CLAIMS

1. A multifunctional wet waste processing system for electricity and clean water generation, comprising:

a fuel dryer assembly having a fuel path with a fuel inlet configured to receive a flow of wet organic-based sludge comprising a mixture of water and solid fuel material, the fuel dryer assembly having a heater portion configured to boil the sludge and thermally separate water from the solid fuel material to provide dried fuel, the fuel dryer having a first steam outlet, a dry fuel outlet, and a condenser portion having fluid path with a steam inlet and a fluid outlet, the fluid path being isolated from the fuel path;

a fresh water condenser assembly coupled to the first steam outlet and configured to condense water vaporized from the sludge into clean liquid water;

a dry fuel combustor assembly coupled to the dry fuel outlet of the fuel dryer assembly, the dry fuel combustor assembly having a combustor portion and having a boiler configured to receive heat from the combustor portion, the boiler having a first water inlet and a second steam outlet;

a steam-powered generator coupled to the second steam outlet of the boiler and configured to generate electricity, the steam-powered generator having a third steam outlet coupled to the steam inlet of the condenser portion; and

a water pump having a second water inlet coupled to the fluid outlet of the condenser portion of the fuel dryer; and the water pump having a water outlet coupled to the first water inlet of the boiler;

wherein the boiler is configured to convert a flow of water entering the boiler to a flow of steam to power the steam-powered generator;

wherein the fuel dryer assembly is a multi-segment dryer having sequential first and second dryer segments each coupled to the

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condenser portion and each configured to dry the sludge by vaporizing water from the sludge using heat from exhaust steam from the steam-powered generator; and

wherein the first dryer segment generates sludge steam from the sludge, and the second dryer segment uses the sludge steam from the first dryer segment to dry the sludge.

2. The system of claim 1, wherein the fuel dryer assembly comprises a steam-heated auger in the fuel carrier and configured to move and heat the sludge during the drying process.

3. The system of claim 1, wherein the first dryer segment generates first dryer steam from water vaporized from the sludge, and the second dryer segment has a first steam carrier portion coupled to the first dryer segment and configured to carry the first dryer steam adjacent to the sludge, and the second dryer segment having a second steam carrier portion isolated from the first steam carrier portion and configured to carry the exhaust steam from the steam-powered generator adjacent to the sludge, wherein heat from the first and second steam carrier portions dries the sludge moving therein.

4. The system of claim 1, wherein the fuel dryer assembly is configured to receive in the condenser portion exhaust steam from the steam-powered generator, the first dryer segment is connected to the fuel inlet and has a first heater portion coupled to the condenser and configured to vaporize a first portion of the water from the sludge with heat from the exhaust steam, and the second dryer segment is connected in series to the first dryer segment and configured to vaporize a second portion of the water from thickened sludge received from the first dryer segment with heat from the exhaust steam.

5. The system of claim 1, wherein the condenser portion of the fuel dryer assembly is configured to receive exhaust steam from the steam powered generator

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through the first steam inlet, and the first dryer segment is connected to the fuel inlet and adjacent to the condenser portion.

6. The system of claim 1, wherein the combustor portion is a fluidized bed combustor assembly.

7. The system of claim 1, wherein the fuel dryer assembly, the fresh water condenser, the dry fuel combustor assembly, the steam powered generator, and the water pump are mounted on a frame and transportable with the frame as a unit.

8. The system of claim 1, wherein the steam-powered generator is a single action, liquid cooled steam engine.

9. The system of claim 1, comprising a steam engine coupled to a second steam outlet of the boiler to receive steam therefrom, and the generator being configured to generate electricity, the steam powered generator having a third steam outlet coupled to the steam inlet of the condenser portion; wherein heat from the steam exhausted from the steam engine boils the water in the sludge in the sludge dryer; and wherein the steam exhausted from the steam engine is condensed to a flow of liquid water.

10. The system of claim 9, wherein the fuel dryer assembly has a heater portion comprising a sludge carrier portion through which the sludge moves, a steam carrier adjacent to the sludge carrier and positioned adjacent to the sludge for delivery of heat from steam in the steam carrier to the sludge, and a plurality of propulsion members moveably disposed within the fuel carrier and configured to move the sludge in the fuel carrier relative to the steam carrier.

