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Pulverizer system

Abstract

A pulverizer may have such features as a drum having a top and bottom, a rotating shaft extending vertically in the drum having radially extending arms that create flow currents within the pulverizer to size reduce a material, and a dust collection system coupled to the outlet for extracting air and dust from the size reduced material. The pulverizer may have an ability to detect wrapping as well as possibly deter wrapping. A processor may also adjust the speed of rotation of the arms within the pulverizer and/or the speed of feed of input for various considerations. In fact the rotation direction may be reversed for at least brief periods of time in an effort to remove wrapped material. Vibration may also be sensed and efforts to prevent damage may be instigated by a processor.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This application is a division of U.S. application Ser. No. 15/405,626 filed Jan. 13, 2017, now issued as U.S. Pat. No. 11,440,021, and issued as U.S. Pat. No. 11,440,021, which, in turn, claims the benefit of U.S. Provisional Application No. 62/279,309 filed Jan. 15, 2016, the disclosures of which are hereby incorporated in their entirety by reference herein.

TECHNICAL FIELD
(1) The present invention relates to a pulverizer also known as a vertical grinding mill which are provided with a rotating shaft with a plurality of arms spinning thereabout which generate a series of air currents inside of a cylinder to pulverize, separate, aerate, and/or homogenize material.
BACKGROUND
(2) Solid materials such as garbage, rubbish or other solid materials have been collected by trucks and transported for disposal for many years.
(3) Burkett developed a centrifugal mill sometime around in the mid-1970s and ended up with U.S. Pat. No. 3,987,970 and others. The applicant's predecessor-in-interest filed Canadian Patent Application Nos. 2,125,797 and 2,147,666 for use with various equipment and methods for pulverizing rock and remediating soil utilizing an improved pulverizer configuration. All three of these patents/applications are incorporated herein by reference in their entirety.
(4) Still others have commercialized an embodiment of the Burkett mill and are trying to sell that design in the marketplace today. However, when attempting to build a Burkett mill with improvements, the applicant discovered there were components of that basic design which could be improved.
SUMMARY
(5) It is the present object of many embodiments of the present invention to provide an improved

vertical gyroscopic mill or pulverizer having advanced capabilities.
(6) It is another object of many embodiments of the present invention to provide an improved pulverizer having improved safety features.
(7) It is another object of many embodiments of the present invention to provide an improved pulverizer having improved performance characteristics.
(8) It is another object of many embodiments of the present invention to provide improved efficiency, possibly coupled to increased output and/or reduced down time.
(9) It is another object of many embodiments to provide improved performance for a pulverizer by having adjustable air flow characteristics other than adjustable shaft rotation speed alone.
(10) It is another object of many embodiments of the present invention to provide an improved shaft wrapping removal system.
(11) It is another object of many embodiments of the present invention to provide an improved dust collection system.
(12) Accordingly, in accordance with a presently preferred embodiment of the present invention, a pulverizer or vertical gyroscopic mill can be combined with a conveyor system for (a) feeding the pulverizer and/or (b) likely for removing discharge. The speed of the conveyor(s), particularly the feed conveyor, as well as the speed of the rotation of the pulverizer are preferably controlled by a processor possibly in an interrelated manner. Furthermore, the shaft may be driven by a variable frequency drive motor or other variable speed motor to allow for the processor to control aspects of the speed of the motor. Feedback loops are helpful for some operations of the processor as well, such as to maintain constant power levels and/or feed flows.
(13) A system may control the rate of infeed to at least assist in controlling the process for at least some embodiments.
(14) A system may control the speed of the rotor for some embodiments such as to maintain a specified power level and/or for other objectives.
(15) Additionally, for at least some embodiments, it may be that the speed of the motor and the speed of the conveyor can be linked together so that if the speed of the shaft rotation of the pulverizer is sensed to decrease, then the speed of the conveyor can be correspondingly decreased as well, such as a proportional amount, possibly as compared to overall speeds, amount of decrease or other amounts. Furthermore, if a high resistant object is encountered with an arm and the shaft speed slows down a significant amount, it may be that the processor can direct the ramping back up of the shaft speed after a sudden slow down possibly as well as a corresponding slowing down and then speeding up of the conveyor.
(16) For some embodiments, a vibration sensor can be used to detect when the shaft and/or other components of the pulverizer are vibrating too much to then direct a potential shut down sub-routine to determine the cause of the vibration. The vibration could be caused by unbalanced loading, which could be addressed by first slowing, and then possibly stopping the feed conveyor. The shaft may be slowed slightly, or significantly to see if the vibration clears. Finally, if none of the above slows the vibration issue, the shaft may be stopped.
(17) Additionally, software of at least some embodiments can detect wrapping by sensing an increase in amperage possibly coupled with other effects such as no significant increase or decrease in output or throughput and/or other effects. Once detecting a wrapping step, the processor may stop the shaft. After stopping the feed conveyor, the processor may direct a reverse direction of the shaft for a predetermined speed and/or time (or alternating directions) to allow attempt to dislodge material from wrapped arms. Similarly, if resistance is deemed too low, the processor can speed up certain factors.
(18) Additionally, in an effort to prevent shaft wrapping which can often occur with the top of the pulverizer above the uppermost arm segments, at least one cutting mechanism can be provided in an effort to attempt to cut material which may otherwise wrap towards an upper end of the shaft.
(19) A door opening prevention separator lock for many embodiments can be provided to prevent

