The Relationship Between Process Parameters and Finishing Results

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Abstract

Nowadays, mass-finishing machines can produce “ready to sell” surfaces. Although the users of these mass-finishing machines are using recommended finishing media, often their result could be improved with just a few changes of process parameters like speed, time, compound, etc. Anyone who mass finishes jewelry needs to understand the relationship between process parameters and finishing results. Learn how much surface-hardening different finishing media can produce and to what extent steel-ball burnishing can close porosity. The proportional cut rate that wet media gives and the influence the water-compound mixture flow-through has on surface quality are defined, as are the influence the speed of the machine have on rounding edges and what influence other machine parameters might have on damage to jewelry parts. The influence that compound and polishing paste has on oxidation is also discussed. With this information, you will be able to evaluate the process parameters of your massfinishing machine and change them to achieve better finishing results.

Contents:

Introduction

All the following tests were done with disc-finishing machines. Because the price of silver jewelry is rising more and more, and causes the most headaches in mass finishing, we concentrated on silver jewelry in the tests.

1. How much do different finishing media harden the surface?

The items used in these tests were silver rings with a weight of about 5.5 grams (Figure 1.0). The compound water mixture was 5 liters/hour and the speed used in the machine was 280rpm, which is about 85% of the maximum speed. All six different types of wet grinding chips, with which the rings were processed, were new. This means the chips were creating, in this stage, the maximum amount of abrasion and “waste,” due to the fast rounding of the chips’ edges up to a certain radius. This waste consists mainly of the abrasive particles (silicon oxide), the compound with the water and binding material.

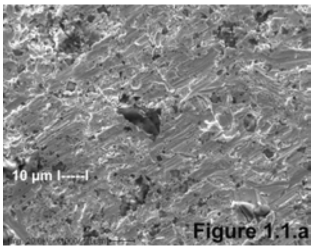
The main subjects we concentrated on were:

1. How much does the surface get hardened?
2. How big are the inclusions in the surface after the process?
3. What kind of inclusions could be found?
4. How much silver was cut off per three hours (average process time in reality)?
5. How big is the mass loss of the chips during a three-hour process?

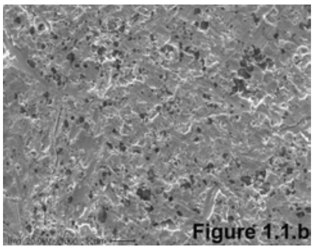
media used for the wet grinding process	Ceramic chips triangle shape	Ceramic chips triangle shape	Ceramic chips triangle shape	Plastic chips cone shape	Plastic chips cone shape	Plastic chips cone shape
process time	4 hours	6 hours	8 hours	6 hours	6 hours	8 hours
size of chips	10/8 mm	6/6 mm	4/4 mm	10mm		
abrasiveness of the chips	strong	strong	strong	strong	middle	fine
surface hardness after the process in HK 0.3*	185	134	162	170	113	110
inclusions	SiO_2 (silicon oxide)					
amount of inclusion	many	many	many	less	some	almost none
size of the inclusions	big (up to 10 µm)	big (up to 10 µm)	big (up to 10 µm)	medium (up to 4 µm)	small (up to 2 µm)	small (up to 2 µm)
loss of silver after 3 hours	7.3 %	3.3 %	1.5 %	3.5 %	3.4 %	2.6 %
loss of chips after 3 hours	9.2 %	4.5 %	2.0 %	7.8 %	8.7 %	6.4 %

***Chart 1** Summary of wet grinding using different types of media*
**The hardness is measured in HK 0.3, which means Knoop hardness with an impact of 300 grams to the metal. We choose this method because the impact of the diamond to the surface is equivalent to the wear while wearing the jewelry. This hardness value can be compared with HV (Vickers hardness).*

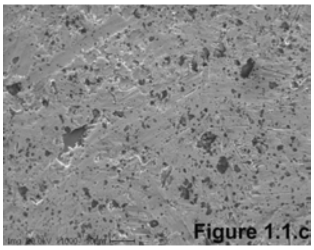
***Figures 1.1** Scanning electron microscope (SEM) magnifications 1000X. The pictures show the magnified surface of silver rings, wet-processed with different sizes of ceramic chips.*



ceramic chips triangle shape
10/8 mm



ceramic chips triangle shape
6/6 mm



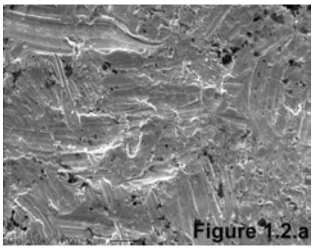
ceramic chips triangle shape
4/4 mm

Results of the surface treated with ceramic chips

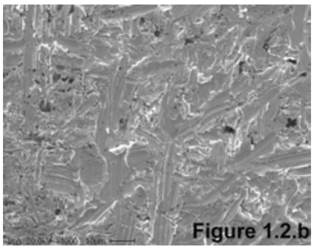
The bigger the chips used, the rougher the surface structure.

As you can see in the Figure 1.1.a, the surface is smeared. A less-smeared surface is achieved by smaller chips, due to their lower weight (see Figure 1.1.b and Figure 1.1.c). This smearing effect has negative influence to the subsequent polish. If chips smear (here because of the hardness and the weight), it means they are cutting less. In the wet process, we want to have an abrasion instead of smearing so that, for example, no particles will be enclosed in the surface.
The dark spots in the picture are SiO_2, the abrasive particles of the chips. Even when the chips are getting smaller, which means less weight and therefore less impact to the silver surface, the presence of the SiO_2 is not decreasing. The size of the SiO_2 is up to about 10µm. The hardness values are affected by two main parameters: the process time and the weight of the chips. The heavier the chips and the longer the process, the more the surface will be densified and hardened. In Chart 1, you can see the hardness values of the surface treated with ceramic chips. The bigger, and therefore heavier the chip, the harder the surface of the silver. The smallest chips (4 x 4mm) created a harder surface than the chips sized 6 x 6mm because the process time was longer.