11. The system of claim 9, wherein the first dryer segment comprises a first fuel carrier, a first steam carrier adjacent to the first fuel carrier, a plurality of propulsion members moveably disposed within the first fuel carrier and configured to move the sludge through the first fuel carrier past the first steam carrier; and the

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second dryer segment comprises a second fuel carrier, a plurality of steam-heated members within the second fuel carrier and being stationary relative to the second fuel carrier, and a second steam carrier assembly rotatably disposed within the second fuel carrier and configured to move the sludge within the second fuel carrier and past the steam-heated members.

12. The system of claim 1, wherein the combustor portion is a fluidized bed combustor assembly with a firebox having a combustor bed for dry fuel combustion and an air grate configured to provide combustion air to the combustor bed, and the boiler comprising first heat exchanger connected to the water inlet and configured to heat water flowing therethrough, a steam drum coupled to the first heat exchanger, an evaporator coupled to the steam drum and configured to receive heated, saturated fluid therefrom, the steam drum being configured to receive a flow of steam from the evaporator, and a second heat exchanger coupled to the steam drum and configured to receive dry steam from the steam drum, the second heat exchanger connected to the second steam outlet.

13. The system of claim 1, further comprising a

a sludge containment tank

a sludge transporter connected to the sludge containment tank and configured to provide the sludge to the sludge inlet of the sludge dryer assembly.

14. A fecal waste processing system for electricity and potable water generation, comprising:

a steam-powered electricity generation system comprising a boiler assembly, a steam engine, and a condenser interconnected and having a primary water circuit that carries primary water through the boiler assembly, steam engine assembly, and condenser, wherein operation of the steam engine assembly generates electricity;

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a fecal sludge system that receives at least a portion of the electricity generated from the steam engine assembly, the fecal sludge system comprising a sludge dryer assembly and a sludge delivery system configured to deliver a flow fecal sludge to the sludge dryer assembly, wherein the condenser is attached to the sludge dryer assembly and configured to deliver first heat to the flow of fecal sludge to liberate water as first steam from the fecal sludge and to dry solid fuel material in the fecal sludge;

a water collection system connected to the sludge dryer assembly and configured to receive and condense the first steam for collection in a collection portion as clean, liquid potable water; and

combustor system connected to the fecal sludge system and the boiler of the electricity generation system, the combustor system comprising a combustor configured to burn the dry solid from the fecal sludge system and provide heat to water circuit in the boiler assembly, wherein the boiler assembly provides steam to the steam engine;

wherein the sludge dryer assembly is a two-stage dryer having sequential first and second dryer stages, wherein the first dryer stage generates sludge steam from the sludge, and the second dryer stage uses the sludge steam from the first dryer stage to dry the sludge.

15. The system of claim 14, wherein the first dryer stage receives a substantially continuous flow of fecal sludge from the sludge delivery system and provides a substantially continuous flow of partially dried thickened fecal sludge to the second dryer stage, and the second dryer stage provides substantially dried solid fuel material to the combustor, and wherein steam from the first and second dryer stages is provided to water collection system.

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16. The system of claim 14, wherein the sludge containment tank is a fecal sludge containment tank, and the sludge transporter is configured to provide fecal sludge to the sludge inlet of the sludge dryer assembly.

17. The system of claim 1, wherein the sludge inlet of the sludge dryer assembly is configured to receive a flow of organic-based sludge.

18. The system of claim 1, further comprising a water filtration system coupled to the freshwater condenser assembly and configured to receive the clean water, the water filtration system having one or more filters that filters the clean water and provides potable water.

19. The system of claim 1, wherein the fluid inlet of the fluid dryer assembly is configured to receive a flow of fecal sludge.

20. The system of claim 1, wherein the sludge dryer assembly comprises a rotatable, hollow auger in the heater portion and configured to receive steam exhausted from the steam engine to heat the auger, wherein the auger is configured to move and heat the sludge during the drying process.

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