an access door of the pulverizer from being opened while in operation, or even during spin down after shutting off the pulverizer. Once the shaft is stopped, the interlock may then allow the access door to open.
(20) Additionally, software can be used to maintain the environment of pressure below ambient such as at some vacuum value possibly in combination with a dust depression system at an outlet of the pulverizer possibly with a separator lock option at the outlet so as to prevent, or at least significantly reduce dust in the environment to reduce dust about the pulverizer during operation.
(21) Still these and/or other features may be provided with still other embodiments.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) The particular features and advantages of the invention as well as other objects will become apparent from the following description taken in connection with the accompanying drawings in which:
(2) FIG. **1** is a schematic representation of a pulverizer system of a presently preferred embodiment of the present invention;
(3) FIG. **2** is a detailed cross sectional view of the dust collection intake shown in FIG. **1**;
(4) FIG. **3** is an internal view of detail B shown in FIG. **1**;
(5) FIG. **4** is a schematic view of a portion of the present invention; and FIG. **5** is a schematic view of a portion of the present invention.
DETAILED DESCRIPTION
(6) FIG. **1** shows essentially a schematic representation of the pulverizer system **100** in the form of a feed conveyor **12**, feeding to an inlet **14** of a pulverizer **16**. Once material is pulverized, it exits out at **18** where optional air lock **20** may assist in discharging ground material onto conveyor **22** or alternatively, it may be that material directed from outlet is deposited directly onto conveyor **22** without optional air lock **20**, illustrated.
(7) Dust collection system **24** is useful for some, if not many embodiments, to remove dust and will be described in further detail with reference back to FIGS. **1** and **4**, possibly under the direction of processor **26**. Processor **26** can control many aspects of the system **100** in the pulverizer **16** as will be discussed in further detail below.
(8) The pulverizer **16** is preferably equipped with a variable speed motor **28** such as a variable frequency drive motor which can allow for the processor **26** to assist in controlling the speed of the motor **28**. Additionally, the processor **26** may also control the speed of feed of the conveyor **12**.
(9) For instance, by having a processor **26** control operation of both the feed (i.e., the amount of fed material) into inlet **14** by controlling the speed of the conveyor **12**, possibly in combination with sensors such as sensor **30** directed at conveyor **12** which can sense the input of material into inlet **14**. The amount of feed directed into the pulverizer **16** through inlet **14** can be monitored and/or controlled possibly in combination with the speed of rotation of the shaft **32** in an effort to address a variety of different operating conditions.
(10) For instance, during normal operations, if a particular hard grind product is directed into inlet **14**, the shaft **32** may reduce rotational speed about rotation axis **34**. In order to ramp back up to optimal, it may be that the processor **26** has a ramp up speed routine as provided to the motor **28** so that instead of attempting to instantaneously maintain speed, either a predetermined ramp up routine is selected such as a linear increase or non-linear curve back to speed or possibly having a predetermined intermediate speeds back up to an optimum speed is achieved by the processor **26** running software as provided therewith. Conveyor **12** may follow a similar or dissimilar routine.
(11) Another aspect of the pulverizing system **100** is that the input as provided through inlet **14** can be varied, possibly together with the speed of rotation of the shaft **32** by the motor **28** under certain