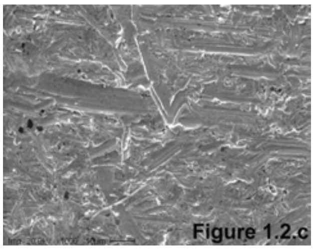
Figures 1.2 *SEM magnifications 1000X. The pictures show the magnified surface of silver rings, wet processed with plastic chips. The chips had different abrasive effects.*



plastic chips cone shape10 mm
strong grinding effect



plastic chips cone shape10 mm
middle grinding effect



plastic chips cone shape10 mm
fine grinding effect

Results of the surface treated with plastic chips
The strong-grinding plastic chips produce a rough surface on the silver ring.
The finer the grinding effect, the smoother the surface will be. The smoother the surface, the easier and faster a subsequent polishing process will be.
The size of the abrasive SiO_2 particles embedded in the surface (Figure 1.2.a) are about 4µm. Rule of thumb: the finer the chips grind, the smaller the SiO_2 particles in the chip. Their size is decreasing to 2µm in the middle and fine grinding chips (Figures 1.2.b and c). The amount of particles left in the surface also decreases with the finer grinding chips. The hardness of the silver surface also decreases from 170 HK 0.3 (wet-cut with strong abrasive plastic chip) to 113 HK 0.3 (wet-cut with middle abrasive plastic chip) and to 110 HK 0.3 (wet-cut with fine abrasive plastic chip). The surface quality of the fine cutting chips is the best.
It is reasonable to expect chips with larger abrasives to leave larger particles embedded in the silver, and chips with smaller abrasives to leave smaller particles.
This is evident in Chart 1 where you can see the plastic cone results.

Loss of silver and media
The silver rings are decreasing in size because a certain amount of the metal is cut off. This amount of “mass loss” depends mainly on the following parameters:

1. time of the wet-grinding process
2. size of the chips
3. weight of the chips
4. speed of the machine
5. abrasive effect of the chips

Let us first have a look at the three results after cutting with ceramic media. Due to less weight and therefore less pressure to the surface, the mass loss of silver decreases with the chips getting smaller. The big chips reduced the ring‘s weight by 7.3%, while the smallest chips removed only 1.5% in the same time. The mass loss of the chips decreases in almost the same ratio.

Looking at the plastic chips, we have to focus on different parameters:

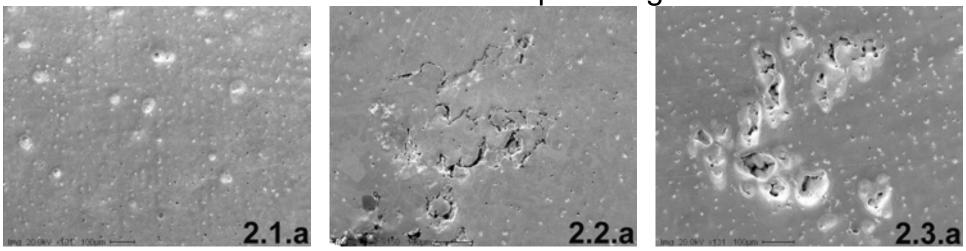
the binding of abrasive particles (SiO2) to the chips and the size of the particles.
The weight of the silver ring processed with the strong cutting chips decreased by 3.5%. The weight of the silver ring processed with the middle cutting chips decreased by 3.4%, while the weight of the ring processed with the fine cutting chips (which are responsible for the final process before the polishing), decreased only 2.6% in the same time. The reason for this is that the different grades of plastic binders “release” the abrasive particles at different pressures from the chips. As a SiO2 particle gets round (less cutting ability), it breaks off the chips and gives way to new (sharp) particles hidden at that time in the chip.
The weaker the binding, the earlier a particle breaks off. The longer a particle stays in the chip, the rounder it will get and the less aggressive the cutting. This results in the chips smearing the metal and hardening the surface and, abrasive particles are burnished into the surface of the metal where they are trapped.
In our tests, the strong cutting chips had bigger particles (4µm) than the middle cutting chips (2µm). This explains the fast and strong cutting ability. The middle cutting chips can cut off more than the fine cutting chips, even though the abrasive particles have the same size (2µm). Because the binding in the middle cutting chips is softer, it releases the abrasive particles earlier.
If they break off before they are too round, the chips will cut faster. This also explains the higher mass loss of the middle cutting chips compared to the fine cutting ones. For the chips to release a lot of “waste,” the amount of the flow of the water compound mixture has to be increased to flush out the SiO2 particles before the plastic chips have time to rub them into the surface.

2. To what extent can steel-ball polishing remove defects?

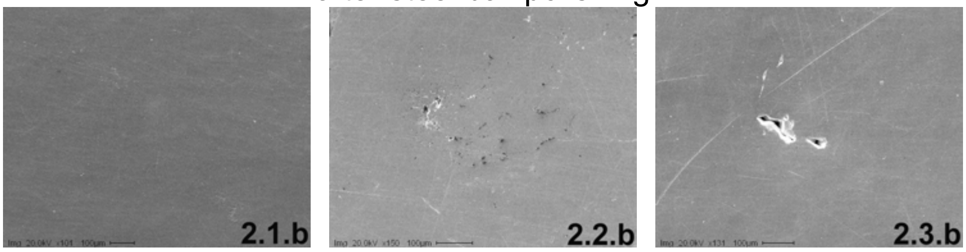
As test jewelry, we again took the silver rings, mentioned on the previous page.
We concentrated on two different kinds of porosity which could be found after casting on the rings: shrinkage porosity and little “droplets” on the surface due to faults on the wax or porosity of the hardened investment powder in the flask.

