[0016] In one embodiment the biomass comprises a hydrocarbon source. In various embodiments the biomass comprises a hydrocarbon source selected from the group comprising biological material, organic matter, plant matter, animal matter, waste material, organic waste material, plant waste material, animal waste material, dairy processing wastewater, abattoir wastewater, abattoir waste material, food processing wastewater, food processing waste material, wood pulp, lignocellulose pulp, pulp processing wastewater, pulp processing waste material, paper processing wastewater, paper processing waste material, municipal waste material, municipal wastewater, solids from municipal wastewater, lignocellulosic biomass, wastewater from lignocellulosic biomass processing, biosolid waste material from lignocellulosic biomass processing, or any combination of any two or more thereof.

[0017] In one embodiment the solids content of the biomass is at least about 0.5, 1, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65 or 70 % by weight, and useful ranges may be selected between any of these values (for example, about 0.5 to about 5, about 0.5 to about 10, about 0.5 to about 15, about 0.5 to about 20, about 0.5 to about 25, about 0.5 to about 30, about 0.5 to about 35, about 0.5 to about 40, about 0.5 to about 45, about 0.5 to about 50, about 0.5 to about 55, about 0.5 to about 60, about 0.5 to about 65, or about 0.5 to about 70% by weight). At low solids concentrations, the biomass may also be useful to dilute other process streams, such as the mixture resulting from microbial digestion.

[0018] In one embodiment the biomass comprises one or more microorganisms. The microorganisms may be naturally present in the biomass or the biomass may be inoculated with one or more microorganisms. Suitable microorganisms are discussed below. In another embodiment the biomass substantially free of microorganisms, contains less than about 50,000 cfu/ml microorganisms or is substantially sterile.

[0019] In various embodiments, subjecting biomass to microbial digestion by contacting biomass with one or more microorganisms may be conducted in a biological reactor. The biological reactor may be an anaerobic tank or anaerobic digester, for example. The one or more microorganisms may be present in the biomass or may be added to the biomass.

[0020] The process of the invention includes applying conditions such that the microbial digestion of the organic biomass generates volatile fatty acids and/or solvents but minimises methanogenesis or other further digestion of the volatile fatty acids and/or solvents.

[0021] In one embodiment the microbial digestion conditions comprise a temperature of up to about 1, 5, 10, 15, 20, 25, 30, 25, 40, 45 or 50°C, and useful ranges may be selected between

CLAIMS

1. A process for the treatment of biomass comprising

(1) subjecting biomass to anaerobic microbial digestion for about 0.5 to about 20 days under conditions so as to convert at least a portion of the organic biomass to volatile fatty acids and/or solvents while leaving at least some of the organic biomass in the form of biosolids or unconverted organic material and minimising methanogenesis to create a mixture of biosolids, unconverted organic biomass and volatile fatty acids and/or solvents, and

(2) subjecting the mixture to wet oxidation thereby reducing biosolid volume and producing a resulting mixture under conditions that do not result in the mass destruction of the volatile fatty acids and/or solvents.

2. A process for the treatment of biomass comprising

(1) subjecting biomass to anaerobic microbial digestion for about 0.5 to about 20 days by contacting biomass with one or more microorganisms under conditions that promote acidogenesis while retarding methanogenesis to produce a mixture comprising

(a) volatile fatty acids and/or solvents such as short chain (C1 to C7) fatty acids, short chain (C1 to C7) alcohols, short chain (C1 to C7) ketones or any mixture of any two or more thereof, and

(b) undigested biomass, and

(2) subjecting at least a portion of the mixture to wet oxidation under conditions to reduce the volume of the undigested biomass while maintaining or increasing the concentration of the volatile fatty acids and/or solvents that are present.

3. A process according to Claim 1 or 2, in which the microbial digestion conditions comprise a digestion time of up to about 0.5 to about 10 days.

