conventional diesel engines. However, a similar cold flow problem with conventional biodiesel fuels still remains. This problem is at least partly due to the fact that at lower temperatures, e.g., around freezing (ca. 0°C), conventional biodiesel often thickens and does not flow as readily. Therefore a limitation of biodiesel produced in this way is that it generally possesses a higher cloud point (and pour point) that renders it unusable in some, particularly colder, climates.

[0005] An alternative to the above-described transesterification, and as described herein, is to mix a vegetable oil (e.g., canola oil) with conventional diesel to form a mixture, and to then hydrotreat the mixture to yield a hybrid diesel biofuel. Generally, the vegetable oil is present in the mixture in an amount that is less than that of the conventional diesel. Depending on the embodiment, the vegetable oil typically comprises less than about 10 weight percent of the mixture.

[0006] When a vegetable oil is added to the diesel going to a hydrotreater, the cloud point is typically increased, driving the diesel "off-spec." This requires readjustment of the diesel cut point, thereby reducing yield. While the prior art teaches isomerization dewaxing catalysts to lower cloud point, these catalysts either require removal of H_2S and NH_3 from the hydrotreater effluent ahead of the dewaxing reactor, or else have to operate at high temperature where life of the dewaxing catalyst is short. Accordingly, a method that could economically-utilize biomass in the production of hydrotreated diesel fuels, while still maintaining a relatively low cloud point, is still very much needed and would be highly beneficial.

BRIEF DESCRIPTION OF THE DISCLOSURE~~INVENTION~~

[0007] In some embodiments, the present disclosure~~invention~~ is directed to methods (i.e., processes) and systems for co-processing vegetable oil and petroleum diesel to yield a hybrid diesel product comprising a biomass-derived component. Typically, such methods and systems work to provide a hybrid diesel product that benefits from a (partial) biomass-derived component, but without the poor low-temperature properties of conventional ester-based biodiesel.

[0008] So as to address at least some of the above-described limitations and/or recognized needs of biofuels and/or their processing, in some embodiments the

present disclosure~~invention~~ is directed to methods by which a mixture of vegetable oil and petroleum diesel is first hydrotreated to yield a reduced-sulfur hybrid intermediate, and then the hybrid intermediate is processed in an isomerization unit to yield a low cloud point hybrid (bio)diesel product that is partially derived from biomass. The low cloud point hybrid diesel product ideally possesses a cloud point within (or at least close to) the standard diesel range. Typically, such embodiments utilize a sulfur- and/or nitrogen-tolerant isomerization catalyst such that H_2S and NH_3 are generally not removed from the hybrid intermediate stream prior to isomerization. By forgoing interstage removal of H_2S and NH_3, such sulfur- and/or nitrogen-tolerant isomerization catalysts can enable the favorable economics of such methods/systems. Such isomerization catalysts are described in Miller, United States Patent Application Serial No. 12/181,652, filed July 29, 2008, and incorporated by reference herein.

[0009] In some embodiments, the present disclosure~~invention~~ is directed to one or more methods for producing a hybrid diesel (bio)fuel product, such methods comprising the steps of: (a) combining vegetable oil with diesel fuel to form a first mixture, wherein the vegetable oil comprises not more than 10 weight percent of said first mixture; (b) hydrotreating the first mixture to yield a second mixture, wherein triglyceride components of the first mixture are deoxygenated, and wherein at least 95 atomic percent of the sulfur present in the first mixture is converted to H_2S in the second mixture; (c) isomerizing the second mixture in the presence of an isomerization catalyst to yield a third mixture comprising hybrid diesel fuel having a cloud point that is lower than that of the second mixture, wherein H_2S in the second mixture has not been removed prior to isomerizing; and (d) isolating the hybrid diesel fuel of the third mixture to yield a hybrid diesel fuel product.

[0010] So as to facilitate the production of such above-described hybrid diesel fuel and/or to implement any or all of the aforementioned methods, in some or other embodiments, the present disclosure~~invention~~ is directed to one or more systems for generating a hybrid diesel fuel product, such systems generally comprising: (a) a mixing unit for combining vegetable oil with diesel fuel so as to form a first mixture, wherein the vegetable oil comprises not more than 10 weight percent of said first mixture; (b) a hydrotreating unit for hydrotreating the first mixture to yield a second mixture, wherein said unit is operable for deoxygenating triglyceride components of the first

mixture, and wherein at least 95 atomic percent of the sulfur present in the first mixture is converted to H_2S in the second mixture; and (c) an isomerization unit for isomerizing the second mixture in the presence of an isomerization catalyst to yield a third mixture comprising hybrid diesel fuel having a cloud point that is lower than that of the second mixture, wherein H_2S in the second mixture has not been removed prior to isomerizing.

[0011] The foregoing has outlined rather broadly the features of the present disclosure~~invention~~ in order that the detailed description of the disclosure~~invention~~ that follows may be better understood. Additional features and advantages of the disclosure~~invention~~ will be described hereinafter which form the subject of the claims of the disclosure~~invention~~.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] For a more complete understanding of the present invention, and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

[0013] FIG. 1 illustrates, in flow diagram form, methods for producing hybrid diesel biofuel compositions, in accordance with some embodiments of the present invention; and

[0014] FIG. 2 depicts, schematically, systems for implementing methods such as illustrated in FIG. 1, in accordance with some embodiments of the present invention.