CLAIMS

1. A process for treating construction and/or demolition (C&D) debris comprising:

providing a feedstock comprising a frangible material and a ductile material;

providing a kinetic pulverizer comprising a pulverizing rotor assembly disposed within an interior chamber, wherein the pulverizing rotor assembly is configured to rotate to form vortices that subject the feedstock to self-collisions within the interior chamber;

subjecting the feedstock to a kinetic pulverization stage wherein the feedstock is fed into the kinetic pulverizer to produce a pulverized material comprising a size-reduced fraction derived from the frangible material and an oversized fraction derived from the ductile material;

withdrawing the pulverized material from the kinetic pulverizer; and

subjecting the pulverized material to a separation stage to produce a size-reduced stream and an oversized stream.

2. The process of claim 1, wherein the separation stage comprises screening using a single screen or two or more screens arranged in parallel or in series.

3. The process of claim 2, wherein the screening is performed using at least one of: a trommel screen, a vibrating screen, a tumbler screen, a gyratory screen, and a high frequency screen.

4. The process of any one of claims 1 to 3, further comprising:

monitoring at least one parameter of: the feedstock, the pulverized material, the oversized stream and/or the size-reduced stream; and

adjusting the kinetic pulverization stage based on the at least one parameter.

5. The process of claim 4, wherein at least one of:

- the at least one parameter comprises at least one of: an infeed rate of the feedstock, a moisture content of the feedstock, size properties of the feedstock, a composition of the feedstock,

- size properties of the size-reduced fraction in the pulverized material, a composition of the pulverized material, a flow rate of the oversized stream, a flow rate of the size-reduced stream, a composition of the oversized stream, and a composition of the size-reduced stream

- the adjusting of the kinetic pulverization stage comprises adjusting the rotation speed; and

- the adjusting of the kinetic pulverization stage comprises adjusting the infeed rate of the feedstock.

6. The process of any one of claims 1 to 5, the feedstock comprises between 40% and 60% glass, and the size-reduced stream is composed of over 95%, 96%, 97%, 98% or 99% glass.

7. The process of any one of claims 1 to 6, further comprising at least one of:

- subjecting the feedstock to an upstream magnetic separation stage to remove metal therefrom and produce a metal depleted feed stream that is fed to the kinetic pulverization stage;

- subjecting at least one of: the pulverized output stream, the oversized stream, and the size-reduced stream to a downstream magnetic separation stage to remove metal therefrom;

- subjecting the oversized stream to a secondary separation stage to produce a ductile stream and an infrangible stream;

- subjecting the pulverized material to a dust collection stage to recover a dust fraction therefrom and produce a dust reduced pulverized stream that is fed to the separation stage to produce the size-reduced stream and the oversized stream;

- subjecting a C&D source material to an upstream separation stage to produce at least one stream of the feedstock;

- subjecting the feedstock to a pre-treatment stage prior to subjecting the feedstock to the kinetic pulverization stage;

- subjecting the feedstock to a drying stage or a surface wetting pre-treatment stage upstream of the kinetic pulverization stage; and

- incorporating a friable additive into the feedstock such that the friable additive is size reduced and is homogenized with the frangible material to form part of the size-reduced fraction.

8. The process of claim 7, wherein at least one of:

- the upstream magnetic separation stage is performed by one or more magnetic separators configured relative to a feed of the feedstock;

- the downstream magnetic separation stage is performed by one or more magnetic separators configured relative to a feed of the at least one of: the pulverized output stream, the oversized stream, and the size-reduced stream;

- the upstream magnetic separation stage or the downstream magnetic separation stage is performed by at least one of: a non-ferrous metal separator and a ferrous metal separator;

- the upstream separation stage comprises manually removing reusable materials from the C&D source material;

- the secondary separation stage comprises screening;

- the secondary separation stage comprises magnetic separation;

- at least a portion of the dust fraction is combined with a portion or all of the size-reduced stream;

- the dust collection stage facilitates separation of at least a portion of the ductile material in the oversized fraction;

- the dust collection stage facilitates separation of at least a portion of the frangible material in the size-reduced fraction;

- the upstream separation stage comprises mechanical screening to pre-size the C&D source material to produce the at least one stream of the feedstock;

- the upstream separation stage comprises upstream magnetic separation to remove metal from the C&D source material or the at least one stream of the feedstock and produce a metal depleted feed stream that is fed to the kinetic pulverization stage;

- the upstream separation stage comprises an upstream dust collection stage to remove at least a portion of the ductile material from the at least one stream of the feedstock or the C&D source material;

- the pre-treatment stage comprises a crushing or grinding stage upstream of the kinetic pulverization stage;

- the friable additive comprises at least one of: a porosity agent, a soil additive, a building material additive, a compost additive, peat moss, a glass product additive, and a recycled concrete aggregate (RCA); and

- the friable additive is introduced into the feedstock upstream of the kinetic pulverization stage or the friable additive is introduced directly into the kinetic pulverizer as a separate stream from the feedstock.

9. The process of claim 8, wherein the friable additive is the RCA and the RCA comprises at least 60% by weight of a mixture of the RCA and the size-reduced fraction.