4. A process according Claim 1, 2 or 3, in which the microbial digestion conditions comprise a pH of about 4 to about 6.4 or a pH of about 7.3 to about 10.

5. A process according to any preceding claim, in which the microbial digestion conditions are substantially free of hydrogen gas.

6. A process according to any preceding claim, in which the process further comprises sterilisation of the biomass before microbial digestion followed by inoculation with unsterilised biomass, a mixed culture, or one or more monocultures, or any combination of any two or more thereof.

7. A process according to any preceding claim, in which the microbial digestion conditions further comprise a methanogenesis inhibitor.

8. A process according to any preceding claim, in which the biomass comprises a hydrocarbon source.

9. A process according to any of Claims 1 to 7, in which the biomass comprises municipal waste material, municipal wastewater, and/or solids from municipal wastewater.

10. A process according to any of Claims 1 to 7, in which the biomass comprises a hydrocarbon source selected from the group comprising biological material, organic matter, plant matter, animal matter, waste material, organic waste material, plant waste material, animal waste material, dairy processing wastewater, abattoir wastewater, abattoir waste material, food processing wastewater, food processing waste material, wood pulp, lignocellulose pulp, pulp processing wastewater, pulp processing waste material, paper processing wastewater, paper processing waste material, municipal waste material, municipal wastewater, solids from municipal wastewater, lignocellulosic biomass, wastewater from lignocellulosic biomass processing, biosolid waste material from lignocellulosic biomass processing, or any combination of any two or more thereof.

11. A process according to any preceding claim, in which the solids content of the biomass is at least about 0.5 to about 70 % by weight.

12. A process according to any preceding claim, in which the biomass comprises one or more microorganisms.

13. A process according to any of Claims 1 to 11, in which the biomass is substantially free of microorganisms.

14. A process according to any preceding claim, in which the microbial digestion conditions comprise a temperature of up to about 1 to about 50°C.

15. A process according to any preceding claim, in which the microbial digestion conditions comprise a volatile suspended solids content of about 0.5 to about 10 g/L.

16. A process according to any preceding claim, in which the microbial digestion is continued until the concentration of volatile fatty acids and/or solvents in the digestion medium reaches a maximum.

17. A process according to any preceding claim, in which the microbial digestion is continued until the concentration of volatile fatty acids and/or solvents is at least about 100 to about 250 mg/gVSS.

18. A process according to any preceding claim, in which the process provides a gross yield of acetic acid that is at least about 10% to about 100% or more greater than with wet oxidation of unfermented biosolids.

19. A process according to any preceding claim, in which the process provides a gross yield of acetic acid over the first 1, 2, 3, 4, or 5 hours of oxidation that is at least about 10% to about 100% or more greater than with wet oxidation of unfermented biosolids.

20. A process according to any preceding claim, in which the process provides a gross yield of volatile fatty acids that is at least about 10% to about 85% or more greater than with wet oxidation of unfermented biosolids.

21. A process according to any preceding claim, in which the process provides a gross yield of volatile fatty acids over the first 1, 2, 3, 4, or 5 hours of oxidation that is at least about 10% to about 85% or more greater than with wet oxidation of unfermented biosolids.

22. A process according to any preceding claim, in which the process provides acetic acid purity, or volatile fatty acid purity, or both that is at least about 10, 20 or 30% greater than with wet oxidation of unfermented by solids.

23. A process according to any preceding claim, in which the process provides an increase in the rate of production of acetic acid or of total volatile fatty acids (VFA), or both that is at least 10%, 20%, 30%, 40%, 50% faster that the rate of production of acetic acid or total volatile fatty acids, or both from unfermented solids under similar wet oxidation conditions.

24. A process according to any preceding claim, in which the process provides an increase in the rate of production of acetic acid or of total volatile fatty acids, or both over the first 1, 2,

3, 4, or 5 hours of wet oxidation that is at least 10%, 20%, 30%, 40% or 50% or more faster than the rate of production of acetic acid or total volatile fatty acids, or both from unfermented solids under similar wet oxidation conditions.

