

TITLE OF THE INVENTION
METHOD FOR RECYCLING CONSTRUCTION WASTES

BACKGROUND OF THE INVENTION

(a) Field of the Invention

The present invention relates, in general, to a recycling treatment of construction wastes, and in particular, a recycling method to recover materials namely metal, paper, wood and hardcore. The present invention also relates to a method for recycling hardcore to provide recycled concrete, and particularly, a hardcore recycling method effectively conserves resources and avoids environmental pollution.

(b) Description of the Prior Art

Natural resources decrease as more and more resources are used up for development. In most of the larger cities of developing countries, vast amounts of construction wastes are produced in the course of architectural developments, and rebuilding. It is imperatively important to effectively treat and recycle these construction wastes so as to conserve the limited useful resources on earth and to protect environment.

As well known to those skilled in the art, construction waste articles typically include various materials such as earth, sand,

pebbles, stones, and waste brick. It is difficult to effectively treat and recycle the waste articles.

Conventional system and method for treating and recycling waste articles have been disclosed. In this method, 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 effectively collecting useable articles and conserving resources. To achieve this method of operation, the system is provided with 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 (or a horizontal conveyor) which are arranged in order. This conventional system also has an inclined frame with the waste inlet opening being formed at the top portion of the frame. The first roller crusher has a set of shafted rollers of which the outer surfaces are uneven, thus crushing the waste articles. This system and method fail to effectively classify the waste articles and thus the recycled products are of poor quality.

Other typical methods for treating and recycling construction waste articles fail to effectively provide recycled waste, which can be reused in building road kerb or support surface in car parks.

In another conventional recycle method, only about 45.5 % hardcore is available. In this conventional method, fine and coarse aggregates are mixed to provide temporary access, and after the construction, the hardcore is mixed with soil and produced waste. The drawback of such recycle process is that the value added to the recycled construction waste is low.

Construction waste composition roughly contains 49% hardcore, including mainly concrete, aggregates, tiles, bricks, sand and the like; 3% being paper and metal; 20% being non-recyclable waste; and 28% wood material. Generally, most of the construction wastes are sent to incineration plant or landfill, which will contribute to long-term environmental problems and are costly to process the waste. In some cases, hardcore is used to build construction site temporary access. Based on experience, up to 80% of the construction and demolition waste can be either recycled, recovered or reused. Therefore, the bulk of the waste (49%) requires a better method to produce high value added products without polluting the environment.

It is therefore necessary to provide a method for recycling construction waste, such as earth, sand, waste brick, waste concrete, waste wood, and to produce high quality recycled aggregate and to conserve resources without generating contaminants to pollute the environment.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a method for recycling construction waste by sorting, crushing, washing and screening to recover useful metal, wood waste, and fine and coarse aggregates. The aggregates are further recycled and then fed to a mixing plant to produce recycled concrete mix.

Yet another object of the present invention to provide a method for recycling hardcore from construction sites, wherein the recycled concrete mix can be used to produce pre-cast products, for instance road kerb, channel drain, etc.

A further object of the present invention is to provide a method for recycling hardcore from construction sites, wherein the obtained recycled aggregates are used as base materials replacing virgin aggregates for the manufacturing of non-structural pre-cast concrete products.

Yet another object of the present invention is to provide a method for recycling hardcore from construction sites, wherein the construction hardcore, sand, bricks are collected and introduced to a shaker and separators to separate into coarse hardcore and finer hardcore. The finer hardcore is transferred to a fine crusher while the coarse hardcore is first crushed by a coarse crusher before the coarse hardcore is transferred to the fine crusher. The crushed hardcore from the fine crusher undergo a washing step by a screw washer.

An aspect of the present invention is to provide a method for recycling hardcore from construction sites comprising the steps of: separating hardcore by a shaker and a separator into coarse hardcore and fine hardcore;
crushing the coarse hardcore by means of a coarse crusher into fine hardcore;
finer-crushing the fine hardcore from the shaker and the separator and that from the coarse crusher;
washing the fine-crushed hardcore by a screw-log washer;
screening the washed hardcore to separate sand and aggregate of different sizes; and
introducing cement, and concrete admixtures (if needed), the screened aggregate and sand into a cement mixer to obtain recycled concrete.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and other advantages of the present invention will become more apparent from the following description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a block diagram showing the process of recycling construction waste in accordance with the preferred embodiment of the present invention.

