

SYSTEM AND METHOD OF RECYCLING BRICKS

Technical Field

5 The present invention relates, in general, to recycling of bricks from building or construction waste, and, more particularly, to a system and method used for treating and recycling bricks for effectively conserving resources and effectively preventing environmental pollution caused by such waste articles.

10 Background

In most countries with developed architectural and public civilization, construction and reconstruction produces rebuilding waste articles, such as earth, sand, waste brick, waste concrete, waste wood and waste asphalt which have to be effectively
15 treated and recycled, thereby conserving resources and protecting the environment.

Therefore, it is time to provide measures to effectively treat such waste articles and pollutants, produced in countries driving forward a high-growth policy.

20 Particularly, the amount of construction waste articles, produced from building or public works, is rapidly increased in most countries since some urban or local areas in such countries include superannuated buildings, which compromise the safety of residents and fail to meet newly required residential functions, thus needing reconstruction.

25 As well known to those skilled in the art, construction waste articles typically include various materials such as earth, sand, pebbles, stones, waste brick, waste concrete, waste wood, waste asphalt and sludge. A characteristic of such construction waste articles is that the articles have an inorganic composition which is not harmful to the
30 human body. However, due to the various materials included among construction waste articles, it is somewhat difficult to effectively treat and recycle the waste articles. Such difficulty in treatment for the construction waste articles is a cause of the indifference of most governments and companies toward the recycling of such waste articles.

The indifference of the governments and companies toward the recycling of construction waste articles results in waste of resources and reduction in quality of recycled articles which have been reutilized in some way. In this regard, such
5 construction waste articles are just used as a material for raising the ground or reclaiming land and it is a matter of regret.

Therefore, it is necessary to actively strive for the appropriate treatment and recycling of such construction waste articles in an effort to achieve the protection of the
10 environment, the conservation of resources and the reduction in construction expenses.

In order to meet the above necessity, some countries make or improve related laws and regulations in such a way to force related industries to recycle construction waste
15 articles and provide various systems for recycling such waste articles.

Such an obligation to recycle construction waste articles results in the development of various systems capable of partially or totally processing such waste articles so as to reutilize the waste articles.
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As an example of known systems for recycling construction waste articles, movable crushers, capable of recycling the waste articles, are used at building or public works. However, such known movable crushers are problematic in that they can not effectively treat the waste articles, including various materials, and fail to provide a
25 desired quality of recycled articles.

Another problem of the above crushers is that the crushers are similarly designed and manufactured while disregarding the different characteristics of construction waste articles to be treated by the crushers. The operational effect of such crushers is thus
30 reduced and this limits use of the crushers.

Korean Utility Model Publication 94-4771 discloses a system for treating and recycling waste articles. In the above Korean system, waste articles fall by their weight while being processed at a plurality of steps of, for example, dividing the

falling articles into metals and nonmetals, cutting the metals and nonmetals into pieces and collecting earth or dust from the pieces, thus more effectively collecting usable articles and conserving resources.

5 In order to accomplish the above-mentioned operational effect, the Korean system comprises a waste inlet opening, a first conveyor, a first roller crusher, a first magnetic conveyor, a cutter, a first screen, a second roller crusher, a second conveyor, a second magnetic conveyor, a second screen and a third conveyor (a horizontal conveyor) which are arranged in order. The system also has an inclined
10 frame with the waste inlet opening being formed at the top portion of the frame. The first roller crusher comprises a set of shafted rollers of which the outer surfaces are uneven, thus crushing the waste articles. The first magnetic conveyor comprises a electromagnetic roller, a nonconductive/nonmagnetic roller and a cylindrical pipe. The cutter comprises two blades: a fixed blade and a movable blade.

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As well known to those skilled in the art, waste concrete amounts to at least 30% of all construction waste articles.

For example, Korea, a developing country, generates about 10⁷ tons
20 (43^{times}10⁵ m³) of waste concrete, about 7^{times}10⁶ tons of waste asphalt concrete, about 58^{times}10⁵ tons of construction sludge, about 3^{times}10⁶ of waste wood and about 58^{times}10⁵ tons of mixed waste articles for a year.