operating conditions as well. Depending on the particular type of input in inlet **14**, a different rate of feed of the conveyor **12** can be selected relative to the speed of the rotation of the shaft **32** about axis **34**. Other factors may be addressed with processor **26** to attempt to improve efficiency as well.

(12) Depending on the particular input at issue, it may be that the speed of rotation of the shaft **32** can be selected relative to the speed of the conveyor **12** and/or vice versa and/or the amount of input in inlet **14** possibly in combination with the sensor **30** or other way to measure input into inlet **14**. Another feature which can be controlled with the pulverizer **16** is its internal pressure which may be assisted in being controlled by a dust collection system **24** or other system. By directing the pressure inside pulverizer **16** to possibly be below atmospheric pressure such as by using the dust collection system **24**, the relative size of particulate leaving the outlet **18** can be reduced. Under certain circumstances, the particulate size as deposited from the outlet conveyor **22** may be more preferably controlled by addressing a pressure in the pulverizer **16**, such as with processor **26**. Of course, outlet conveyor **22** could have material redirected back into inlet **14** under certain conditions to regrind material and/or could be controlled by processor **26** as well. Dust collection system **24** could be useful to prevent the area around the pulverizer **16** from being a dusty mess. Dust collection system **24** may also collect useful products from the grinding operation.

(13) Also, when the shaft **32** is ramping back up to speed as directed by the processor but the processor **26** may also simultaneously slow down the conveyor **12** and/or maintain a predetermined speed during the ramp up process so as to not overload the input in the inlet **14** of the pulverizer **16**.

(14) Also, the processor **26** may perform other functions like direct the flow of input into inlet **14** in order to attempt to maintain a relatively stable power level based on consumption of energy of either the overall system and/or by the motor **28**.

(15) For instance, when encountering an increased power consumption by the motor **28**, it may be that the input is slowed such as by slowing the conveyor **12** or other step. Furthermore if power consumption is not significant enough as consumed the motor **28**, it r ray be that the conveyor **12** can be sped up by the processor **26**.

(16) In addition to providing instructions to control both the speed of the motor **28**, to thus control the rotational speed of the shaft **32**, as well as the speed of the conveyor **12**, it may be that there is a feed back loop provided back to the processor **26** for various effects. For instance, it has been discovered that through shelf height optimization, as will be described in further detail below, it may be that a higher throughput (i.e., a higher rate of flow from both into the inlet **14** and outlet **18**) can be achieved with a lower power consumption of the motor **28** based on the shelf **36** being provided at a selected height provided through way of adjustment. A 20% higher throughput has been achieved for some feed streams by selecting the specific height of the shelf **36** for some embodiments. By changing the shelf **36** height, the vortices flow in at least the middle section **38** can be varied to effectively change the configuration of those vortices, at least elevationally. Furthermore, it may be that the change in shelf height **36** it may be imparted to the other shelves namely **40** and/or **42** and/or other shelves which could be changed in height as well. Additionally, the relative shape of deflectors or shelves **36**,**40**,**42** such as deflector **44** in a similar or dissimilar manner as the shelf **36** is changed in height as will be explained in further detail below.

