AIR BLAST POWER UNITS FOR SHOT PEENING APPLICATIONS

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ABSTRACT

The paper describes the features that may be incorporated in air blast power units designed for general impact treatment applications, in order to provide the control and monitoring necessary to meet the specific requirements of shot peening.

KEYWORDS

Reclamation; shape classification; feed control; mass flow monitoring; pneumatic recovery.

INTRODUCTION

Conventional compressed air blasting machines which are widely used for a variety of impact treatment applications, can be similarly applied to shot peening processes merely by the use of suitable media such as round steel or glass shot. However while such machines may perform satisfactorily when first put into operation or for treatment of limited duration, control and monitoring is essential to ensure that variations do not occur during continuous processing. These variations may result for example from deterioration of the media, changes in the machine performance, or contamination by debris or after a change in the grade of media employed.

There are therefore many features that can be applied to conventional air blast machines in order to improve their performance, provide the continuous control necessary for shot peening, and even monitor and record many of the variables to ensure repeatability. These can include for example:-

1) The basic design of the machine to ensure that the risk of contamination when changing the grade of media is reduced to a minimum.

2) Improved reclaimer systems to provide continuous grading of the recovered media prior to reuse, and permit several grades of media to be used within the same peening installation.

3) Monitoring of the media quantity and period of usage to avoid media starvation during processing and meet the quality control requirements of shot peening specifications.

4) Adjustable media feed control with monitoring of the mass feed rate to the nozzle.

5) Monitoring of the pneumatic recovery or ventilation system to ensure consistent performance, and the incorporation of specific features for collecting hazardous dusts.

BASIC DESIGN

There are many steps that can be taken within the equipment itself to reduce the risk of contamination when changing from one media grade to another. Hopper angles should be at least 45 degrees to ensure free draining of all media, and ledges eliminated wherever possible. "Dead spots" within pneumatic recovery systems can present a risk area to be avoided, although, by comparison, mechanical systems present an almost impossible contamination problem when the grade of media is changed. As an example of the type of action that can be taken, Fig. 1, shows a media transfer valve in its standard form and after modification to eliminate unnecessary ledges.

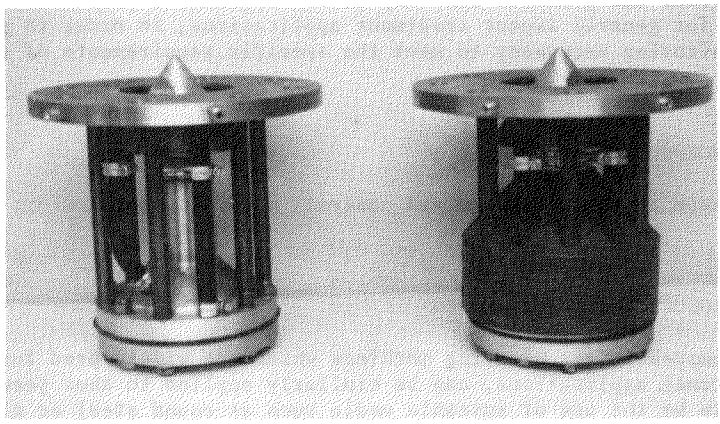

Fig. 1. Transfer Valve modified for shot peening.

RECLAMATION

Reclamation systems are another area for consideration since the standard necessary for shot peening is considerably greater than for general impact treatment. Where the equipment may be used for cleaning with angular abrasive it is necessary to remove the dust and excessively broken down media before reuse. However apart from critical applications such as metal spraying there is every advantage in allowing an "operating mix" of media size to develop. The large particles would remove tenacious deposits while the finer particles would scour and generally clean the surface.

In the case of equipment used for shot peening, every effort must be made to remove all undersized media. With standard air wash reclaimers this is if anything more readily achievable with glass beads which tend to shatter on impact. Although steel shot tends to break down at a relatively low rate, there is still a requirement to remove debris or contamination from other grades of media.

Most simple reclaimers consist of an air wash stage, where the media passes over a weir or annulus through an adjustable air stream, followed by a vibrated screen section to remove oversize debris. Reclaimers modified for shot peening would have increased baffling in order to concentrate the air wash stream more effectively through the falling media, and at the same time extend the period during which the media is passing through the air wash. The result may if anything tend to carry over some reusable media in order to achieve a higher separating efficiency. A further modification for shot peening is that the vibrated screen would be sized more closely to the upper limit of the media grade than would be the case for general impact treatment.

