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(54) **METHOD AND SYSTEM FOR FUELING A
POWER/HEAT GENERATING UNIT WITH
PLASTIC MATERIAL**

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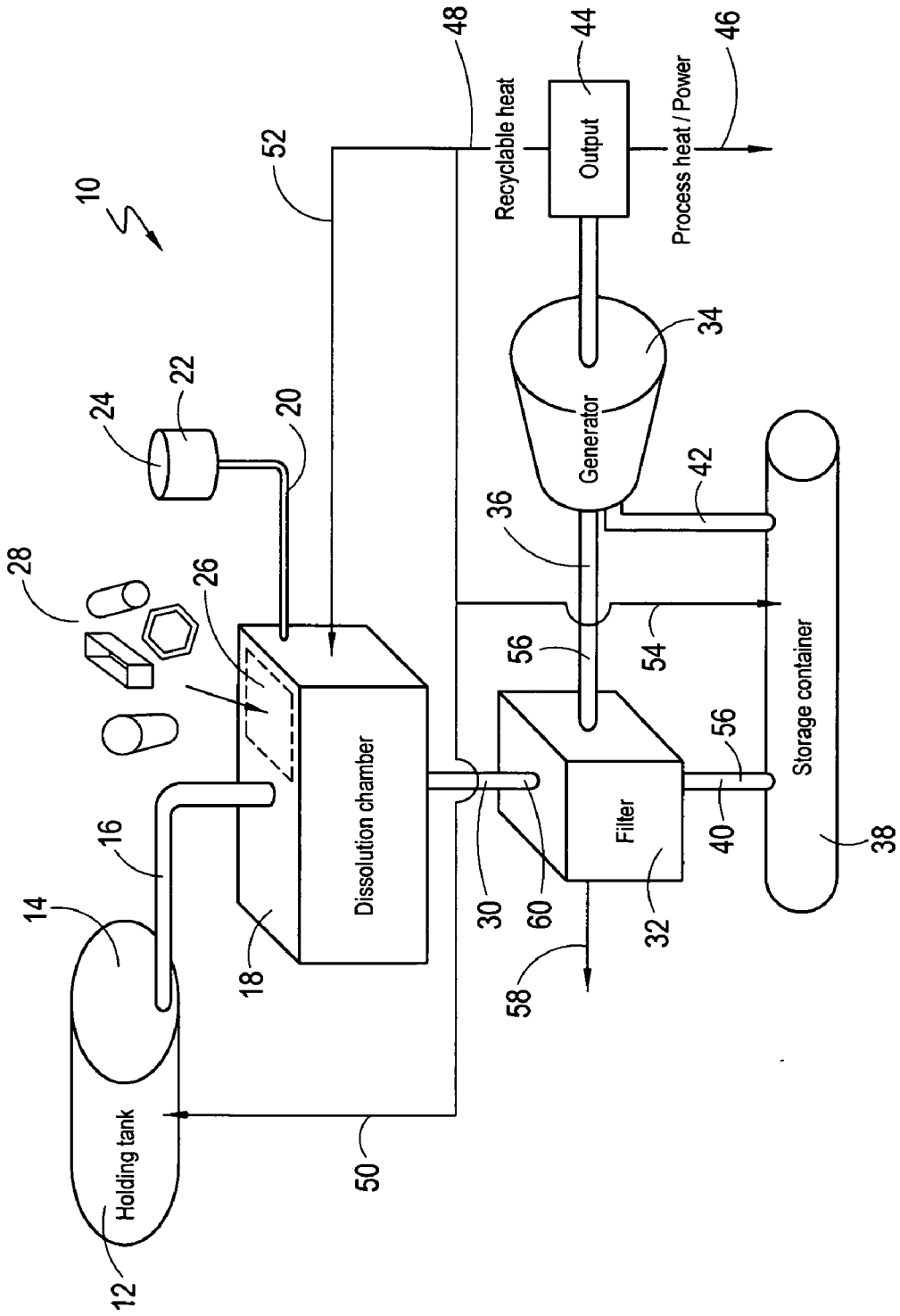
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(57) **ABSTRACT**

A method and system for using plastic material as a fuel includes dissolving the plastic material in biodiesel to form a solution. After the solution is created, it is filtered to remove insoluble contaminants and is then fed to a generator that oxidizes the solution to create power and/or heat. Heat from the oxidation of the solution can be utilized to facilitate the further dissolution of plastic material in biodiesel and to reduce the viscosity of the resulting solution.



Figure

**METHOD AND SYSTEM FOR FUELING A
POWER/HEAT GENERATING UNIT WITH
PLASTIC MATERIAL**

FIELD OF THE INVENTION

[0001] The present invention pertains generally to systems and methods for using plastics. More particularly, the present invention pertains to the use of plastics in fuel for power/heat generating units. The present invention is particularly, but not exclusively, useful in methods or systems that dissolve plastic material in biodiesel for use as fuel.