(17) By providing a feedback route such as with an accelerometer **46** connected to the shaft **32** as well as a variable speed motor **28** such as could be driven by a variable frequency drive system or otherwise, a way of not only providing a desired signal to the motor **28** for a desired speed of the shaft **32** can be provided, but also the speed itself can be sensed with sensor **46** and provided to processor **26**.

(18) Other sensors can be utilized with this system which are not presently utilized.

(19) Specifically, a door locking interlock and/or sensor **48** can be provided for use by processor **26** or other device so that access door **50** so that the door **50** may not be opened as illustrated in FIG. **1**, unless the shaft **32** is stationary. This feature can prevent the door **50** from being unlocked such as with locking system **52** as might be restrained from opening by lock **48** under certain conditions.

Additionally, a vibration sensor **54** may be provided so as to be able to sense vibration of the shaft **32** and/or other portions of the pulverizer **16**. A vibration protocol may be employed by the processor **26** so that upon reaching a first predetermined amount of vibration, certain steps are performed such as by first slowing down the motor **28** and/or conveyor **12** to see if the vibration diminishes, and if not, then possibly securing the conveyor **12** and then end the motor **28**. A second predetermined amount could result in shutdown of the motor **28** directly.

(20) If the vibration sensor **54** detects the shaft **32** as sensing too much vibration, then it could indicate that a pin is sheared, an arm pad has been damaged, or other complicating factor internal to the pulverizer **16** which could then be somewhat of a self-diagnosing pulverizer **16**. If a second predetermined amount of vibration is sensed, it may be that the motor **28** is secured immediately as opposed to going through a slowing step to discourage internal damage in the pulverizer **16**.

(21) Of course, the processor **26** could also control the air lock **20**, if utilized, as well as the speed of being able to move material onto conveyor **22** and/or the speed of the conveyor **22**. Processor **26** may also control the air flow through the dust collection system **24** if utilized and/or could assist in maintaining a desired pressure such as a vacuum or other pressure internal to the pulverizer **16** and/or assist in maximizing efficiency of the fan **56** of the dust collection system **24** for efficiency or other purposes such as removing dust of a given particulate size.

(22) Fan **56** might be a 30 horsepower motor capable of drawing 1000 cubic feet per minute or have other specifications for various other dust collector systems **24**. It turns out that for many processes, the dust collected in various bags or dust collection hopper **58** can prove to be quite valuable such as when grounding electronics, it may be that gold dust can be retrieved from the bags or dust collection hopper **58**. Other waste may have other valuable components which may be recovered from waste bags or dust collection hopper **58**. Plenum **60** could be made of the appropriate gauge of material to be able to withstand the suction forces as provided by fan **56** and it may be that the amount of suction can be varied such as not only with the speed of the fan **56** but also with the size of the opening **62** as will be discussed in further detail with reference to FIG. **4** below either of which could be controlled by processor **26** or otherwise.

(23) The software used by the processor **26** could detect wrapping such as by sensing an increase of amperage without noticing any increase in output **18** and/or input **14** and/or possibly also observing that the amperage is slowly increasing by the motor **28** as it being required by the motor **28**. Vibration sensed by the vibration sensor **54** may also contribute to the ability to detect wrapping.

(24) If wrapping is occurring on the aims, such as any of arms **64**,**66**,**68**, then a routine can be employed to attempt to shed the wrap material from the arms. Specifically, the shaft **32** could be stopped as shown by processor and possibly even the arms **64-68** could then be reversed in direction to attempt to free the arms **64-68** from the wrap material. It may be that a series of spinning in the first direction about the axis and then reversing direction about the axis **34** may be employed in order to attempt to remove such material. Should this step fail to work, then it may be that the door **50** might need to be opened or the shafts **32** stopped to remove any excess wrapped material.

