Effect and Causes of Imbalance in Operating Mix on Shot Blasting Process and Suggested Remedies

Mr. Kadam Arjun Pandurang[1], Rohan Sanjay Varpe[2]

[1]Assistant Professor Bharati Vidyapeeth's College of Engineering Kolhapur
[2]PG student, Bharati Vidyapeeth's College of Engineering Kolhapur

---

Abstract - *Shot blasting being very common process in foundries, accountable for expenses through number of consumables like abrasive, electricity, wearable parts of machine. Supply as well cost for these consumables are extensively influenced by market conditions, government policies. Inappropriate utilization of these consumables results in heavy economical losses and are generally not recognized by semi or unskilled labor under continuous production. In concern abrasives being working fluid plays vital role to maintain optimum process cost under constrains of output quality and process time*

1.1 Introduction

Operating mix is the distribution of sizes of steel abrasive present at any instance in Machine Every particle completing its life cycle gets gradually decreases in its size. The same should be replaced by new fresh charge of abrasive after predefined instance of time or after defined blasted tonnage. Being working fluid of blasting machine, abrasives are most dominant cause for maintaining process cost. Process cost does include number of costs viz. Abrasive cost, electricity cost, maintenance cost, and Depreciation cost. An imbalance in operating mix causes these costs to vary drastically. Many of semi or unskilled workers do miss this indication of imbalance in Operating mix and do contribute high process cost.(Fig-1)

1.2 Effect on Electricity cost:

Coarse particles being heavy in mass do transfer high kinetic energy to substrate and hence tends high cleaning efficiency. While smaller particles with less mass do transfer lower amount of kinetic energy to substrate and hence posses less cleaning efficiency. Excessive amount of coarse particles will contribute to high surface roughness, while smaller particles cause to fine surface finish. Hence a well balanced operating mix is the one who does play both roles of cleaning with optimum time and surface finish constraints

Apart mass of particle, the traveling velocity of particle on blades also plays vital role on cleaning efficiency and on cycle time. The wearing of particle do changes the size as well shape of particle. Shape of particle determines velocity and direction of particle leaving blades.

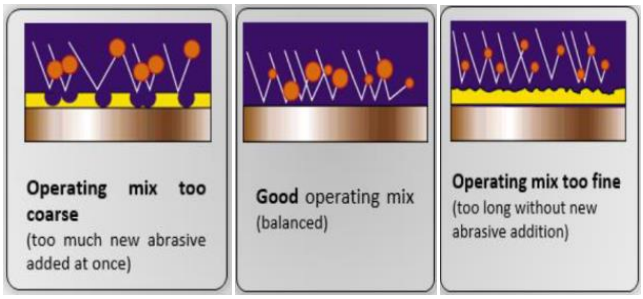


Fig-1: Material removal under different particle size

Smaller particles being worn one have other than non spherical shapes and hence leaves blades at slower velocity by tumbling action and in delayed direction than to desired, while coarse particles being least worn with at most spherical in shape will leaves blades at faster velocity by gliding action in advance direction than to desired. This wrong direction will cause missing the hot spot (**Fig-3)** and hence less cleaning per indentation, consequently high cycle time. A Balanced operating mix is the one with 40% to 50% particles of nominal size and remaining decreasing gradually in size with 5% of eliminating size.