BACKGROUND OF THE INVENTION

[0002] The world's annual consumption of plastic materials has increased from around 5 million tons in the 1950s to nearly 100 million tons today. While recycling efforts have been made to reduce the amount of plastic waste landfilled, applications or markets for recycled plastics are often limited. Additionally, the costs involved in collecting, transporting, and separating plastic waste often result in recycled plastic products that are more expensive than new plastic products. This is particularly true for situations in which special storage and transport of the waste is required. For instance, shipboard waste or waste at remote forward military bases may require special disposal procedures.

[0003] As with the concerns for handling waste, the storage and transport of fuel incurs high costs for many operations, such as on ships and military bases. Therefore, a reduction in the need for fuel can significantly reduce costs. One fuel source that can be used in such operations is biodiesel. Biodiesel, i.e. fatty acid alkyl esters, is a fuel made from fatty acids and oils from animals and plants, particularly soybeans. It is fully renewable and can be used in many diesel engines. Its high cost, however, currently prevents it from competing with traditional diesel fuel. Nevertheless, by somehow increasing the output from the oxidation of biodiesel, it can be made more cost competitive.

[0004] With the above in mind, consideration is given here for dissolving plastic material in biodiesel before using it as fuel. As a result, the amount of plastic material that must be transported for landfilling or other recycling is reduced. Additionally, the plastic material that is transported (in fuel form) is far less bulky and far easier to ship. Furthermore, the heating value of the plastic material can make the biodiesel cost competitive as a fuel.

[0005] In light of the above, it is an object of the present invention to provide methods and systems for using plastic material dissolved in biodiesel as fuel. Another object of the invention is to provide methods and systems for recycling plastic waste as a component of a fuel. Another object of the present invention is to provide methods and systems for increasing the output of biodiesel as fuel. It is yet another object of the present invention to provide methods and systems for reducing the volume of plastic material, particularly plastic waste. Still another object of the present invention is to provide systems for using plastic material as a fuel, and methods of using the systems, that are relatively easy to create, simple to use and comparatively cost effective.

SUMMARY OF THE INVENTION

[0006] In accordance with the present invention, a system and method are presented for dissolving plastic material in

a fuel for the purpose of increasing the heating value of the fuel. Specifically, the system includes a holding tank for storing a biodiesel fuel, and the holding tank is connected in fluid communication with a dissolution chamber. Biodiesel can then be selectively transferred from the holding tank to the dissolution chamber. Additionally, the dissolution chamber is provided with an access port for dumping plastics and other plastic-type wastes into the dissolution chamber. The purpose here is to dissolve the plastics in the biodiesel to thereby create a supplemented biodiesel fuel.

[0007] A tube is provided that leads from the dissolution chamber to a filter where insoluble products are removed from the supplemented biodiesel. Once the insoluble products are removed, the supplemented biodiesel can then be transferred via a storage inlet tube to a storage container. Outlet pipes from the storage container and the filter are also provided to selectively transfer the supplemented biodiesel from the storage container, or directly from the filter, for use by a heat or power-generating device (generator) such as an engine, turbine, heater or burner.

[0008] Another aspect of the present invention is that the output heat from the generator can be provided to other systems or devices as desired. For instance, the heat can be provided back to the holding tank or the dissolution chamber, or both, to heat the biodiesel to assist in dissolving the plastics that are introduced into the dissolution chamber to create the supplemented biodiesel. Additionally, the heat can be provided back to the dissolution chamber or storage container, or both, to heat the supplemented biodiesel. Heating the supplemented biodiesel reduces its viscosity and allows it to be more easily fed to, and burned by, the generator.

[0009] In operation, biodiesel is released from the holding tank to the dissolution chamber. Plastic waste material can then be added to the dissolution chamber. Additives or heat may also be added to the dissolution chamber to facilitate dissolution of the plastic material within the biodiesel. The consequence of this addition is that as the soluble plastic material dissolves, the biodiesel and plastic material form a supplemented biodiesel solution. If insoluble plastic material or other non-plastic materials (nonsoluble materials) are included within the supplemented biodiesel solution, the solution and nonsoluble materials form a slurry which needs to be filtered.

[0010] After dissolution is completed, the slurry is pumped out of the dissolution chamber through the chamber exit tube. The slurry then passes through a filter which separates the nonsoluble materials from the supplemented biodiesel solution. From the filter, the solution is fed to the generator which burns the solution as a fuel to create heat and/or power. For immediate use of the solution as fuel, a generator feed conduit delivers the solution directly from the filter to the generator. In other cases, the solution may be piped to containers for storage or transport. When needed, the solution is fed from the storage containers to the generator.