25 According to the above statistics, it is noted that waste concrete accounts for at least 1/3 of all construction waste articles generated in Korea.

It is, therefore, necessary to more effectively recycle construction waste articles, such as earth, sand, waste brick, waste concrete, waste wood and waste asphalt, produced
30 from building or public works, and to produce high quality recycled aggregate and to conserve resources.

Of course, such a recycling of construction waste articles has to be free from the

generation of contaminants.

Summary

5 One of the objects of certain exemplary aspects of the present disclosure is to address the aforementioned exemplary problems and/or to overcome the exemplary deficiencies commonly associated with the prior art as described herein. Accordingly, for example, provided and described herein are certain exemplary embodiments of exemplary methods, processes and techniques for recycling bricks.

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According to one aspect of this disclosure, there is provided a method for bricks recycling. The method comprises impacting bricks covered with mortar waste to remove the mortar waste therefrom and crushing the bricks to obtain brick aggregates.

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In another aspect, there is provided a method of producing a mixture for growing plants. The method comprises impacting bricks covered with mortar waste to remove the mortar waste therefrom, crushing the bricks to obtain brick aggregates and mixing the brick aggregates with plant nutrients and compost to obtain the mixture.

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Brief Description of the Drawings

Embodiments of the disclosure are described hereinafter with reference to the following drawings, in which:

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FIG. 1 is a block diagram showing a system 100 for recycling of bricks according to several embodiments of this disclosure.

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FIG. 2 is a block diagram showing a process 200 of recycling bricks in accordance with several embodiments of this disclosure.

Detailed Description

5 Representative embodiments of the disclosure for addressing one or more of the foregoing problems associated with conventional bricks and/or bricks recycling are described hereafter with reference to FIGs. 1 to 2. For purposes of brevity and clarity, the description herein is primarily directed to systems, devices, and techniques for bricks recycling. This, however, does not preclude various
10 embodiments of the disclosure from other applications where fundamental principles prevalent among the various embodiments of the disclosure such as operational, functional, or performance characteristics are required. In the description that follows, like or analogous reference numerals indicate like or analogous elements.

15 Accordingly, the present disclosure has been made keeping in mind the above problems occurring in the prior art, and an object of the present invention is to provide a method and system used for treating and recycling bricks by segregating, screening and crushing the bricks, thus providing high quality recycled brick aggregates while conserving resources and effectively preventing environmental
20 pollution caused by such used bricks. The bricks referred to in this disclosure include used bricks, red bricks and used red bricks.

The recycled brick aggregates are used for various applications such as plant growing media, pre-cast concrete, ready-mix concrete, plastering sand and as a backfilling
25 material.

FIG. 1 is a brick recycling system 100 according to several embodiments of this disclosure. The brick recycling system 100 comprises of a primary screening unit 110, a first conveyor system 112, a crushing unit 120, a second conveyor system 122,
30 a magnetic device 124 and a secondary screening unit 130. The primary screening unit 110 is coupled to the crushing unit 120 by way of the first conveyor system 112 and the crushing unit 120 is coupled to the secondary screening unit 130 by way of the second conveyor system 122. In this disclosure, conveyor systems, for instance, the first conveyor system 112 and the second conveyor system 122 comprises one or

more of a wheel loader, excavator, ship loader, belt conveyor and bucket elevator. The brick recycling system 100 is automatically operated by a Central Processing Unit, which can be controlled by way of user-interfaces such as keyboards or keypads. This conserves labour and more effectively process a large amount of used
5 bricks in a short time. In many embodiments, the recycling system 100 is operated by an operator or a team of operators.

FIG. 2 is a process flow diagram showing a brick recycling method 200 in accordance with several embodiments of this disclosure. The bricks are
10 predominantly obtained from construction waste materials and the bricks are covered with mortar waste such as unwanted cement, used articles and sand. The bricks can include unused bricks which are defective or rejected from the brick manufacture company or new brick which is available in the market. In order to produce recycled bricks aggregate using construction waste materials and/or unused bricks which are
15 defective or rejected from the brick manufacturing company, it is necessary to transport the construction waste materials and/or unused bricks which are defective or rejected from the brick manufacturing company to a recycling plant equipped with the necessary system, such as the brick recycling system 100.

