

Design and Development of Portable Blasting Machine

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Abstract: Shot blasting is a method used to clean, polish or strengthen metal. Shot blasting is used in almost every industry that uses metal, including aerospace, automotive, construction, foundry, shipbuilding, rail, and many others. Shot blasting machines can take the form of a blast cabinet, the blast media is pneumatically accelerated by compressed air and projected by nozzles onto the component to roughen a smooth surface, shape a surface or remove surface contaminants. For the application of local sand blasting process on a small components, as we cannot carry out blasting process in open atmospheric, so many times we have to shift jobs to confined room. Due to this job handling cost increases. To avoid this, there is need of design of portable type shot blasting machine.

Keywords: Shot blasting process, Components, Work handling system.

1. Introduction

Shot blasting is commonly used for: Abrasive blasting, more commonly known as sandblasting, is the operation of forcibly propelling a stream of abrasive material against a surface under high pressure to smooth a rough surface, roughen a smooth surface, shape a surface or remove surface contaminants.

Shot Blasting is a surface treatment process using high velocity steel abrasive. Shot blasting is method through which it is possible to obtain excellent cleaning and surface preparation for secondary finishing operations [1].

- The cleaning of iron, steel, non-cast parts, forgings, etc.
- Mechanical cleaning of sheets, rods, coils, wire, etc.
- Shot peening to alter mechanical properties (increasing resistance to fatigue for springs, gears, etc.)
- Preparing surfaces to be painted, coated, etc.

2. Problem statement

Remove the oil, grease and scale present on the surface, the projection of the abrasives removes corrosion from the surface and providing such a surface condition which has easy adhesion to the paint. We know that approximately 80% of the surface failures occur when the pretreatment of the surfaces is not done properly. Therefore, this step of sandblasting the surface, prior

to painting, galvanization or any sort of coating must not be overlooked as it is considered as the most critical stage for a good pretreatment of surface. It is one of the easiest and the fastest way to remove old paint and rust from the metal surface.

But for the application of local sand blasting process on a small components, As we cannot do blasting process in open atmospheric, so every time we need to do same in closed confined space, after doing blasting process on whole job in blasting confined space, sometimes jobs required some new parts attachment or some small rework on job though we did blasting process on job, so again we shift jobs to confined room for same in this way job handling cost increases. In this paper to avoid this handling cost, there is need of design and development of portable sand or shot blasting machine, with the help of same, instead of handling job, we can do local blasting of reworked components or new welded small components on same place, in this way we can minimize handling cost jobs.

3. Working principle

This is the process of blowing fine sand at a high pressure with the help of compressed air that is passed through the nozzle at a very high velocity. The sequences of operations in sandblasting are as follows:

1. Loading of abrasives into the cylinder.
2. Second step is focusing of pressurized air through the nozzle on the surface to be sandblasted.

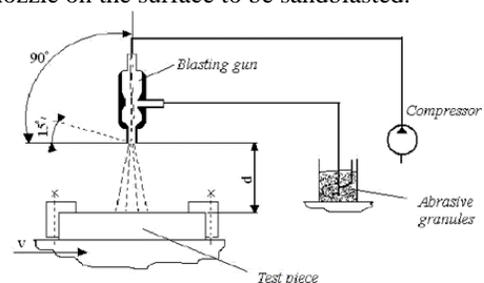


Fig. 1. Schematic diagram of working principle

Nozzle along with controlling the pressure and velocity also helps in creating a trajectory for the blast. Pressure blast systems are the systems which are ten times more effective and quicker than the suction blasters. Pressure blasters Pressure

blast systems are the systems which are ten times more effective and quicker than the suction blasters. They are also easier to use. They consist of large container comprising of silica sand under high pressure. A gun is joined to the upper portion of the container with the help of a hose that can bear the abrading effects of sand. These blasters are moderately cheap and are more likely to find. They consist of three main parts. A sandblasting gun with two hoses of which one hose is connected to the bottom of the handle and the other hose is connected to the lower side of the barrel. It has a repository of loose sand. Some type of container or bucket is formed by this type. As the gun is fired, the air creates a suction that pulls the sand into the gun. Now sand can be reused by collecting it and placing back into the reservoir [1].



Fig. 2. Actual shot blasting process

A. Pre-treatment of Surfaces

Prior to die casting, anodization, powder coating and painting, the surface needs some sort of pretreatment or cleaning. This step is similar to laying down the foundation. This process of cleaning of the surfaces puts a heavy impact on the post processes. Therefore, for this sandblasting is a very good surface treatment process.

Pretreatment for mild steel Tendency of material- Picking up the rust and dirt when the material is exposed to bare atmosphere is the tendency of material and hence there is a need of sandblasting. Sandblasting is done to remove the oil, grease, rust and black scale formed on the surface. Mild steel material is also recognized for its tendency of undergoing rapid oxidation when exposed to bare atmosphere. Result of oxidation is formation of a layer of oxide on the surface called rust. To avoid this, material is not directly exposed to bare atmosphere. For this, we mostly make use of rust preventive oil on mild steel surface. This oil does not allow metal to contact directly with the air and thus deferments oxidation [2], [3].