[0011] Depending on the composition of the filtered solution, i.e., the ratio of plastic to biodiesel, the solution may be too viscous to be used as a fuel. In such cases, the solution is heated to reduce its viscosity. Alternatively, solvents or additives may be utilized to lower the solution viscosity. In order to maximize efficiency of the system, at least a portion

of the heat output of the generator is directed to the dissolution chamber or storage containers to reduce the viscosity of the solution. Furthermore, heat may be provided to the dissolution chamber to facilitate dissolution of the plastic waste.

[0012] While the invention has been described as using plastic waste material, it is contemplated that non-waste plastic material may also be used.

BRIEF DESCRIPTION OF THE DRAWING

[0013] The novel features of this invention, as well as the invention itself, both as to its structure and its operation, will be best understood from the accompanying drawing, taken in conjunction with the accompanying description, in which the FIGURE is a process flow diagram of a system for using plastic material as fuel in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] Referring to the FIGURE, a system for using plastic material as fuel in accordance with the present invention is shown and generally designated 10. As shown, the system 10 includes a holding tank 12 that stores biodiesel 14. A biodiesel conduit 16 provides fluid communication between the holding tank 12 and a dissolution chamber 18. Additionally, an additive hose 20 provides fluid communication between the dissolution chamber 18 and an additive reservoir 22 that holds additives 24 such as solvents. Further, the dissolution chamber 18 includes a port 26 for receiving the plastic material 28.

[0015] As shown in the FIGURE, a chamber exit tube 30 provides an outlet to the dissolution chamber 18 and leads to a filter 32. The filter 32 includes a sieve, grate or other filtering mechanism. Downstream of the filter 32 is a generator 34, which may be an engine, turbine, heater or burner. A generator feed conduit 36 provides direct fluid communication between the filter 32 and the generator 34. Alternatively, a storage container 38 may be positioned between the filter 32 and generator 34. In such a case, a storage inlet pipe 40 leads from the filter 32 to the storage container 38 and a storage outlet pipe 42 leads from the storage container 38 to the generator 34.

[0016] The output 44 of the generator 34 includes power and/or process heat 46. Additionally, the output 44 may include recyclable heat 48. As shown in the FIGURE, the recyclable heat 48 is directed to system components to provide heat where desired. Specifically, a tank heating conduit 50 connects the recyclable heat 48 to the holding tank 12, a chamber heating conduit 52 connects the recyclable heat 48 to the dissolution chamber 18, and a container heating conduit 54 connects the recyclable heat 48 to the storage container 38.

[0017] During operation of the system 10, a desired amount of biodiesel 14 is fed from the holding tank 12 through the biodiesel conduit 16 to the dissolution chamber 18. Then, the plastic material 28 is added to the biodiesel 14 in the dissolution chamber 18. Preferably, the plastic material 28 is polymeric and may comprise polystyrene, polyethylene, polypropylene or other thermopolymers.

[0018] Once the plastic material 28 is received within the dissolution chamber 18, the biodiesel 14 begins to dissolve

at least a portion of the plastic material 28 to form a supplemented biodiesel solution 56. In certain cases, particularly for polyethylene and polypropylene, the biodiesel 14 may require heating to over 120° C. to facilitate dissolution of the plastic material 28. For polyethylene, the biodiesel 14 should be heated to about 130° C. to prompt dissolution. For polypropylene, the biodiesel 14 needs to be heated to about 160° C. to prompt dissolution. Some polymers, however, such as polystyrene, may be dissolved by biodiesel 14 at ambient temperature.

[0019] In addition to the biodiesel 14 and plastic material 28, additives 24 including solvents may also be introduced to the dissolution chamber 18. The additives 24 may facilitate dissolution of the plastic material 28 or provide desired characteristics to the resulting supplemented biodiesel solution 56. If the plastic material 28 includes any nonsoluble material 58, such as non-plastic material or insoluble plastics, then a slurry 60 of the supplemented biodiesel solution 56 and nonsoluble material 58 is formed in the dissolution chamber 18.

[0020] As shown in the FIGURE, the slurry 60 is fed from the dissolution chamber 18 to the filter 32 by the chamber exit tube 30. The filter 32 removes the nonsoluble material 58 from the supplemented biodiesel solution 56. While a static filter 32 is shown in the FIGURE, it is contemplated that a movable filter can be used to remove the nonsoluble material 58 from the dissolution chamber 18 or from the slurry exit tube 30.