10. The process of any one of claims 1 to 9, wherein the feedstock comprises gypsum drywall and wherein the size-reduced fraction comprises a pulverized gypsum product and/or the oversized fraction comprises a plurality of paper or cellulose based underlayers.

11. The process of claim 10, wherein the pulverized gypsum product is configured for use as an agriculture amendment, a soil amendment, a cement mixture additive, or in the production of drywall panels and/or

the plurality of paper or cellulose based underlayers are configured for use as animal bedding, mulch, cement kiln fuel, or in the production of paper products.

12. The process of any one of claims 1 to 9, wherein the feedstock comprises asphalt shingles and wherein the size-reduced fraction comprises an asphalt product and/or the oversized fraction comprises a plurality of paper or fiberglass based underlayers.

13. The process of claim 12, wherein the asphalt product is configured for use as a cement mixture additive, in the production of biofuels, as a hydrocarbon-based additive, in the production of asphalt, or in the production of shingles and/or wherein the plurality of paper or fiberglass based underlayers are configured for use as animal bedding, mulch, or in the production of paper products.

14. A construction and demolition (C&D) debris processing system, comprising:

    a kinetic pulverizer configured to receive and process a feedstock comprising a frangible material and a ductile material to produce a pulverized stream comprising a size-reduced fraction derived from the frangible material and an oversized fraction derived from the ductile material, wherein the kinetic pulverizer comprises a pulverizing rotor assembly disposed within an interior chamber that is configured to rotate to form vortices that subject the feedstock to self-collisions within the interior chamber;

    a pulverizer conveyor configured to transport the pulverized stream downstream; and

    at least one separator operatively coupled to the pulverizer conveyor and configured to receive the pulverized stream and produce a size-reduced stream comprising the frangible material and an oversized stream comprising the ductile material.

15. The system of claim 14, further comprising at least one of:

    - a monitoring unit configured for monitoring at least one feed parameter of the feedstock and/or at least one output parameter of the pulverized stream, the oversized stream, and/or the size-reduced stream and a control unit coupled to the

monitoring unit and configured for adjusting the kinetic pulverizer based on the at least one feed parameter and/or the at least one output parameter;

- an upstream magnetic separator to remove metal from the feedstock and produce a metal depleted feed stream that is fed to the kinetic pulverizer;
- a downstream magnetic separator to remove metal from at least one of: the pulverized output stream, the oversized stream, and the size-reduced stream; and
- a dust collection unit configured to recover a dust fraction from the pulverized stream and produce a dust reduced pulverized stream that is fed to the screen.

16. The system of claim 15, wherein at least one of:

- the upstream magnetic separator is operated relative to a feed of the feedstock.
- the downstream magnetic separator is operated relative to a feed of the at least one of: the pulverized output stream, the oversized stream, and the size-reduced stream;
- the at least one separator is the downstream magnetic separator; and
- the dust collection unit is configured to supply a portion or all of the dust fraction to be combined with at least a portion of the size-reduced stream.

17. The system of 15 or 16, wherein the dust collection unit comprises:

a dust collector coupled with respect to an outlet of the kinetic pulverizer or with respect to the pulverizer conveyor; and

a dust recovery unit coupled to the dust collector and configured to cause separation of the dust and transport of the dust fraction from the dust collector to a storage vessel.

18. The system of claim 17, wherein at least one of:

- the dust collector comprises a settling chamber;
- the dust recovery unit comprises a baghouse that is in fluid communication via ducting with the settling chamber;
- the dust recovery unit comprises a cyclone that is in fluid communication via ducting with the settling chamber;
- the dust collector surrounds the kinetic pulverizer along a majority of a length thereof.

19. A process for treating asphalt shingles comprising:

providing the asphalt shingles which comprise a frangible asphalt component coupled to a ductile component;

providing a kinetic pulverizer comprising a pulverizing rotor assembly disposed within an interior chamber, wherein the pulverizing rotor assembly is configured to rotate to form vortices that subject the asphalt shingles to self-collisions within the interior chamber;

subjecting the asphalt shingles to a kinetic pulverization stage wherein the asphalt shingles are fed into the kinetic pulverizer to produce a pulverized material comprising a size-reduced fraction derived from the frangible asphalt component and an oversized fraction derived from the ductile component;

withdrawing the pulverized material from the kinetic pulverizer; and

subjecting the pulverized material to a separation stage to produce a size-reduced stream comprising asphalt and an oversized stream comprising paper or fiberglass.

20. A process for treating gypsum drywall comprising:

providing the gypsum drywall comprising a frangible gypsum component coupled to a ductile component;

providing a kinetic pulverizer comprising a pulverizing rotor assembly disposed within an interior chamber, wherein the pulverizing rotor assembly is configured to rotate to form vortices that subject the gypsum drywall to self-collisions within the interior chamber;

subjecting the asphalt shingles to a kinetic pulverization stage wherein the gypsum drywall is fed into the kinetic pulverizer to produce a pulverized material comprising a size-reduced fraction derived from the frangible gypsum component and an oversized fraction derived from the ductile component;

withdrawing the pulverized material from the kinetic pulverizer; and

subjecting the pulverized material to a separation stage to produce a size-reduced stream comprising gypsum and an oversized stream comprising paper.