shrinkage porosity

before steel ball polishing

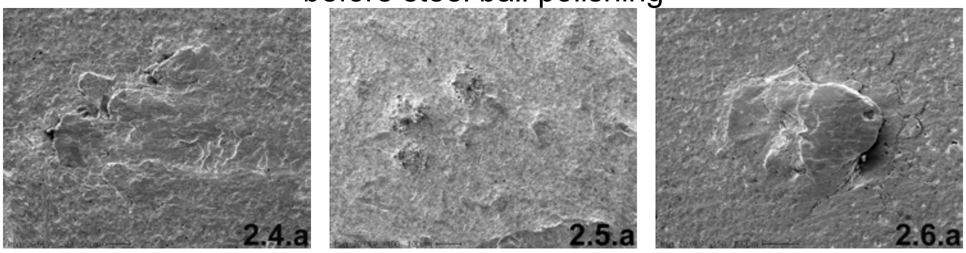


after steel ball polishing

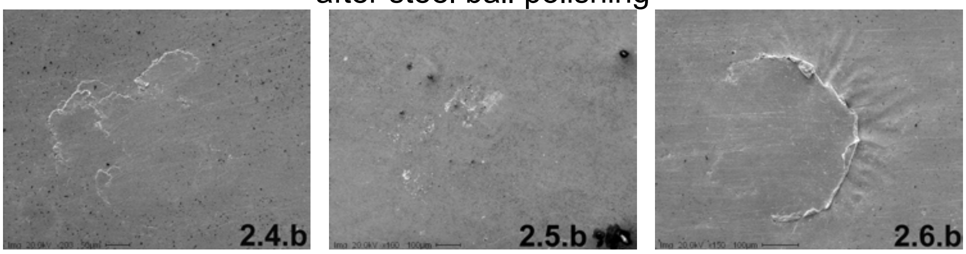


droplets on the silver

before steel ball polishing



after steel ball polishing



The rings went into the steel-ball polishing process in the as-cast condition for two hours using 2.4mm diameter steel balls. As you can see (Figures 2.1.a through 2.6.b), even a fairly big defect can be closed or removed to a certain extent.

However, some concerns have to be considered after polishing with steel balls:

- Will the **treatment after the steel-ball** polishing process **open the porosity again** because there is only a tiny layer of material covering the holes?

- The **surface is harder now** (densified), so that a following **hand polish is more difficult.**

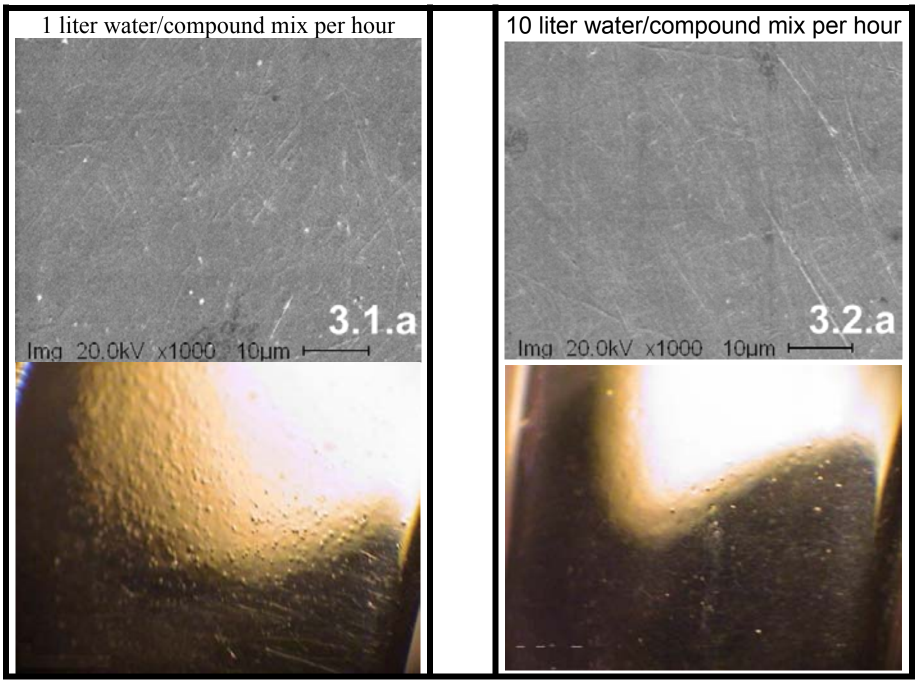
- The **surface** after steel-ball polishing is **very bumpy** (Figure 2.7) depending on the type of machine used, such as vibratory machine, tumbler or disc-finishing machine.

- If the process container of the machine still contains **contamination (SIO_2)** from the grinding process (white or gray residues), they will be mechanically **rubbed into the surface.**

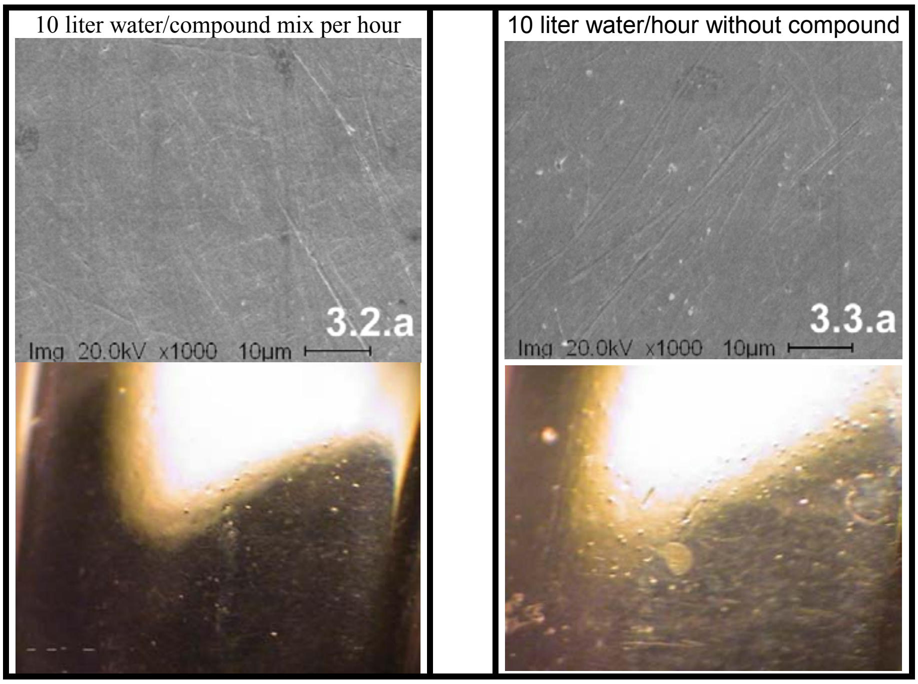
Figure 2.7 *Surface after steel-ball polishing*

