stability makes processing (e.g. storage, blending with conventional fuels, upgrading) difficult.

A need exists for improved methods of producing biofuels from organic matter that avoid one or more of the disadvantages stated above.

Summary ~~of the invention~~

In a first aspect, the present disclosure~~invention~~ provides a method for producing a biofuel, the method comprising treating organic matter with an aqueous solvent and at least one additional catalyst at a temperature of between about 250°C and about 400°C, and a pressure of between about 100 bar and about 300 bar.

In a second aspect, the present disclosure~~invention~~ provides a method for producing a biofuel, the method comprising:

providing a reaction mixture comprising organic matter and an aqueous solvent, and;

treating said reaction mixture at a temperature of between about 250°C and about 400°C, and a pressure of between about 100 bar and about 300 bar in a reaction vessel;

wherein said reaction mixture comprises at least one additional catalyst that originates independently of other reaction mixture components and of said reaction vessel.

In yet another aspect, there is provided a method for producing a biofuel, the method comprising:

treating organic matter with an aqueous solvent and at least one additional catalyst selected from the group consisting of: an alkali metal formate catalyst; an alkali metal carbonate catalyst; a transition metal catalyst; a transition metal salt catalyst; a transition metal formate catalyst; an alkali metal salt catalyst; an alkaline earth metal salt catalyst; an acid catalyst; a solid acid catalyst; a water-gas-shift catalyst; a zeolite or alumino-silicate catalyst; a supported transition metal catalyst; a sulphide catalyst; and a base catalyst that is an alkali metal salt or a transition metal salt; at a temperature of between about 250°C and about 400°C, and a pressure of between about 100 bar and about 300 bar, wherein the organic matter and aqueous solvent is provided in the form of a slurry, and said treating is under conditions of continuous flow with a minimum volume-independent flow velocity of the slurry greater than the settling velocity of solid matter within the slurry; and

cooling and depressurisation of the slurry.

In one embodiment of the first and second aspect, the additional catalyst is not present, or is substantially not present, in any one or more of the organic matter, the aqueous solvent, or a reactor vessel wall.

In another embodiment of the first and second aspect, the additional catalyst is also present in any one or more of the organic matter, the aqueous solvent, or a reactor vessel wall.

In one embodiment of the first and second aspect, the additional catalyst is an additional base catalyst.

In one embodiment of the first and second aspect, the additional base catalyst is an alkali metal hydroxide catalyst or a transition metal hydroxide catalyst.

In one embodiment of the first and second aspect, the additional base catalyst is sodium hydroxide or potassium hydroxide.

In one embodiment of the first and second aspect, the biofuel is an oil product.

In one embodiment of the first and second aspect, the biofuel is a bio-oil.

In one embodiment of the first and second aspect, the bio-oil is derived from processing fossilised organic material (e.g. coals such as lignite).

(i) additional catalyst,

(ii) additional catalyst that enhances the incorporation of hydrogen into the organic matter; and/or

(iii) additional catalyst that enhances the removal of oxygen from the organic matter,

is added to the organic matter when said temperature is greater than about 340°C and said pressure is greater than about 230 bar.

In another embodiment of the first and second aspect, the organic matter is lignocellulosic matter, and the

(i) additional catalyst,

(ii) additional catalyst that enhances the incorporation of hydrogen into the organic matter; and/or

(iii) additional catalyst that enhances the removal of oxygen from the organic matter,

is added to the organic matter when said temperature is greater than about 310°C and said pressure is greater than about 180 bar.

In another embodiment of the first and second aspect, the method comprises the steps of:

(i) cooling the organic matter to a temperature of between about 160°C and about 200°C in a time period of less than about 30 seconds after said treating; and

(ii) depressurisation and cooling the organic matter to ambient temperature by release through a pressure let down device.

In another embodiment of the first and second aspect, the pressure let down device is enveloped in ambient temperature water.

In one embodiment of the first and second aspect, the biofuel comprises an oil component having a gross calorific value of more than 35 MJ/kg.

In one embodiment of the first and second aspect, the biofuel comprises an oil component having greater than about 8% wt db hydrogen and less than about 10% wt db oxygen.

In one embodiment of the first and second aspect, the biofuel comprises a char component having a gross calorific value of more than 30 MJ/kg.

In a third aspect, the present disclosure~~invention~~ provides a biofuel produced by the method of the first or second aspect.

In one embodiment of the third aspect, the biofuel is an oil product.