“Soft” Acting Grinding Wheels

I put together a few ideas and questions that concern factors that relate to “soft” acting grinding wheels. How did the operator determine the grinding wheels were acting “soft”?

1. Has the wheel usage increased? Do inventory records confirm increased usage for the current production level?
2. Does the grinding spindle motor amp meter read lower than before the problem?
3. Is the part size hard to hold?
4. Is the part taking longer to grind?

“Soft” grinding wheels are often blamed for a host of problems found in grinding operations. It is understandable because the grinding wheel is the most visible item in the grinding process. The grinding wheels is also the item that is usually the most in control. It is a simple matter to ask the grinding wheel company to make a “Harder” wheel, and the problem is usually solved. This plan can usually be implemented in about two weeks, and there would be no need to read any further.

The downside to the above plan that only fixes the symptom, occurs when the real cause(s) get worse, or go back to the original condition. At some time in the future we can expect this new grade of grinding wheels to also act either “Hard” or “Soft”. By this time, all the circumstantial evidence, will point to the unanimous plant conclusion, “the ____ grinding wheel company is a bunch of idiots” and can not make the same grinding wheel twice. I would prefer not to be called “idiot”, but to find the real cause of the problem.

Finding process information can be almost impossible for many plants. It is very unusual to have enough data to compare prior conditions with present conditions. Accurate written chronological records help make these problems easier to solve.

Operators often were not present or seldom remember changes in the operation. Engineers can often only run experiments to determine the effect of changes they make. It is important during these tests to change only one variable at a time and grind more than a few parts to determine the effect. The following list is a good place to start any “soft” wheel investigation.

Grinding Wheel

1. Is the correct grinding wheel being used? Check the specification marked on the wheel and compare it to wheel suggested on the process sheet. Compare markings on previous wheels and ask about any differences.
2. Was the grinding wheel made to the correct specifications? Ask the manufacturer to recheck the production records and verify the grind-o-sonic reading as tested. If multiple wheels from different production batches still act “soft”, the quality of the grinding wheel can usually be eliminated as the cause.

3. Has the grinding wheel been properly balanced? Excessive vibration causes "soft" acting grinding wheels. Make sure the flow coolant nozzles are completely blocked when the machine is not running and that grinding wheels are spun out to dry at the end of the day.
4. Has the grinding wheel been correctly mounted in the holder per the manufacturers instructions? Incorrect torque on wheel nuts, dirty mounting adapters, and shifted centerlines can all result in vibration that makes grinding wheels act "soft".

Part

1. Do the incoming parts being ground have the same amount of stock? What appears to be a few thousanths of an inch extra stock, can often be a significant percentage of the total stock removed. There is a direct relationship (by percentage) to increases in wheel usage.
2. Has the material changed for the incoming part? Some steels are harder to grind than others. A change in the alloy or carbon percentage can easily change grinding ratios by 200%. Are you having tooling problems on other operations?
3. Has the heat treat or part hardness changed for the incoming part? Harder parts or excessive heat treat scale will cause faster wear of the grinding wheel. Are you having tooling problems on other operations?

Grinding Operation

1. Has the total part surface area changed under the grinding wheel and are the parts still loaded in the same configuration? Broader grinding areas tend to increase wheel usage, smaller grinding areas tend to use less motor amps.
2. Has the part infeed or rotation speed increased to cause higher wheel wear? Increases in the material removal rate are inversely proportional to decreases in wheel life.
3. Has the grinding wheel infeed rate (ipm) or amount of pick feed per part increased? Increases in the material removal rate are inversely proportional to decreases in wheel life.

Machine

1. Is the same wheel used on more than one grinder? Does it act "soft" on other machines?
2. Does the part and fixture (or chuck) remain rigid during the grinding operation? Movement, chatter, or harmonic induced vibration can cause higher grinding wheel consumption.
3. Has the wheel spindle alignment or head settings changed? Amp load tends to increase as the grinding wheel face is flatter to the work. A tilted wheel cuts with less pressure and lower motor spindle amp load.
4. Is there excessive end play in grinding wheel spindle bearings? Wheels act several grades softer when bad bearings allow movement in the spindle. Often wheels that get "harder" as the wheel wears are the first symptom. (balance is a function of weight/moment arm)

5. Has the rpm of the grinding wheel spindle changed? Slower wheel rotational speeds cause "soft" acting grinding wheels.

Dressing

1. Is the grinding wheel quickly wearing due to excessive or improper wheel dressing? What was the dress frequency, traverse rate and type of tooling used before the complaint of "soft" acting wheels?
2. Is the dressing arm rigid? Excessive vibration in dressing arms can dress waves into the face of the disc wheel. These harmonic oscillations can build on the face of the wheel to create vibration and "soft" acting wheels.

Coolant

1. Are coolant nozzles directed with the flow into the grinding zone? Sharp wheel grains must be cooled to prevent melting the bond until the grain is dull?
2. Are coolant nozzles and water ports plugged with wheel swarf?
3. Is the coolant temperature higher than normal? Higher coolant temperatures can soften the grinding wheel bond, increase concentrations, change machine head settings, and distort part flatness to increase wheel wear.
4. Is the coolant mixture held at the normal concentration [within a 1 % range]. Changes in concentration cause lubricity or loading problems as the grain does not effectively penetrate the part during grinding?
5. Is the coolant mix PH too basic [> 9.8] and dissolving the resin bond?
6. Has old or recycled coolant mix created high levels of total alkalinity and ionic concentrations to weaken the bond's hold on the grain?
7. Is there excessive tramp oil or dirt in the coolant system? Loaded grinding wheels often cut with a glaze, break, glaze pattern that causes higher wheel consumption.

Okay, but you have already checked all of this, and the wheel is still soft. What next? I have personally gone through similar lists may times in the past, without any better apparent results. I have also found enough incorrectly reported items to make me leery of most data collected by others. It is safe to assume that bad data gives bad results.

If you have a "good" old grinding wheel, re-mount it on the machine spindle and see how it acts. Then mount the "soft" new grinding wheel on the same spindle. Note any differences in performance when running under the exact same conditions. If you find any real differences, we will ask you to ship both wheels back to the factory.

Upon arrival at our plant, each wheel will be evaluated in our laboratory. We will drill each wheel to determine relative hardness, and compare the results to our process control charts. Each

wheel has a unique serial number, that corresponds to a computerized production record, with data that has been automatically recorded for every important production process during the wheel's manufacture.

If we find the wheel "soft" during our tests, we will try to determine the cause. While we have an excellent quality control system, we will continue to find new ways to make mistakes. If we find the grinding wheel left on grade and returned "soft", bad coolant is the most likely cause of the problem.

We may ask you to change your coolant, or if that is not feasible, we can change the grinding wheel bond. The chemistry of coolant tanks is a very complex system, so while one bond fails another bond is often successful. It is relatively easy to change from B1, B2, or B3, using minor grade changes.

I want to work with you on this problem. I am just a telephone call away.

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