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## **Process and System for Recycling and Resizing Abrasive Blast Material**

### **Field of Invention**

This invention relates generally to abrasive materials used for sandblasting. In particular, it relates to a process and a system therefor for recycling and resizing used Abrasive Blast Material (ABM) to produce recycled ABM, which is used in sandblasting for surface preparation of structural steel.

### **Background**

Sandblasting is a common process that uses abrasive materials for removing paint, dirt, corrosion or other coatings from a variety of surfaces of materials such as structural steel. In most cases the cleaning abrasive materials have no hazardous properties. The shipbuilding and maintenance, transportation and bridging industries, and the military are heavy users of sandblasting.

With this many different industries using sandblasting, a large amount of abrasive blast material (ABM) is therefore required. However this subsequently increases the amount of used ABM that requires disposal of after sandblasting. In light of stringent waste management regulations and heightened awareness of environmental contamination, additional focus has been placed on the management of these waste streams.

Used ABM can contain materials from cleaned surfaces which impart hazardous characteristics. Sandblasting is often used to remove paint from metal and other material surfaces. These metal surfaces are often coated with paint to protect the metal surface from deterioration and corrosion when exposed to the environment, most notably the marine environment.

Usually, such paint contains heavy metals which act as an anti-fouling and anti-corrosion agent. During regular maintenance, metal surfaces are cleaned via sandblasting and repainted which results in heavy metals contained in the removed paint contaminating the used ABM. Such contaminants in the used abrasive materials



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give rise to restrictions during disposal and recycling thereof. Therefore, there is a need for determining disposal and reuse options.

One such method is described in U.S. Patent No. 4,523,988 wherein used ABM is  
5 filtered to obtain usable reclaimed ABM for reuse. The method helps to reduce the amount of used ABM that is disposed and also reduces the amount of new ABM that is required for sandblasting. Therefore this reduces the cost of sandblasting.

However, this conventional method does not allow control of the sizes of the  
10 reclaimed ABM which is usually smaller than the new ABM. Due to the restricted size of the reclaimed ABM, there is a need to increase the amount of reclaimed ABM needed for cleaning a particular surface when compared with use of new ABM material for sandblasting. Even with the cost savings from using reclaimed ABM, the usage of recycled ABM greatly reduces productivity of the sandblasting process.

15 Therefore there is a need for a process and system for recycling used ABM into recycled ABM for reducing the amount of used ABM for disposal while producing recycled ABM which is of similar dimension or shape to new ABM.

## 20 **Summary**

The present invention provides a process and a system for recycling used abrasive materials which are used in sandblasting for surface preparation of structural steel. Conventionally, used abrasive materials are collected and disposed in landfills. However, this option becomes less viable when the amount of used abrasive materials  
25 being collected increases.

An alternative option conventionally used is to reclaim used abrasive materials. Used abrasive materials are filtered for usable abrasive materials in order to reduce the amount of used abrasive materials that is being disposed. This option is cost effective  
30 and alleviates the need for allocating space within the landfill for the used abrasive materials.

The present invention not only recycles the used abrasive materials but also produces recycled abrasive materials from the used abrasive materials which have similar specifications as the new abrasive materials.

- 5 The process and system used in the invention involves a first sieving machine for separating debris from the used abrasive mixture to obtain abrasive materials therefrom. A smelting furnace smelts the abrasive materials into molten state and molds the abrasive materials in the molten state into an abrasive block, and a rock crusher forges the abrasive block into crushed particles for use in sandblasting.

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### **Brief Description of the Drawings**

Fig. 1 illustrates a basic system flow diagram of the invention according to an embodiment of the invention;

- 15 Fig. 2 is an extended system flow diagram of the invention in Fig. 1;

Fig. 3 shows a system flow diagram of a dust and moisture removal system of Fig. 2; and

- 20 Fig. 4 shows a system flow diagram of a second sieving and packaging system of Fig. 2.

### **Detailed Description**

- With reference to the drawings, the invention, an abrasive material recycling system,  
25 is described hereinafter for recycling and resizing used Abrasive Blast Material (ABM) into recycled ABM, which is used in sandblasting for surface preparation of structural steel.

- Used ABM from sand blasting is usually disposed in landfills. Additionally,  
30 conventional methods for reclaiming used ABM cannot provide reclaimed ABM with sizes similar to new ABM which is more effective in cleaning metal surfaces.

A process and a system therefor according to the invention facilitates used ABM to be recycled for reducing the amount of used AMB being disposed while producing recycled ABM which is similar and comparable in size to new ABM. The process and apparatus is capable of resizing recycled ABM into any suitable dimension  
5 required by sandblasting companies.

