Claims

1. A method for extracting hydrogen from a compound comprising carbon, oxygen, and hydrogen, the method comprising:

(i) combining water with the compound to produce a wet form of the compound;

(ii) transferring the wet form of the compound into a reaction processing chamber;

(iii) heating the wet form of the compound within the reaction processing chamber to a temperature between 700°C and 1100°C such that elements comprised by the wet form of the compound dissociate and react through a hydrous pyrolysis reaction, wherein one reaction product comprises hydrogen gas; and

(iv) extracting the hydrogen gas.

2. The method recited in claim 1, further comprising determining an amount of water to combine with the compound to produce the wet form of the compound and to react through the hydrous pyrolysis reaction with the compound.

3. The method recited in claim 2, wherein determining the amount of water to combine with the compound to produce the wet form of the compound comprises: determining a weight percent water of the compound; and determining a remaining mass of water to combine with the compound to form the wet form of the compound, wherein the remaining mass of water depends on the determined weight percent water of the compound.

4. The method recited in claim 1, wherein heating the wet form of the compound within the reaction processing chamber occurs under atmospheric pressure conditions.

5. The method recited in claim 1, wherein the compound consists of carbon, oxygen, and hydrogen.

6. The method recited in claim 1, wherein the compound comprises cellulose.

7. The method recited in claim 1, wherein the compound comprises lignin.

8. The method recited in claim 1, wherein the compound comprises hemicellulose.

9. The method recited in claim 1, wherein the compound comprises a waste stream.

10. The method recited in claim 1, further comprising:

providing a flow of an inert gas to the reaction processing chamber.

11. The method recited in claim 10, wherein the inert gas comprises argon and/or nitrogen.

12. The method recited in claim 1, wherein the extracted hydrogen gas is processed to generate electrical power and/or heat.

13. The method recited in claim 1, wherein the extracted hydrogen gas is processed to produce liquid fuels.

14. The method recited in claim 1, wherein the extracted hydrogen gas is processed by burning the hydrogen gas.

15. The method recited in claim 1, wherein the extracted hydrogen gas is processed by feeding the hydrogen gas into a fuel cell.

16. The method recited in claim 1, wherein the water comprises liquid water.

17. The method recited in claim 1, further comprising passing reaction-product gases through a reduced pressure chamber to remove traces of unreacted carbon.

18. The method recited in claim 1 or 17, further comprising passing reaction-product gases through a water-cooled chamber to remove unreacted water.

19. The method recited in claim 1, wherein transferring the wet form of the compound into the reaction processing chamber occurs continuously.

20. The method recited in claim 19, wherein the continuous transfer of the wet form of the compound into the reactor utilizes a geometry that reduces the presence of air.

21. A system for extracting hydrogen from a compound comprising carbon, oxygen, and hydrogen, the system comprising:

(i) a processing chamber, wherein the processing chamber and a heating source heats a wet form of the compound within the processing chamber such that elements comprised by the wet form of the compound dissociate and react through a hydrous pyrolysis reaction;

(ii) [[a]] the heating source in thermal communication with an interior of the processing chamber, wherein the processing chamber and/or the heating source heats a wet form of the compound to a temperature between 700 °C and 1100 °C to induce the hydrous pyrolysis reaction;

(iii) a source of water for reacting with the compound, wherein the source of water combines water with the compound to produce the wet form of the compound outside the processing chamber;

(iv) a conveyor for conveying the wet form of the compound into the processing chamber; and

(v) an exhaust system for extracting resultant hydrogen gas from the processing chamber.

22. The system recited in claim 21, wherein the processing chamber is configured to operate under atmospheric pressure conditions.

23. The system recited in claim 21, wherein the compound consists of carbon, oxygen, and hydrogen.

24. The system recited in claim 21, wherein the compound comprises cellulose.

25. The system recited in claim 21, wherein the compound comprises lignin.

26. The system recited in claim 21, wherein the compound comprises hemicellulose.

27. The system recited in claim 21, wherein the compound comprises a waste stream.

28. The system recited in claim 21, further comprising:
gas delivery system providing a flow of inert gas to the processing chamber.

29. The system recited in claim 28, wherein the inert gas comprises argon and/or nitrogen.

30. The system recited in claim 21, wherein the extracted hydrogen gas is processed to generate electrical power and/or heat.

31. The system recited in claim 21, wherein the extracted hydrogen gas is processed to produce liquid fuels.

32. The system recited in claim 21, wherein the extracted hydrogen gas is processed by burning the hydrogen gas.

33. The system recited in claim 21, wherein the extracted hydrogen gas is processed by feeding the hydrogen gas into a fuel cell.

34. The system recited in claim 21, wherein the water comprises liquid water.

35. The system recited in claim 21, wherein the exhaust system for extracting resultant hydrogen gas from the processing chamber passes reaction-product gases through a reduced pressure chamber to remove traces of unreacted carbon.

36. The system recited in claim 21, wherein the exhaust system for extracting resultant hydrogen gas from the processing chamber passes reaction-product gases through a water-cooled chamber to remove unreacted water.

