The Heart of the Machine

A major revolution in Indian Foundry Industry occurred in 1958 with the introduction of the Airless Abrasive Blasting Equipment instead of using Compressed Air (Sand blasting) to propel abrasive. Centrifugal force was used with abrasive being thrown from a rapidly rotating wheel on the work to be cleaned. In Compress Air system 1.14 kw/kg energy is consumed compared to rotating wheel type where energy consumption .05 kw/kg. Each machine is fitted with right size, type & quantity of wheels powered by motors with the HP required to achieve the desired abrasive velocity and flow rate. Patel Furnace has developed over 26 years many models to meet several applications.

Shot Blasting is indispensable not only for foundry but also many other industries like Automobile, Railway, Auto Components, Power Sector, Earth Moving Equipments, Tractors, Compressors, Pumps, Pipe & Fittings, Textile, Cement, Agro Machinery, Machine Tools, Sanitary Castings, Defence Production and Exports. There are about 5500 to 6500 foundries in India. Out of which 85% can be classified as small and medium enterprises producing 10 million tonnes castings and holding 3rd position after China and U. S. in global market. The industries employ 5 Lac people and indirectly 1.5 Lac people.

Shot Blasting Equipments are used in Foundry, Forging, Shot Peening, Strip Descaling, Plate, Billet, Wire, Stainless Steel, Cement Paver, and have many more applications. Shot blasting minimizes operation cost beside giving excellent finish. It reduces maintenance cost therefore there is need to understand the basic factor which controls the process. The purpose of this technical paper is to make the user more aware about the shot blasting equipment as well as its design construction and maintenance. Effective maintenance will improve the finish of components shot blasted. It will also reduce operation cost, which is approx. 50 paisa kgs. to 70 paisa per kgs depending on power, abrasive, spare parts and labour cost in different parts of India. & abroad.

If we look at actual working condition of shot blasting machines, you will notice that most machines are running at low efficiency say 50 to 60% due to several reasons like non availability of jobs near the machine in time as pouring, cooling, fettling, cutting, runner riser take time. Many time there is break down when spares are not available, or non-availability of steel shots, shortage of power, finishing of casting being last operation. Any bottleneck affect company sales and finance.

New RLM Wheel (Fig.1).

With need to increase output it has become apparent that shot blasting cycle on the machine must be reduced. In effort to give increased output we have introduced new RLM wheel, which throws more abrasive and consumes less power.
In this way one machine is able to do the work formerly done by two machines. The new wheel has larger control cage and impeller making it possible to throw more abrasive and better and faster cleaning, easy of maintenance.

**Direct Drive Wheel : (Fig.2)**

Our new direct drive wheel uses direct coupled motors, throw more abrasive as it is running at 2800 RPM, uses, less space compared to RLM wheel, reduces power usage and it is bidirectional, so it will run clockwise and anti-clockwise, so only one set of spares is required which reduces maintenance.

With frequency convertors, rotational speed are adjusted and different surface and dimension can be treated like aluminium, window section, thin wall castings can be blasted cleaned without deformation.

**SEPARATOR Function : (Fig.3)**

Foundry sand drastically increases wear on blade, impeller, control cage in blasting machine. Therefore it is necessary to removed from shots. The function of the separator is to remove sand and contaminants from abrasive so that good cleaned abrasive of proper size are fed to the wheel. Separator also controls the size of abrasive mix, this gives faster and better cleaning Fig-3 shows setting of the separator which is very important in controlling all phase of operation.

What usually does wrong with separator, ? The drop of air pressure on separator can be too great, causing the removal of good shot with sand. This can be corrected by adjusting the blast gate sliding baffle and swing baffle.

If the separator is functioning properly, sand will continue to come out of dribble valve when shot blasting machine is running. As the effective operation of the separator depends on the airflow, please ensure that filter collector either bag type or ultra jet or cartridge type operating efficiently.

**MAGNETIC SEPARATOR : (Fig.4)**

Patel Furnace offer magnetic separator Fig-4 when there is extremely heavy sand load condition. For example large size steel valve body has very heavy cores. During first three four minute of blasting sand and shot in large quantity released. The magnetic separator significantly increases the ability to remove sand from steel shot or girt. The addition of magnetic separator to shot blasting machine increases the life of wearable parts like blade, impeller, control cage, liners etc., because sand is the primary cause of wear. Magnetic separator reduces blast cycle time, increases the life of replacement parts, reduce equipment maintenance and abrasive consumption and total operation cost.
Blast Pattern: (Fig. 5,6)

Fig 5, Shows Blast Pattern located 8” inches to the right of the Vertical centerline on a clockwise wheel. The Pattern is called hot Spot, and will feel warm to the hand if touched immediately after shot blasting. The ½” movement of control cage opening will shift the Blast Pattern by several inches wear tolerance has been build into blast equipment but when wear goes beyond the tolerance components like Blade, Control Cage, Impeller, can not perform properly and blast pattern shifts from set target. When wear on the leading edge of the impeller exceeds 4 to 5mm. The abrasive will hit the back of the blade than being delivered to the throwing face. Fig 6, as a result the hot spot and over all blast pattern becomes badly differed and increase blasting time and wear on bare wheel and other wheel components.

WHEEL UNIT LINERS: (Fig.7,8)

The blast wheel is usually enclosed within a housing serving as a safety guard and abrasive seal around rapidly rotating wheel to minimize wear on the housing. A series of special alloy cast liners are installed inside the housing.

