TESTING THE WEAR LIFE OF SANDPAPER

TRACK OR CATEGORY
Tribotesting (3067440)

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INTRODUCTION

"Sandpaper" is the term widely used for fixed abrasive on a flexible support. Initially the abrasive was sand and the support was paper. However, current sandpaper is called"sanding sheets" by one manufacturer and the type of abrasive particles is not listed. It is usually aluminum oxide. Sand as an abrasive for finishing wood and the like has been banned in the USA for decades because of health risks associated with silicon dioxide particulate. Commercially available abrasives for "sanding sheets" include aluminum oxide, silicon carbide and garnet. The flexible support for the fixed abrasives addressed in this study was a paper product versus metal foil as the test feature.

Sanding sheets are made by coating the support one-layer thick with abrasive particles. Particle density can range full coverage (75 to 100 percent coverage) or open coat (40 to 70 percent coverage.) The abrasive particles are applied to adhesive covered support by electrostatic or related techniques and this produced the "bond coat". A second application of adhesive over the particles called the "size coat" covers the particles and fills in valleys between particles. Sanding sheets are made to particle sizes, like 100 grit, 150 grit, etc.

This study was initiated to compare a proposed new type of fixed abrasive product on a flexible metal support to existing sanding-sheet products. The study evolved in to the development of a test method to compare the removal rate of different sanding sheets. It is the purpose of this paper to present this test methodology and to present test results using the methodology on a variety of woods. The objective of the work was to explore the feasibility of standardizing the test method. This paper will describe candidate tests, development of the "combo" test, results ranking the abrasivity of the test fixed abrasives, results of aluminum oxide fixed abrasive on different woods and on metals and interpretation of test results.

CANDIDATE TESTS

How does one compare the effectiveness of various sandpapers? There is an ASTM abrasion testing standard that uses fixed abrasives (ASTM G174 [1]), but in the form of microfinishing tape. This test would not accommodate cut sheets or the sheet-metal product to be evaluated. ASTM G132 [2] uses fixed abrasives in the form of sandpaper, but the test method was really written for riding a pin on a large drum covered with fixed abrasive. Again this test was not suitable for cut sheets of sandpaper.

The use of a reciprocating pin-on-flat test like ASTM G133 [3] was considered, but not adopted because of fear that rubbing a wood pin on a single wear track would clog the abrasive papers. Affixing test sanding sheets to the faceplate of a lathe and programming a pin rider (wood) to rub on fresh abrasive, spiraling for the center out, was considered, but not adopted because it would require the development of a complicated machine control program. Finally, it was decided to use a test rig that was originally developed to assess the relative abrasivity of magnetic media containing alumina for head cleaning. This test combined a reciprocating wear tester with a pin-on-disk tester (Figure 1). The reciprocating arm imposes the pin test specimen on a slowly rotating platen to which the abrasive species is attached. The rider does not see fresh abrasive, but the rider rubs a significant area of the abrasive sheet which prevents clogging and wear-through of the abrasive material.

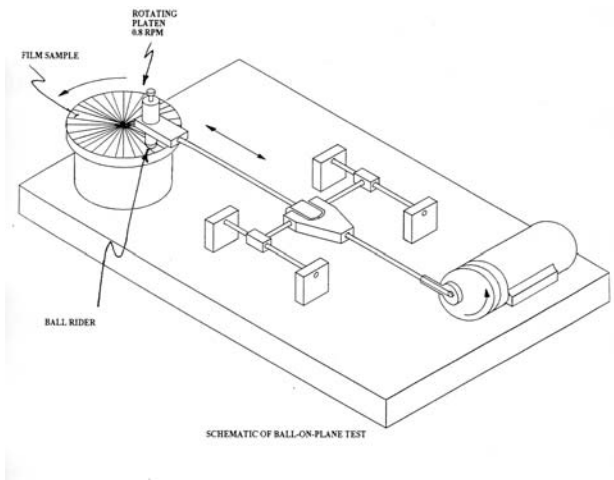

Figure 1. Schematic of combo tester.

TEST PROCEDURE

The experimental sandpaper (feature) was compared to reference sanding sheets of 220 grit alumina and silicon carbide. Sheets of fixed abrasive 100mm square were fastened to the rotating platen of the combination (combo) tester. A white oak pin10mm in diameter, 60mm in starting length was loaded against the sheet with a force of 5 N; the reciprocating stroke was set at 65mm (one back and forth movement) at 1 Hz and the platen rotational speed was 0.85 rpm. The wood rider was measured axially for wear volume every ten minutes and the test continued for 30 minutes. The same procedure was repeated with woods of different hardnesses and with hard (60 HRC) and soft (92HRB) metal.

TEST RESULTS

The wear versus time characteristics of the three different fixed abrasives versus white oak is shown in Figure 2. The alumina had the highest removal rate and the metal sanding sheet had removal characteristics like those of silicon carbide. The wear (sandability) of the different woods is shown in Figure 3. Ebony had the lowest wear (worst sandability) and white pine the highest (best sandability).

