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 16:31

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mark76 wrote:

wickededge wrote:

As far as the 'stiction' of the different strops goes, I think it might be a function of how much paste is on the surface and how much moisture it has.

That is a good one. In my experiences the leather strops usually work a little better than the balsa strops for burnishing. However, I had one case in which the balsa worked better. That might be the reason.

I tried, by the way, to increase the stiction of a leather strop by making it wet. Not the slightest effect. Next up is stropping with chewing gum on balsa

Totally funny. I just redid some of the tests and the role of stiction seems to be huge. I'll post more below.

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Re: A theory of how the WE diamond pastes work
Posted by razoredgeknives - 03 Apr 2012 16:40

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!

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Re: A theory of how the WE diamond pastes work
Posted by wickededge - 03 Apr 2012 16:42

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.

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Re: A theory of how the WE diamond pastes work

Posted by wickededge - 03 Apr 2012 16:46

Okay, back on track now... Returned to the 1000 grit stone, worked the stone until I reached the edge:

510x - 1000 grit diamond stone - 150 passes

Then I took the 1 micron strops and completed 300 passes:

510x - 1 micron diamond and leather strops after 1000 grit diamond stones - 300 passes

There was an extreme amount of stiction with this strop, much more so than with the others, most likely because it's the one seeing the most action. Pushing the strop against the blade was causing the Paperstone base to lift with each stroke.

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Re: A theory of how the WE diamond pastes work

Posted by wickededge - 03 Apr 2012 16:54

Back again to the 1000 grit diamond stone for another 150 passes:

510 x - 1000 grit diamond stones - 150 passes

510 x - 10 micron diamond and leather strops after 1000 grit diamond stones - 100 passes

510 x - 3.5 micron diamond and leather strops after 10 micron diamond and leather strops - 100 passes

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

There was a very marked difference in resistance from the different strops with the resistance from the 1 micron set being by far the highest.

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Re: A theory of how the WE diamond pastes work

Posted by wickededge - 03 Apr 2012 16:59

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So, here are side by side the 1µ - 300 passes and the 10µ -100 passes> 3.5µ - 100 passes> 1µ - 100 passes:

510x - 1µ - 300 passes

510x - 10µ -100 passes> 3.5µ - 100 passes> 1µ - 100 passes

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Re: A theory of how the WE diamond pastes work

Posted by wickededge - 03 Apr 2012 17:04

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So far, it seems like we've confirmed that the best stropping effects come from burnishing, which happens when there is adequate 'stiction'. Learning how to get the strops properly seasoned so that they have the right amount of 'stiction' is something we should study next.

I deliberately did a few strokes at an angle in the last progression to help us visualize the scratches from the finer strops which opens up a whole line of inquiry: what density of diamonds at which grit provides the best teeth for which jobs?

I'm going to try adding some of Keith's 1 micron spray to my 1 micron pasted strops to see if I can keep the stiction but add more diamonds. More studies to come!

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Re: A theory of how the WE diamond pastes work

Posted by razoredgeknives - 03 Apr 2012 17:09

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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.

Still curious... which blade is this you are sharpening?

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Re: A theory of how the WE diamond pastes work

Posted by wickededge - 03 Apr 2012 17:24

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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.

Still curious... which blade is this you are sharpening?

That's a blade I designed for hunting that we'll be releasing soon. AUS-8 steel at 57-58 RHC. It's nothing fancy, actually a very inexpensive knife that fills a particular need. Details to come soon...

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Re: A theory of how the WE diamond pastes work

Posted by wickededge - 03 Apr 2012 17:33

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

I started with a polished edge, then went back to the 1000 grit stones before progressing to the strops. Here is the edge after the 14µ strops:

510x - 14µ diamond and leather strops after 1000 grit diamond stones - 100 passes

510x - 10µ diamond and leather strops after 14µ diamond and leather strops - 100 passes

510x - 5µ diamond and leather strops after 10µ diamond and leather strops - 100 passes

510x - 3.5µ diamond and leather strops after 5µ diamond and leather strops - 100 passes

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