Older wheel Fig-7 consisted of 21 liners where abrasive bounces in uncontrolled manner. In our new RLM Fig-8) wheel only nine liners are installed inside the housing. High chrome liners are approx. 25mm thick with labyrinth type joints providing and abrasive tight seal between the liners and very Long life.

FUNCTION AND ROLE OF BLADE, IMPPELLER CONTROL CAGE: (Fig.8)

The blade plays a key roll in shot blasting operation. The blade catch the shot delivered from impeller and control cage and throw out to work pieces with an accelerated speed. The blade is the quickest wearing part among all moving parts. As the wear widens the disperse angle of shot will change and reduce the projection speed.

MOULDING TECHNIQUE:

Most popular moulding technique used in India is green sand moulding and About 80% of foundries use this technique. The drawback of this technology is that large amount of sand, sticks on surface of the castings, which are to be cleaned by shot blasting.

Foundry, using cupola has more sand compared to automated foundries. Other technology like CO2 process has 5% to 10% sand sticking to casting because of bad shaking operation, poor property of mould and core there fore shot blasting is quite essential.

There are number of items produced by Indian foundries. Some of them are impeller castings, pump castings, valve bodies & automobile or tractor components like break drum, cylinder head, housings, fly wheel, manifold covers, weighing from 5 kgs to 60 Kgs. or
more. To clean these castings it takes 7 to 10 minutes using S-550 (1.4mm) shot. Some other types of castings when hanged on monorail take 15-20 minutes for a lot of 500 Kgs. or more.

**SHOT & ABRASIVE : (Fig.9)**

The impact Power, and coverage of steel abrasive is governed by its mass and velocity in accordance with equation of kinetic energy. $Ke = \frac{1}{2} MV^2$ (Where $Ke$ = Kinetic Energy $M$=Mass $V$=Velocity). The impact force delivered to the work piece will change only if the mass factor (i.e. the abrasive size) is altered. The relationship of abrasive size to both impact power and coverage is shown in figure 9. The economy and performance of blast cleaning depends upon the abrasives used. The proper size and type of abrasives and its quality which are most important. The following four factors should be considered while selecting the abrasives

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<th>Effect of Shot Size on Impact &amp; Coverage</th>
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| Shot Impact Value varies as the cube of the diameter (2: 1 Size = 8:1 Impact Value and 1:8 number of shots / lb). Considering Impact value of 70 size shot as 1. |

Deburring Aluminum Castings : (Fig.10)

Aluminum Die casted components manufactured from Aluminum, Zink & Magnesium Alloys Like Crank Case, Clutch Cover Case, Cylinder Blocks, Brake drum etc. required to be blasted for removing burrs, and also gives aesthetic value with aim to obtain even, shine finish on all sides. Many users prefer stainless steel shot as the consumption is one sixth of steel shot, carbon steel shot give dull grey finish, while stainless steel imparts matt silver finish pleasing to eye. Many auto units like Honda, Bajaj, Endurance use stainless steel shots.

**ECONOMICAL MODELS OF SMALL SHOT BLASTING MACHINES FOR FOUNDRIES.**

Various systems exists for conveying the parts depending upon the type, size and quality of the items to be shot blasted.

**Tumblast Type Machines : (Fig. A)**

It is suitable for shot blasting components like valve bodies, connecting rods, small auto and tractor components. The design employs endless conveyor belt made of steel links and flats or rubber conveyor belt, which does not damage the jobs during tumbling. Many machines are in operation with small and medium foundries.
Table Type Machines : (Fig. B)

In swing table type shot blasting machine the work table rotates the work beneath the blast stream, when door is opened full table is accessible for loading and unloading. Additional second door can be provided to increase productivity by 50% with minor extra cost. Many swing table shot blasting machines are running successfully in India and abroad.

Door Hanger Machines : (Fig. C)

In this machine jobs are hung on the door. The parts are carried into abrasive stream after closing the door. The parts are mounted in the front of the wheel on completion of shot blasting door is opened and second door with jobs hung enters in the cabinet. In this type of two door machine foundries can get 30 to 40% more production.

Hanger Type – “Y” / Straight / Loop / Continuous Monorail Machines :
(Fig. D)

In this type of machine parts are suspended on trees hung on hanger or special fixture and are carried into abrasive stream. Upon completion of blasting door is opened and hanger with blasted component taken out and second loaded hanger pushed in. Various work handling monorails like Straight / Tee / Y and Continuous Loop is possible. Machine can handle 500 Kgs., load. Many machines are in operation.

Room Plant and Hand Cabinets. (Fig. E)

For small foundries with low production, we offer pressure blast cabinet, where small jobs are handled manually and blasted with various media like steel abrasive, garnet, aluminum oxide, glass bead, coconut shell. For larger jobs blast room plants are offered. The room dimensions are governed by job sizes. Automatic, semi-automatic recovery systems are provided. We also offer portable machine for site work.

Concluding Remarks :

Shot blasting is no more an optional process in a foundry. It provides fast and better cleaning, it saves power, labour, space and permits better inspection, thus minimizing the rejection of castings. Proper understanding about the machine, its construction and use, enable user to improve its efficiency and utility. Before selecting the equipment it is necessary to compare parts and sub-assemblies fitted in the machine and the life it will give. The component metallurgy is very important. Having our own foundry for making alloy parts, manganese liners and other type of castings needed for making sound and durable machines. Before selecting the machine it is necessary to consider above points. Begin-in 1991, in 25 years we have sold more than 4000 machines for various applications and exported to several countries. We have helped many MSME Units.