20 The bricks are segregated in a segregation process 210 of FIG. 2. This involves separating the bricks from the other waste materials. The segregation process 210 is done manually and/or by way of machines. For instance, manual labour is deployed to remove other construction wastes articles apart from bricks such as rubbish, concrete and metals. Depending on the composition of the bricks or the waste
25 materials, the segregation process 210 can include use of a magnetic device or apparatus to attract and remove metals such as reinforcing steel pieces, nails and screws.

A first screening process 220 is carried out on the segregated bricks. In many
30 embodiments of this disclosure, the first screening process 220 is carried out by a primary screening unit 110. The input material, for instance, the segregated bricks for the first screening process 220 is approximately 300 mm in size. In many embodiments, the segregated bricks are not larger than 300 mm. The primary

screening unit 110 is a rotary screen apparatus which is configured to remove the mortar waste such as unwanted cement, used particles and sand coated on surfaces of the segregated bricks. This process is carried out by loading the segregated bricks into a rotary drum (not shown) operated by a motor where the segregated bricks are tumbled within or in the rotary drum. In many embodiments, the primary screening unit 110 comprises protrusions or blades mounted on the inner surface of the rotary screen apparatus. By having such protrusions or blades, the segregated bricks in the rotary screen apparatus can be carried to the top of the screen during rotation and released by gravity to create impaction. The walls of the rotary drum include perforations adapted to remove the mortar waste. In many embodiments, the perforations on the walls of the rotary drum are approximately between 0.01 mm and 30 mm in size. Loading of the segregated bricks into the rotary drum is carried out by way of the first conveyor system 112. The speed of rotation can vary and is controlled by a controller (not shown) by way of a user interface (not shown). For instance, the primary screening unit 110 can rotate at speeds of between approximately 12 and 22 revolutions per minute (rpm). By rotating the rotary drum, the segregated bricks are impacted against each other and this enables the mortar waste coated on the surfaces of the brick aggregates to be broken, detached or cracked and hence removed from the rotary drum through the perforations on the walls of the rotary drum. The removal of the mortar waste is carried out by way of impaction and erosion between the segregated bricks. For instance, impacting the segregated bricks to remove the mortar waste therefrom results in erosion of the mortar waste from the segregated bricks. The mortar waste includes materials that are approximately between 0.01 mm and 30 mm in size and the mortar waste are removed from the brick recycling system 100 upon impaction and erosion. Depending upon embodiment details, a hopper and/or a wheel loader and/or a collection bay is situated below and/or adjacent to the primary screening unit 110 to consolidate the mortar waste. In some embodiments, the force of the impaction between the segregated bricks can cause them to break into smaller bricks of not larger than approximately 70 mm in size.

Upon completion of the first screening process 220, the segregated bricks of not larger than approximately 70mm in size are transported to the crushing unit 120. This is carried out by way of the first conveyor system 112, which is operable by an

operator or a team of operators, who has control over the speed (i.e 0 km/h to 10 km/h) of the first conveyor system 112. In a crushing process 230, the segregated bricks are crushed into aggregates of not larger than 180 mm in size. However, it should be understood that the size of the aggregates from the crushing process 230 is not limited to the above-mentioned size.

The crushing unit 120 is a jaw crusher where the segregated bricks are placed between two solid surfaces before application of sufficient force to bring the surfaces together to generate enough energy to crush the segregated bricks to obtain brick aggregates of between approximately 0.01 – 70 mm in size. The size of the crushed brick aggregates is dependent upon an adjustable tension spring of the jaw crusher. Depending on the outcome of the crushing, a magnetic device 124 may be used to remove any remaining metals from the brick aggregates while the brick aggregates are being fed by the second conveyor system 122. The second conveyor system 122 is inclinedly positioned under the crushing unit 120, while the magnetic device 124 is movably placed at a periphery of the second conveyor system 122 and generates a high magnetic force (Gauss) enough to effectively attract and remove metals such as reinforcing steel pieces and nails. In some embodiments, the operator of the recycling system 100 can control the magnitude of the magnetic force. The second conveyor system 122 feeds the brick aggregates from the crushing unit 120 to the secondary screening unit 130. The operator can control the operation of the second conveyor system 122. For instance, speed of the second conveyor system 122 can be adjusted by the operator.