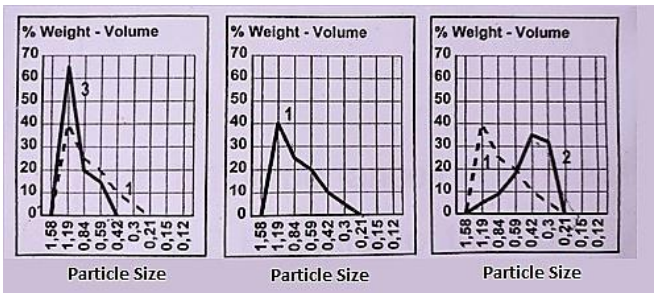


Fig-2: Operating mix under coarse, balanced, fine condition respectively

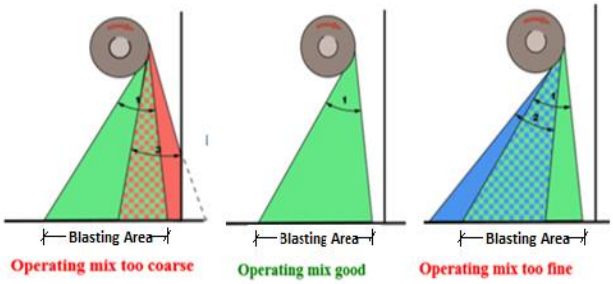


Fig-3: Change in hot spot as per change in operating mix

Following is the example illustrating the severity of change in cycle time.

Assumptions:

1) Machine blasting capacity per cycle :500 kg
2) Aggregate Machine Power : 65 HP
3) Current **Machine running time per cycle :** 6 min
4) Loading / unloading time : 1 min
5) Blasted products are same in geometry, surface area

Process Parameters	Current cycle time	Reduced cycle time by 1 min
Machine running time per cycle	6 min	5 min
Loading /unloading time	1 min	1 min
Total time	7min	6min
Number of cycles in one hour	8.5	10
Machine running time(in min) per hour	51 min	50 min
Machine running time(in hr) per hour	0.85hr	0.83 hr
For 65 Hp. Machine consumed units	55.25 units	53.95 units
Blasted Metal in one hour	4250 Kg	5000 kg
Units per ton blasted metal	13 units	10.79 units

The example shows change in cycle time by 1 minute can even cause change in unit rate by 2.21 units per ton of blasted metal. Under such a circumstances for blasting metal in thousands of ton, it accounts for major expenditure.

1.3 Effect on Abrasive cost:

Abrasive consumption is amount of abrasive being consumed and exhausted by machine for every tonnage of blasted material.

This is most likely factor being accessed by majority of consumers. As mentioned above excessive smaller and worn out particles and excessive coarse particles will miss the hot spot and hence increases the cycle time.

Increase in cycle time will cause large number of bombarding and hence higher wear than to necessary. This will lead to excessive amount of material for every tonnage of blasting. Below mentioned are general indications for eliminating sizes based on purpose of blasting.

1) Surface Preparation and descaling: 1/4*Nominal dimension
2) Desanding : 1/3*Nominal dimension
3) Shot Peening : ½ *Nominal dimension

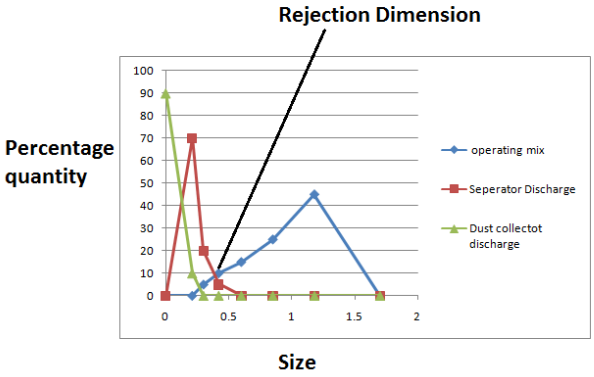


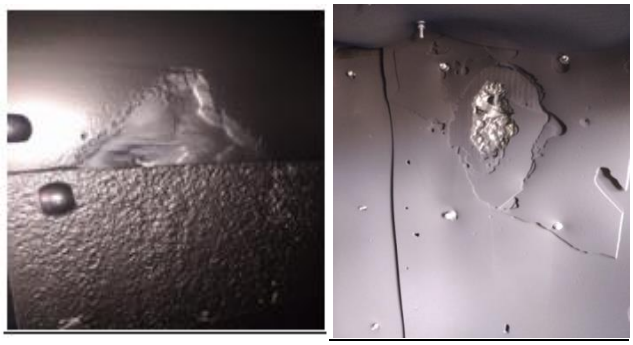
Chart-1: Rejection size and percentage in operating Mix

