CLAIMS

What is claimed is:

1. A method of treating wastewater, the method comprising:

(a) directing a wastewater stream into a secondary treatment unit, wherein the secondary treatment unit provides biological treatment of the wastewater stream and produces a treated sludge stream ;

(b) directing the treated sludge stream into a solids thickening device, wherein the solids thickening device separates the treated sludge stream into a centrate stream and a sludge solids stream;

(c) directing the sludge solids stream into a wet air oxidation (WAO) unit, wherein the WAO unit solubilizes the sludge solids stream by wet air oxidation to provide a WAO effluent stream;

(d) separating the WAO effluent stream into a solid slurry stream and a decanted liquid stream; and

(e) directing the decanted liquid stream into a digester, wherein the decanted liquid stream is subjected to anaerobic digestion to produce a digester gas stream, and wherein the digester gas stream comprises methane, carbon dioxide, and hydrogen.

2. The method of claim 1, further comprising removing a recycled sludge stream from the digester, and directing the recycled sludge stream into the solids thickening device.

3. The method of claim 1 or claim 2, further comprising processing the digester gas stream to provide a product methane source.

4. The method of any one of claims 1 to 3, further comprising directing the solid slurry stream to a dryer to produce a sludge disposal stream.

5. The method of any one of claims 1 to 4, further comprising removing a supernatant stream from the digester, and directing the supernatant stream into the secondary treatment unit.

6. The method of any one of claims 1 to 5, further comprising directing the centrate stream into the secondary treatment unit.

7. The method of any one of claims 1 to 6, further comprising clarifying the wastewater stream in a primary treatment unit upstream from the activated sludge unit.

8. The method of any one of claims 1 to 7, further comprising clarifying the treated sludge stream in a secondary clarifier upstream from the solids thickening device.

9. The method of any one of claims 1 to 8, wherein the method achieves a reduction in volatile solids (VSR) from the wastewater stream to the digester gas stream of at least 50%.

10. The method of any one of claims 1 to 9, wherein the wet air oxidation of the sludge solids stream in the WAO unit is carried out at a temperature of 130 °C to 320 °C.

11. A wastewater treatment system, the system comprising:

(a) a secondary treatment unit configured to provide biological treatment of a wastewater stream;

(b) a wet air oxidation (WAO) unit downstream from the secondary treatment unit, wherein the WAO unit is configured to solubilize a sludge solids stream by wet air oxidation to provide a WAO effluent stream;

(c) a means for separating the WAO effluent stream into a solid slurry stream and a decanted liquid stream; and

(d) a digester downstream from the WAO unit, wherein the digester is configured to subject the decanted liquid stream to anaerobic digestion to produce a digester gas stream, and wherein the digester gas stream comprises methane, carbon dioxide, and hydrogen.

12. The system of claim 11, further comprising a recycled sludge stream configured to flow from the digester into a solids thickening device upstream from the WAO unit.

13. The system of claim 12, wherein the solids thickening device is configured to provide the sludge solids stream and a centrate stream.

14. The system of claim 12 or claim 13, wherein the sludge solids stream is configured to flow from the solids thickening device into the WAO unit.

15. The system of any one of claims 11 to 14, further comprising a dryer configured to process the solid slurry stream to produce a sludge disposal stream.

16. The system of any one of claims 11 to 15, further comprising a supernatant stream configured to flow from the digester into the secondary treatment unit.

17. The system of any one of claims 13 to 16, wherein the centrate stream is configured to flow from the solids thickening device into the secondary treatment unit.

18. The system of any one of claims 11 to 17, further comprising a primary treatment unit upstream from the secondary treatment unit.

19. The system of any one of claims 11 to 18, further comprising a secondary clarifier downstream from the secondary treatment unit and upstream from the WAO unit.

20. The system of any one of claims 11 to 19, wherein the digester is configured to receive only the decanted liquid stream as an inlet stream.