Inside sharpening stones

THE DIFFERENCES BETWEEN NATURAL AND MAN-MADE PRODUCTS

BY GARRETT HACK

Walk into Norton's manufacturing plant in Littleton, N.H., and the smell is reminiscent of a bakery. Arranged like so many pastries on cooling racks are row after row of fresh Crystolons, Indias, and waterstones—just some of the dozens of different sharpening stones they bake daily.

Just down the road, the Pike Manufacturing Company has quarried its world-famous stones for well over a century: "1,100 different abrasive products, a whetstone for every purpose." Holding a hunk of this mica schist in one hand and a fresh man-made India stone in the other prompted me to learn more about sharpening stones. Where do they come from? How are they made? What are the differences between natural stones and man-made stones, and what series of grits do you need to keep your tools sharp?

The properties of sharpening stones

All stones, man-made or natural, share distinct features that give them the ability to cut tool steel. Steel isn't easy to cut: It can be hard and tough, especially the new alloys such as A2 that are finding their way into plane irons and chisels.

To bite into the steel and scrape some away, a good sharpening stone has to have plenty of tough, hard grit particles. While the maximum size of the particles should be uniform, free of the odd large pieces that would cut extra-deep scratches, smaller particles are fine; in fact, they fill voids around the larger particles and cut and polish, too. The particles can't be bonded too tightly together, though, or no fresh ones will be exposed with use and the stone will glaze and clog.

It isn't easy to see what's inside a sharpening stone, even with a microscope. You can't just take one apart to see the grit, although manufacturers try to understand a competitor's product by doing just that. There is much subtlety in producing man-made stones, and lots of proprietary knowledge. It's possible to know the relative grit size of a stone, but little of how much grit there is or its sharpness and durability.

With both natural and man-made stones, the best you can do is get a feel for how the stone cuts, and perhaps look at the honed surface with a magnifying lens. Some stones feel smooth and slippery, while others give the friction of a steady cut. Every stone is different.

Natural stones go back a long time

Until about 1870, all sharpening stones were natural. Today, most natural stone comes from quarries in Japan or Hot Springs, Ark. The Arkansas stones are quarried from novaculite, a sedimentary rock composed mostly of microcrystalline quartz. The rock is classified by the abrasives industry into two categories: Arkansas stone and

Quarried or baked?

Until relatively recently, all sharpening stones came from natural sources. A novaculite quarry near Hot Springs, Ark., still produces hard black Arkansas stones (left). Synthetic stones are created by baking a mixture of materials. Looking remarkably like wheels of mature cheddar, Norton's 8,000-grit waterstones (right) start life as disks before being cut into individual stones.

Photos, except where noted: Mark Schofield; this page (left): John David McFarland, Arkansas Geological Commission

Creating a combination stone. *A mixture of 100-grit abrasive and ceramic material is used to fill the hollow area in the molding table (top). After the layer of coarse grit has been compressed at nearly 2,500 psi, a layer of 320-grit mixture is spread over the top (center). After a second compressing, the combination stone joins others ready to be baked for about 48 hours in a kiln at 2,000°F (right).*

Washita stone. The former is very fine and uniformly grained, light gray or white, with a waxy luster. The latter is less dense, more porous, and has a dull luster.

Novaculite was deposited underwater and over eons was pressed into its present dense and hard form. The water part of its history accounts for the consistency of the grit: The larger particles were deposited first and formed the coarser stones, while the finest translucent and black Arkansas stones were made from the smallest sediment that remained suspended the longest.

Typically, the veins are narrow and 50 ft. to 100 ft. long, but they're often so fractured that the yield of the best stone is only 5% to 10% of what is quarried. Because of the brittle nature of the stone, the quarries use little or no blasting. Instead, circular diamond saws lubricated and cooled with water are used to remove blocks of novaculite. These blocks are either cut to size and lapped on horizontal grinding machines, or they are ground into dozens of shaped slips.

Novaculite is dense with grit that cuts slowly, leaving an excellent finish on tool steel. Novaculite wears slowly, too, so the stone stays flat with only minor maintenance. Lubricated with oil or water to float away abraded bits of steel and grit, the hardest Arkansas stone feels very smooth, almost polished.

Man-made stones have a wider range of grits

Man-made stones, both oil and water, first evolved as a means of making sharpening stones less expensive and more consistent.