25. A process according to any preceding claim, in which the microbial digestion conditions or the one or more microorganisms comprises one or more mixed cultures or one or more monocultures of bacteria or algae or a combination thereof.

26. A process according to any preceding claim, in which the microbial digestion conditions or the one or more microorganisms comprises one or more acidogenic microorganisms selected from Acetobacterium, Aeromonas, Clostridia, Klebsiella, Moorella and Ruminococcus, and any combination of any two or more thereof.

27. A process according to any preceding claim, in which the microbial digestion conditions or the one or more microorganisms comprises one or more acidogenic microorganisms selected from *Acetobacterium* spp., *Aeromonas* spp., *Clostridia* spp., *Klebsiella* spp., *Moorella* spp. and *Ruminococcus* spp., *Acetobacterium woodii*, *Clostridium thermoaceticum*, *Clostridium thermolacticum*, *Clostridium ljungdahlii*, *Clostridium acetobutylicum*, *Clostridium formicaceticum*, *Clostridium glycolicum*, *Moorella thermoautotrophica*, and *Ruminococcus productus*, and any combination of any two or more thereof.

28. A process according to any preceding claim, in which the microbial digestion conditions or the one or more microorganisms comprises one or more acetogenic microorganisms.

29. A process according to any preceding claim, in which the microbial digestion conditions or the one or more microorganisms comprises one or more microorganisms selected from Acetobacterium, Clostridium, Moorella and Ruminococcus, and any combination of any two or more thereof.

30. A process according to any preceding claim, in which the microbial digestion conditions or the one or more microorganisms comprises one or more microorganisms selected from *Acetobacterium woodii*, *Clostridium thermoaceticum*, *Clostridium thermolacticum*, *Clostridium ljungdahlii*, *Clostridium acetobutylicum*, *Clostridium formicaceticum*, *Clostridium glycolicum*, *Moorella thermoacetica*, *Moorella thermoautotrophica* and *Ruminococcus productus*, and any combination of any two or more thereof.

31. A process according to any preceding claim, in which the microbial digestion conditions or the one or more microorganisms comprises one or more microorganisms selected from one or more acidogenic or acetogenic algae.

32. A process according to any preceding claim, in which the solids content of the mixture resulting from microbial digestion is, or is diluted or dewatered to, about 0.5 to about 10% by weight.

33. A process according to any preceding claim, in which the wet oxidation conditions comprise a temperature of up to the critical point of water, about 100 to about 374°C.

34. A process according to any preceding claim, in which the wet oxidation conditions comprise an oxidant.

35. A process according to Claim 34, in which the oxidant concentration is at least about 0.5. 0.75, 1, 1.5 or 2 times the stoichiometric amount required for complete oxidation of the organic material in the mixture entering the wet oxidation stage.

36. A process according to any preceding claim, in which the wet oxidation conditions comprise a residence time of about 5 to about 180 minutes.

37. A process according to any preceding claim, in which the wet oxidation conditions reduce the volume of biosolids by at least about 60 to 99%.

38. A process according to any preceding claim, in which an amount of liquid from wet oxidation is added to an amount of the mixture before the mixture is subjected to wet oxidation.

39. A process according to any preceding claim, in which the process further comprises separating at least one of the volatile fatty acids or solvents from the mixture following wet oxidation.

40. A process according to any preceding claim, in which the process further comprises separating ammonium from the mixture following wet oxidation.

41. A process according to any preceding claim, in which the process further comprises separating a precipitated phosphorus-containing compound from the mixture following wet oxidation.

42. A process of producing a fuel or fuel precursor, the process comprising processing at least one of the separated volatile fatty acids or solvents produced by a method according to any preceding claim into a fuel or fuel precursor.