(25) Additionally, if wrapping up on the shaft **32** such as at any of the hubs or even towards the upper portion **74** of pulverizer **16**, a shaft wrapping removal system could be employed similar to the one shown in FIG. **3**. Specifically, a spacing rib **70** is shown which can assist in pushing material up and away from the shaft **32** or alternatively along a shedding cone **72** or such as one outwardly extending from shaft **32** which might otherwise direct material up towards the spacing rib **70** and/or upper portion **74** of the pulverizer **16**. As it travels up the spacing rib **70**, it may encounter a first blade **76** which preferably cuts through any material as it passes through or certainly once a predetermined thickness illustrated as thickness **78** is encountered, a second blade or stop **80** can contact the material to either assist in pushing that wrapped material against the first blade **76** and/or cut wrap material with the second blade or stop **80**. Accordingly, the most that could be possibly wrapped would likely be of a thickness **78** between the first blade **76** and the

second blade or stop **80**. Accordingly, as the material attempts to wrap, the material is removed and cut by the blades **76** and/or **80**. VHS tapes particularly have a tendency to come unraveled and perform as well as do other certain feed stocks possibly including wires, labels, plastic and/or other materials.

(26) The cone **72** when utilized works as a shedding cone to assist the direction of such materials up into the cutting area of the shaft wrapping removal device illustrated. An access plate **82** may be useful to be able to open the access either the first or second cutting blade **76**,**80** possibly from outside the pulverizer **16** for adjustment and/or replacement. The cone **72** can be a shedding cone and can further assist in the ability to direct material up to the cutting surfaces of the blade **76** and/or **80**. The cone **72** has a larger diameter at a bottom of the cone **72** and increases in diameter before going downwardly.

(27) Accordingly, some embodiments provide a pulverizer **16** comprising a top **1** with an inlet **14**, and a conveyor **12** feeding an inlet **14** at the top, a bottom **3**, a drum **5** located between the top **1** to the bottom **3**, a rotating shaft **32** having radially extending arms **64**,**66**,**68** creating flow currents within the pulverizer thereby reducing the size of product input at the inlet **14** and discharged at the bottom **3** at exit **18**, and a processor **26** directing the speed of at least one, if not both, of (a) the shaft **32** and (b) the conveyor **12** based at least partially on input of sensors **30** and/or **46**, and/or others. A variable speed motor **28**, such as a variable frequency drive motor or other motor, directed by the processor **26** may drive the shaft. The processor **26** may be used for other functions such as at least assist in controlling pressure in the drum of the pressurizer **16** such as by controlling a dust collection system **24**, possibly having a variable vacuum controlled by the processor **26**. Another processor function may be directing the rotation of the shaft **32** in one of a forward and a reverse direction based on detected wrapping of debris about one of the shaft and the arms **64**,**66**,**68**.

(28) Some embodiments may provide a shaft speed sensor **46** and further comprising a feed back loop communicating shaft speed to the processor **26**. These or other embodiments may provide a door interlock **48** whereby the processor **26** prevents opening an access door **50** to the drum when the shaft **32** is rotating. These or other embodiments may provide a vibration sensor such as **46** with the processor **26** directing slowing down the pulverizer **16** if vibration exceeds a first predetermined threshold, and/or stopping the pulverizer **16** if vibration exceeds a second predetermined threshold.

(29) Some embodiments may provide a wrap detection algorithm used by the processor **26** whereby wrapping of material about the arms **64**,**66**,**68** is detected by performance of the pulverizer **16**. Some algorithms may employ sensing at least one of an increase in amperage required by the motor **28**, slowing down of the shaft and increased vibration such as may be sensed by sensor **46** and/or another sensor. If wrapping about the shaft **32** is detected, some embodiments may provide, the pulverizer **16** reverses direction of rotation of the shaft **32**, at least briefly in an effort to dislodge wrapped material on the arms **64-68**. Spacing ribs **70** and/or a shedding cone **72** located in the drum **5** toward the inlet **16** at the top **1**, or upper portion **74** of the pulverizer **16**, may be useful to discourage wrapping for many embodiments as well. With the shedding cone **72**, for at least some embodiments, at least one blade **76** or **80** near a top of the cone **72** may assist in cutting debris which might otherwise wrap about the shaft **32**. Still other embodiments may have some, or all of these features, as well as, or even others.