For purposes of brevity and clarity, the description of the invention is limited hereinafter to applications related to reclaiming and recycling of used ABM. This however does not preclude the invention from other areas of application that requires  
10 similar operating function and performance for material reclamation.

The invention is described in greater detail hereinafter for a process and a system therefore for reclaiming used ABM. In the detailed description provided hereinafter and illustrations provided in Figs. 1 to 4 of the drawings, like elements are identified  
15 with like reference numerals.

With reference to Fig 1, a basic embodiment of the invention as shown in an abrasive material recycling system 100 for achieving satisfactory economy in the use of ABM. It is common practice to salvage used abrasive mixtures 102, which may contain  
20 debris and contaminants, after sandblasting of metal surfaces. The used abrasive mixtures 102 are collected onto trucks and sent to the recycling plant for recycling. At the plant, the used abrasive mixtures 102 are loaded onto a conveyor belt system which conveys the used abrasive mixtures 102 to a first sieving machine 104. The first sieving machine 104 is used for separating the debris and contaminants from the  
25 used abrasive mixtures 102 to obtain usable abrasive materials 105.

After obtaining the usable abrasive materials 105, the abrasive materials 105 are conveyed to a smelting furnace 106. The smelting furnace 106 contains a heating element which applies high heat, preferably more than 900°C, to the abrasive  
30 materials 105 such that impurities within the abrasive materials 105 are substantially purged and removed and the abrasive materials 105 are melted to molten state. In the molten state, different metals forming the abrasive materials 105 are fused together

due to the high temperature within the smelting furnace 106. The melted abrasive materials 105 are then molded into a substantially rectangular shape for casting the melted abrasive materials 105 into an abrasive block 107. Subsequently, the abrasive block 107 is allowed to cool before it is sent to a rock crusher machine 108.

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The cooled abrasive block 107 is sent to the rock crusher machine 108 via a second vibrating hopper (not shown). The second vibrating hopper is employed to control feed of the abrasive block 107 into the rock crusher machine 108 in which the abrasive block 107 is crushed to produce crushed particles 110 of differing dimensions and preferably within a range of 1mm to 3.8mm as required by a user. In addition, the crushing process of the rock crusher machine 108 generates dust particles. The rock crusher machine 108 is therefore connected to a dust removal machine (not shown) which draws the dust particles away therefrom to obtain the necessary sized abrasive particles 110.

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The first sieving machine 104, the smelting furnace 106 and the rock crusher 108 form a basic process and system flow of the abrasive material recycling system as shown in Fig. 1. This basic system flow can be further extended and enhanced by including a dust and moisture removal system 202, and a second sieving and packaging system 204 to the abrasive material recycling system 200 as shown in Fig. 2. The dust and moisture removal system 202 cleans the abrasive materials 105 collected from the first sieving machine while the second sieving and packaging system 204 filters the crushed particles 110 to obtain conformal particles 206 having at least a size between 1mm to 3.8mm from the rock crusher machine 108 and packages the conformal particles 206 for sale.

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With reference to Fig. 3, the dust and moisture removal system 202 comprises a sand washer machine 302, a temporary storage 304 and a sand dryer machine 306. The abrasive materials 105 obtained from the first sieving machine 104 are usually covered with dust and are thus rendered unsuitable for sand blasting. Therefore, the abrasive materials 105 are sent to the sand washer machine 302. Bulldozers are used to transport the abrasive materials 105 from the first sieving machine 104 to the sand

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washer machine 302. In the sand washer machine 302, water is sprayed onto the dust covered abrasive materials 105 for settling and washing away the dust particles.

5 The cleaned abrasive materials 105 are then collected and stored in a container. The container is placed on a conveyer belt for transportation to the temporary storage 304. The container is stored in the temporary storage 304 for allowing the moist abrasive materials 105 to dry. The container is preferably kept in storage for up to 24 hours.

10 After the abrasive materials 105 are substantially dried, the cleaned abrasive materials 105 are further sent to the sand dryer machine 306 to remove the remaining moisture from the abrasive materials 105. Subsequently, bulldozers are employed to transport the container to a first vibrating hopper (not shown). The first vibrating hopper is connected to the sand dryer machine 306 using a conveyer belt system wherein the first vibrating hopper controls the amount of abrasive materials 105 being fed into the  
15 sand dryer machine 306. The abrasive materials 105 feed rate is preferably 100kg per minute.