43. A process according to Claim 42, in which the fuel or fuel precursor comprises alcohol.

[0016] In one embodiment the biomass comprises a hydrocarbon source. In various embodiments the biomass comprises a hydrocarbon source selected from the group comprising biological material, organic matter, plant matter, animal matter, waste material, organic waste material, plant waste material, animal waste material, dairy processing wastewater, abattoir wastewater, abattoir waste material, food processing wastewater, food processing waste material, wood pulp, lignocellulose pulp, pulp processing wastewater, pulp processing waste material, paper processing wastewater, paper processing waste material, municipal waste material, municipal wastewater, solids from municipal wastewater, lignocellulosic biomass, wastewater from lignocellulosic biomass processing, biosolid waste material from lignocellulosic biomass processing, or any combination of any two or more thereof.

[0017] In one embodiment the solids content of the biomass is at least about 0.5, 1, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65 or 70 % by weight, and useful ranges may be selected between any of these values (for example, about 0.5 to about 5, about 0.5 to about 10, about 0.5 to about 15, about 0.5 to about 20, about 0.5 to about 25, about 0.5 to about 30, about 0.5 to about 35, about 0.5 to about 40, about 0.5 to about 45, about 0.5 to about 50, about 0.5 to about 55, about 0.5 to about 60, about 0.5 to about 65, or about 0.5 to about 70% by weight). At low solids concentrations, the biomass may also be useful to dilute other process streams, such as the mixture resulting from microbial digestion.

[0018] In one embodiment the biomass comprises one or more microorganisms. The microorganisms may be naturally present in the biomass or the biomass may be inoculated with one or more microorganisms. Suitable microorganisms are discussed below. In another embodiment the biomass substantially free of microorganisms, contains less than about 50,000 cfu/ml microorganisms or is substantially sterile.

[0019] In various embodiments, subjecting biomass to microbial digestion by contacting biomass with one or more microorganisms may be conducted in a biological reactor. The biological reactor may be an anaerobic tank or anaerobic digester, for example. The one or more microorganisms may be present in the biomass or may be added to the biomass.

[0020] The process of the invention includes applying conditions such that the microbial digestion of the organic biomass generates volatile fatty acids and/or solvents but minimises methanogenesis or other further digestion of the volatile fatty acids and/or solvents.

[0021] In one embodiment the microbial digestion conditions comprise a temperature of up to about 1, 5, 10, 15, 20, 25, 30, 35, 40, 45 or 50°C, and useful ranges may be selected between

CLAIMS

1. A process for the treatment of biomass comprising

(1) subjecting biomass to anaerobic microbial digestion for about 0.5 to about 20 days under conditions so as to convert at least a portion of the organic biomass to volatile fatty acids and/or solvents while leaving at least some of the organic biomass in the form of biosolids or unconverted organic material and minimising methanogenesis to create a mixture of biosolids, unconverted organic biomass and volatile fatty acids and/or solvents, and

(2) subjecting the mixture to wet oxidation thereby reducing biosolid volume and producing a resulting mixture under conditions that do not result in the mass destruction of the volatile fatty acids and/or solvents.

2. A process for the treatment of biomass comprising

(1) subjecting biomass to anaerobic microbial digestion for about 0.5 to about 20 days by contacting biomass with one or more microorganisms under conditions that promote acidogenesis while retarding methanogenesis to produce a mixture comprising

(a) volatile fatty acids and/or solvents such as short chain (C1 to C7) fatty acids, short chain (C1 to C7) alcohols, short chain (C1 to C7) ketones or any mixture of any two or more thereof, and

(b) undigested biomass, and

(2) subjecting at least a portion of the mixture to wet oxidation under conditions to reduce the volume of the undigested biomass while maintaining or increasing the concentration of the volatile fatty acids and/or solvents that are present.

3. A process according to Claim 1 or 2, in which the microbial digestion conditions comprise a digestion time of up to about 0.5 to about 10 days.

