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\( \frac{MV^2}{2} \) - - - IT SURE SAYS A LOT ABOUT BLASTCLEANING - - -

BUT - - - IT DOESN'T SAY IT ALL!

Whether blast-cleaning, blast-peening, or blast-etching, a major key to achieving the desired end-result is IMPACT. \( \frac{MV^2}{2} \) provides the means for measuring the degree of impact intensity. The "M" represents "Mass" as provided by the individual shot or grit particles. The "V" represents "Velocity", as determined by the blast-wheel diameter and RPM (or, nozzle-size and air-pressure in air-blast).

Impact intensity can be varied by changes in velocity and/or abrasive work-mix size. However, in virtually all blast-cleaning and blast-peening equipment the wheel diameter and RPM (velocity) is a constant. Thus, the only means of changing impact value is by varying the mass (the work-mix size distribution). A slight change in size will make a dramatic change in impact value:

A mere 10% increase in average size of the work-mix will produce 33% greater impact value; conversely, a mere 10% decrease in average work-mix size will generate 25% less impact value.

In blast-etching hard (64 Rc or more) steel mill rolls, variable speed drives are utilized so wheel RPM (velocity) can be varied. The change in impact value, assuming no change in abrasive size, is also quite significant:

A 10% increase in RPM will increase the impact value about 22%. (Note: abrasive flow is reduced as RPM increases.)
A 10% decrease in RPM will decrease the impact value about 18%.

Yes, \( \frac{MV^2}{2} \) sure does say a lot about the impact variable in blastcleaning - - - but it doesn't say all that must be said, and done, to achieve optimum blastcleaning results.
FOUR FACTORS

Four basic factors are involved in all abrasive-blasting applications: FINISH (the reason for it all); SPEED (blast-time required); ABRASIVE COST (use-life x price); M & R COSTS (parts replacement and down-time).

The priorities assigned to these four factors will vary from user to user. In addition to IMPACT-INTENSITY, there are two additional variables that can be used to achieve whichever of the four factors rates top priority - - - i.e. the user's "hot-button" - - -

HARDNESS - - (Rc of the shot or grit used.)
SHAPE - - - (Not only shot vs. grit, but even more so, the critical difference in shape between new, unused grit and its ultimate work-mix shape, after being subjected to use-abuse.)

HARDNESS

Hardness of most work being blastcleaned is under 25 Rc. Standard SAE hardness for steel shot or grit is 40-50 Rc, or about twice as hard as the work being cleaned. However, higher hardness levels are available. For example, Ervin's Amasteel MG grit is 50-55 Rc, LG grit is 55-60 Rc, and untempered HG grit is 64-plus Rc.

Use of the harder grit may be merited where the user's "hot-button" is FINISH (with a specific etch/anchor-pattern requirement to assure optimum coating performance) or SPEED (where a harder grit's more aggressive cutting action is needed to speed contaminant removal). There's a trade-off, though. Harder grit will increase the cost factors of ABRASIVE and M & R - - - the harder the grit, the faster its breakdown; the harder the grit, the greater the wear and tear factor on the blast-equipment.

Some blast-aplications have no choice: Steel mill roll-etching requires grit at least as hard as the 64-plus Rc rolls; Shot peening of hard parts requires shot at least as hard as the work being peened. In general, the rule-of-thumb guideline should be, in any application: Don't use shot or grit any harder than it needs to be to meet the FINISH or SPEED requirement.

In air-blast applications where the user is switching from use of sand or mineral abrasive to steel grit, the tendency has been to specify the hardest grit (untempered HG grit at 64-plus Rc). The reasoning has been that since steel is replacing extremely hard/brittle sand, the steel grit ought to be as hard as possible - - - and, because an air-blast nozzle delivers so little abrasive flow, compared to wheel-blast equipment, again, the most aggressive steel grit seems called for.
However, this reasoning overlooks the "mass" factor in impact intensity ($M\cdot V^2$). Size for size, a particle of steel grit weighs 2.5 times as much as sand — thus, when traveling at the same velocity, its impact-intensity advantage over sand is apparent. Field tests have shown that even standard SAE grit (40-50 Rc) will clean up to 7 times faster — and better, too! LG grit at 55-60 Rc is often considered to be the best grit to use when switching from sand — it is sufficiently aggressive to do the job, and one ton of LG grit will do the work of over 100 tons of sand. Once the operation has stabilized and is working satisfactorily, moving down in hardness can be attempted if more grit durability is desired, or if the M & R factor is excessive.