The secondary screening unit 130 is used in the second screening process 240. The brick aggregates that are fed into the secondary screening unit 130 are not larger than approximately 70 mm in size. Depending upon embodiment details, the secondary screening unit 130 includes a multi layer screening machine and/or 2 or more sets of individual screening machines. The multi layer screening machine can comprise two or more screening machines coupled substantially vertically adjacent to each other. In some embodiments, the secondary screening unit 130 is a single screening machine. For clarity, where more than one screening machine is utilized, the screening machines will be denoted as a first screening machine, second screening machine and so on.

The screening machine of this disclosure includes one of a rotary screen, a circular screen and a vibrating screen. Each of the screening machine, for instance the rotary screen, the circular screen and the vibrating screen comprises perforations and is
5 vibrated, rotated and/or shaken at a regular frequency by a motor. Each screening machine is configured to screen/extract brick aggregates of varying sizes. For instance, the screening machine can be configured to screen for brick aggregates of 10 mm, 25 mm, 45 mm and/or 60 mm.

10 When the brick aggregates are fed by way of the second conveyor system 122 to the secondary screening unit 130, a second screening process 240 takes place. Each screening machine of the secondary screening unit 130 comprises perforations and is vibrated at a regular frequency by a motor. By vibrating the screening machine of the secondary screening unit 130, brick aggregates of different sizes can be screened
15 and/or extracted and/or separated. For instance, the screening machine can screen, extract and/or separate brick aggregates of 25 mm or bigger in size from those smaller than 25 mm in size.

In configurations with more than 1 screening machines, the perforations of the first
20 screening machine allows brick aggregates that are smaller than 25 mm in size to be screened through and the brick aggregates of smaller than 25 mm will be transported to a second screening machine by way of a conveyor system. If no other screening is required, for instance, where a single screening machine is utilized, the brick aggregates of smaller than 25 mm will be collected and/or received by a tray, hopper
25 or collection device.. Brick aggregates that are 25 mm or greater in size remain on the first screening machine and will be processed later. In some embodiments, these brick aggregates that are 25 mm or greater in size are then transported by a conveyor system to the crushing unit 120 for further crushing. Upon any subsequent crushing, the brick aggregates can undergo a subsequent second screening process 240.
30 However, depending upon user requirements, the brick aggregates of 25 mm and above can be utilized in the area of construction. For example, as construction backfilling works. If this is the case, the brick aggregates of 25 mm or greater in size do not have to undergo further crushing.

As described above, brick aggregates that are smaller than 25 mm in size are fed to the second screening machine for further screening. Analogous to the first screening machine, the second screening machine comprises perforations and is vibrated at a regular frequency by a motor. The second screening machine can be used to screen
5 brick aggregates of 10 mm in size and below.

The perforations of the second screening machine allow brick aggregates that are smaller than 10 mm in size to be screened through and be processed for use. The brick aggregates that are bigger than 10 mm but smaller than 25 mm in size remain
10 on the second screening machine for further processing depending upon embodiment and/or application details.

The first screening machine can be configured to screen, extract and/or separate brick aggregates of varying sizes. For instance, the first screening machine can be
15 configured to screen, extract and/or separate brick aggregates of 50 mm or bigger in size from those smaller than 50 mm in size. Similarly, it will be appreciated to a person of ordinary skill in the art that the second screening machine can be used to screen brick aggregates of other sizes. For example, brick aggregates of 5 mm in size and below.

20 In order to prevent vinyl pieces, fabric pieces or wire pieces from being caught by the screening machines, they are provided with a perforated panel in place of a conventional iron net. The use of the perforated panel enables the screening machines to be usable for a longer period of time and reduces maintenance cost. Further, the
25 screening machines are each provided with a guide wall at both side edges, thus preventing the brick aggregates from being unexpectedly dropped from the screening machine during the screening process 240.