While these are basic modifications to standard machines, two other features should be mentioned which are being increasingly applied to shot peening reclaimer units. The first is multiple screening with two screens to remove oversized and undersized media, selected in accordance with the shot specification. Alternatively several screens, normally gyratory vibrated can be incorporated with two or more separate takeoffs for the reusable media which are then fed into separate generators for selective use. It is not of course possible to have an overlap in size between the reusable media since the low limit screen of the larger grade would also be the high limit screen of the smaller grade. This however has not been found to present a problem since the two media grades would normally be distinct in size such as S230 and S460.

The second requirement, specific to shot peening reclaimers, is to continuously shape classify a percentage of the recovered media, say 10/20%. This is achieved by a metered drain from the reclaimer storage hopper which is ducted through a spiral centrifugal shape classifier into the blast enclosure for continuous recovery. Any unacceptable media from the shape classifier is separately collected, the effect being to extend considerably the period between complete dumping of the media charge, either to be scrapped or completely re-classified.

MEDIA LEVEL AND CONDITION MONITORING

It is essential that the shot peening process, once initiated is uninterrupted over the duration of the component treatment. Pressure blast generators may be used of the non-continuous type whereby the media stored in the pressure vessel, once discharged, is recovered and stored ready for transfer when the pressure vessel is exhausted. It is essential of course that the media volume is sufficient for the maximum processing time anticipated. As an alternative continuous cycling generators are available, utilising an intermediate pressure vessel for the continuous transfer of the recovered media. At the same time, suction fed blast systems are inherently continuous cycling.

With any system however whether non-continuous or continuous it is essential that a low level indicator is incorporated in the media storage hopper to warn when the media has reached an unacceptably low level.

The majority of shot peening specifications call for the media to be discarded or reclassified after a set period of usage. A timer can be incoporated indicating the number of blasting hours so that at a predetermined time a warning is given to inform the operator that the media must be checked.

MEDIA FEED CONTROL AND MONITORING

The rate of media feed into the air flow to the blast nozzle, while having little effect in the case of suction nozzles, can have a marked effect on pressure fed systems. Lean feed rates will result in a higher air flow with corresponding increase in media discharge velocity and almen intensity, and a typical graph of the effect of media feed rate is shown in Fig. 2. Feed rate is a factor that is not sufficiently stressed in many peening specifications, since the effect of a variation is similar to a change in air pressure, although the latter is more readily apparent to the operator.

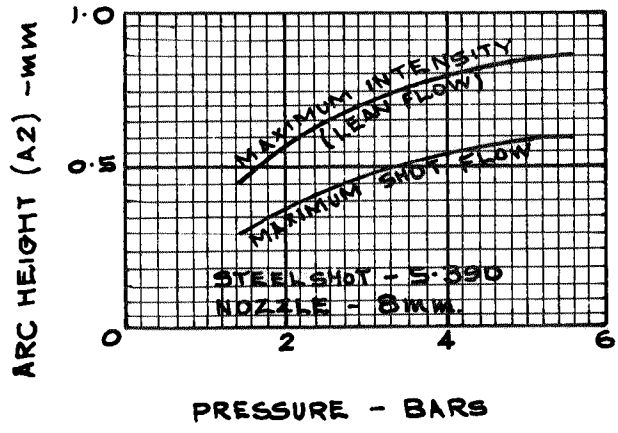

Fig. 2. Effect of media feed rate on almen intensity.

The feed valve which meters the media feed into the nozzle air stream should therefore be adjustable against a scale for recording and re-setting. There is also advantage in incorporating remote control with the feed valve adjustment located in the main control panel, together with the regulated pressure control.

Further benefit results in monitoring the mass feed rate of the media, if not to provide a measured indication, at least to detect abnormal changes after the equipment has been set up for processing. One system now available operates on the principle of capacitance noise, by which the very small changes in capacitance which occur when particles move in a pipe are detected. An alternative system uses a photodiode in an optical scanner in order to detect the mass density being metered into the air stream.

In either system simple warning lamps can be used to indicate excessive variation from the preset feed rate. Alternatively, direct dial indication of the mass flow can be provided, with continuous chart recording if required.