3. Influence of the amount of flow of water-compound mixture on the surface quality

In these tests, silver rings were processed in three steps in a disc-finishing machine: wet cut for four hours with medium-cutting plastic chips, then a wet cut for one hour with fine-cutting plastic chips, and then a dry polish for one hour with walnut shell granule.
The difference in the first series of tests was the amount of water-compound mixture that was flowing during the wet-cutting process.
Test 3.1 was done with a flow of 1 liter water-compound mixture per hour, and in test 3.2, the flow was increased to 10 liter water-compound mixture per hour.
In the pictures from the SEM (Figures 3.1.a and 3.2.a) you can see the amount of scratches decreasing when the flow rate gets higher. In the pictures from the optical camera (Figures 3.1.b and 3.2.b), you can see even more clearly that the surface of Figure 3.2.b is much smoother than the one in Figure 3.1.b.
Less flow of water-compound mixture results in less removal of the residues from the cutting process, so that the chips can press or hammer these fine particles into the surface.
A higher concentration of the residual particles (a higher contamination of SiO2 and other silver particles, for example), will be in the surface, leading to corrosion problems, the effects of which will be discussed in Section 7.

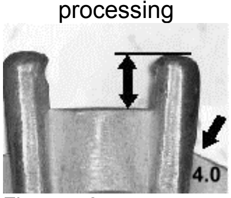
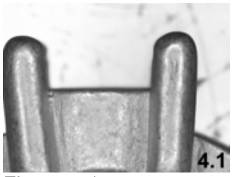
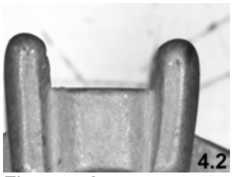
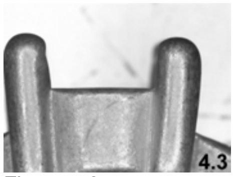


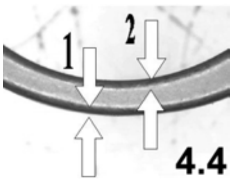
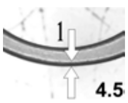
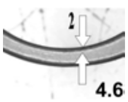
In the second series of tests, we wanted to know if the concentration of compound in the machine plays an important role.
In the 3.3 test, we eliminated the compound completely from the process and processed with only fresh water. The amount of flow in both processes was the same.
As you can see in Figure 3.3.a, there are more and deeper surface scratches than in Figure 3.2.a. Obviously, because of the reduced slipping effect, the chips have a higher impact on the silver surface. Also, the inclusions of the SiO2 particles increase because the compound is missing and there is only water in the process.



The shining after the polishing was approximately the same, although the surface of the rings processed in test 3.2 was the smoothest and had the least inclusion of SiO_2 particles.

4. To what extent does speed variation influence the rounding of the jewelry edges?

wet process time: 5 hours	**influence on the length of the prongs**			
	speed: 180 rpm wet process media: cones 10 mm	speed: 330 rpm wet process media: cones 10 mm	speed: 330 rpm wet process media: pyramids size 10 mm	12mm
picture before processing	weight each chip 0.6 gr.	weight each chip 0.6 gr.	weight each chip 0.3 gr.	0.6 gr.
 Figure 4.0	 Figure 4.1	 Figure 4.2	 Figure 4.3	
length of prongs before	2.30 mm	2.30 mm	2.30 mm	2.30 mm
length of prongs after	2.30 mm	2.16 mm	2.25 mm	2.17 mm
prongs got shorter by	0.0 mm	0.14 mm	0.05 mm	0.13 mm
length change	0 %	6,1 %	2,1 %	6.0 %
weight before	5.16 gr.	5.20 gr.	5.16 gr.	5.16 gr.
weight after	5.00 gr.	4.90 gr.	4.94 gr.	4.90 gr.
mass loss of weigh	3.1 %	5.7 %	4.2 %	4.9 %

 Figure 4.4		**influence on the radius**			
		speed: 180 rpm wet process media: cones 10 mm	speed: 330 rpm wet process media: cones 10 mm	speed: 330 rpm wet process media: pyramids size 10 mm	12 mm
 Figure 4.5	before	r = 0,198 mm	r = 0,232 mm	r = 0,225 mm	r = 0,232 mm
	after	r = 0,328 mm	r = 0,391 mm	r = 0,364 mm	r = 0,385 mm
	radius increase	+66%	+68%	+62%	+66%
 Figure 4.6	before	r = 0,252 mm	r = 0,276 mm	r = 0,261 mm	r = 0,264 mm
	after	r = 0,337 mm	r = 0,343 mm	r = 0,309 mm	r = 0,319 mm
	radius increase	+33%	+24%	+18%	+21%

In the finishing of jewelry, material is cut off from the surface. This means a reduction of the size of details or the length of prongs, a change of the radius and, for sure, a weight reduction. How can we optimize these parameters in the wet-cut process? All the tests were done with a fine cutting media.

Influence of speed on the radius on edges of the jewelry:

With the same media (cones) and an increased speed, you will increase the radius of the outer edge (Figure 4.5) of the ring more than with a slow speed. With a slower speed, however, the radius of the inner edge (Figure 4.6) of the ring definitely gets bigger. With the higher speed, the chips cannot flow as well through the inside of the ring as they can with a slower speed. At slower speeds, the chips have time to slip through the inside. The bigger the chips, the less likely it is that they slip through. However, when the chips are getting smaller (about 3mm or less), they slip through easily, but due to their small weight, they have a decreased cutting ability.

Mass loss while processing:

The heavier a chip is, the greater its cutting ability. As you can see in the charts on the previous pages, the cutting work increases with the weight of the chips.
Pyramid-shaped chips with a size of 10mm weigh approximately 0.3 g. The same chips in a 12mm size, weigh twice as much, or 0.6 g. While the small chips reduced the weight of the ring by 4.2%, the 12mm chips reduced it by 4.9%.