Depending upon the size requirement of the brick aggregates, the first screening
30 process 220, crushing process 230 and/or second screening process 240 can be iterated. For instance, the brick aggregates of 25 mm or greater in size can undergo subsequent crushing to produce smaller-sized recycled bricks.

In many embodiments of this disclosure, the segregation process 210, the first screening process 220, the crushing process 230 and the second screening process 240 is performed at least once. In some other embodiments, at least one of the segregation process 210, the first screening process 220, the crushing process 230
5 and the second screening process 240 is performed at least once.

Industrial Applicability

As described above, the present invention provides a system and a process for stably
10 and continuously producing high quality recycled brick aggregates from construction waste articles. The system and process of this disclosure reduces production cost of the recycled brick aggregates while conserving resources and preventing environmental pollution caused by such waste articles. The applications of the recycled bricks are described as follows.

15 Aggregates of different sizes have different applications. Depending upon the application, brick aggregates of any size can be used as a backfilling material in the construction industry. Brick aggregates of between approximately 0.01 and 5 mm can be used as sand replacement in Ready-Mix Concrete (RMC) and pre-cast
20 concrete while brick aggregates of between approximately 16 and 25 mm can be used as stone replacement in RMC and pre-cast concrete. Brick aggregates of between approximately 0.01 and 4 mm are used as plastering sand and brick aggregates of between 1 and 3 mm are used as filtering sand.

25 Brick aggregates of below 20 mm, for instance, between approximately 0.01 and 15 mm in size can be can be mixed with plant nutrients, volcanic stone, peat moss, fertilizers, soil and compost to produce a mixture for growing plants. The mixture for growing plants has good growing properties which enables plants to grow exceptionally well. This can be attributed to the good water-absorbing properties of
30 the crushed brick aggregates. Further, the loosen texture of these brick aggregates allow the plant root to penetrate/grow faster and/or easier, relative to normal hard clay soil. Such mixtures are environmentally green and do not have any adverse environmental effects due to a lack of silt. Normal hard clay soil contains a high amount of silt and that may dirty/pollute the surrounding environment in the presence

of rain and/or excess water. Relative to normal hard clay soil, the brick aggregates are lower in density and as such, it is a good growing media for roof top gardens. Some other benefits of the mixture include being free from diseases or viruses, better water retention and aeration and less susceptible to insect breeding.

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In the foregoing manner, various embodiments of the disclosure are described for addressing at least one of the foregoing disadvantages. Such embodiments are intended to be encompassed by the following claims, and are not to be limited to specific forms or arrangements of parts so described and it will be apparent to one skilled in the art in view of this disclosure that numerous changes and/or modification can be made, which are also intended to be encompassed by the following claims.

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Claims

1. A method for bricks recycling, the method comprising:
 impacting bricks covered with mortar waste to remove the mortar
5 waste therefrom; and
 crushing the bricks to obtain brick aggregates.
2. The method of claim 1, wherein the bricks are red bricks.
- 10 3. The method of claim 1, wherein the bricks are obtained from construction waste materials.
4. The method of claim 1, wherein the mortar waste comprises unwanted
15 cement, used articles and sand.
5. The method of claim 1, wherein the brick aggregates are between
approximately 0.01 and 70 mm.
- 20 6. The method of claim 1, wherein the step of crushing bricks to obtain brick aggregates comprises crushing the bricks by a jaw crusher.
7. The method of claim 1, wherein the step of impacting bricks covered with
mortar waste to remove the mortar waste therefrom results in erosion of
25 the mortar waste from the bricks.
8. The method of claim 7, wherein impacting the brick comprises tumbling
the bricks in a rotary drum.
- 30 9. A method of producing a mixture for growing plants, the method comprising:
 impacting bricks covered with mortar waste to remove the mortar
waste therefrom;
 crushing the bricks to obtain brick aggregates; and

mixing the brick aggregates with plant nutrients and compost to obtain the mixture.

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