4. A process according Claim 1, 2 or 3, in which the microbial digestion conditions comprise a pH of about 4 to about 6.4 or a pH of about 7.3 to about 10.

5. A process according to any preceding claim, in which the microbial digestion conditions are substantially free of hydrogen gas.

6. A process according to any preceding claim, in which the process further comprises sterilisation of the biomass before microbial digestion followed by inoculation with unsterilised biomass, a mixed culture, or one or more monocultures, or any combination of any two or more thereof.

7. A process according to any preceding claim, in which the microbial digestion conditions further comprise a methanogenesis inhibitor.

8. A process according to any preceding claim, in which the biomass comprises a hydrocarbon source.

9. A process according to any of Claims 1 to 7, in which the biomass comprises municipal waste material, municipal wastewater, and/or solids from municipal wastewater.

10. A process according to any of Claims 1 to 7, in which the biomass comprises a hydrocarbon source selected from the group comprising biological material, organic matter, plant matter, animal matter, waste material, organic waste material, plant waste material, animal waste material, dairy processing wastewater, abattoir wastewater, abattoir waste material, food processing wastewater, food processing waste material, wood pulp, lignocellulose pulp, pulp processing wastewater, pulp processing waste material, paper processing wastewater, paper processing waste material, municipal waste material, municipal wastewater, solids from municipal wastewater, lignocellulosic biomass, wastewater from lignocellulosic biomass processing, biosolid waste material from lignocellulosic biomass processing, or any combination of any two or more thereof.

11. A process according to any preceding claim, in which the solids content of the biomass is at least about 0.5 to about 70 % by weight.

12. A process according to any preceding claim, in which the biomass comprises one or more microorganisms.

13. A process according to any of Claims 1 to 11, in which the biomass is substantially free of microorganisms.

14. A process according to any preceding claim, in which the microbial digestion conditions comprise a temperature of up to about 1 to about 50°C.

15. A process according to any preceding claim, in which the microbial digestion conditions comprise a volatile suspended solids content of about 0.5 to about 10 g/L.

16. A process according to any preceding claim, in which the microbial digestion is continued until the concentration of volatile fatty acids and/or solvents in the digestion medium reaches a maximum.

17. A process according to any preceding claim, in which the microbial digestion is continued until the concentration of volatile fatty acids and/or solvents is at least about 100 to about 250 mg/gVSS.

18. A process according to any preceding claim, in which the process provides a gross yield of acetic acid that is at least about 10% to about 100% or more greater than with wet oxidation of unfermented biosolids.

19. A process according to any preceding claim, in which the process provides a gross yield of acetic acid over the first 1, 2, 3, 4, or 5 hours of oxidation that is at least about 10% to about 100% or more greater than with wet oxidation of unfermented biosolids.

20. A process according to any preceding claim, in which the process provides a gross yield of volatile fatty acids that is at least about 10% to about 85% or more greater than with wet oxidation of unfermented biosolids.

21. A process according to any preceding claim, in which the process provides a gross yield of volatile fatty acids over the first 1, 2, 3, 4, or 5 hours of oxidation that is at least about 10% to about 85% or more greater than with wet oxidation of unfermented biosolids.

22. A process according to any preceding claim, in which the process provides acetic acid purity, or volatile fatty acid purity, or both that is at least about 10, 20 or 30% greater than with wet oxidation of unfermented by solids.

23. A process according to any preceding claim, in which the process provides an increase in the rate of production of acetic acid or of total volatile fatty acids (VFA), or both that is at least 10%, 20%, 30%, 40%, 50% faster than the rate of production of acetic acid or total volatile fatty acids, or both from unfermented solids under similar wet oxidation conditions.

24. A process according to any preceding claim, in which the process provides an increase in the rate of production of acetic acid or of total volatile fatty acids, or both over the first 1, 2,

3, 4, or 5 hours of wet oxidation that is at least 10%, 20%, 30%, 40% or 50% or more faster than the rate of production of acetic acid or total volatile fatty acids, or both from unfermented solids under similar wet oxidation conditions.

