

PROCESS AND SYSTEM FOR RECLAIMING REUSABLE ABRASIVE MATERIALS

5 **Field Of Invention**

The present field of invention generally relates to processing abrasive materials used for surface preparation. Specifically, the present invention relates to a processing method and a processing system therefor for processing abrasive materials that have been used for surface preparation.

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Background

Surface preparation is a method that utilises abrasive materials for removing corrosion, paint, dirt or other coatings from new and old surfaces made of materials such as metal or stone. Industries that perform surface preparation include the marine industry, and the transportation and bridging industry.

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In particular, an abrasive material such as copper slag is heavily used in the marine industry for surface preparation activities prior to surface painting. Copper slag is a by-product from the refining of copper. Typically, copper slag comprises iron compounds and oxides. The predominant compounds are ferrosilicate ($\text{Fe}_2\text{Si}_2\text{O}_6$) and silica dioxide (SiO_2), which generally constitute more than 45% and 31% of copper slag, respectively.

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Copper slag is by far the most cost effective material used for surface preparation activities in the marine industry. The properties of copper slag such as its angular surfaces and its denseness make it an ideal abrasive material for surface preparation. Thus, copper slag is widely used in shipyards for cleaning surfaces of ships before painting commences.

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The above-mentioned industries are heavy users of surface preparation materials and massive amounts of abrasive materials are thus required to support their surface preparation activities. Consequently, the amount of abrasive materials used for surface preparation that requires disposal is also huge. Conventionally, abrasive

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materials are collected and disposed of once they have been used and the typical method of disposal is through land filling.

After the abrasive materials have been used for surface preparation, a material mix is obtained which comprises used abrasive materials and other materials such as scrap metals, plastics, fibres, paint, dirt and rust. In particular, the material mix generally contains some materials that are harmful to the environment. One example of such a material present in the material mix is paint containing heavy metals that have been removed from surfaces by surface preparation.

Metal surfaces are often coated with paint that contains heavy metals acting as anti-fouling and anti-corrosion agents so as to protect the metal surfaces from deterioration and corrosion when exposed to the environment, especially the marine environment. During surface preparation to clean surfaces coated with such paints, the removed paint is mixed with the material mix and the heavy metals contained in the removed paint consequently contaminate the material mix.

As such, contaminants such as heavy metals and other toxic substances may leach from the material mix after disposal which potentially results in environmental pollution. In view of stringent waste management regulations and increased awareness of environmental pollution, a greater importance has been placed on the management of material mix. Hence, disposal of the material mix through land filling is not a sustainable practice for the management of material mix.

As mentioned above, the material mix usually contains several other materials. However, there also exists a significant portion of the material mix that is reusable. Thus, instead of disposing the material mix entirely, recycling methods can be employed to recover the significant portion that is reusable, as well as to reclaim the other materials present in the material mix for recycling.

Therefore, there is a need for a method and system for processing used abrasive materials contained in the material mix for reducing the amount of material mix that needs to be disposed of and for better material mix management.

Summary

The present embodiment of the invention disclosed herein provides a processing method and a processing system for processing used abrasive materials contained in a material mix. By recovering the portion of the material mix that is reusable instead of
5 disposing the material mix entirely, the disclosed processing method and system allow for better material mix management and for reducing land filling needs and costs.

In accordance with a first aspect of the invention, there is disclosed a processing method for processing used abrasive materials contained in a material mix. The
10 processing method comprises obtaining the used abrasive materials from the material mix. The processing method also comprises washing the used abrasive materials for obtaining washed abrasive materials therefrom. Further, the processing method comprises heating the washed abrasive materials for obtaining dried abrasive materials therefrom. The dried abrasive materials comprise at least one of reusable
15 abrasive materials and non-reusable abrasive materials. Lastly, the processing method comprises identifying the reusable abrasive materials in which the reusable abrasive materials have at least a pre-determined size.

In accordance with a second aspect of the invention there is disclosed a processing
20 system for processing used abrasive materials contained in a material mix. The processing system comprises a washing station for washing used abrasive materials for obtaining washed abrasive materials therefrom. The processing system also comprises a heating station for heating the washed abrasive materials for obtaining dried abrasive materials therefrom. The dried abrasive materials comprise at least one
25 of reusable abrasive materials and non-reusable abrasive materials. Lastly, the processing system comprises a sizing station for identifying the reusable abrasive materials in which the reusable abrasive materials have at least a pre-determined size.