[0021] After removal of the non-soluble material 58, the supplemented biodiesel solution 56 is fed to the generator 34 through the generator feed conduit 36. Alternatively, the supplemented biodiesel solution 56 is fed to the storage container 38 through the storage inlet pipe 40. In such a case, the storage container 38 is filled with supplemented biodiesel solution 56 and is stored and/or transported. When use of the supplemented biodiesel solution 56 is desired, fluid connection between the storage container 38 and the generator 34 is established via a storage outlet pipe 42. After such connection, the supplemented biodiesel solution 56 may be fed to the generator 34. If the supplemented biodiesel solution 56 is too viscous for use as fuel, it may be heated prior to delivery to the generator 34. Typically, high viscosity is encountered when the plastic material 28 comprises about 20-50 wt. % of the supplemented biodiesel solution 56. Supplemented biodiesel solutions 56 comprising less plastic material 28, such as a solution 56 comprising 90 wt. % biodiesel and 10 wt. % polystyrene, may exhibit a lower viscosity and not require heating.

[0022] The generator 34 burns the supplemented biodiesel solution 56 upon receiving it from the generator feed conduit 36 or the storage outlet pipe 42. Due to the increased energy value of the supplemented biodiesel solution 56, as compared to the original biodiesel 14, the generator 34 creates an increased output 44. The output 44 comprises process heat and/or power 46 in addition to recyclable heat 48. As shown, the recyclable heat 48 may be communicated to other system components. For instance, the recyclable heat 48 may be communicated to the holding tank 12 via the tank heating conduit 50 to heat the biodiesel 14. Further, the recyclable heat 48 may be communicated to the dissolution chamber 18 via the chamber heating conduit 52 to heat the biodiesel 14 or the supplemented biodiesel solution 56 or slurry 60

formed therein. Finally, the recyclable heat **48** may be communicated to the storage container **38** to heat the supplemented biodiesel solution **56**.

[0023] While the particular system for using a plastic material as fuel as herein shown and disclosed in detail is fully capable of obtaining the objects and providing the advantages herein before stated, it is to be understood that it is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended to the details of construction or design herein shown other than as described in the appended claims.

What is claimed is:

1. A method of using a plastic material as a fuel comprises the steps of:

providing the plastic material and a biodiesel;

dissolving the plastic material in the biodiesel to form a solution having a fuel value; and

burning the solution in a device to utilize the fuel value.

2. The method as recited in claim 1 further comprising the step of filtering out insoluble contaminants from the solution after dissolving the plastic material in the biodiesel.

3. The method as recited in claim 1 wherein the solution has a viscosity and further comprising the steps of:

heating the solution to facilitate the dissolving step; and

mixing the solution to facilitate the dissolving step.

4. The method as recited in claim 3 further comprising the step of using heat created during the burning step to heat the solution to reduce the viscosity.

5. The method as recited in claim 1 further comprising the step of heating the biodiesel.

6. The method as recited in claim 1 wherein the plastic material is waste material.

7. The method as recited in claim 1 wherein the device is selected from the group consisting of an engine, a turbine, a burner and a heater.

8. The method as recited in claim 1 wherein the plastic material comprises a polymer.

9. The method as recited in claim 8 wherein the polymer is selected from the group consisting of polystyrene, polyethylene and polypropylene.

10. The method as recited in claim 1 wherein the solution is 20-50 wt. % plastic.

11. A method of reducing a volume of a plastic material comprising the steps of:

providing the plastic material and a biodiesel; and

dissolving the plastic material in the biodiesel to form a solution for use as a fuel.

12. The method as recited in claim 11 further comprising the steps of:

filtering out insoluble contaminants from the solution after dissolving the plastic material in the biodiesel;

heating the solution to reduce viscosity;

feeding the solution to a device; and

burning the solution in the device.

13. The method as recited in claim 12 wherein the burning step creates heat and wherein a portion of the heat created from the burning step is used in the heating step.

14. The method as recited in claim 11 further comprising the step of increasing the temperature of the biodiesel before the dissolving step.

15. The method as recited in claim 14 wherein the burning step creates heat and wherein a portion of the heat created from the burning step is used in the increasing step.

16. The method as recited in claim 12 further comprising the step of increasing the temperature of the biodiesel before the dissolving step wherein the burning step creates heat and wherein portions of the heat created from the burning step are used in the heating step and in the increasing step.

17. A system for using a plastic material for fuel, the system comprising:

a dissolution chamber for receiving a biodiesel and the plastic material, with the biodiesel dissolving the plastic material to form a solution having a fuel value; and

a device for burning the solution, with the device receiving the solution from the dissolution chamber, and with the device providing heat to the dissolution chamber.

18. The system as recited in claim 17 wherein the device is selected from the group consisting of an engine, a turbine, a burner and a heater.

19. The system as recited in claim 17 further comprising a means for heating the solution in the dissolution chamber.

20. The system as recited in claim 17 further comprising a filter for removing insoluble contaminants from the solution.

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