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 razoredgeknives - 04 Apr 2012 12:51

Yeah Mark, you may be right... I guess I'm a little confused about which pictures were the right ones? These are the side-by-side comparisons that you posted Clay...

wickededge wrote:

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

But then in the post above this one, you had another pic of a the same progression it seemed, ending with 100 passes on the 1m leather strops...

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

Unless I missing something, there is a noticeable difference in the first two pictures, but a HUGE difference in smoothness in the last one...

I am referencing post # 2463 & 2464.

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Re: A theory of how the WE diamond pastes work

Posted by wickededge - 04 Apr 2012 13:48

In your post above, you've got images from two sets of tests, two on the AUS-8 knife and one on the CPM-154 blade.

Here are three from the CPM-154 knife:

3.5 Micron strops - 100 strokes:

The bevel is very smooth after the 3.5 strops.

1 Micron Strops - both paste and spray - 100 strokes:

There were many, more obvious scratches after adding the spray to the 1 micron strops. I had lost the 'stiction' here and seemed to be getting more abrasion and less burnishing.

1 Micron Strops - both paste and spary - 200 strokes:

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.

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Re: A theory of how the WE diamond pastes work

Posted by BassLakeDan - 04 Apr 2012 14:30

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mark76 wrote:

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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 !

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Re: A theory of how the WE diamond pastes work

Posted by BassLakeDan - 04 Apr 2012 14:33

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

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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

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

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