1.4 Effect on Maintenance cost:

Worn steel shot do loses its shape and forms angular profiles with sharp edges. Being working fluid these particles travels excavating tiny amount of material from various elements of system viz. wheel feed spout , impeller, blades, screw conveyors ,for each pass .Many times NI hard liners of cabin and roof of cabin is found to be torn at different places. Blades, impellers, control cage, wheel liners are the most common wearing parts

Wear of Straight liner **Wear of Blades**

Worn Guide plate **Worn Control Cage**



Worn cabin NI hard liner **Worn cabin rubber liner**

Fig-5: Wear of machine under imbalanced operating Mix

2. Causes and suggested Remedies

2.1 In appropriate hot spot setting :

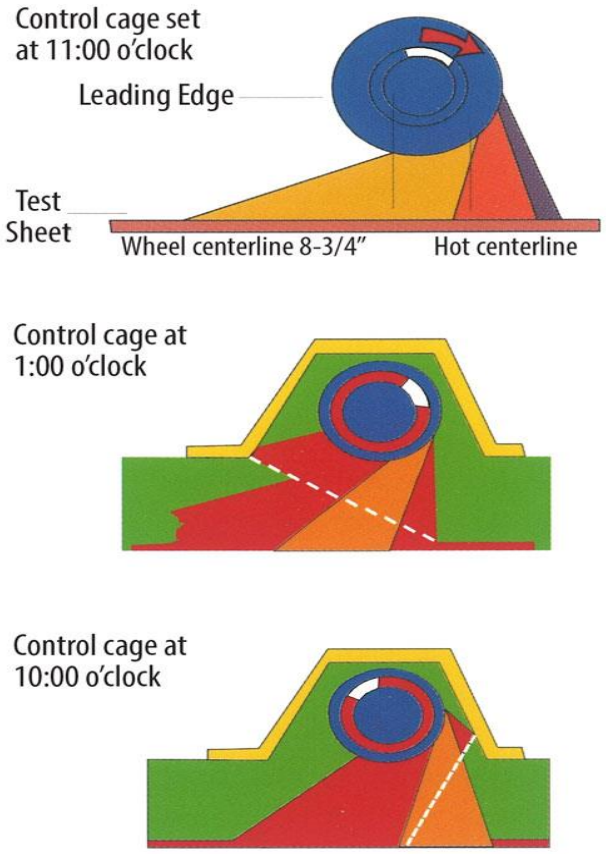


Fig-6: Control cage setting and its effect on Hot- Spot

As mentioned earlier, it is very important to direct abrasive particles on desired span of cabin i.e. work holding device to get high cleaning efficiency. If abrasive hits on Nickel hard liners of cabin, shot gets rapidly worn promoting imbalance of operating mix. So in order to avoid such waste of energy and wear, hot spot need to maintain at standard quality of operating mix. Hot spot can be adjusted by changing control cage angle.**(fig-6)** Though it should be adjusted at first hot spot setting only If there is change in hotspot been found, and certainly it is sign of imbalance in Operating mix. It is advised to check hot spot once in month. Hot spot is checked by blasting duly painted metal sheet in blasting cabining case of number of wheels blasting is done individually for each wheel and not more than 20 seconds, otherwise reflected particles will create blur pattern

2.2 Deficient suction pressure in system

Role of suction pressure in system is to remove loosened surface containment particles, dust particles at number of location like cabin, air Separator. The fine dust particles are carried to dust collector where they are separated from flow by bags of dust collector. If dust collector bags are not been cleaned regularly, they get blocked and reduces suction pressure of system ahead. In such case coarse contaminant particles and dust particles do not get separated from abrasives and are carried to wheel for blasting. These particles do not have properties to act as blasting medium and hence increases cycle time. The problem is also unrecognizable by semi or unskilled workers as ammeter shows the high rotor load. High cycle time again worn out good abrasive particles in mixture and negative cycle continues. In order to avoid such condition, it is very important to maintain efficient suction pressure in system by maintaining dust collector bags, pipe sections, system rupture regularly.

