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 - 04 Apr 2012 15:12

BassLakeDan wrote:

well that chart did not take here on the forum board software, so let me try it again as a JPG..

Thanks for jumping in and for your feedback and healthy skepticism. I took a photo last night of the CPM-154 blade after polishing with the .5 micron strops with a hair from my nephew's head for comparison:

You can just barely see the faint scratches on the surface and it seems possible to imagine fitting quite a lot of them into the width of that hair.

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Re: A theory of how the WE diamond pastes work

Posted by wickededge - 04 Apr 2012 15:23

Added a couple more with measurements, these are all 500x magnification:

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Re: A theory of how the WE diamond pastes work

Posted by mark76 - 04 Apr 2012 15:25

BassLakeDan wrote:

Well, the whole subject of sub-micron particle stropping has me baffled in more was than one.. I question if it is even possible. See the following chart for a reality check on what worlds of size we are talking about then ask yourself. "what exactly is it am doing or trying to accomplish by putting this size particle on a sample of cow hide and hand applying that to a knife edge".., Hummmm.

Thanks to www.standridgegranite.com/calibration.htm#19 Standridge Granite company for the chart .. There are very few people in the world that know more about "flat" than these folks/. It would be interesting if we could get one of their engineer to participate on this thread !

Hey Dan, thanks for the reality check!
.I'll think of that hair when I am staring through the microscope at a 1 micron scratch... (Or better yet, make a photograph of the hair after it has passed the hanging hair test
.)

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Re: A theory of how the WE diamond pastes work

Posted by wickededge - 04 Apr 2012 15:33

Went back to the 1 micron shot with the most clearly defined scratches and added a .050mm scale. A micron is .001mm, so if we can fit 50 of those scratches into the space of that scale, we're looking good:

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Re: A theory of how the WE diamond pastes work

Posted by mark76 - 04 Apr 2012 15:52

I thought I'd go for something completely different.

So yesterday I did some stropping with a stropping paste from Dovo, a German company that makes straight razors. It is probably the most used stropping paste where I live. (Yes, next to Germany.) I went for the "green paste", since it is the coarsest stropping compound they offer, which should leave most traces. It supposedly contains 5-8 micron chromium oxide.

I wanted to know whether it worked like the Wicked Edge pastes, with a lot of burnishing. And I wondered whether it would be more abrasive than the Wicked Edge pastes, leaving wider scratches. Perhaps of a 5-8 micron size or a little lower?

I can reveal already that the Dovo paste hardly (or not at all) burnishes. And for abrasion... well, read my blog
.

I am happy with my Wicked Edge pastes.

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Re: A theory of how the WE diamond pastes work

Posted by mark76 - 04 Apr 2012 15:57

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wickededge wrote:

I did another 100 strokes with the 1 micron strops after the spray had dried. The stiction returned and the surface smoothed out immediately. I believe that once the spray dried, burnishing resumed and abrasion was minimized.

That is an interesting observation! The diamonds in the paste were also very good at hiding. What is that paste doing?

Makes me think of that old joke of two diamonds in a jewellery shop when two rich ladies come in. The diamonds immediately hide in some stropping compound...

I am still interested in why you thought the results of the tapes were not overwhelming, Clay. It was my impression they resulted in a pretty even scratch pattern (in your second series of photographs) resembling that made by a stone.

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Re: A theory of how the WE diamond pastes work

Posted by wickededge - 04 Apr 2012 16:00

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mark76 wrote:

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I am still interested in why you thought the results of the tapes were not overwhelming, Clay. It was my impression they resulted in a pretty even scratch pattern (in your second series of photographs) resembling that made by a stone.

I think we were looking at it differently - you were looking for scratches and I was looking for smoothness!

Now that I understand a little better, I'd agree that the edge does look good in terms of a nice, even and well distributed scratch pattern.

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Re: A theory of how the WE diamond pastes work

Posted by wickededge - 04 Apr 2012 16:12

Nice write up on your blog. Thanks for making that test.

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Re: A theory of how the WE diamond pastes work

Posted by mark76 - 05 Apr 2012 16:53

Clay, some of the edges you've posted photographs of are among the smoothest I've ever seen. Have you ever done any cutting test with them? My thoughts are that they should be very good in push cutting, but I don't know exactly what this smoothing does to the edge of the edge?

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Re: A theory of how the WE diamond pastes work

Posted by dschur - 05 Apr 2012 19:20

Awesome info Clay. Given these findings, I wonder if you have any tips to simplify my sharpening regimen?

Currently (mostly sharpening stainless such as VG-10, CPM 154, S30V, ZDP189, S90V, etc), I am coming off the 1000 grit, through both ceramics, and then onto 5u, 3.5u, 1u leather strops. I often finish with some clean paddles that have just a touch (looks like regular leather with a couple of diagonal crayon marks on it) iron oxide jewelers rouge which seems to increase the polish . I should probably stop doing that last step, I may be imagining the benefit.

Is there a step or two I could reduce? Maybe coming off the ceramics and just doing 3.5 and 1 u? I am doing about 150 strokes on each side.

I'm not looking for mirror perfection, All of my blades are users, but I do like a wicked edge

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