Shot Size(s) 1994045

by Jack Champaigne

I was reviewing some of our files recently and came across the following letter.

> Jack:
>
> Thanks again for your help! I ran the tests we discussed. The graph on another sheet shows the results, as you said it would. It shows the maximum arc after a gradual rise. I have no idea why it wouldn't do this yesterday.
>
> Signed,
> (name withheld)

What was he referring to? See the table below.

Strokes	Arc Height
1	7.0
2	8.0
3	8.5
4	8.8
5	9.7
6	9.8
8	10.0

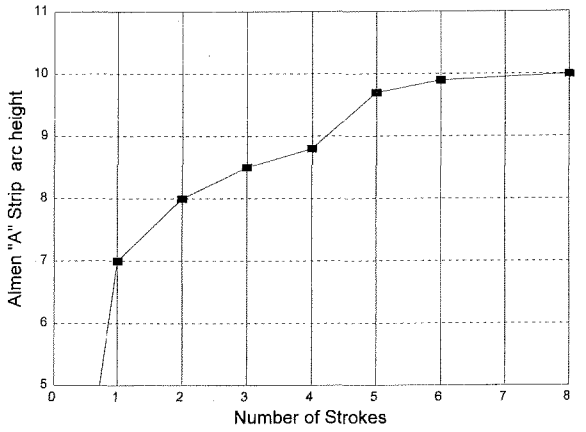

Fig. 1

The graph in Figure 1 shows the data from the table. There appears to be an abrupt increase in arc height after four strokes. My response was as follows:

> Dear Name Withheld:
>
> A mix of two shot sizes hides the facts. Look closely—there are actually two curves. Coverage for S-170 takes over 3 times as long as coverage for S-110.
>
> Signed,
> Jack

When I saw his graph I immediately suspected poor media control. What I didn't expect was to learn that someone had dumped 150 lbs. of S-170 shot in "to increase the intensity a little bit".

If we re-draw the graphs we can clearly see the independent effect of shot size on arc height. When the sizes are mixed the smaller quantity of larger shot eventually achieve enough coverage to have an impact (pun intended).

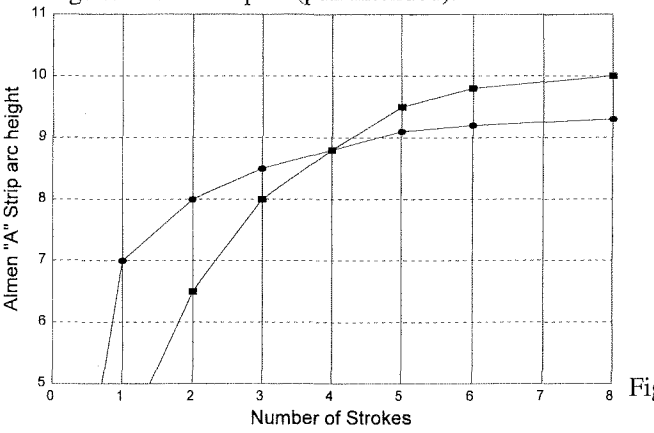

Fig. 2

Figure 2 shows how each shot size reaches equilibrium or saturation, only when sufficient coverage is achieved. The smaller size shot, being more numerous, can quickly achieve coverage and hence reach saturation quickly.

The larger size shot, being fewer in number, require more time to achieve coverage and saturation. However, when you wait long enough the larger shots finally achieve their peening impact and exhibit a higher arc height and intensity.

Remember the definition of effective peening is "when the largest, hardest, fastest shot strike the surface at the most direct angle. Any shots that are smaller, softer, slower, or lower angle do not contribute to the peening benefit". As it turns out the S-110 shot is really a waste of time.

Any of the impacts made by the S-110 shot will (eventually) be covered over with the S-170 shot, making a bigger dimple and causing a larger arc height. There is no benefit to the smaller shot in this process.

To further elaborate this principle, suppose you have one shot size that is double the diameter of another size. The smaller size shot will have eight times the number of shots per pound compared to the larger size. However many dimples you can make in one minute with the small size—you can only get one-eighth as many with the larger size. It's no wonder that someone wanting fast production will specify small shot size. Unfortunately, this produces a rough surface which may not be appropriate.

This case history illustrates the importance of media control. Even if you don't have someone purposely mixing two (or more) shot sizes, you should continually inspect the range of sizes. You can do this with conventional sieve analysis or newer technology from Definitive Imaging (call (216)333-6557). If you find that you have a 2:1 or 3:1 range of shot sizes you might be wasting more time than you are aware of. You should evaluate your screen separators for proper sizing. (You do have a screen separator?)

Some people feel that 80% of your success with shot peening is related to your media condition. We cannot over-emphasize this point. ❍