(30) Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However, it is to be understood that the present disclosure relates to the preferred embodiment of the invention which is for purposes of illustration only and not to be construed as a limitation of the invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.

Claims

1. A pulverizer comprising: a drum having a top with an inlet and a bottom with an outlet, the inlet being operatively coupled to a conveyor for feeding the inlet at the top; a rotating shaft extending vertically within the drum between the top and the bottom, the rotating shaft having multiple sets of rigid arms extending radially from the rotating shaft in a spaced apart manner, wherein a first set of arms is spaced apart vertically from a second set of arms, to generate flow currents within the pulverizer and reduce a size of a material input at the inlet so as to produce a size reduced material that is discharged at the outlet, the size reduced material comprising dust and a size reduced fraction; a dust collection system coupled to the outlet for extracting a fluid mixture of air and the dust from the size reduced fraction, the dust collection system comprising: a material opening configured to discharge the size reduced fraction; a dust opening configured to discharge the fluid mixture; and a fan configured to provide suction at the dust opening to separate the fluid mixture from the size reduced material and discharge the fluid mixture; an outlet conveyor operatively coupled to the material opening; and a processor programmed to: control a speed of the rotating shaft to thereby increase or decrease the flow currents generated by the multiple sets of rigid arms; control the suction of the fan; and control a speed of the conveyor to control an infeed rate of the material input at the inlet; wherein the dust in the fluid mixture has a dust particulate size smaller than a size of the size reduced fraction; and wherein: the dust collection system is configured for separating the dust from the air and returning the dust to the outlet conveyor; and the outlet conveyor is configured to redirect at least a portion of the size reduced fraction to the inlet when the at least a portion of the size reduced fraction meets a predetermined condition.
2. The pulverizer of claim 1, wherein the dust collection system includes a variable vacuum controlled by the processor.
3. The pulverizer of claim 1, wherein the processor is further programmed to: control an airlock coupled to the material opening.
4. The pulverizer of claim 1, wherein the dust collection system includes one or more bags or one or more hoppers operatively coupled to the dust opening for collecting the dust.
5. The pulverizer of claim 1, wherein the dust collection system is configured for directing the dust towards a dust collection hopper, and the dust collection hopper is configured to return the dust to the outlet conveyor.
6. The pulverizer of claim 1, wherein the dust collection system further comprises at least one of: a conduit extending from the outlet, wherein the material opening and the dust opening are in the conduit; and a plenum extending from the dust opening and wherein the fan is operatively coupled to the plenum to provide the suction.
7. The pulverizer of claim 1, wherein the processor is further programmed to control the speed of the rotating shaft by controlling a speed of a motor driving the rotating shaft.
8. The pulverizer of claim 1, wherein the processor is further programmed to provide a ramp up routine to increase at least one of: a speed of a motor driving the rotating shaft to an optimal speed of the motor; the speed of the rotating shaft to an optimal speed of the rotating shaft; or the speed of the conveyor to an optimal speed of the conveyor.
9. The pulverizer of claim 8, wherein the ramp up routine comprises at least one of a linear increase, a non-linear curve increase, or predetermined intermediate speeds to reach the optimum speed of the motor, the rotating shaft, and/or the conveyor.
10. The pulverizer of claim 9, wherein the ramp up routine comprises: increasing the speed of the rotating shaft to the optimal speed of the rotating shaft while controlling the speed of the conveyor to decrease and/or maintain a predetermined speed.
11. The pulverizer of claim 1, further comprising at least one of: a sensor on the inlet and/or conveyor to sense the infeed rate of the material input at the inlet, wherein the processor is programmed to select the speed of the conveyor and/or the speed of the rotating shaft based on information received by the sensor; one or more shelves coupled to an inner surface of the drum,

