Cast Steel Shot and Grit
The Miracle Workers of Blast Cleaning, Profiling, Peening
Part 4 of a 5 part series

To achieve effective performance in any steel abrasive blastcleaning-profiling-peening application, careful and reasoned consideration must be given to choices made with respect to SIZE, SHAPE (Shot vs. Grit) and HARDNESS of the steel abrasive.

Chapters Two and Three of this series dealt with the choice of abrasive size, its effect on removal of surface contaminants and on finish profile, or anchor pattern. Chapter Four discusses the choices to be made on abrasive shape and hardness and the effect those choices have on product finish.

Three key facts about blastcleaning-profiling that must be understood are:

1) Whatever size or shape of steel abrasive is purchased—it is just the raw material from which is developed the abrasive work-mix that actually performs the functions of cleaning and profiling.

2) The same incredible impact-power of steel particles propelled at high velocity that removes surface contaminants and provides the anchor pattern profile also takes its toll on the steel shot or grit itself. The hundreds and hundreds of impacts suffered by the abrasive, while doing its work, reduces its particle size and alters particle shape. It goes through several changes before it is reduced in size to the point it is too fine and is taken out of the system by the air-wash separator.

3) Hardness of the abrasive affects abrasive shape and abrasive work-mix changes in two ways: Standard SAE hardness has an average of about 45 HRC—this is much harder than most work to be blastcleaned-profiled, but is still sufficiently ductile to deform and change shape, due to the tremendous impact-abuse it receives. On the other hand, because of that ductility, it is more resistant to the fracture mode of failure and is more durable than a harder steel shot or grit. Conversely, while harder shot and grit is less ductile and thus fracture-fails more readily, it is more resistant to changes in shape.

To illustrate how these factors of constantly changing size and shape interplay with respect to the finish obtained, let us consider the options available to a manufacturer of forged hand wrenches.

First, there are two functions involved: (1) Removing oxide scale caused by the forging process; and (2) Producing the required finish profile. Finish options include: shot-peened aspect, grit etched aspect, or machined finish (which first requires blastcleaning to remove the oxide scale).

For the forged wrenches, and for the vast majority of all applications, removal of surface contaminant (whether oxide scale, sand or ceramic from the metal casting process, old paint or other coatings, etc.) is more dependent upon size of the steel shot or grit, rather than shape or hardness. Given the incredible impact-power of steel shot or grit, if the contaminant is hit, it will be gone whether shot or grit is used. (There are exceptions, of course—some contaminants require the cutting action of extremely hard grit.)

Thus, the choice of shape and hardness is primarily based on the Finish profile required—shot for the peened-aspect—grit for the etched-aspect. Simplistically, we would like to think that the use of shot can be likened to the blast equipment hurling millions of mini-ballpeen hammers per minute at the work—and use of grit to hurling millions of mini-cold-chisels each minute. Unfortunately, that's too simplistic!

When steel shot fracture-fails, it breaks into grit-like particles with sharp edges and points. (That's understandable considering that steel grit is made by crushing fully hardened shot, then tempering the resultant grit to the desired hardness level.) When steel grit fracture-fails, it breaks into smaller, but still sharp-edged particles. Hardness of the shot and grit now determines what happens with respect to shape as the shot or grit is subjected to more impacts (again, hundreds and hundreds of them).

At the standard SAE hardness, with its average at about 45 HRC, fractured shot particles quickly have any sharp points/edges rounded over, and eventually will round into spheres—then the process repeats (fracturing and rounding). Fractured grit particles, of that same hardness, will have their shape changed by first rounding or blunting the points/edges and then finally rounding up into near-spheres. Thus, 46-47 Rc shot or grit work-mixes will consist of large, medium, and small particles in various phases of shape change, but will be mostly rounded, leaving only the most recent new grit addition to impart an etch.

At higher hardness levels, grit shape change comes more slowly, and the work-mix will contain fractured particles that may have points/edges starting to blunt but still basically retaining angular shape. The harder the grit the more likely it is that it will fracture again before any rounding effect takes over. Full-hard, 60-plus Rc, for example, will show some blunting of points/edges, but always retain its grit-shape.

Obviously, hardness of the work-piece makes a difference, too. The softer the work, the slower will be any change in media size and shape. Peen-indentations or etch-indentations in the surface will be deeper than would be the case in harder products. For that reason, soft, non-ferrous products customarily use smaller initial steel shot or grit sizes, thus reducing the over-all impact power.

THE LESSON LEARNED: Consistency of profile, no matter what shape or hardness steel abrasive is purchased, depends strictly upon operating practice. Additions of new material must be made as frequently as possible with the abrasive feed hopper kept 3/4-full at all times. Then, if separator practice is monitored, the work-mix will maintain the proper percentage of original size and shape, with the balance phasing through its natural process of size/shape change—consistently!

Important as this is for efficient and effective contaminant removal, it is absolutely imperative for profile control—and particularly so when grit is used!

The next and last chapter of this series will cover how abrasive choices can affect the speed of cleaning.

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