Fig. 3. Portable shot blasting machine

4. Technical calculation

DESCRIPTION : SHELL THK CALCULATION FOR MINI BLASTER
 APPLICABLE CODE : ASME SEC VIII DIV 1 EDITION 2017

DESCRIPTION	SYMBOL	UNIT	VALUE
INSIDE DIAMETER	D	mm	202.74
INSIDIE RADIUS	R	mm	101.37
WORKING PRESSURE	p	bar (g)	7
WORKING TEMPERATURE	t	°C	30
MINIMUM DESIGN METAL TEMPERATURE	T1	°C	0
DESIGN PRESSURE	P	bar (g)	8.4
DESIGN TEMPERATURE	T	°C	40
MATERIAL		--	SA 106 Gr.B
MAXIMUM ALLOWABLE STRESS (As per Sec II Part D)	S	N/mm2	118
WELDING JOINT EFFICIENCY (As per UW-12)	E	--	0.7
CORROSION ALLOWANCE	CA	mm	1.6
$t = \frac{PR}{SE - 0.6P}$ or $P = \frac{SEt}{R + 0.6t}$			
REQUIRED THICKNESS AFTER CORRSION (As per UG-27)	t	mm	1.04
$T = t + CA$			
REQUIRED THICKNESS	T	mm	2.64
SELECTED THICKNESS		mm	8.18

INPUT VALUES
DERIVED VALUES
CALCULATED VALUES

DESCRIPTION : I/L & O/L NOZZLE WALL THK CALCULATION
 APPLICABLE CODE : ASME SEC VIII DIV 1 EDITION 2017

DESCRIPTION	SYMBOL	UNIT	VALUE
INSIDE DIAMETER	D	mm	26.64
INSIDIE RADIUS	R	mm	13.32
WORKING PRESSURE	p	bar (a)	7
WORKING TEMPERATURE	t	°C	30
MINIMUM DESIGN METAL TEMPERATURE	T1	°C	0
DESIGN PRESSURE	P	bar (g)	8.4
DESIGN TEMPERATURE	T	°C	40
MATERIAL		--	SA 106 Gr.B
MAXIMUM ALLOWABLE STRESS (As per Sec II Part D)	S	N/mm2	118
WELD JOINT EFFICIENCY (As per UW-12)	E	--	0.7
CORROSION ALLOWANCE	CA	mm	1.6
$t = \frac{PR}{SE - 0.6P}$ or $P = \frac{SEt}{R + 0.6t}$			
REQUIRED THICKNESS AFTER CORRSION (As per UG-27)	t	mm	0.14
$T = t + CA$			
REQUIRED THICKNESS	T	mm	1.74
SELECTED THICKNESS		mm	3.18

INPUT VALUES
DERIVED VALUES
CALCULATED VALUES

5. Test and controls

Before the beginning of the activities the Painting Supervisor must be established that the minimum environmental conditions and appropriate to the requirements of the treatments (including materials) to be made. The lack of these requirements involves the suspension of the works and the re-evaluation of the conditions, from the Painting Responsible.

Table 1
Record of environmental conditions

Description	Acceptance criteria	Survey frequency
Air temperature	>5 °C	3 times a day, during the execution of the treatments and in phase of drying of the coated products.
Relative humidity	< 85 %	
Metal surface temperature	> 3 °c dew point	

The adhesion test (destructive test) must be performed at least 10-12 days after applying the finishing coat. The test area should be identified and reversed just after the test.

Table 2
Test and Controls on blasted and coated products

Type	Phase	Tool
Environmental Conditions check	Once every 3 hours. And once every 2 hours during rainy season	Hygrometer
Surface Cleanliness	During Blasting operation	Comparator
Surface Roughness	After surface preparation	Profile Gauge & Press-o-Film
Soluble Salts	After surface preparation	BRESEL Kit
Dust Level	Before paint application	Dust Tape
Detection wet film thickness (WFT)	During Painting operations (self-control)	WFT Feelers
Detection dry film thickness (DFT)	After painting operations (Primer, Intermediate, & final)	Digital Feelers
Adhesion test	After completion of the painting cycle	Cutter dynamometer

6. Validation of working cycles

Painting is a special process, that is why the result cannot be verified by subsequent activities of monitoring or measurement, or where such checks require time and high resources; the qualification should be performed according to the following scheme:

Process; namely,

- Defining processing cycles or specific instructions
- Verification of the suitability of the means of production.

The controls during the qualification must be made by qualified inspectors NACE level II.

7. Conclusion

The portable sand blasting machine is very economical & useful for heavy fabrication company. There are such big products in size and it requires sand blasting process before painting, so every time we need to re-shift such big products in confined space of blasting after welding small components or some rework on small attachments, this increase material handling cost. After manufacturing portable sand blasting machine, we can do local blasting on small components which we welded after first blasting process; this can be done on same location where we can manufacture, in this way we need not to shift same again to confined space of blasting room. On same place we can do blasting with the help portable sand blasting machine & same time we can release to painting. In this way we can save handling time as well as handling cost also. It helps to reduce human fatigue by considering handling process.

References

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