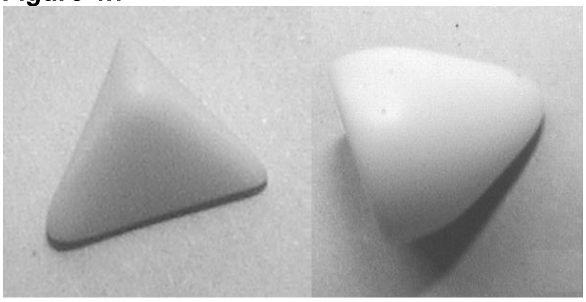
Influence of the chips’ shape on the radius on outer edges of the jewelry:

The shape of the chip has little influence on the rate of cutting outer edges, as long as the chip weight is the same.
Tests showed that pyramid-shaped chips (size 12mm) and cone-shaped chips (size 10mm) are performing the same cutting work (weight of both chips is 0.6 g. per piece). The outer radius (Figure 4.5) was rounded to almost the same extent and the length of the prongs decreased by almost the same percentage (approximately 6.0%).

Conclusion:

- If you want to cut very fast, use big, heavy chips (cones are twice as heavy as pyramids of the same size!).
- If you want to get the radius of the inner edges (Figure 4.6) to be rounded, or if you need a fine surface on the inside of the rings, reduce the speed and the size of the chips.
- If you have to process concave areas or edges with small radiuses (arrow in Figure 4.0), the shape of the chips is important. A pyramid can do a better job due to its smaller radius compared to that of a cone (see Figure 4.7).

Figure 4.7



radius of a cone   radius of a pyramid

5. Influence of machine parameters on impact marks during processing of jewelry

The parameters used to process silver rings in these series of tests were all done with fine-cutting plastic chips for the wet cut, and then some of them were dry polished with walnut shell grains.

Figure 5.0

5.1. Influence of a too-high water level while wet-cutting

During the wet-cutting process, the height of the water level in the machine does not seem to have any influence on the mechanical damage. All the processed rings had more or less the same (very limited) amount of small impact marks.

5.2. Does the shape of the chips influence the impact marks?

Also in this test, where we processed 100 rings with only cones, and another 100 rings with only pyramids, we found that the amount of mechanical damage was not influenced by the shape of the media, if the media had the same size.

5.3. To what extent does speed variation influence the amount of impact marks?

In this test, we just increased the speed of the machine step-by-step. The amount of rings was 200. With a lower speed (180 rpm), there were about five impact marks per 25mm square. They were hardly to be seen and didn't influence the polished result. After the speed was increased to 240 rpm, the size of the impact marks didn't change, but astonishingly, the number of impact marks decreased. After speeding the machine up to maximum speed, the impact marks became bigger and the number increased to about five impact marks in a 25mm square area. The results of these tests relate to wet and dry processing.

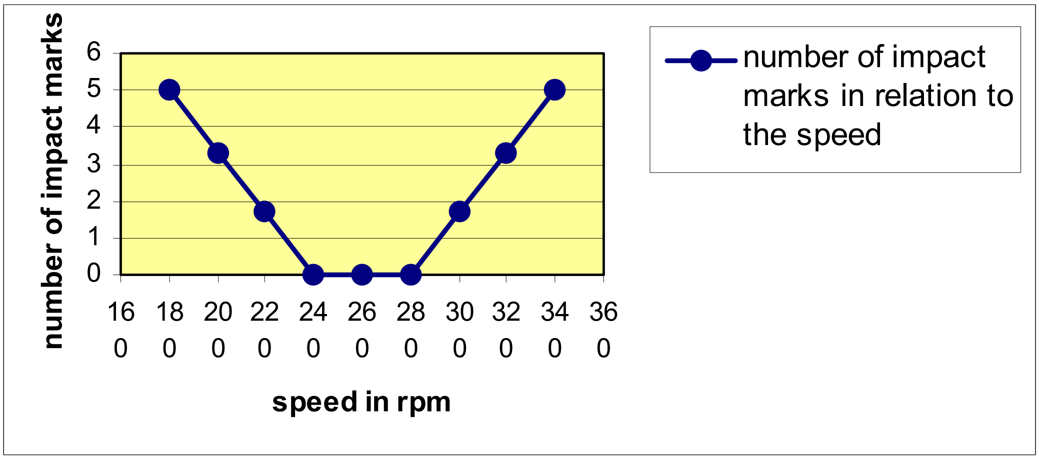


Figure 5.3 *Impact marks and speed variation*

If we look at the structure of a disc-finishing machine, we can understand why this happens.

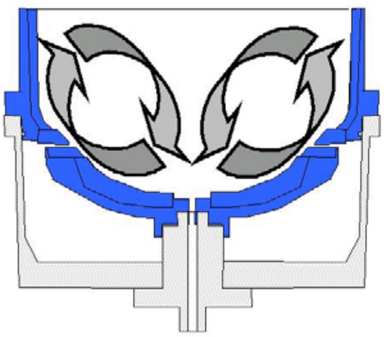


Figure 5.3.1

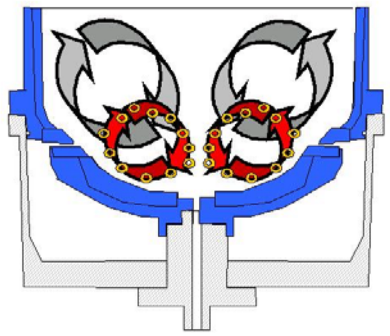
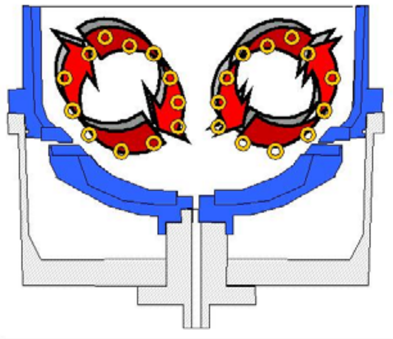


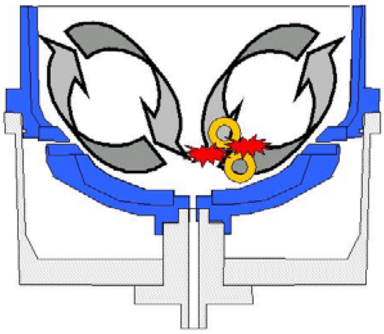
Figure 5.3.2

Due to the weight of the rings and a low speed in the machine, they are not pushed up into the complete whirl-like movement of the media (Figure 5.3.1), but the rings move in a smaller, cycle-like movement (Figure 5.3.2).