25. A process according to any preceding claim, in which the microbial digestion conditions or the one or more microorganisms comprises one or more mixed cultures or one or more monocultures of bacteria or algae or a combination thereof.

26. A process according to any preceding claim, in which the microbial digestion conditions or the one or more microorganisms comprises one or more acidogenic microorganisms selected from Acetobacterium, Aeromonas, Clostridia, Klebsiella, Moorella and Ruminococcus, and any combination of any two or more thereof.

27. A process according to any preceding claim, in which the microbial digestion conditions or the one or more microorganisms comprises one or more acidogenic microorganisms selected from *Acetobacterium* spp., *Aeromonas* spp., *Clostridia* spp., *Klebsiella* spp., *Moorella* spp. and *Ruminococcus* spp., *Acetobacterium woodii*, *Clostridium thermoaceticum*, *Clostridium thermolacticum*, *Clostridium ljungdahlii*, *Clostridium acetobutylicum*, *Clostridium formicaceticum*, *Clostridium glycolicum*, *Moorella thermoautotrophica*, and *Ruminococcus productus*, and any combination of any two or more thereof.

28. A process according to any preceding claim, in which the microbial digestion conditions or the one or more microorganisms comprises one or more acetogenic microorganisms.

29. A process according to any preceding claim, in which the microbial digestion conditions or the one or more microorganisms comprises one or more microorganisms selected from Acetobacterium, Clostridium, Moorella and Ruminococcus, and any combination of any two or more thereof.

30. A process according to any preceding claim, in which the microbial digestion conditions or the one or more microorganisms comprises one or more microorganisms selected from *Acetobacterium woodii*, *Clostridium thermoaceticum*, *Clostridium thermolacticum*, *Clostridium ljungdahlii*, *Clostridium acetobutylicum*, *Clostridium formicaceticum*, *Clostridium glycolicum*, *Moorella thermoacetica*, *Moorella thermoautotrophica* and *Ruminococcus productus*, and any combination of any two or more thereof.

31. A process according to any preceding claim, in which the microbial digestion conditions or the one or more microorganisms comprises one or more microorganisms selected from one or more acidogenic or acetogenic algae.

32. A process according to any preceding claim, in which the solids content of the mixture resulting from microbial digestion is, or is diluted or dewatered to, about 0.5 to about 10% by weight.

33. A process according to any preceding claim, in which the wet oxidation conditions comprise a temperature of up to the critical point of water, about 100 to about 374°C.

34. A process according to any preceding claim, in which the wet oxidation conditions comprise an oxidant.

35. A process according to Claim 34, in which the oxidant concentration is at least about 0.5. 0.75, 1, 1.5 or 2 times the stoichiometric amount required for complete oxidation of the organic material in the mixture entering the wet oxidation stage.

36. A process according to any preceding claim, in which the wet oxidation conditions comprise a residence time of about 5 to about 180 minutes.

37. A process according to any preceding claim, in which the wet oxidation conditions reduce the volume of biosolids by at least about 60 to 99%.

38. A process according to any preceding claim, in which an amount of liquid from wet oxidation is added to an amount of the mixture before the mixture is subjected to wet oxidation.

39. A process according to any preceding claim, in which the process further comprises separating at least one of the volatile fatty acids or solvents from the mixture following wet oxidation.

40. A process according to any preceding claim, in which the process further comprises separating ammonium from the mixture following wet oxidation.

41. A process according to any preceding claim, in which the process further comprises separating a precipitated phosphorus-containing compound from the mixture following wet oxidation.

42. A process of producing a fuel or fuel precursor, the process comprising processing at least one of the separated volatile fatty acids or solvents produced by a method according to any preceding claim into a fuel or fuel precursor.

43. A process according to Claim 42, in which the fuel or fuel precursor comprises alcohol.