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EDGE ANGLES IN CUTTING: MEASUREMENT OF EDGE ANGLE AND IMPACT ON PROCESSES IN CUTTING WITH A KNIFE

Engineering

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ABSTRACT

Knife cutting is a widely used process as a tool for utilities and hence needs to be studied and understood properly. We will mostly focus on two aspects of this process : 1. The sharpness of the knife 2. The material being cut. By categorizing our experiment on this basis, we will then proceed to determine how to improve the process of knife cutting.

KEYWORDS:

edge angle

EXPERIMENT DESIGN AND PROCEDURE

1. We made two knives in the Mechanical Workshop : 1. Mild Steel 2. Galvanized Iron
2. They were sharpened using the grinding wheel
3. Hence an edge angle was provided to the cutting edge
4. Measure the width and length of the cutting edges
5. Use both the knives to carry out single cuts on various materials such as a wooden block, chocolate bars and raisins.
6. Compare the depth of cuts in each of the cases

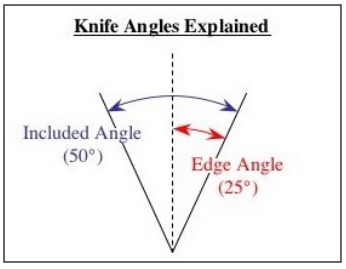

FIGURE 1.1. EDGE ANGLE OF THE CUTTING EDGE OF A KNIFE

Edge angle is the angle at which the knife is held to the sharpening stone while being made. It becomes the most important factor in determining the sharpness of the knife. We'll study the relationship between the edge angle and sharpness in this experiment.[1]

2. OBSERVATIONS

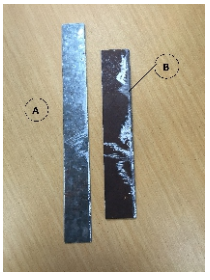

FIGURE 2.1. A. GALVANISED IRON KNIFE B. MILD STEEL KNIFE

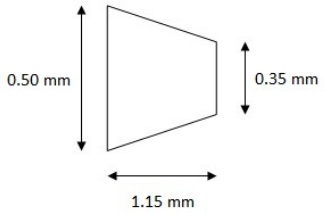

FIGURE 2.2. GALVANISED IRON KNIFE : MEASUREMENTS OF THE CUTTING EDGE

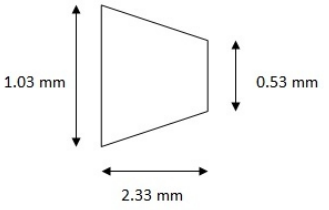

FIGURE 2.3. MILD STEEL KNIFE : MEASUREMENTS OF THE CUTTING EDGE

$$\tan\theta = \frac{A-B}{H} \quad (1)$$

θ –> Edge Angle (in °)
A –> Higher Width (in mm)
B –> Lower Width (in mm)
H –> $Heig\square t\ (in\ mm)$

TABLE 2.1. CUTTING EDGE ANGLES

	A (IN MM)	B (IN MM)	H (IN MM)	(IN °)
GALVANIZED IRON	0.50	0.35	1.15	7.43
MILD STEEL	1.03	0.53	2.33	12.00

Hence we observe that the Galvanized Iron Knife has a lower edge angle than the Mild Steel Knife. Now we will move on to use the knives for cuts to determine the relationship between the edge angle and the sharpness of a knife.

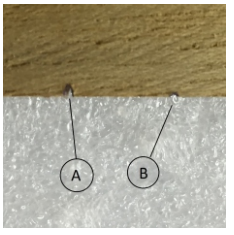

FIGURE 2.4. A. GALVANISED IRON CUT B. MILD STEEL CUT

Hence we observe that the Galvanized Iron Knife has a greater depth of cut than the Mild Steel Knife. This observation is further reaffirmed when cuts produced on chocolate bars also reveal the same result of the Galvanized Iron Knife cut being greater than the Mild Steel one. Raisins however cannot be used for observations since they simply get

deformed instead of being cut. More rigid materials like the wooden bar and chocolate bars are more reliable to measure cuts.

Furthermore, we observe, that out of the several materials cut, some materials were cut deeper than others. The Galvanized Iron was able to produce a greater depth of cut in one go in the case of a chocolate brownie than in the case of a wooden bar.

3. INTERPRETATION

We observe from our study that as the edge angle decreases, the depth of cut increases. One possible justification can be attributed to the fact that a lesser angle contributes to the ease of slicing an item as opposed to a more blunt angle, hence resulting in a greater depth of cut. It must be ensured however that the edge angle cannot be too little. A very tiny edge angle will make the cutting edge extremely fragile and prone to failure in the case of cutting hard materials. Hence a greater edge angle contributes to the strength of a knife. The optimum edge angle is a compromise between strength and sharpness and can be decided according to the use of a knife. For instance, a shaving knife has an edge angle of roughly 10° to 15°, a kitchen knife has an edge angle of roughly 17° to 22° while a hunting knife has an edge angle of roughly 30° to 40°.[2]

We also see that since hardness is the resistance of a material to permanent deformation, hence a softer material is more likely to be cut deeper than a harder material. This is also interpreted from our experiment when we observe that a chocolate brownie is cut deeper than a wooden block in a single cut produced from the same knife.

4. CONCLUSIONS

We have made the following conclusions from this experiment :

1. The lower the edge angle of the knife employed for cutting, the greater will be the depth of cut produced
2. The softer the material which is being cut, the greater will be the depth of cut produced

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[1] Mulder J., & Scott J. (2016). The Measurement of Knife Sharpness and the Impact of Sharpening Technique on Edge Durability. (Technical Report).
[2] Tormek Tool Sharpening Machines, (2016). http:// www. tormeksharpening.com/jigs-knife-long.html.