wherein the processor is programmed to control a height of the one or more shelves in the drum; or an access door providing access to an interior of the drum, wherein the processor is programmed to prevent the access door from opening when the rotating shaft is rotating.
12. The pulverizer of claim 1, wherein the processor is programmed to simultaneously controls the speed of the rotating shaft and the speed of the conveyor based on a power consumption of the pulverizer or a motor driving the rotating shaft.
13. The pulverizer of claim 12, wherein the processor is programed to at least one of: control the speed of the conveyor to maintain a stable power level based on the power consumption; decrease the speed of the conveyor in response to an increased power consumption by the motor; or increase the speed of the conveyor in response to a decreased power consumption by the motor.
14. The pulverizer of claim 1, wherein the processor is programmed to; control the outlet conveyor to cause the at least a portion of the size reduced fraction to be redirected back to the inlet; and/or control a speed of the outlet conveyor.
15. The pulverizer of claim 1, wherein the predetermined condition is based on a relative size of the at least a portion of the size reduced fraction.
16. A pulverizer comprising: a drum having a top with an inlet and a bottom with an outlet, the inlet being operatively coupled to a conveyor for feeding the inlet at the top; a rotating shaft extending vertically within the drum between the top and the bottom, the rotating shaft having multiple sets of rigid arms extending radially from the rotating shaft in a spaced apart manner, wherein a first set of arms is spaced apart vertically from a second set of arms, to generate flow currents within the pulverizer and reduce a size of a material input at the inlet so as to produce a size reduced material that is discharged at the outlet, the size reduced material comprising dust and a size reduced fraction; a dust collection system coupled to the outlet for extracting a fluid mixture of air and the dust from the size reduced fraction, the dust collection system comprising: a material opening configured to discharge the size reduced fraction; a dust opening configured to discharge the fluid mixture; and a fan configured to provide suction at the dust opening to separate the fluid mixture from the size reduced material and discharge the fluid mixture; an outlet conveyor operatively coupled to the material; and a processor for simultaneously controlling a speed of the rotating shaft and a speed of the conveyor based on a power consumption of the pulverizer or a motor driving the rotating shaft, wherein the processor further controls an airflow through the dust collection system; and wherein: the dust collection system is configured for separating the dust from the air and returning the dust to the outlet conveyor; and the outlet conveyor is configured to redirect at least a portion of the size reduced fraction to the inlet when the at least a portion of the size reduced fraction meets a predetermined condition.
17. The pulverizer of claim 16, wherein the processor is programmed to control the airflow through the dust collection system by at least one of: control the speed of the rotating shaft to thereby increase or decrease the flow currents generated by the multiple sets of rigid arms; control the suction of the fan; or control an airlock coupled to the material opening to effect at least one of: maintaining a desired pressure inside the drum, controlling a pressure within the drum, and maximizing efficiency of the fan to selectively remove the dust of a given dust particulate size.
18. The pulverizer of claim 16, wherein the processor is programmed to at least one of: control the speed of the conveyor to maintain a stable power level based on the power consumption; decrease the speed of the conveyor in response to an increased power consumption by the motor; or increases the speed of the conveyor in response to a decreased power consumption by the motor.
19. The pulverizer of claim 16, wherein the processor is programmed to select the speed of the conveyor and/or the speed of the rotating shaft based on a type of the material input at the inlet.
20. The pulverizer of claim 16, wherein least one of: the pulverizer further comprises a sensor on the inlet and/or conveyor to sense the infeed rate of the material input at the inlet, wherein the processor is programmed to select the speed of the conveyor and/or the speed of the rotating shaft based on information received by the sensor; the pulverizer further comprises one or more shelves

coupled to an inner surface of the drum, wherein the processor is programmed to control a height of the one or more shelves in the drum; the pulverizer further comprises an access door providing access to an interior of the drum, wherein the processor is-is-programmed to prevent the access door from opening when the rotating shaft is rotating; or wherein the processor is programmed to control the outlet conveyor to cause the at least a portion of the size reduced fraction to be redirected back to the inlet; and the predetermined condition is based on a relative size of the at least a portion of the size reduced fraction.