After finding the right speed, which in this case was about 240 rpm, the rings found their way all around in the machine and followed the path of the chips (Figure 5.3.3). The impacting was minimized or completely eliminated.

Figure 5.3.3



If the machine is speeded up to the maximum, the rings have only a little time for acceleration on the bottom of the process container (Figure 5.3.4). They get hit by the rings falling down.

Figure 5.3.4

Depending on the design of the machine, another hitting point will be at the transition between the disc and the upper cylinder (Figure 5.3.5). If the design of the process container slows down the jewelry too much at this point, the rings, which follow and are still moving fast, can hit them with a high impact.

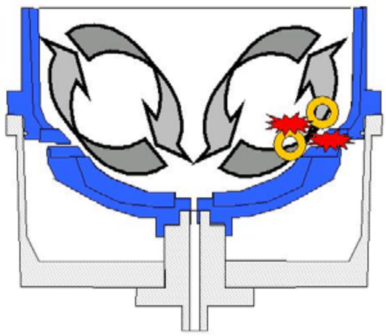


Figure 5.3.5

The shape of the disc also plays an important role. The higher the speed, the deeper (or rounder) the disc can be, but then the danger of impact marks increases at the transition between the disc and the upper cylinder even more (Figure 5.3.5).

If the speed is too slow, some parts may stay on the bottom of the disc (Figure 5.3.6) where they don't have enough centrifugal force to rise up to the circle.
This means they might damage each other or just stay on the bottom without moving. They will not be processed.

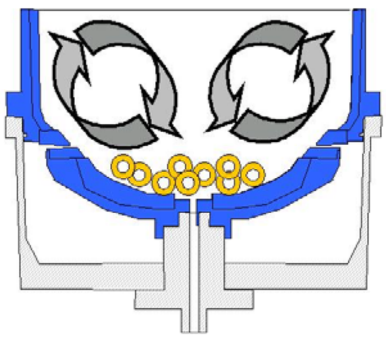


Figure 5.3.6

If the design of the disc is too flat, then there is the same danger of impact marks at the transition between the disc and the upper cylinder (Figure 5.3.5).
The flatter the disc, the more the vertical power to push the parts up into the perfect whirl-like movement is decreasing. If the disc is too round, the power needed to bring the parts into the whirl-like cycle has to be very high. This vertical movement can only be created by a higher centrifugal speed. However, the heavier the jewelry is, the more this speed can lead to damage. This shows that the design of the process area of a disc-finishing machine plays a very important role relating to the speed and weight of the jewelry.

5.4. To what extent can you load a machine with jewelry?

If a machine is loaded with too much jewelry in relation to the media, the pieces touch each other and, regarding the impact, they can damage each other (relates to wet and dry processing). But to what extent? We processed several amounts of rings of the same size at the same speed for 30 minutes.

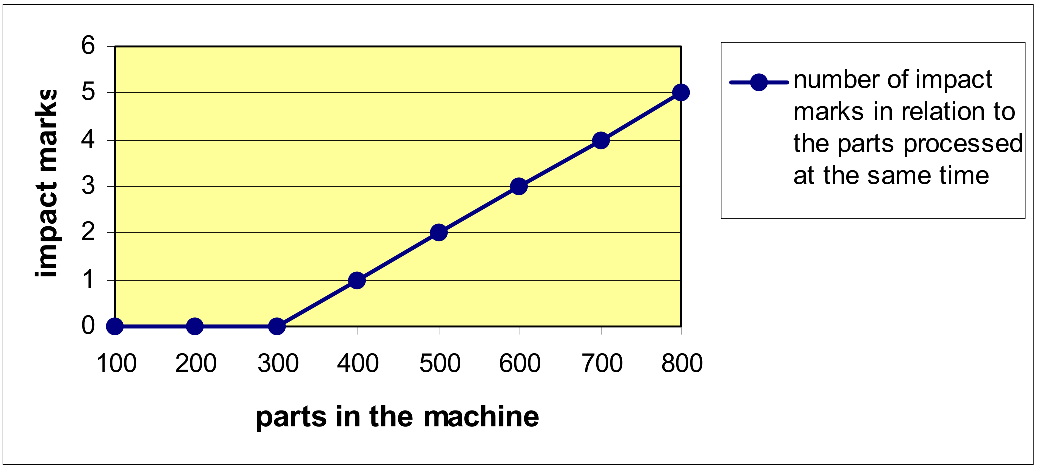


Figure 5.4 *Impact marks and machine load*

When only 100 rings were processed, there were no impact marks to be found.
After another 100 rings were added, the mechanical damage started (Figure 5.4).
Then we increased the number of rings by 200 pieces each time until we reached 800 rings per load. The size of the impact marks didn't change, but the number of impact marks increased in direct proportion to the number of parts.

Conclusion:
Many factors influence the damage. The size, weight, shape, speed, material, etc.
Rule of thumb: the ratio of the volume of the media to the volume of the jewelry should be approximately 5:1.

- The bigger the process container, the more volume you can load.
- The bigger and heavier the jewelry, the less you can process in each batch.
- The rounder the shape of the parts, the more you can load.

Try to find the amount where there is no damage. Even 50 grams of jewelry too much in the machine can ruin your desired result of a perfect surface.

5.5. To what extent shall you fill the machine with media while dry polishing?

Here too, we could determine in the tests that both extremes, a too-low filling as well as a too-high filling, can cause mechanical damage.