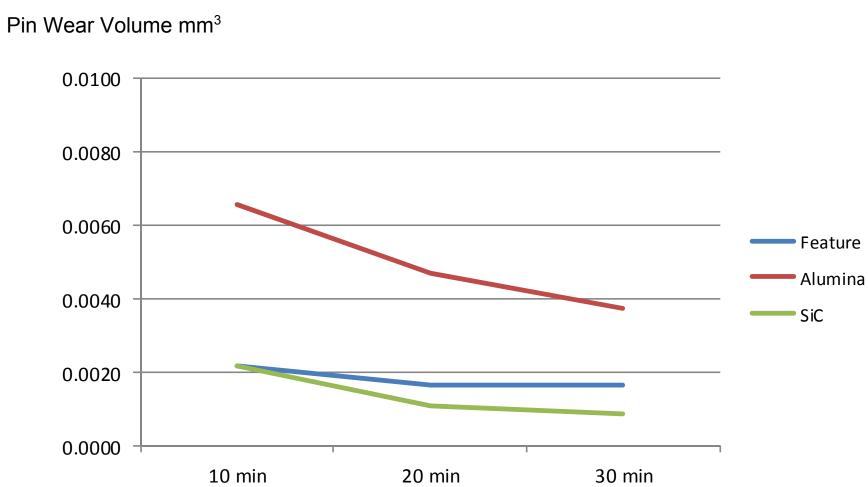

Figure 2. Removal rate of the test feature compared with alumina and silicon carbide.

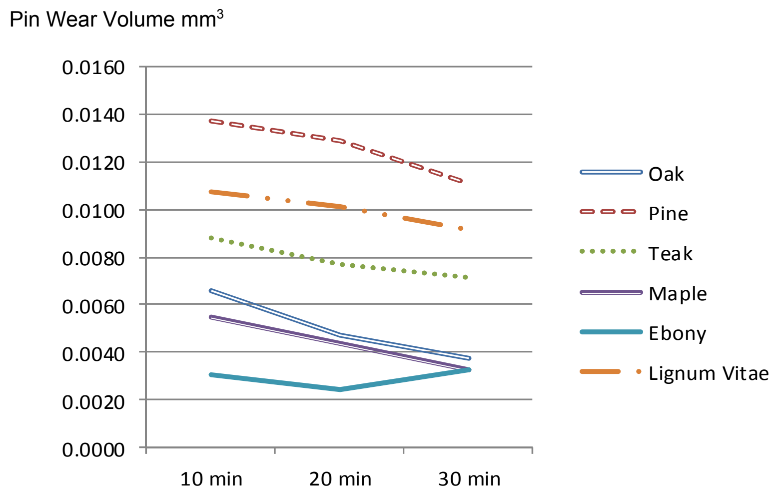

Figure 3. Comparison of "sandability" of different woods versus 220 grit alumina.

DISCUSSION

The finding that the feature fixed abrasive did not perform as well as the alumina, ended the study with that particular abrasive and product design. It would be redesigned. Optical microscopy studies on new versus used abrasive papers suggested that the feature abrasive sheets did not perform as well as commercially available alumina sanding sheets because the metal-plated abrasive particles did not appear to have the sharpness of the alumina particles. Alumina was more acicular while the abrasive particles on the metal support appeared to be more "blocky" in shape.

The results with the metals versus alumina fixed abrasive produced a 4.5 wear ratio for 1020 steel versus hard 52100 steel. The ASTM G 65 [4] 3-body abrasion test produced a wear ratio of 6.6 and the ASTM G 174 2-body abrasion test produced a wear ratio of 7.1. Based upon hardness differences one would expect the wear ratio to be 6.6. Thus the combo test did not show the same soft/hard wear ratio as the two standard abrasion tests. This may be explained by loading of the fixed abrasive valleys with wear detritus.

CONCLUSIONS

1. Aluminum oxide fixed abrasive sheet is more abrasive to wood than silicon carbide abrasive and plated diamond abrasive of the same nominal grit size.
2. The sandability of wood with aluminum oxide fixed abrasive sheet correlates with the Janka hardness of the wood; the harder the wood the lower the sandability.
3. The combination reciprocating and pin-on-disk test developed for this study works well for assessing the aggressiveness and wear life of fixed abrasives in sheet form, but further study is needed to apply the test to metals.

REFERENCES

[1] ASTM G174 Standard Test Method for Measuring the Abrasion Resistance of Materials by Abrasive Loop Contact, West Conshohocken PA: ASTM International.
[2} ASTM G132 Standard Test Method for Pin Abrasion Testing, West Conshohocken PA: ASTM International.
[3] ASTM G133 Standard Test Method for Linearly Reciprocating Ball-on-Flat Sliding Wear, West Conshohocken PA: ASTM International.
[4] ASTM G65 Standard Test Method for Measuring Abrasion Using the Dry-sand /Rubber Wheel Apparatus, West Conshohocken PA: ASTM International.

KEYWORDS

Sandpaper, Fixed Abrasive, Sanding, Abrasion Testing