CLAIMS

1. A process (100) for solubilizing an organic solid contained within a composite material comprising an organic solid and an inorganic matrix, the process (100) comprising:

   contacting the composite material with an oxidant in superheated water to form an aqueous mixture comprising at least one solubilized organic solute.

2. The process (100) of claim 1, wherein the oxidant is molecular oxygen (O_2).

3. The process (100) of claim 2, wherein the molecular oxygen is supplied by any method selected from the group consisting of:

   in situ decomposition of hydrogen peroxide;
   fractional distillation of liquefied air;
   electrolysis of water;
   transfer from a stored oxygen supply;
   membrane separation from air; and
   any combination thereof.

4. The process (100) of claim 3, wherein the molecular oxygen is supplied by in situ decomposition of hydrogen peroxide.

5. The process (100) of claim 1, wherein the composite material is contacted with the oxidant in a superheated water at a temperature ranging from about 100° C to about 374° C.

6. The process (100) of claim 5, wherein the composite material is contacted with the oxidant in superheated water at a temperature ranging from about 200° C to about 350° C.

7. The process (100) of claim 1, wherein the composite material is contacted with the oxidant in superheated water at a pressure ranging from about 100 kPa to about 22 MPa.

8. The process (100) of claim 7, wherein the composite material is contacted with the oxidant in superheated water at a pressure ranging from about 1.5 MPa to about 17 MPa.

9. The process (100) of claim 8, wherein the composite material is contacted with the oxidant in superheated water at a pressure ranging from about 12 MPa to about 16 MPa.

10. The process (100) of claim 1, wherein the composite material is selected from the group consisting of coal, bituminous sand, carbonaceous shale, biomass, and any mixture thereof.

11. The process (100) of claim 10, wherein the composite material is biomass, and wherein at least one solubilized organic solute comprises at least one of a low molecular weight sugar, an oxidized low molecular weight sugar, and any combination thereof.

12. The process (100) of claim 1, wherein the composite material is contacted with the oxidant in the superheated water within a reactor (200), wherein the composite material, oxidant, and superheated water are maintained in a non-gaseous phase to inhibit the formation of a head space within the reactor (200).

13. The process (100) of claim 1, further comprising chilling the aqueous mixture to a temperature of about 20° C.

14. The process (100) of claim 1, wherein the aqueous mixture has a pH ranging from about 1 to about 5.

15. The process (100) of claim 1, wherein the aqueous mixture comprises at least 50% of the organic solid from the composite material.

16. The process (100) of claim 15, wherein the aqueous mixture comprises at least 90% of the organic solid from the composite material.

17. The process (100) of claim 16, wherein the aqueous mixture comprises at least 95% of the organic solid from the composite material.

18. The process (100) of claim 1, further comprising:

pulverizing the composite material; and

combining the pulverized composite material with water to form a slurry prior to contacting the composite material with the oxidant in the superheated water.

19. The process (100) of claim 18, wherein the pulverized composite material has a particle size ranging from about 60 mesh to about 20 mesh.

20. The solubilized organic solute of the process (100) of any preceding claim.

CLAIMS

1. A process for solubilizing a biomass, the process comprising:

   contacting the biomass with an oxidant in superheated water to form an aqueous mixture comprising at least one solubilized organic solute,

   wherein the biomass is contacted with the oxidant in the superheated water within a reactor, wherein the biomass, oxidant, and superheated water are maintained in a nongaseous phase to inhibit the formation of a head space within the reactor, and

   wherein at least one solubilized organic solute comprises at least one of a low molecular weight sugar, an oxidized low molecular weight sugar, and any combination thereof.

2. The process of claim 1, wherein the oxidant is molecular oxygen (O_2).

3. The process of claim 2, wherein the molecular oxygen is supplied by any method selected from the group consisting of:

   in situ decomposition of hydrogen peroxide;
   fractional distillation of liquefied air;
   electrolysis of water;
   transfer from a stored oxygen supply;
   membrane separation from air; and
   any combination thereof.

4. The process of claim 3, wherein the molecular oxygen is supplied by in situ decomposition of hydrogen peroxide.

5. The process of claim 1 , wherein the biomass is contacted with the oxidant in a superheated water at a temperature ranging from about 100° C to about 374° C.

6. The process of claim 5, wherein the biomass is contacted with the oxidant in superheated water at a temperature ranging from about 200° C to about 350° C.

7. The process of claim 1 , wherein the biomass is contacted with the oxidant in superheated water at a pressure ranging from about 100 kPa to about 22 MPa.

8. The process of claim 7, wherein the biomass is contacted with the oxidant in superheated water at a pressure ranging from about 1 .5 MPa to about 17 MPa.

9. The process of claim 8, wherein the biomass is contacted with the oxidant in superheated water at a pressure ranging from about 12 MPa to about 16 MPa.

10. The process of claim 1, wherein the low molecular weight sugar is selected from the group consisting of glucose, fructose, galactose, sucrose, maltose, and lactose.

11. The process of claim 1, wherein the oxidized low molecular weight sugar is selected from the group consisting of keto, aldo, and carboxy derivatives of glucose, fructose, galactose, sucrose, maltose or lactose.

12. The process of claim 1, further comprising chilling the aqueous mixture to a temperature of about 20° C.

13. (New) The process of claim 1, wherein the aqueous mixture has a pH ranging from about 1 to about 5.

14. The process of claim 1, wherein the aqueous mixture comprises at least 50% of the biomass.

15. The process of claim 4, wherein the aqueous mixture comprises at least 90% of the biomass.

16. The process of claim 5, wherein the aqueous mixture comprises at least 95% of the biomass.

17. The process of claim 1, further comprising:

pulverizing the biomass; and

combining the pulverized biomass with water to form a slurry prior to contacting the biomass with the oxidant in the superheated water.

18. The process of claim 7, wherein the pulverized biomass has a particle size ranging from about 60 mesh to about 20 mesh.

19. The process of claim 1, wherein the biomass comprises materials selected from the group consisting of cellulose, hemicellulose, lignin, protein, carbohydrates, , grains, fruits, vegetables, corn husks, trees, shrubs, grasses, branches, bushes, canes, energy crops, forests, flowers, grains, herbaceous crops, leaves, bark, needles, logs, roots, saplings, short rotation woody crops, switch grasses, vines, hard and soft woods, municipal solid waste, organic waste materials generated from agricultural processes, virgin biomass and/or non-virgin biomass including agricultural biomass, commercial organics, construction and demolition debris, paper, cardboard, scrap wood, saw dust, and plastics.

20. The solubilized organic solute of the process of any preceding claims 1-19.