37. The system recited in claim 21, wherein the conveyor continuously transfers of the wet form of the compound into the processing chamber utilizing a geometry that reduces the presence of air.

38. A method for extracting hydrogen comprising:

(i) heating a wet compound to a temperature between 700 °C and 1100 °C, the compound comprising carbon, oxygen, and hydrogen, such that elements comprised from the wet compound dissociate and react through a hydrous pyrolysis reaction to form at least hydrogen gas; and

(ii) processing the hydrogen gas.

39. The method recited in claim 38, further comprising determining an amount of water to combine with the compound to produce the wet form of the compound and to react through the hydrous pyrolysis reaction with the compound.

40. The method recited in claim 39, determining the amount of water to combine with the compound to produce the wet form of the compound comprises: determining a weight percent water of the compound; and determining a remaining mass of water to combine with the compound to form the wet form of the compound, wherein the remaining mass of water depends on the determined weight percent water of the compound.

41. The method recited in claim 38, wherein the hydrogen gas is processed to generate electrical power and/or heat.

42. The method recited in claim 38, wherein the hydrogen gas is processed to produce liquid fuels.

43. The method recited in claim 38, wherein the compound consists of carbon, oxygen, and hydrogen.

44. The method recited in claim 38, wherein the compound comprises cellulose.

45. The method recited in claim 38, wherein the compound comprises lignin.

46. The method recited in claim 38, wherein the compound comprises hemicellulose.

47. The method recited in claim 38, wherein processing the hydrogen gas comprises burning the hydrogen gas.

48. The method recited in claim 38, wherein processing the hydrogen gas comprises feeding the hydrogen gas into a fuel cell.

49. The method recited in claim 38, further comprising:
forming the wet compound through mixing water with the compound comprising carbon, oxygen, and hydrogen, before heating the wet compound.

50. A system for extracting hydrogen comprising:
(i) a processing chamber in thermal communication with a heat source heating a wet compound to a temperature between 700 °C and 1100 °C, the compound comprising carbon, oxygen, and hydrogen, such that elements comprised from the wet compound dissociate and react through a hydrous pyrolysis reaction to form hydrogen gas;
(ii) a chamber mixing and/or combining water with the compound to form the wet compound before the processing chamber in thermal communication with the heat source heats the wet compound; and
(iii)an exhaust system processes the hydrogen gas.

51. The system recited in claim 50, wherein the exhaust system processes the hydrogen gas to generate electrical power and/or heat.

52. The system recited in claim 50, wherein the exhaust system configured to process the hydrogen gas is configured to process the hydrogen gas to produce liquid fuels.

53. The system recited in claim 50, wherein the compound consists of carbon, oxygen, and hydrogen.

54. The system recited in claim 50, wherein the compound comprises cellulose.

55. The system recited in claim 50, wherein the compound comprises lignin.

56. The system recited in claim 50, wherein the compound comprises hemicellulose.

57. The system recited in claim 50, wherein the exhaust system burns the hydrogen gas.

58. The system recited in claim 50, wherein the exhaust system configured to process the hydrogen gas is configured to feed the hydrogen gas into a fuel cell.

59. The system recited in claim 50, further comprising:
a conveyor transfers the wet compound to the processing chamber.

60. A method for making a liquid fuel from a compound comprising carbon, oxygen, and hydrogen, the method comprising:
(i) combining water with the compound to produce a wet form of the compound;
(ii) transferring the wet form of the compound into a reaction processing chamber; and
(iii)heating the wet form of the compound within the reaction processing chamber to a temperature between 700 °C and 1100 °C such that elements comprised by the wet form of the compound dissociate and react through a hydrous pyrolysis reaction, wherein one reaction product comprises the liquid fuel.

61. The method recited in claim 60, further comprising determining an amount of water to combine with the compound to produce the wet form of the compound and to react through the hydrous pyrolysis reaction with the compound.

62. The method recited in claim 61, whereindetermining the amount of water to combine with the compound to produce the wet form of the compound comprises: determining a weight percent water of the compound; and determining a remaining mass of water to combine with the compound to form the wet form of the compound, wherein the remaining mass of water depends on the determined weight percent water of the compound.

63. The method recited in claim 60, wherein the compound comprising carbon, oxygen, and hydrogen comprises cellulose.

64. The method recited in claim 60, wherein the compound comprising carbon, oxygen, and hydrogen comprises lignin.

65. The method recited in claim 60, wherein the compound comprising carbon, oxygen, and hydrogen comprises hemicellulose.

66. The method recited in claim 60, wherein:

(i) the liquid fuel comprises methanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 6H_2O \rightarrow CH_4O + 5CO_2 + 9H_2$.

67. The method recited in claim 60, wherein:

(i) the liquid fuel comprises methanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 5H_2O \rightarrow 2CH_4O + 4CO_2 + 6H_2$.