Brief Description Of The Drawings

30 An embodiment of the invention is described hereinafter with reference to the following drawings, in which:

FIG. 1 shows a process flow diagram of a processing method for processing used abrasive materials contained in a material mix according to an embodiment of the invention;

5 FIG. 2 shows a system flow diagram of the process flow diagram of FIG. 1; and

FIG. 3 shows a system flow diagram of a processing system for processing used abrasive materials contained in a material mix for the processing method of FIG. 1.

10 **Detailed Description**

A processing method and a processing system for processing used abrasive materials contained in a material mix are described hereinafter for addressing the foregoing problems.

15 For purposes of brevity and clarity, the description of the invention is limited hereinafter to applications related to processing of material mix. This however does not preclude various embodiments of the invention from other applications that require similar operating function and performance for reclaiming materials.

20 An embodiment of the invention is described in the detailed description provided hereinafter is in accordance with Fig. 1 to Fig. 3 of the drawings, in which like elements are numbered with like reference numerals.

With reference to Fig.1 and Fig 2, a system 20 and a processing method 100 for
25 processing used abrasive materials 24 contained in a material mix 22 according to an embodiment of the invention are described. The material mix 22 comprises the used abrasive materials 24 and other materials such as scrap metals, plastics, fibres, paint, dirt, rust and contaminants. However, there is a significant portion of the material mix 22 that is reusable. Thus, the processing method 100 is used to recover a portion
30 of the material mix 22 that is reusable.

In the processing method 100 as shown in Fig.1, in a step 110, the material mix 22 is provided for recovering the portion of the material mix 22 that is reusable. One

example of the material mix 22 is used copper slag which generally is copper slag that has been used for surface preparation, such as sandblasting, for cleaning surfaces of ships before the surfaces are repaired and repainted. The used copper slag usually contains debris such as plastic sheets, pieces of scrap iron, wires, fibres and lead electrodes due to ship reparation and modification works. Furthermore, the used copper slag also contains fine ferrous material and pollutants such as paint residues that contain heavy metals acting as anti-fouling and anti-corrosion agents, which are removed from the surfaces during surface preparation.

10 Next in a step 112, debris 26 and ferrous material 28 are removed from the material mix 22 for obtaining the used abrasive materials 24 therefrom. Generally, the debris 26 is substantially larger in size than the used abrasive materials 24. Thus, the debris 26 is easily separated from the used abrasive materials 24 by sieving. The ferrous material 28 present in the material mix 22 usually comes from removing steel rust
15 from surfaces during surface preparation. After removing the debris 26, the material mix 22 can be loaded onto a conveyor belt system which conveys the material mix 22 to a ferrous material extractor. The ferrous material extractor is for removing the ferrous material 28 present in the material mix 22. Furthermore, the debris 26 and the ferrous material 28 that are extracted can be recycled for other purposes.

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Following the step 112, the used abrasive materials 24 are washed for obtaining washed abrasive materials 30 in a step 114. The used abrasive materials 24 are washed so as to remove dust, fine contaminants and other low-density impurities such as organic residues. A liquid, such as water, is introduced to the used abrasive
25 materials 24 at a pre-determined liquid to used abrasive materials 24 ratio for washing the used abrasive materials 24. The used abrasive materials 24 are then washed for a pre-determined duration and the liquid is removed after washing of the used abrasive materials 24.

30 Next in a step 116, the washed abrasive materials 30 are heated for obtaining dried abrasive materials 32. The washed abrasive materials 30 are heated at a pre-determined temperature of preferably 900⁰C and for a pre-determined duration for destroying contaminants 34 that are present, as well as for drying the washed abrasive

materials 30. The dried abrasive materials 32 obtained thereafter comprise at least one of reusable abrasive materials 36 and non-reusable materials 38. The dried abrasive materials 32 are generally substantially clean from various contaminants 34 and impurities after heating.

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Following the step 116, the reusable abrasive materials 36 are identified from the non-reusable abrasive materials 38 in a step 118. The reusable abrasive materials 36 have at least a pre-determined size, for example, at least 1mm. Hence, the non-reusable abrasive materials 38 are those dried abrasive materials 32 that have a size smaller
10 than the pre-determined size of the reusable abrasive materials 36. The dried abrasive materials 32 can be sieved for substantially segregating the reusable abrasive materials 36 from the non-reusable abrasive materials 38. The reusable abrasive materials 36 obtained are collected for reuse, for example, for use in other surface preparation activities. The non-reusable abrasive materials 38 are collected for
15 recycling in various ways such as for use in making pre-cast concrete.