2.3 Deficient Separator working:

Generally operating mix is cleaned in system at following two locations

a) Air separator
b) Primary & Secondary magnetic separator

Deficient working of these two sub systems will not able to clean the operating mix leading imbalance in operating mix.

Uneven distribution of abrasive flow on air separator lip will cause low air movement through abrasive curtain **(Fig-7).** Such uneven curtain will carry smaller particles to be carried in operating mix leading imbalance.

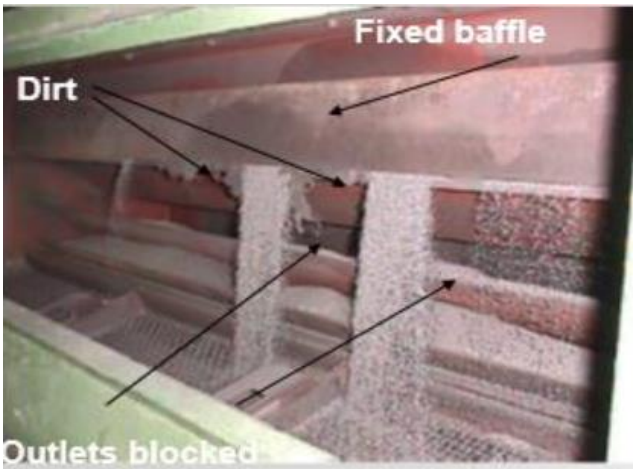


Fig-7: Unevenly distributed abrasive curtain

Uneven distribution of abrasive curtain on air separator lip to avoid the issue regular cleaning of fixed baffle and swinging plate is necessary with maintenance of guide plate for any punctures.

2.4 Good addition pattern:

Being consumable, worn out charge must be replaced with fresh charge to maintain balance. At a time not more than 10-20 % of hopper capacity of charge should be added. In accordance the time interval for addition pattern must be derived for reduction in 10-20 % of charge in hopper.

2.5 Unnecessary high cycle time:

Majority of industries do manufacturers number of parts with different geometries and scales. In accordance blasting time differs for all of them. An semi or unskilled workers may not provide due importance to adjust optimum cycle time. Under such circumstances excessive blasting may possible causing excessive wear and imbalance in operating mix. A keen supervision for blasting time for different works must be decided

2.6 Worn out blades:

Worn, torn blades do not able to throw shot in right quantity and in right direction.

This will cause increase cycle time for cleaning and deficient use of motor capacity

High cycle time will again imbalance operating mix and consumption rate

Fig-8: worn blades

3. Conclusion

Operation Mix is being working fluid controls the efficiency of process. Electricity cost, maintenance cost, abrasive consumption costs are directly linked to operating mix quality. Operating mix quality depends upon process parameters like Hot Spot, Cycle Time, Suction Pressure, Separators' efficiency, addition pattern, and maintenance frequency. These cyclic interdependent parameters will lead to reduce efficiency of process drastically. In concern to avoid adverse effect on process cost Operating mix balance plays vital role.

4. References

[1] Steel Abrasive blasting W.A.E Handbook- Winoa abrasive

[2] Hansink, J.D. Minimizing dust during abrasive blast cleaning. J. Protective Coating &Linings. 1995, 12 (4), 18-19.

[3] Robert Lowes, "Super – Blasting Once considered inefficient overkill, abrasive blasting over 100 PSI is in the here and now",

[4] Gary S. Settles, Sanjay Garg, "A Scientific view of the Productivity of Abrasive Blasting Nozzles", Journal of Protective Coatings and Linings, April, 1995, 28-41, 101-102.