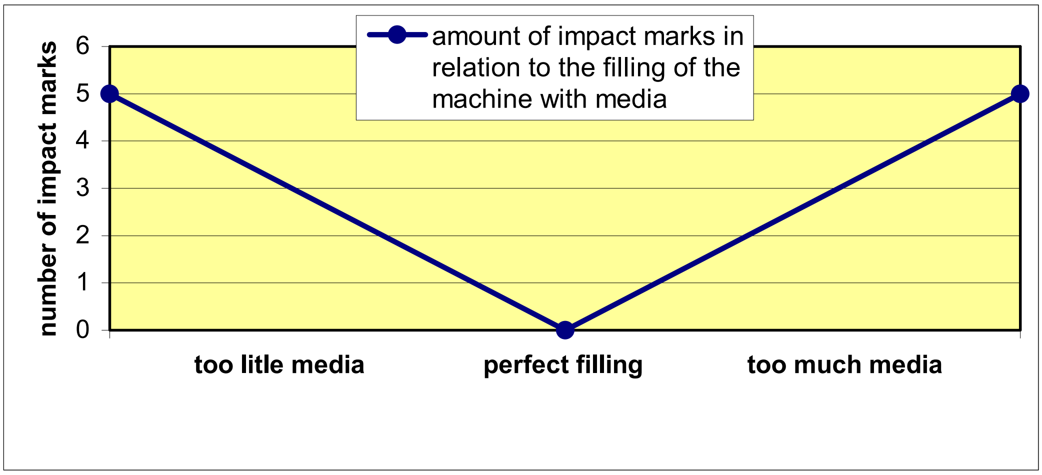
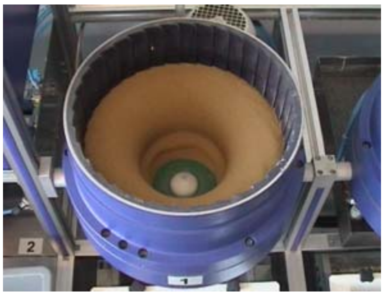


***Figure 5.5** Impact marks and amount of media*

If the machine is filled to a too-low extent (Figure 5.5.a),, the ratio of the parts to be processed and the processing media decreases. This means that the distance between the parts is not sufficient enough to function as a damage-preventing buffer.
If however, the machine is filled to the top of the process container (Figure 5.5.c), the ratio of the parts and the media rises and the flow seems to be inhibited.
The whole amount of media cannot flow nicely all the way in the container. While the media on the bottom of the container keeps on flowing and circulating, the media on the top of the process area stops. Some of the rings in the “resting” media are hit by others, which are still flowing sufficiently. Find the best whirl-like movement in your specific machine (Figure 5.5.b).



Too little media
Figure 5.5.a

Correct media level
Figure 5.5.b

Too much media
Figure 5.5.c

5.6. Does walnut shell size really matter?

Polishing with bigger grains inhibits the tendency of the parts to hit each other.
The damage-preventing buffer in this case is increased, because the resistance in the machine increases.
Just imagine you have two glasses filled with walnut shell grains. One is filled with big grains and one with fine grains. Now you drop a ring into both glasses. The ring dropped in the fine walnut shell grains will enter the grains deeper than the other one. The same will happen in the machine. The parts are “buffered” better with big grains than with fine ones. The parts cannot run into each other so easily. The shining, however, decreases with the grains getting bigger.

Conclusion:
If the jewelry is so big that it becomes damaged in fine grain after some time, you can polish with big grains as a first step. For the final “buffing,” use fine grains for just some minutes, which will give you the final gloss. While the big, and therefore heavy, grains can flatten the surface, they still leave bigger “scratches” on the surface. The fine grains have less impact to the surface, therefore the scratches are not as deep. This results in a higher gloss of the jewelry.

6. Influence of compound and polishing paste on tarnishing of jewelry

The first question we came across was whether wet polishing prevents silver jewelry from oxidizing better than dry polishing. To find this out, we polished with three different polishing methods:

- Wet polishing with porcelain chips
- Wet polishing with steel balls
- Dry polishing with walnut shell grains

After the polishing, the rings were left in a workshop environment for about four weeks (just as they came out of the polishing process, and without cleaning).
The result after that time was, that the steel-ball polished surface was still shining.
The second best result was the silver ring wet-polished in the porcelain chips. The silver ring polished with walnut shell grains was already rather dull.
It seems that the different surfaces, produced by the different weights of the polishing media, are the reason for it. The heavier the media, the longer the oxidation could be prevented. The micropores were better closed in the tests with the heavier media.

Another reason was that the remains of the polishing paste on the surface caused corrosion (see section 7).

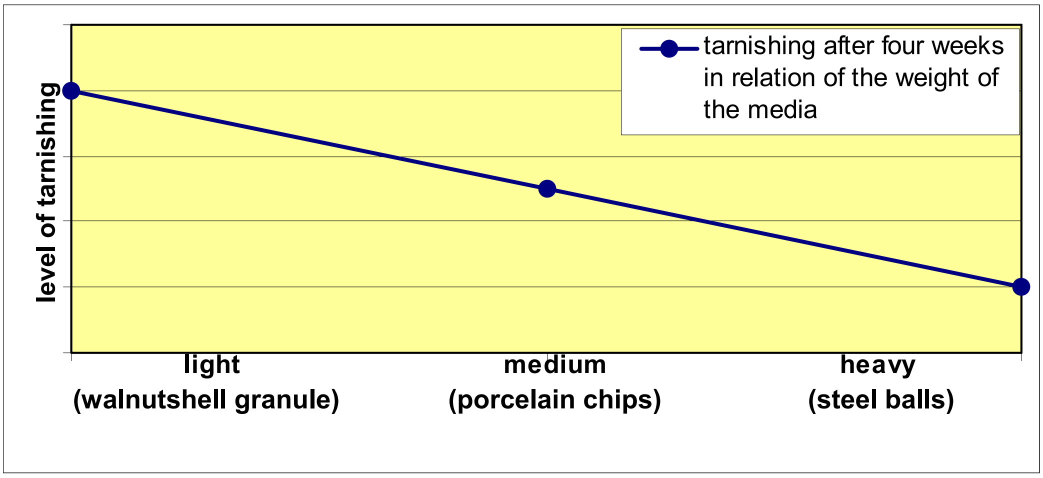


Figure 6.1 *Tarnish rates of different polishing media*

The surface quality (flat, even structure), however, decreased with the increase of the weight of the polishing media. The weight of the media creates mechanical deforming of the surface, depending on the construction of the machine used and on the shape and weight of the media. While the finish with walnut shell media became perfectly even, the surface got worse the heavier the polishing media was.
The next question to be investigated was: Does polishing paste prevent silver from tarnishing?
Again, we tested several dry-polishing pastes together with walnut shell granules. After the polishing, the rings were neither placed in an ultrasonic bath, nor had they been electroplated. The rings were not cleaned and were left in a workshop environment for about four weeks.
The result was that after four weeks, we could not see any significant differences in the shining between the rings. They were all dull, approximately to the same extent.
This tarnishing is the result of not cleaning the silver after the process. See in the next section how important it is to clean the jewelry immediately after the finishing process.