Furthermore, a processing system 200 for processing the used abrasive materials 24 contained in the material mix 22 for the processing method 100 according to the embodiment of the invention is described with reference to Fig. 3. The processing
20 system 200 comprises an extracting station 210, a washing station 212, a heating station 214 and a sizing station 216.

The extracting station 210 is for performing the step 112 for obtaining the used abrasive materials 24 from the material mix 22, while the washing station 212 is for
25 performing the step 114 for washing the used abrasive materials 24 for obtaining the washed abrasive materials 30. The heating station 214 is for performing the step 116 for heating the washed abrasive materials 30 for obtaining the dried abrasive materials 32. Lastly, the sizing station 216 is for performing the step 118 for identifying the reusable abrasive materials 36 by size. Additionally, the processing system 200
30 further comprises a packaging station 218 for packaging the reusable abrasive materials 36 and the non-reusable abrasive materials 38 for reuse and recycling respectively.

In an example according to the processing method 100 and the processing system 200, a processing method and a processing system for processing used copper slag are described hereinafter.

- 5 The used copper slag, which is copper slag that has been used for surface preparation activities, such as for cleaning surfaces of ships before the surfaces are repaired and repainted, generally contains a considerable portion that is reusable and other materials such as debris, ferrous material and contaminants.
- 10 The debris and ferrous material present in the used copper slag are removed as in the step 112 for obtaining extracted copper slag. The extracted copper slag is then washed as in the step 114 for obtaining washed copper slag. Following that, the washed copper slag is heated for obtaining dried copper slag as in the step 116 for destroying contaminants that are present in the washed copper slag. The dried copper
- 15 slag obtained comprises at least one of reusable copper slag and non-reusable copper slag. Lastly, the reusable copper slag is identified by a pre-determined size, for example, at least 1mm, as in the step 118. The reusable copper slag is collected and packaged for reuse, for instance, for use in other surface preparation activities. The non-reusable copper slag, which has a size smaller than the pre-determined size of the
- 20 reusable copper slag, is collected and packaged for recycling.

Furthermore, the processing system for processing used copper slag comprises an extracting station, a washing station, a heating station and a sizing station as in the extracting station 210, the washing station 212, the heating station 214 and the sizing

25 station 216. Additionally, the processing system for processing used copper slag further comprises a packaging station as in the packaging station 218.

In the foregoing manner, a processing method and a processing system for processing used abrasive materials contained in a material mix are described according to one

30 embodiment of the invention for addressing the foregoing problems. An example of applying the processing method and system to used copper slag, an example of a material mix, is provided. Although only one embodiment of the invention is disclosed, the invention is 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 without departing from the scope and spirit of the invention.

Claims

1. A processing method for processing used abrasive materials contained in a material mix, the processing method comprising:
 - obtaining the used abrasive materials from the material mix;
 - 5 washing the used abrasive materials for obtaining washed abrasive materials therefrom;
 - heating the washed abrasive materials for obtaining dried abrasive materials therefrom, the dried abrasive materials comprising at least one of abrasive materials having at least a pre-determined size and abrasive materials
 - 10 having a size smaller than the pre-determined size; and
 - segregating the abrasive materials having at least a pre-determined size from abrasive materials having a size smaller than the pre-determined size in a manner for identifying reusable abrasive materials and non-reusable materials, the reusable abrasive materials having at least a pre-determined size and the
 - 15 non-reusable materials having a size smaller than the pre-determined size.
2. The processing method as in claim 1, wherein the material mix further comprises at least debris.
- 20 3. The processing method as in claim 2, wherein obtaining the used abrasive materials comprising:
 - removing the debris from the material mix.
4. The processing method as in claim 3, wherein obtaining the used abrasive
- 25 materials further comprises removing ferrous material from the material mix.

5. The processing method as in claim 1, wherein washing the used abrasive materials comprising:

introducing liquid to the used abrasive materials at a pre-determined
5 liquid to used abrasive materials ratio for washing the used abrasive materials.

6. The processing method as in claim 5, wherein washing the used abrasive materials comprising:

washing the used abrasive materials for a pre-determined duration for
10 removing at least one of dust, fine contaminants and impurities from the used abrasive materials.

7. The processing method as in claim 6, wherein washing the used abrasive materials comprising:

15 removing the liquid after washing the used abrasive materials.

8. The processing method as in claim 1, wherein heating the washed abrasive materials comprising:

heating the washed abrasive materials at a pre-determined temperature
20 for destroying contaminants present in the washed abrasive materials.

