THE IMPORTANCE OF PROPER BLASTING NOZZLE SELECTION AND USE
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While the cost of a blasting nozzle is relatively minor as compared to the overall cost of an abrasive blasting system, the selection of the most effective type of nozzle will often determine the profitability or loss on a specific job operation. Unfortunately, many times a nozzle is selected on the basis of its unit cost alone with disregard to other considerations.

The nozzle is a critical point of mechanical control in a blasting system. It can determine whether the abrasive is properly utilized, whether optimum blasting patterns are attained, and whether the compressed air is used efficiently. The nozzle’s internal design materially affects the velocity at which the abrasive impacts the surfaces to be cleaned. As a result, for each job the nozzle affects the amount of labor that will be required, the amount of abrasive material that will be consumed, and to a great extent, the size of the compressor that will be required. For example, if a job is to be estimated using $50/hour labor and based on a conventional 3/8 in. i.d., long venturi nozzle, it might take 100 hours. Substituting a similar style smaller nozzle, 5/16 in., to save $20 in purchase price might result in a 25 percent loss of production, and the cost would be $6,250 rather than the expected $5,000. Similarly, had a newer ultra high efficiency nozzle been selected and had there been sufficient air supply to operate it, productivity would be increased by 15 percent from estimate, and the cost would be lowered to $4,250.

Nozzle Size
When selecting a bore size, several factors are brought into consideration:
• the nature of the target, i.e., large, flat surfaces or small, tubular or angle iron;
• the size and air compressor size;
• complete or spot cleaning; and
• the degree of surface preparation.

When considering these factors, the largest practical nozzle should be used to fit the available air supply because production will be done in proportion to the bore size used.

Bigger is not always better. The use of oversized nozzles is, in fact, a common occurrence due to neglect of monitoring the bore size and replacing the nozzle when worn. If an operator selects a nozzle that is too large for the air compressor to maintain 100 psi (at the nozzle), there will be a substantial loss in productivity. The National Association of Corrosion Engineers (NACE) has suggested that for every pound of lost pressure below 100 psi at the nozzle, there will be a corresponding loss of 1-1/2 percent in production. Although there may be sufficient compressed air to operate an oversized or worn venturi nozzle, the design of a long venturi nozzle relates to its performance. Once the nozzle begins to wear, performance is drastically affected because the velocity of the abrasive begins to decrease. A well designed, long venturi nozzle can reach near Mach I speed as compared to a straight bore nozzle, which provides less than half of the long venturi velocity.

All factors being equal, a nozzle should be replaced once the bore size is larger than its original size. A simple way to determine this is to place a common metal drill bit, which has the same diameter as the original nozzle bore, into the nozzle. If you can observe light around the circumference of the bore and drill bit, the nozzle is worn and should be replaced. Another simple observation for nozzle wear is to look down the bore of an open nozzle. A ripple or “orange peel” effect to the carbide liner creates turbulence and reduces the abrasive velocity.

Recently, it has been determined that with some abrasives, blasting at higher pressures (i.e., up to 150 psi) increases productivity by achieving higher abrasive velocity. Since most blast pots are rated for 125 psi, it is important to minimize pressure losses within the system. Utilization of “wide throat” nozzles will help reduce pressure drop if a 1-1/4 in. blast hose is connected to the nozzle. If whip hoses are used, they should be as short as possible (10 ft in length). Also, the use of double venturi nozzles with whip hoses will help offset the pressure loss.

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continued

Nozzle Materials

Until recent years most nozzles used in blasting of structural steel were lined with tungsten carbide. With the advent of "high tech" ceramics, operators are now subjected to confusing selection decisions. A brief discussion of several of the nozzle materials that are currently available follows.

- **Sintered Tungsten Carbide** - This is the most common material used for nozzle liners. This dense metal has high wear resistance when abrasives like sand, slag, steel shot, or grit are used and usually has an effective service life of 300 to 600 hours. It is physically the strongest of the modern liner materials and will thus take more physical abuse than the other materials.

- **Sintered Silicon Carbide** - This ceramic material is very light in weight. It is more resistant to wear than tungsten carbide and is priced competitively. To benefit from the longer life of silicon carbide, the operator should use considerable care to avoid impact that results in fracturing the liner. Once the liner is fractured, it will continue to crack until it shatters into many small fragments. Silicon carbide-lined nozzles work extremely well with sand, slag, and other abrasives that weigh less than 150 lb/cu ft. Service life with silica sand or slag abrasives should range from 400 to 700 hours. Steel shot and steel grit are not recommended because heavy particle impact may crack the liner.

- **Hot Pressed Boron Carbide** - This liner material offers the greatest wear resistance of the "high tech" ceramic materials. The service life of this material is generally four to six times greater than tungsten carbide or silicon carbide, and it is approximately 2-1/2 times higher in cost. Boron carbide is normally used with highly aggressive abrasives such as aluminum oxide. Since boron carbide is more fragile than tungsten carbide, its use in field or site work is limited.

It should be noted that other materials are used in abrasive blasting nozzles, but their use is relatively limited, and they are not considered to be cost-effective in surface preparation of structural steel.

Nozzle Style

For most operations where the level of surface preparation requires the removal of heavy to moderate millscale or removal of old coatings, the long venturi style is commonly used. Wide throat or double venturi nozzles are enhanced versions of the long venturi-style nozzles.

Short venturi nozzles are lower velocity nozzles that offer a wide blast pattern. This makes them ideal for a brush blast or commercial blasting of light rust on large, flat surfaces of new steel.

Long straight bore nozzles are used for the preparation of long running weld seams. They clean with a very tight blast pattern. Short straight bore nozzles are used closer to the surface and in areas where complex weld segments are prepared.

Angle nozzles are used to clean behind angles and flanges and where the operator cannot see the surface while he is blasting. Another application for the angle nozzle is blasting the inside of pipes.

Use and Care

One last point to consider is the proper use and care of the blast nozzle. To resist the high level of abrasion, nozzle liners are constructed of dense carbide materials. While these materials are very hard, they are extremely brittle and subject to fracture on impact. Newer jacking designs tend to absorb some types of impact, which helps to reduce fracturing, but reasonable care should be taken to avoid impact or abuse to any nozzle. The general appearance of the exterior of a nozzle will give clues as to how an operator is treating a nozzle.