SHAPE

To demonstrate how the variable of SHAPE comes into play, Ervin uses (in its Seminars) mild steel plates that have been blasted with shot, with grit, and with work-mix samples of both. A Co2 shot-gun that fires thimble-size shot-shells, at a velocity equivalent to that of abrasive thrown by a blast-wheel, is used to produce blast-patterns on the target plates. S-280 steel shot, at a distance of 24" muzzle-to-plate, produced a pattern that could be covered by a 50-cent piece. Firing equivalent-sized G-25 grit produced a pattern exceeding 4" in diameter.

This difference in pattern is due solely to the manner in which the SHAPE of the media responds to the air-resistance encountered in the 24" of flight. Obviously, the spherical shape of shot offers much less resistance and thus loses much less velocity or impact-intensity than does new grit. The peened-indentations on the plate blasted with shot were much deeper than the angular indentations from the grit.

A third plate shows the pattern produced by a work-mix sample of SG-25 (40-50 Rc) grit. Its pattern was almost identical with that of the S-280 shot. The lesson: SAE 40-50 Rc grit, in wheel-blast equipment, will round up in use — and such rounded particles will perform similarly to a shot work-mix with respect to the four factors: Finish, Speed, and Cost of Abrasive and M & R. (The surface, in either case, will be chemically clean with all contaminants removed.)

However, there are instances where users have found that SG-grit, alone or as a mix with an equivalent size shot, will produce a finish appearance preferred vs an all-shot finish. Whether this finish is preferred because of coloration (light refraction) or because the profile is more angular, that difference is due solely to SHAPE of that percentage of the work-mix that is grit that still retains some degree of angularity, prior to becoming fully rounded. (A grit work-mix will have a variation in shape from the new grit just added to the system, to the grit that was added several days earlier and has rounded.)
It is of extreme importance that a grit (or grit/shot) work-mix be kept in balance, constantly, both as to size-distribution and shape distribution. Small, frequent additions (even twice each shift), plus keeping the feed hopper level constant, is absolutely mandatory if consistency of finish is desired.

Any hardness of tempered grit will eventually round up in use in wheel-blast equipment -- but, the harder the grit, the longer it will retain angularity. Where angularity or etch of profile is a priority (as opposed to the "peened" look), the MG or LG grit hardness offers the ideal compromise.

A point to remember, though, is this: Where the finish-profile has to meet a certain mil-spec (1.5 mil or 2.0 mil, for instance), the harder the grit, the finer will be the work-mix it generates, due to its faster breakdown. Thus, even though the grit is harder and more aggressive, the resultant finer work-mix has a reduced impact-value, which, in turn, means the peak-valley configuration will show a smaller number than would the same grit size in a lower hardness. If the hard grit's angular anchor-pattern is desired, but a higher peak-valley number is required, adjusting the size upward is indicated.

Grit used in air-blast will retain its angularity much, much longer than in wheel-blast. This is because the recycling frequency of the individual particles is so much slower in air-blast, with abrasive flow at about 60 pounds per minute in a \( \frac{3}{8} \)" nozzle, compared to one 40-HP wheel throwing and recycling 1,000 pounds per minute.

FOUR FOR FOUR, BUT, WHICH FOR WHICH?

As we have seen, there are four variables (size, velocity, hardness, and shape) from which to choose in order to better respond to the user's "hot- button" priority among the four factors: Finish, Speed, Abrasive Cost, and M & R Cost. There is no one variable that is best for all four factors. There is no one factor that universally rates top priority. It's still a case of the old bromide being true: "One man's meat is another man's poison."

But, once the priority is established, the information in this Technical Bulletin should provide the user with a reasoned, logical approach to achieving that priority by using the appropriate variables to best advantage.

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