7. Influence of SiO2 particles in the surface on the tarnishing of silver

In almost all the wet-cutting processes, SiO2 is used as the abrasive agent.
Depending on many factors or parameters discussed before, these particles (bound in the plastic of the chip) can remain to some extent in the surface of the jewelry (Figure 7.1).
As we saw in some of the sections before, residues of the chips can be rolled, rubbed, pushed or hammered into the surface of the jewelry. Why do we have to prevent these SiO2 particles from getting there?
After processing silver jewelry, most of the items will be electroplated with a thin layer of silver to provide a nice, uniform silver color to the jewelry.
There are many reasons why the items are oxidizing. One of them, probably the main reason, can be eliminated in the finishing process.
After the SiO2 particle is pressed into the surface, it is almost impossible to remove it again. Sometimes the particles that are not so deep in the metal can, to a certain extent, be removed by the following polishing process. If the silver gets brushed or even sandblasted, these particles remain until the coating process.

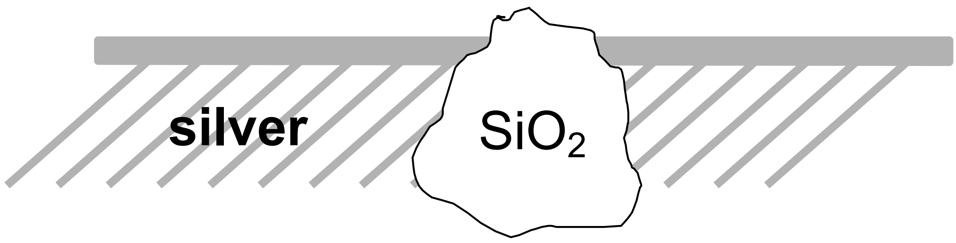


Figure 7.1 *Embedded SiO2 particle*

What happens when SiO2 or other "waste" particles are not prevented from getting into the surface, or are not removed before electroplating? Below is additional information on how we can prevent them from entering the surface:

1. Because SiO2 particles are not electroconductive, they cannot be covered by the silver coating, and therefore the jewelry can start oxidizing especially at these interrupted sections (see Figure 7.2).

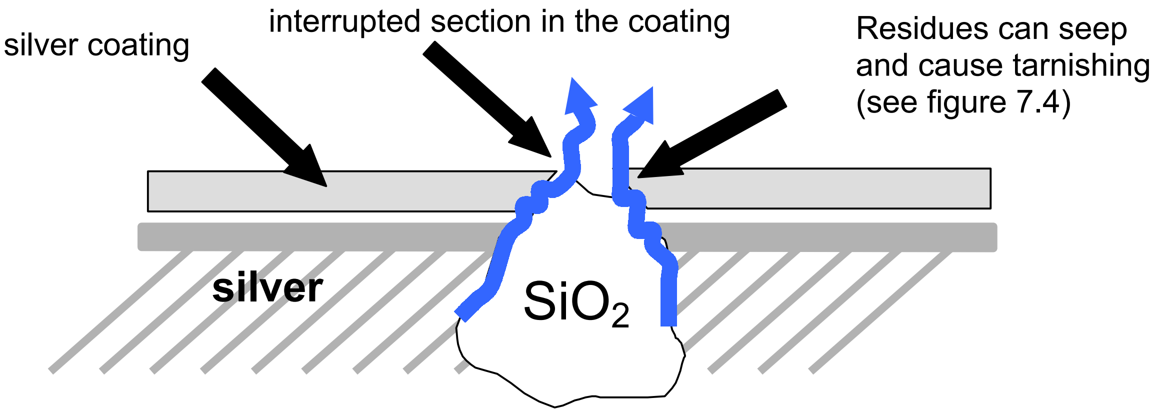


Figure 7.2 *Failure of silver coating due to SiO2 particle*

2. In the final polishing, they can cause so-called "comet tails" (Figure 7.3), which you can see as little pimples on the surface.

Figure 7.3 *"Comet tails" after final polishing*

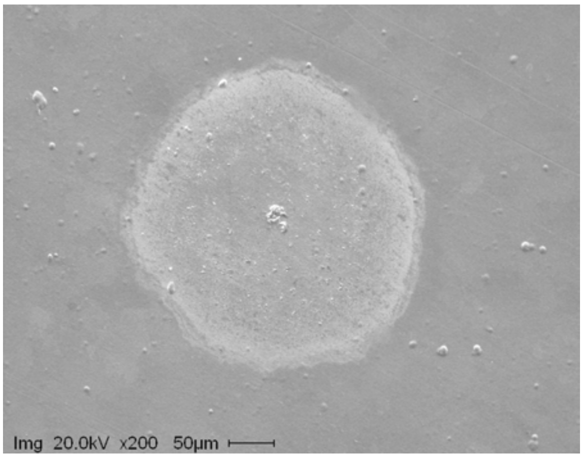


Figure 7.3 *residues were seeping*

3. Brushing the silver items or sandblasting them directly after the wet-grinding process will not remove the particles. Even more particles will be put into the surface. Polishing the surface before sandblasting can prevent this effect to a limited extent.
4. Remove porosity, because the particles can be trapped easily in these little holes and grooves.
5. If the items are not perfectly cleaned before the galvanic procedure, the baths will be contaminated very quickly. This results in high costs or bad electroplating.

Remember: one of the most cost-intensive procedures is when the jeweler has to repolish his items in the showcase, or even has to send them back to the manufacturer because they have this ugly, yellowish dull appearance, i.e., tarnish.