Fig. 2 is a flowchart showing the segregation process of the recycling construction waste in accordance with the preferred embodiment of the present invention.

Fig. 3 is a process flow chart depicting recycling process of the recovered hardcore by the recycling construction waste in accordance with the preferred embodiment of the present invention.

Fig. 4 is a schematic view showing the recycling process of the recovered hardcore by the recycling construction waste in accordance with the preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

Now to the drawings, there are shown the preferred embodiment of a method for recycling construction wastes according to the present invention. Referring to Fig. 1, construction wastes are collected either from a third party collection 102 or from internal collection 104 of a construction site. In accordance with the present invention, the method for recycling construction wastes in a recycle system comprises the steps of: segregating (101) the construction wastes to obtain wood material, paper, hardcore and metal material; preliminary sorting of the wastes to further categorize wood, paper, hardcore, and metal material; removing the recovered wood material, paper,

metal material and sending the recovered materials respectively to wood recycling plants, metal recycling plants, and paper recycling plant 106, and sending hardcore from the recycle system for further recovery 108. In accordance with the present invention, the recovered hardcore can be made into value added products such as pre-cast concrete 109. Any non-recyclable materials are sent for incineration 105, and any waste wood can also be recycled for further use.

Referring to Fig. 2, there is shown a flowchart showing the segregation process of the recycling construction waste in accordance with the preferred embodiment of the present invention. As shown in Fig. 2, construction wastes are collected from various sites 100 and are consolidated at a proposed sorting/recycling area 200. Next, these collected wastes are then delivered to a preliminary sorting by a mechanical sorting machine 300. The sorted wastes includes: carton boxes, paper which are sent to paper recycle vendor 400; metals which are sent to metal recycle vendor 500; waste woods are sent to further recycling process 700 and waste hardcore, which is further recycled in accordance with the process of the present invention 600. As mentioned earlier, the non-recyclable waste materials are sent to incineration 800.

In accordance with a preferred embodiment of the present invention, a method for recycling hardcore from construction sites is disclosed, and the method comprises the steps of:

separating hardcore by a shaker and a separator 204 into coarse hardcore and fine hardcore;
crushing the coarse hardcore by means of a coarse crusher 205 into fine hardcore;
finer-crushing 206 the fine hardcore from the shaker and the separator 204 and that from the coarse crusher 205;
washing 207 the fine-crushed hardcore by a screw-log washer;
screening 208 the washed hardcore in order to separate sand 301 and aggregate of different sizes; and introducing cement 302, and concrete admixtures (if needed), the screened aggregate and sand into a cement mixer 209 to obtain recycled concrete.

In accordance with the present invention, the concrete admixtures are chemicals that will enhance the cement mix strength, workability, and performance. The introduction of the concrete admixtures is necessary if it is needed and is normally depending on the quality of recycled aggregates.

In accordance with the present invention, the present system has two feeders or loaders, a plurality of conveyor belts, a shaking machine which provides horizontal movement to shake a screen wire mesh, a magnetic drum with a horizontal swinging arm, a fine crusher and a coarse crusher, a washing machine, a screening machine with 3 types of sizes, such as 5mm and less $\frac{3}{4}$ inches, and more than $\frac{3}{4}$ inches, and a mixing plant.

In accordance with the preferred embodiment of the present invention, the construction waste is first segregated and preliminary crushed by the coarse crusher. This preliminary sorting will recover others valuable materials such as wood, paper, hardcore, and metal. In this preliminary sorting step, a magnetic drum is used to recover metal and a plurality of manual sorting stations are used together with other machines.

Referring to Fig. 4, after the sorting step, the hardcore is introduced to a feeder 10 by an excavator (not shown). The feeder 10 delivers the feed (hardcore) at a constant flow of material into an ascending conveyor 20 mounted to the feeder 10. The ascending conveyor 20 transports the materials to a shaker 30, which is connected to the other end of the conveyor 20. In accordance with the present invention, the shaker 30 is a machine having a V-shaped container fabricated from a plurality of wires with 6 inches mesh on the top thereof, and a motor (not shown) is used to drive the container in a horizontal motion. The shaking motion with the wire mesh will separate waste into more than 6 inches waste and less than six inches waste. As the waste is on the top of the shaker 30, a magnetic drum 40 is used to remove small metal. The magnetic drum 40 with a swinging arm swings to the top of the shaker 30 to attract metal, and then swing to the other end of the shaker 30 to deposit the metal in the container (not shown).