68. The method recited in claim 60, wherein:

(i) the liquid fuel comprises methanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 4H_2O \rightarrow 3CH_4O + 3CO_2 + 3H_2$.

69. The method recited in claim 60, wherein:

(i) the liquid fuel comprises methanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 3H_2O \rightarrow 4CH_4O + 2CO_2$.

70. The method recited in claim 60, wherein:

(i) the liquid fuel comprises ethanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 4H_2O \rightarrow C_2H_6O + 4CO_2 + 6H_2$.

71. The method recited in claim 60, wherein:

(i) the liquid fuel comprises ethanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + H_2O \rightarrow 2C_2H_6O + 2CO_2$.

72. The method recited in claim 60, wherein:

(i) the liquid fuel comprises propanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 2H_2O \rightarrow C_3H_8O + 3CO_2 + 3H_2$.

73. The method recited in claim 60, wherein:

(i) the liquid fuel comprises butanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 \rightarrow C_4H_{10}O + 2CO_2$.

74. The method recited in claim 60, wherein:

(i) the liquid fuel comprises gasoline; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing the reaction $C_6H_{10}O_5 + 4C + 4H_2O \rightarrow C_7H_{16} + 2CO_2$.

75. The method recited in claim 60, wherein:

(i) the liquid fuel comprises diesel; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 10C + 2H_2O \rightarrow C_{16}H_{24} + 6CO_2$.

76. The method recited in claim 60, further comprising:

extracting a hydrogen gas that is another reaction product as an end product.

77. The method recited in claim 60, further comprising:

extracting a carbon dioxide gas that is another reaction product as an end product.

78. A system for making a liquid fuel from a compound comprising carbon, oxygen, and hydrogen, the system comprising:

(i) a processing chamber, wherein the processing chamber and a heating source heat a wet form of the compound within the processing chamber such that elements comprised by the wet form of the compound dissociate and react through a hydrous pyrolysis reaction;

(ii) [[a]] the heating source in thermal communication with an interior of the processing chamber, wherein the processing chamber and/or the heating source heat a wet form of the compound to a temperature between 700 °C and 1100 °C to induce the hydrous pyrolysis reaction;

(iii) a source of water to wet the source of the compound, wherein the source of water combines water with the compound to produce the wet form of the compound outside the processing chamber; and

(iv) a subsystem for controlling the heating source to induce a dissociation and reaction of the wet source of the compound, wherein one reaction product comprises the liquid fuel.

79. The system recited in claim 78, further comprising:

an exhaust system for extracting at least the liquid fuel or resulting gases from the processing chamber.

80. The system recited in claim 78, wherein the compound comprising carbon, oxygen, and hydrogen comprises cellulose.

81. The system recited in claim 78, wherein the compound comprising carbon, oxygen, and hydrogen comprises lignin.

82. The system recited in claim 78, wherein the compound comprising carbon, oxygen, and hydrogen comprises hemicellulose.

83. The system recited in claim 78, wherein:

(i) the liquid fuel comprises methanol; and

(ii)heating the wet form of the compound within the reaction chamber comprises inducing the reaction $C_6H_{10}O_5 + 6H_2O \rightarrow CH_4O + 5CO_2 + 9H_2$.

84. The system recited in claim 78, wherein:

(i) the liquid fuel comprises methanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 5H_2O \rightarrow 2CH_4O + 4CO_2 + 6H_2$.

85. The system recited in claim 78, wherein:

(i) the liquid fuel comprises methanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 4H_2O \rightarrow 3CH_4O + 3CO_2 + 3H_2$.

86. The system recited in claim 78, wherein:

(i) the liquid fuel comprises methanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 3H_2O \rightarrow 4CH_4O + 2CO_2$.

87. The system recited in claim 78, wherein:

(i) the liquid fuel comprises ethanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 4H_2O \rightarrow C_2H_6O + 4CO_2 + 6H_2$.

88. The system recited in claim 78, wherein:

(i) the liquid fuel comprises ethanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + H_2O \rightarrow 2C_2H_6O + 2CO_2$.

89. The system recited in claim 78, wherein:

(i) the liquid fuel comprises propanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 2H_2O \rightarrow C_3H_8O + 3CO_2 + 3H_2$.

90. The system recited in claim 78, wherein:

(i) the liquid fuel comprises butanol; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 \rightarrow C_4H_{10}O + 2CO_2$.

91. The system recited in claim 78, wherein:

(i) the liquid fuel comprises gasoline; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 4C + 4H_2O \rightarrow C_7H_{16} + 2CO_2$.

92. The system recited in claim 78, wherein:

(i) the liquid fuel comprises diesel; and

(ii) heating the wet form of the compound within the reaction chamber comprises inducing a reaction $C_6H_{10}O_5 + 10C + 2H_2O \rightarrow C_{16}H_{24} + 6CO_2$.

93. The system recited in claim 78, wherein one resulting gas comprises a hydrogen gas as an end product.

94. The system recited in claim 78, wherein one resulting gas comprises a carbon dioxide gas as an end product.