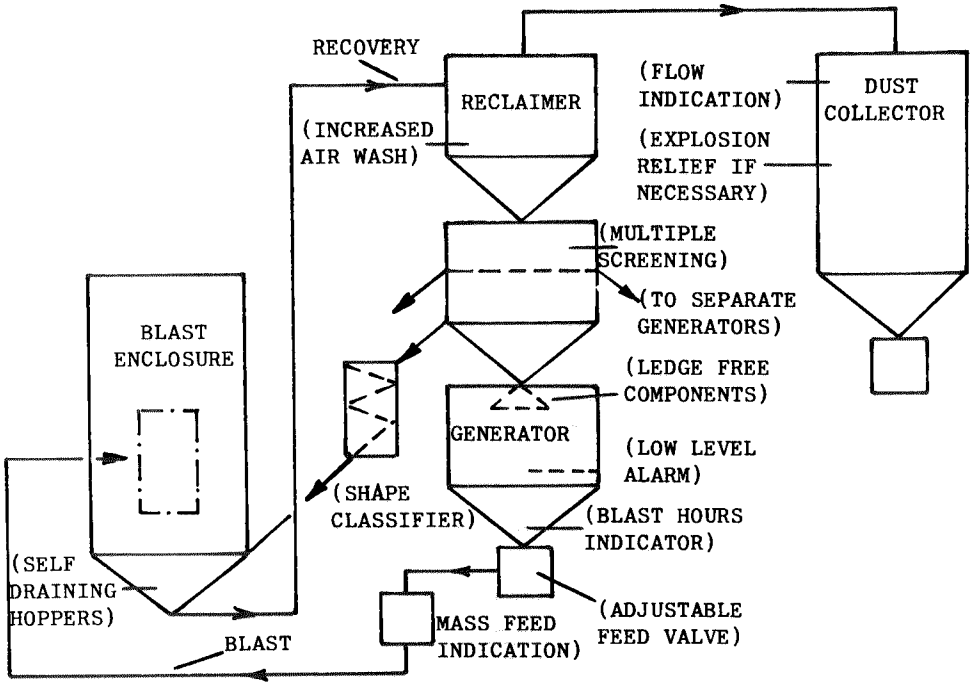

Fig. 3. Schematic summary of shot peening features.

PNEUMATIC RECOVERY AND VENTILATION SYSTEM

In view of the importance of the air wash separator within the reclaimer, it is advisable to monitor the recovery air flow conditions, especially where fabric filters are involved. A convenient method is simply to incorporate a differential pressure gauge and alarm, to indicate when the filter resistance has reached an unacceptable level. Maintenance of the design recovery air flow is especially important where pneumatic recovery of the media is employed with large steel shot. In such cases the use of continuously cleaned reverse pulse filters which provide a constant low pressure loss is increasing.

One particular aspect of ventilation with shot peening equipment is the precautionary measures that should be considered when hazardous dusts are produced. The most commonly encountered application in this respect is the peening of titanium, since although the rate of dust generation may be negligible, the long term effects could provide accumulations which may present an explosion risk. The measures that can be taken are relatively simple and include the following:-

a) The use of wet dust collectors where wetting the dust does not create a more hazardous situation, with explosion relief and hydrogen venting. Where dry dust collectors are employed they should be anti-staticised and fitted with explosion relief, with dust discharge into a metal container clamped in position.

b) Explosion relief panels should be fitted high up in the blast cabinet and all curtains, hoses, and conveyor belting should be of anti-staticised material.

c) Ledges should be eliminated wherever possible and all the hoppers self-draining of dust by the use of a satisfactory hopper angle.

d) The major requirement on such applications is undoubtedly that of good housekeeping in regular examination and removal of all collected dust both from the equipment and surrounding area. The use of naked flames or smoking should also be prohibited in the vicinity of the equipment.

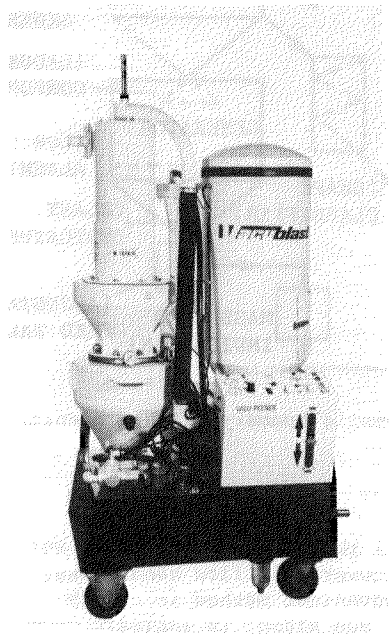

Fig. 4. Closed circuit air blast machine modified for shot peening.

A summary of the features that can be applied to improve the performance of air blast power units can best be shown in the schematic layout in Fig. 3. As an example of a standard air blast machine modified for shot peening, Fig. 4, shows a closed circuit type machine with the shot peening controls and monitoring brought out to a single control panel.