9. The processing method as in claim 8, wherein heating the washed abrasive materials comprising:

heating the washed abrasive materials for a pre-determined duration for
25 drying the washed abrasive materials.

10. The processing method as in claim 1, wherein segregating the abrasive materials having at least a pre-determined size from abrasive materials having a size smaller than the pre-determined size comprises:

5 sieving the dried abrasive materials for substantially segregating the abrasive materials having at least a pre-determined size from the abrasive materials having a size smaller than the pre-determined size.

11. The processing method as in claim 10, further comprising:

10 packaging the reusable abrasive materials for reuse.

12. The processing method as in claim 10, further comprising:

 packaging the non-reusable materials for recycling.

- 15 13. The processing method as in claim 1, wherein the material mix being used comprises copper slag.

14. A processing system for processing used abrasive materials contained in a material mix, the system comprising:

20 a washing station for washing the used abrasive materials for obtaining washed abrasive materials therefrom;

 a heating station for heating the washed abrasive materials for obtaining dried abrasive materials therefrom, the dried abrasive materials comprising at least one of abrasive materials having at least a pre-determined

size and abrasive materials having a size smaller than the pre-determined size; and

a sizing station for segregating the abrasive materials having at least a pre-determined size from abrasive materials having a size smaller than the pre-determined size in a manner for identifying reusable abrasive materials and non-reusable materials, the reusable abrasive materials having at least a pre-determined size and the non-reusable materials having a size smaller than the pre-determined size.

- 10 15. The processing system as in claim 14, wherein the processing system further comprises:

an extracting station for obtaining the used abrasive materials from the material mix.

- 15 16. The processing system as in claim 14, wherein the material mix further comprises at least debris.

17. The processing system as in claim 16, wherein the extracting station is further for removing the debris from the material mix.

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18. The processing system as in claim 17, wherein the extracting station is further for removing ferrous material from the material mix.

19. The processing system as in claim 14, wherein the washing station is further for introducing liquid to the used abrasive materials at a pre-determined liquid to used abrasive materials ratio for washing the used abrasive materials.

5 20. The processing system as in claim 19, wherein the washing station is further for washing the used abrasive materials for a pre-determined duration for removing at least one of dust, fine contaminants and impurities from the used abrasive materials.

10 21. The processing system as in claim 20, wherein the washing station is further for removing the liquid after washing the used abrasive materials.

22. The processing system as in claim 14, wherein the heating station is further for heating the washed abrasive materials at a pre-determined temperature for
15 destroying contaminants present in the washed abrasive materials.

23. The processing system as in claim 22, wherein the heating station is further for heating the washed abrasive materials for a pre-determined duration for drying the washed abrasive materials.

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24. The processing system as in claim 14, wherein the sizing station is further for sieving the dried abrasive materials for substantially segregating the abrasive materials having at least a pre-determined size from the abrasive materials having a size smaller than the pre-determined size.

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25. The processing system as in claim 24, wherein the sizing station is further for packaging the reusable abrasive materials for reuse.

26. The processing system as in claim 24, wherein the sizing station is further for
5 packaging the non-reusable materials for recycling.

27. The processing system as in claim 14, wherein the material mix being used comprises copper slag.

10 28. A method for processing used abrasive materials comprising:
obtaining used abrasive materials from a material mix;
washing the used abrasive materials for obtaining washed abrasive
materials therefrom; and
15 identifying and harvesting a reusable portion of the washed abrasive
materials.

29. The method as in claim 28, the identifying and harvesting of a reusable portion
of the washed abrasive materials comprising segregating the washed abrasive
materials based upon size, wherein the reusable portion of the washed abrasive
20 materials has a size larger than a pre-determined size.

30. The method as in claim 29, wherein a non-reusable portion of the washed
abrasive materials has a size smaller than a pre-determined size.

PROCESS AND SYSTEM FOR RECLAIMING REUSABLE ABRASIVE MATERIALS

5 **Abstract**

The present invention provides a processing method and a processing system therefor for processing abrasive materials that have been used for surface preparation. The processing method and system disclosed involve a washing station for washing used abrasive materials for obtaining washed abrasive materials. A heating station heats
10 the washed abrasive materials for obtaining dried abrasive materials whereby the dried abrasive materials comprise at least one of reusable abrasive materials and non-reusable abrasive materials. Lastly, a sizing station identifies the reusable abrasive materials in which the reusable abrasive materials have at least a pre-determined size. The identified reusable abrasive materials are then collected and reused for other
15 surface preparation activities.

Figure 1