A theory of how the WE diamond pastes work

Posted by mark76 - 01 Apr 2012 15:06

When I first saw Tom's microscope photographs of the edge of a knife after stropping with the 14 micron and 10 micron diamond pastes I was baffled. I was it again when I was able to repeat this myself. Even though the edge got very smooth and sharp, there were only tiny scratches caused by the pastes. How could pastes that were so little abrasive create such smooth edges, both on balsa and on leather?

I did some additional experiments and a bit of thinking. I think I now know why it was so difficult for me to comprehend how the diamond pastes work: I was trying to explain what I saw through the microscope in terms of assumptions I held about why stropping with the diamond compounds worked:

- Leather has a stiction that causes it to burnish the edge, i.e. smear out metal over a larger area that causes scratches to become less wide and less deep or sometimes even to disappear.
- The diamond pastes are abrasive because they remove metal by making lots of scratches with a width and a depth of their specified micron size (or a little lower, since only a part of every diamond particle would touch the edge).
- The diamond pastes work on leather due to the dual effects of burnishing and abrasion.
- The diamond pastes work on balsa due to abrasion.

Tom had already shown that the second assumption was likely not true. It dawned on me when I saw with my own eyes that the first assumption was not true either. The additional experiments and thinking showed that all four assumptions are wrong!

Yet these pastes do work. So I tried to come up with an alternative explanation. You can read it in full on my blog
. But in short I think the following is happening:

- Both the balsa and the leather strops are hardly abrasive by themselves. They do not cause much burnishing by themselves either.
- The strops become effective when loaded with the diamond pastes.
- The diamond pastes cause a lot of burnishing, but hardly any abrasion.

It is the pastes that do the work, not the strops. And these pastes are hardly abrasive, but have a strong burnishing power.

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Re: A theory of how the WE diamond pastes work
Posted by wickededge - 03 Apr 2012 17:38

Next I decided to throw in a little side experiment - I sprayed some Hand American, 1 micron diamond spray on my already pasted 1 micron strops - big difference here, though not totally surprising:

510x - 1µ diamond and leather strops after 3.5µ diamond and leather strops - 100 passes

There are clearly a LOT more diamonds than when I was using the strops with just the paste. Additionally, most of the 'stiction' was gone from the strops after spraying with the HA spray. I decided to do another 100 passes and started getting back to good 'stiction':

510x - 1µ diamond and leather strops after 3.5µ diamond and leather strops - 200 passes

For reference, here is a pic of the 1 micron pasted strops from a little earlier before adding the 1 micron spray:

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Re: A theory of how the WE diamond pastes work
Posted by wickededge - 03 Apr 2012 17:41

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razoredgeknives wrote:

Man, that is really weird why the lapping films were so slow working and hardly did anything... I can't believe it! My assumptions were totally opposite... lol, it seems as if the only way you can get a fast cutting consistant edge at sub micron levels is with the shaptons... I just don't have a grand to drop on stones right now

* edit: keep the test coming Clay! lol, there's gotta be another answer! I haven't given up hope!

If you can hold out til mid-May, I might have just the thing for you!

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Re: A theory of how the WE diamond pastes work

Posted by mark76 - 03 Apr 2012 17:42

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wickededge wrote:

So far, it seems like we've confirmed that the best stropping effects come from burnishing, which happens when there is adequate 'stiction'.

+3.

However, this is the Wicked Edge pastes. Tonight I took photographs of the edge after stropping with Dovo paste. But it is 0:40 in the night here and somebody in the next room is saying I must come to bed. Up tomorrow 🙂

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Re: A theory of how the WE diamond pastes work

Posted by wickededge - 03 Apr 2012 22:09

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mark76 wrote:

wickededge wrote:

So far, it seems like we've confirmed that the best stropping effects come from burnishing, which happens when there is adequate 'stiction'.

+3.

However, this is the Wicked Edge pastes. Tonight I took photographs of the edge after stropping with Dovo paste. But it is 0:40 in the night here and somebody in the next room is saying I must come to bed. Up tomorrow 🙂

Can't wait to see your results!

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Re: A theory of how the WE diamond pastes work

Posted by mark76 - 04 Apr 2012 04:03

Interesting experiments again, Clay!

wickededge wrote:

Slight tangent here - polishing tapes... I decided to retest the polishing tapes, starting from a polished bevel and counting strokes, so here goes, working backwards from 1 micron polish:

510x - 7000 grit polishing tapes after 1 micron polish - 100 passes

510x - 3000 grit polishing tapes after 7000 grit tapes - 100 passes

These look better than yesterday's results but not overwhelming.

Why do you think they are not overwhelmingly better? I clearly see scratches now that (I hope) are from the polishing tapes. They are also quite evenly spaced, creating a nice pattern almost like what a stone would do.

By the way, with current knowledge (it changes per day 🙂
) I think this it the way to test the very low micron size compounds/tapes/stones: first burnish the edge until it is very smooth (e.g. using the 1 micron paste, but I wouldn't be surprised if the 14 micron paste worked as well 🙂
) and then do strokes with the fine stuff.

razoredgeknives wrote:

Thanks so much for this Clay! It would, in fact, seem as if the 10>5>3.5 progression yields better results in the end... wasn't so clear in the first one

I think we should be careful in drawing such conclusions too early. In one post Clay noted that the 1 micron compound had by far the most stiction. That would imply that 300 strokes with the 1 micron paste

should produce more burnishing than 300 strokes (in total) with the 10-3.5-1 micron pastes. But in fact the surface of the edge after the latter progression looks smoother.

I had similar results: sometimes a particular compound seemed to cause more burnishing than another compound, whereas in different circumstances the results were exactly the opposite. I think this might very well be the result of the way in which the strops were seasoned (and the amount of paste applied).

wickededge wrote:

New study, different steel. This is a knife that I had made from CPM-154, hardened to 69-70 RHC.

Are you sure that hardness isn't a typo, Clay? But good to see the burnishing works just as good on harder steels!

wickededge wrote:

Next I decided to throw in a little side experiment - I sprayed some Hand American, 1 micron diamond spray on my already pasted 1 micron strops - big difference here, though not totally surprising:

510x - 1µ diamond and leather strops after 3.5µ diamond and leather strops - 100 passes

There are clearly a LOT more diamonds than when I was using the strops with just the paste.

I am not quite sure what I see here. I I do see scratches, but not as many or as regular as those that would be caused by a 1 micron stone. Is that correct, Clay? If you'd increase the amount of spray applied, would the number of scratches increase and a more regular pattern appear?

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Re: A theory of how the WE diamond pastes work

Posted by wickededge - 04 Apr 2012 08:06

Ooops, I did mean 59-60 RHC!

I'll stitch the 1 micron paste image to the 1 micron paste + spray so we can compare them side by side.

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