The abrasive materials 105 are conveyed to the sand dryer machine 306 to further remove any remaining moisture therefrom in preparation for being sent to the  
20 smelting furnace 106. Hot air is generated within the sand dryer machine 306 for drying the abrasive materials 105. Furthermore, the drying process of the abrasive materials 105 separates the dust particles which cling onto the abrasive materials 105 during the washing process in the sand washer machine 302. Therefore, the dust removal machine 306 is attached to the sand dryer machine to remove the dust  
25 particles within the sand dryer machine 306. At the discharge end of the sand dryer machine 306, a conveyer belt system transports the abrasive materials 105 into the smelting furnace 106.

30 With reference to Fig. 4, the second sieving and packaging system 204 comprises a second sieving machine 402 and a packaging device 404. Crushed particles 110 of differing sizes are generated from the rock crusher machine 108. Therefore, the second sieving machine 402 is needed to separate the crushed particles 110 into

conformal particles 206 and non-conformal particles (not shown). The non-conformal particles, which are smaller than the required size specification preferably within a range of 1mm to 3.8mm for effective sandblasting utilisation of the client, are sent back to the smelting furnace 106 for reconstruction back into another abrasive block 107. Oversized non-conformal particles preferably of more than 3.8mm are also sent back to the rock crusher 108 for breaking down into smaller pieces which fit the required size specification. The dust removal machine is also attached to the second sieving machine 402 for dust extraction since dust particles are also generated during the sieving process.

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The conformal particles 206 are preferably within the required 1mm to 3.8mm range and are transported onto a conveyer belt system and sent to the packaging device 404. The packaging device 404 segregates the conformal particles 206 into portions for packing. The recycling process using the abrasive material recycling system is then repeated after these conformal particles 206 are used during the sandblasting and again collected for recycling. This invention therefore greatly helps to reduce the amount of new ABM that is acquired while recycling used ABM into recycled ABM having similar size specification as new ABM.

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20 In the foregoing manner, a process and a system for recycling and resizing used Abrasive Blast Material (ABM) to produce recycled ABM, which is used in sandblasting process for surface preparation of structural steel is disclosed. While a particular embodiment of the invention has been herein described, it becomes 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.

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**Claims**

1. A system for recycling used abrasive materials, comprising:  
a first sieving machine for separating debris from used abrasive mixture for  
5 obtaining abrasive materials therefrom;  
a smelting furnace for smelting the abrasive materials into molten state and for  
molding the abrasive materials in the molten state into an abrasive block; and  
a crusher for forging the abrasive block into crushed particles,  
wherein smelting the abrasive materials substantially removes impurities  
10 therefrom.
2. The system as detailed in claim 1, further comprising:  
a dust and moisture removal system for cleaning the abrasive materials.
- 15 3. The system as defined in claim 2, the dust and moisture removal system  
further comprising:  
a washer for substantially removing dust particles from the abrasive materials.
4. The system as defined in claim 2, the dust and moisture removal system  
20 comprising:  
a sand dryer for substantially removing moisture from the abrasive materials.
5. The system as defined in claim 1, further comprising:  
a second sieving machine for sieving the crushed particles, the crushed  
25 particles containing conformal and non-conformal particles, and the second sieving  
machine for separating the non-conformal particles from the conformal particles  
contained therein.
6. The system as defined in claim 5, the second sieving machine for filtering out  
30 conformal particles having dimensions within a range of 1mm to 3.8mm.

7. The system as defined in claim 5, further comprising:  
a packaging device for packing the conformal particles for sale.

8. A process for recycling used abrasive materials includes steps of:

- 5 (a) separating the used abrasive mixture into debris and abrasive materials,  
the abrasive materials comprising a plurality of metallic materials,  
(b) fusing the plurality of metallic materials of the abrasive materials into  
an abrasive block,  
(c) breaking down the abrasive block into crushed particles having  
10 substantially a specified size.

9. The process defined in claim 8, the step of separating the used abrasive  
mixture into debris and abrasive materials includes steps of,  
washing of the abrasive materials for substantially removing dust particles  
15 generated during the sieving process in the sieving machine.

10. The process defined in claim 8, the step of separating the used abrasive  
mixture into debris and abrasive materials includes steps of,  
reducing the moisture of the abrasive materials after separating the debris from  
20 the used abrasive mixture.

11. The process defined in claim 8, further includes steps of,  
filtering the crushed particles to obtain conformal particles having sizes  
between a range of 1mm to 3.8mm  
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12. The process defined in claim 8, further includes steps of,  
packaging the conformal particles after filtering the crushed particles.