted for to obtain proper combustion. First, it has a significant amount of "sludge" left over from the biodiesel manufacturing process. Second, it has a high flashpoint and relatively high viscosity even at recommended temperatures. Third, it has high "base" properties. Fourth, it does not mix and suspend well with petroleum products. The following will outline how these characteristics are modified to allow a more reliable combustion.

[0006] It is necessary that the crude glycerin be properly prepared for the combustion cycle. The piping that is used to drain the glycerin from (the reaction vessel or system and move it to a holding tank prior to the burner) must have a filter system. This system is made up of two filters with pressure gauges to allow an indication of when the filters need to be cleaned. A manifold with shut-off valves is built around the filters so that either one can be isolated for safe filter cleaning while the other allows continued operation. To improve durability, the filters need to be wire mesh with a rating that is finer than the smallest passage or port within the burner to keep internal parts from plugging. This is most likely to be the port in the burner nozzle itself. The filter seals need to be replaced with seals that are specifically manufactured for the particular alcohol that is being used. Prior to the filter system, a temperature reduction system needs to be installed if the alcohol exits the reactor above its boiling point. This allows the filters to be cleaned while the alcohol is in a liquid (safer) state. Since provision is made for a filter separate of the burner, it is recommended that the burner filter itself be removed.

[0007] Depending on the exact alcohol content of the glycerin, which alcohol is used and the temperature of the glycerin as it enters the burner; more alcohol may be required to improve combustion. This can be done by adding a venturi along with a passive mixing pump of the kind that swirls the two liquids as it is being moved through the piping towards the storage holding tank. Provision within this area must be made for mixing the fuel on an "as needed" basis, particularly if the system is shut down for more than about 12 hours. Typically at least 20% methanol content is required for sustainable burns.

[0008] Immediately prior to entering the burner, both the processed crude glycerin and the combustion air need to be brought up to a temperature just below the boiling point of the alcohol (145 degrees F. in the case of methanol). This is necessary to bring the fuel as close to its flash point and possible and to improve fuel atomization. This should not be done before the burner's final fuel filter as the pressure drop across the filter can vaporize the fuel (mainly the alcohol) enough to cause the burner's fuel pump to cavitate.

[0009] As in the case of any type of fuel, proper storage and handling of the crude glycerin needs to be addressed. It will have a flash point of around 60 degrees F. due to the methanol content. Vapors from the methanol can present a health hazard to humans if exposure is above recommended OSHA levels. All fire code regulations need to be met. Should the fuel be transported, all applicable regulations need to be met. All insurance requirements will need to be met. Should the fuel need to be stored for lengthily periods, its high ph may need to be compensated for. This can either be done chemically or by the addition of a more acidic carrier fuel—like vegetable oil.

[0010] Some modifications will need to be made to the burner and related equipment. In general, the fuel pressure will need to be raised along with higher-pressure combustion air. This improves atomization and therefore provides an improved burn with lower emissions. Provision needs to be made for assisting ignition under a cold chamber condition (upon start-up). This can be done with either a torch through a port or a constantly operating pilot light. Once the chamber reaches operating temperature, ignition should be self-sustaining. If there are any seals within the burner system that will be exposed to the fuel, they will need to be

replaced with a material that is compatible with alcohol (likely methanol) and a high ph (as high as 11.5).

[0011] Flame temperature can be adjusted through either increasing the fuel pressure or air pressure or combustion air availability. Flame temperature needs to be maintained above 1800 degrees F. to promote proper combustion and minimize pollutants.

[0012] While specific embodiments of this invention have been described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

What is claimed is:

1. Applies to the manufacture and use of the waste product from biodiesel production, commonly known in the trade as "crude glycerin", as a fuel. Other, less frequently terms used are glycerol, glycerides, fatty acids.

2. Applies when the crude glycerin is used "as-is", or if an accelerant is added to promote combustion by lowering the flashpoint. The accelerant is most likely to be the alcohol used in the biodiesel manufacturing process, which would be methanol or ethanol. Also applies if the crude glycerin is used either as a primary or secondary fuel.

3. Applies when the crude glycerin, accelerant or primary fuels are required to be mixed to provide a uniform fuel mixture.

4. Applies when the fuel (either 100% crude glycerin or a mixture of glycerin and alcohol) is filtered to keep parts within the burner from plugging.

5. Applies if it is necessary to replace metal or elastomeric parts within the burner and storage/fuel delivery system to allow improved durability of the burner system.

6. Applies when the crude glycerin is burned in either a commercially available burner system or in a specially designed and modified system. The "specially designed and modified system" would include either a method to raise the temperature of the fuel and/or combustion or atomizing air to bring the fuel closer to its flashpoint. Preheating may also be required to lower the viscosity of the fuel to promote proper atomization to improve combustion.

7. Applies if or when an acid is added to the fuel to neutralize the ph of the fuel to protect storage, delivery or burner parts.

8. Applies when the crude glycerin is either burned at the place of the biodiesel manufacturer or if it is shipped off-site.

9. Applies when any legal or governmental provisions or regulations are required to be met in order for the crude glycerin to be used or classified as a "fuel". This includes, but is not limited to taxation, identification (dying), storage, environmental or transportation restrictions.

10. Applies to the waste stream from the biodiesel process regardless of the raw material used (fresh or waste vegetable oil or animal fat).

11. Applies when any fuel related testing is required, such as BTU content, sulfur content, ash content or related testing by any end user or governmental entity prior to the use of the crude glycerin as a fuel.

12. Applies when any consulting or technical services are required for determination of applicability of equipment, training or determination of parameters required to burn the crude glycerin.

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