After the shaking step, the waste having a size of more than 6 inches in diameter is rolled off the top of the shaker 30 and is

transported to a jaw crusher 50 by a horizontal conveyor 21. These wastes of size greater than 6 inches in diameter are crushed into smaller wastes, which are then fed into a second feeder 211 by a bulldozer (not shown). The second feeder 211 introduces the smaller waste to a second ascending conveyor 222 which will transport the waste to a fine crusher 54. The fine crusher 54 crushes the waste into waste having a size of less than $\frac{3}{4}$ inch in diameter.

Referring to Fig. 4, for those wastes having a size equal to 6 or less than six inches in diameter, the wastes are allowed to pass through the wire mesh of the shaker 30 and are landed at the bottom of the shaker 30. A third ascending conveyor is used to transport these wastes to the fine crusher 54.

The wastes that having a size of less than six inches are fed into the fine crusher 54 and are crushed into wastes having a size of less than or equal $\frac{3}{4}$ inch and are then discharged at a discharging outlet of the fine crusher 54. These discharged wastes are then transported to a washing plant 7, for instance a screw-log washer, by a forth ascending conveyor 41. These wastes are washed and discharged at the outlet of the washing plant 7 to a screening machine 9 by a fifth ascending conveyor 51. In the present invention, the screening machine 9 has three screen sizes, for instance, screen of 5mm or less, $\frac{3}{4}$ inch, and more than $\frac{3}{4}$ inch. These screens are fitted at a slope on top of each other in the screening machine 9, and as the materials feed in from one end of the machine 9 and roll down the slope of the

screen, an additional shaking and vibratory forces are introduced by a motor and spring (not shown) so as to facilitate screening procedure. After the materials are rolled off the screening machine 9, these materials are separated into $\frac{3}{4}$ inch aggregate 110 (coarse), five mm aggregate (fine or sand) 111, and those larger than $\frac{3}{4}$ inch. Those larger than $\frac{3}{4}$ inch will be manually fed into the feeder 10 and are processed from the initial stage of the present method. The fine and coarse aggregates are transported to a mixing plant 13 by means of horizontal conveyors 66, 68.

In accordance with the present invention, these recycled aggregates with an optimal mixing ratio and concrete admixtures (if needed) are mixed with cement and water to produce recycled concrete 14, or pre-cast concrete products for the construction industry.

While the present invention has been particularly described, in conjunction with a preferred embodiment, it is evident that many alternatives, modifications, and variations will be apparent to those skilled in the art in light of the foregoing description. It is therefore contemplated that the appended claims will embrace any such alternatives, modifications and variations as falling within the scope and spirit of the present invention.



CLAIMS

1. A method for recycling construction wastes in a recycle system comprising the steps of:
segregating the construction wastes to obtain wood material, paper, hardcore and metal material;
preliminary sorting of the wastes to further categorize wood, hardcore, paper and metal material;
removing the recovered wood material, paper, metal material and sending the recovered materials respectively to wood recycling plants, metal recycling plants, and paper recycling plant, and sending hardcore from the recycle system for further recovery.
2. A method for recycling hardcore from construction sites comprising the steps of:
separating hardcore by a shaker and a separator into coarse hardcore and fine hardcore;
crushing the coarse hardcore by means of a coarse crusher into fine hardcore;
finer-crushing the fine hardcore from the shaker and the separator and that from the coarse crusher;
washing the fine-crushed hardcore by a screw-log washer;
screening the washed hardcore in order to separate sand and aggregate of different sizes; and



introducing cement and concrete admixtures (if needed), the screened aggregate and sand into a cement mixer to obtain recycled concrete.

3. The method for recycling construction wastes in a recycle system of claim 1, wherein a magnetic drum is used to recover metal materials.
4. The method for recycling hardcore from construction sites of claim 2, wherein the discharged wastes transported to the washing plant have a size of less than or equal to $\frac{3}{4}$ inch.
5. The method for recycling hardcore from construction sites of claim 2, further comprises the step of additional shaking and vibratory forces.
6. The method for recycling hardcore from construction sites of claim 5, wherein a motor and springs are employed to provide the shaking and vibratory forces.
7. The method for recycling hardcore from construction sites of claim 2, wherein the concrete admixtures are mixed with cement and water to enhance the cement mix strength, workability, and performance.