At first they were made from natural grit, ground, sized, and rebonded into a stone. Today, they are made from various grades of aluminum oxide or another man-made grit, silicon carbide, used by Norton in Crystolon and Carborundum oilstones. (For more on these minerals, see "Choosing Sandpaper," pp. 54-61). Silicon carbide is made by burning silica with carbon material such as sawdust. The result is a coarse grit that cuts fast but also dulls quickly and is better suited to cutting cast iron and nonferrous metals rather than tool steel.

Particles are bound together under pressure—Two other important factors in determining the quality of a sharpening stone are the density of the stone and the type of bond holding the grit particles together.

Key to producing the right density is the pressure, up to 2,500 psi, used to mold the stone. Higher pressure makes for a harder stone that will cut and wear more slowly. Stones formed with less pressure feel soft.

Pressure alone would not keep the particles together, so a binder is added—some clay, glass, and organics such as horse glue or flour, which explains where that fresh-baked smell comes from. A little water helps hold everything together.

Most very fine waterstones (8,000 grit and higher) contain a hard resin binder. Resin is used for ease of manufacturing and to yield a dense stone with a good feel and finish.

After the abrasive and binders are

Different measures of abrasion

One difficulty with many man-made stones and all natural ones is that they don't specify numerical grit size. To add to the confusion, most waterstones are measured using the Japanese JIS scale, which is different from both the European FEPA and the American CAMI standards for measuring sandpaper. By comparing common stones and sandpaper grits, the chart will help you compare apples to oranges and select the right range of stones for your shop.

SYNTHETIC OILSTONES	NATURAL OILSTONES	DIAMOND PLATES	SYNTHETIC AND NATURAL WATERSTONES JIS (Japan)	SANDPAPER	
				CAMI (USA)	FEPA (Europe)
Coarse Crystolon			150	100	
Coarse India				120	
Medium Crystolon				150	
				180	P180
		Extra-coarse (220)	220		
				220	P220
Medium India					
				240	
Fine Crystolon					P320
Fine India		Coarse (325)		280	
			360	320	
	Washita			360	
				400	
		Fine (600)	600		P800
	Soft Arkansas		800	600	P1200
			1,000		
				800	P1500
		Extra-fine (1200)	1,200		
	Hard White Arkansas		1,500	1,000	
				1,500	P2500
			2,000		
	Hard Translucent Arkansas		4,000	2,000	
	Hard Black Arkansas				
			8,000		

mixed and pressed, the stones are baked to vitrify the clay and glass and to drive out the moisture and organics. The stones bake at 2,000°F for one to two days and then cool. The spaces left in the matrix from the burned-off organics create a certain porosity of the stone. Coarse stones are more porous, fine ones less so. This is why coarse waterstones need soaking and constant splashing with water, while the water puddles atop fine waterstones. Oil works well as a lubricant, and being more viscous, sinks into a coarse stone more slowly and requires less frequent replenishing than the water on a waterstone. To slow the oil even more, Norton soaks its India and Crystolon stones in a hot waxlike material, which fills their interior pores.

What stones should you buy?

You can see that what makes a stone ideal for sharpening tool steel is a balance of some not-so-obvious factors: the type and grade of grit, the range of particle sizes, the type of bond, and the density of the stone. With Shapton's new 30,000-grit stone, some woodworkers might feel that man-made stones have far surpassed those found naturally. But the natural stones still have their own magic in the way they polish and finish an edge, which ultimately is what sharpening is all about.

Should you buy either oilstones or waterstones, or some combination of the two? Neither is superior, although high-quality waterstones are easier to find. I always have favored oilstones for their easy maintenance and their simplicity of benchtop use. Compared to waterstones that create large amounts of slurry and need frequent flattening and washing, oilstones create little mess, and the oil protects hand tools against rust.

Most important is having a progression of grits and learning to use the stones effectively and maintain them well. To this end, you need a coarse stone (220 to 320 grit) for honing out nicks and renewing a very dull edge; a medium stone (1,000 to 2,000 grit) for refining the edge further; a fine stone (4,000 to 6,000 grit) for polishing the edge; and a superfine stone (8,000 to 12,000 grit) for when you need to get that perfect edge on a plane iron used for a final surfacing. Lubricate your coarse and medium stones well for rapid cutting, and use your finer stones a bit drier to get some polishing action from the broken-down grits that form a paste on the stone.

Flatten sharpening stones regularly on a large diamond plate or silicon-carbide paper on plate glass, and you will get many years of use from them. □