Design and Development of Disposable Razor Tool for Barber on 3D Printing Machine and Testing its strength

Anit Anil Pendhari[1], Dr. Manish Gangil[2]

[1]anitashali31@gmail.com, [2]rkdfbhojpal@gmail.com

[1]Research scholar, Department of Mechanical Engineering, RKDF University, Bhopal

[2]Professor, Department of Mechanical Engineering, RKDF University, Bhopal

Abstract

In recent years, several changes have been made mandatory like replacement of blade for every shaving. The requirement of a handy and disposable barber razor tool with inbuilt blade was felt. For the same, a new Barber Razor holding tool prototype is made with help of latest manufacturing technology of 3D printer and with biodegradable material. The material used has high clarity and can be easily mould in many shapes and dimensions.

Designs of Barber Razor tools RP1, RP2 and RP3 with inbuilt blade were fabricated on 3D printer and the designs were tested for compressive strength using UTM (Universal Testing Machine). There is uniform deformation of material at force of 0.080 KN/mm when subjected to compressive test. The material used is HIPS which is biodegradable. It makes these Razor tool more hygienic and environmental friendly and its recycling is also possible if required. It is the product which is having benefits to become best shaving Razor Tool which can be manufactured easily on large scale and with affordable cost using manufacturing methods like injection moulding and die casting.

I. Introduction

For over 100 years, men have turned to safety metal razor for their shaving needs. The history of shaving has grown alongside the evolution of the men's razor. There are two types of manual razors: straight razor and safety razors is used. The Safety razors are further subdivided into double-edged razors, single edge, injector razors, cartridge razors and disposable razors. Double-edge razors are named so because the blade that they use has two sharp edges on opposite sides of the blade. Current multi-bladed cartridge manufacturers attempt to differentiate themselves by having more or fewer blade than the conventional razor. The shape of the cartridge and the number of blades have changed over time, and a pivot has been introduced between the blades and handle to better simulate the pivot of a barber's wrist and allow better interaction between the razor and skin.

There is no single thin blade material that is appropriate for all cutting applications. There are a wide range of hardened stainless steels, flat ground tool steels, and many other wear resistant materials from which to choose from various manufacturers across the globe. The ideal blade material would be highly wear and shock resistant, economical, available in a wide range of thickness and finish, readily sharpened to a fine quality edge, possess outstanding corrosion resistance, and have no distortion after heat-treatment.

The selection of machinery and equipment generally depends upon the product/products to be manufactured and their processes of manufacture. Since the razors is being manufactured with state-of-the-art machinery and equipment, it is suggested that new units which intend manufacturing of the item can design and develop their own state-of-the-art machinery and equipment constantly focusing on research and development arriving at the optimum production at low cost at their end with in-process quality control being incorporated in the systems. The manufacture of razor blades involves a variety of operations such as punching, hardening etc by using the usual processes.

Now a day's latest manufacturing technology is play a vital role of manufacturing of complex shape product. Also rapid prototyping is one of the manufacturing technology is proven in market as alternative to conventional manufacturing technology.

1.1 Rapid Prototyping:

Rapid prototyping and it refers to group of techniques used to rapidly manufacture a scale model of an actual part or assembly utilizing three-dimensional computer aided design (CAD) data. It is otherwise called a class of technologies and is defined, for the purpose preliminary, as a 'different' set of mechanical devices and assets that can naturally develop actual models from computer-Aided Design (CAD) data. The distinctive rapid prototyping technologies are monetarily accessible, each with distinctive strengths. [1]

The RP techniques are used as follows:

- Stereo Lithography (SLA)
- Laminated Object Manufacture (LOM)
- Selective Laser Sintering (SLS)
- Fused deposition Modeling (FDM)

1.1.1 Stereo Lithography (SLA):

The SLA constructs three dimensional models from fluid photosensitive polymers that solidify when presented to ultraviolet light. As shown in the figure 1.1, the model is based upon a stage arranged just underneath the surface in a tank of fluid epoxy or acryl ate resin. A low-power profoundly focused UV laser follows out the main layer, solidifying the model's cross section while leaving overabundance area liquid.

Then, an elevator gradually brings down the stage into the liquid polymer. A sweeper re-covers the solidified layer with liquid, and the laser follows the second layer on the first. This progression is repeated until the model is finished. A short time later, the solid part is eliminated from the tank and washed clean of excess liquid. Supports are severed and the odel is then located an ultraviolet oven for complete curing.

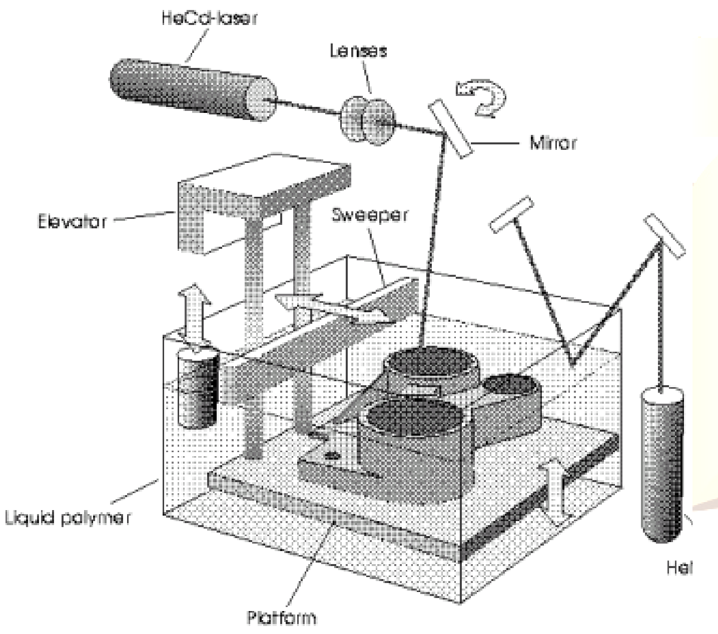

Figure 1.1: Schematic diagram of stereo lithography

1.1.2: Laminated Object Manufacturing

In this technique, created by Helisys of Torrance, CA, layers of of adhesive-coated sheet material are bonded together to shape a model. The first material comprises of paper laminated with heat-activated glue and moved up on spools. As shown in the figure 1.2 below, a feeder/collector mechanism propels the sheet over the build platform, where a base has been developed from paper and double sided form tape. Then, a heated roller applies pressure to bond the paper to the base. A laser cuts the outline of the initial layer into the paper and afterward cross-hatches the excess area (the negative space in the model). Crosshatching separates the additional material, making it simpler to eliminate during post-preparing. During the build, the excess material offers support for overhangs and thin-walled sections. After the main layer is cut, the platform brings down far removed and new material is progressed. The platform ascends to marginally below the past tallness, the roller bonds the second layer to the first, and the laser cuts the subsequent i.e second layer. This cycle is repeated on a case by case basis to assemble the part, which will have a wood-like surface. Since the models are made of paper, they should be fixed and finished with paint or varnish to prevent moisture damage. [1]

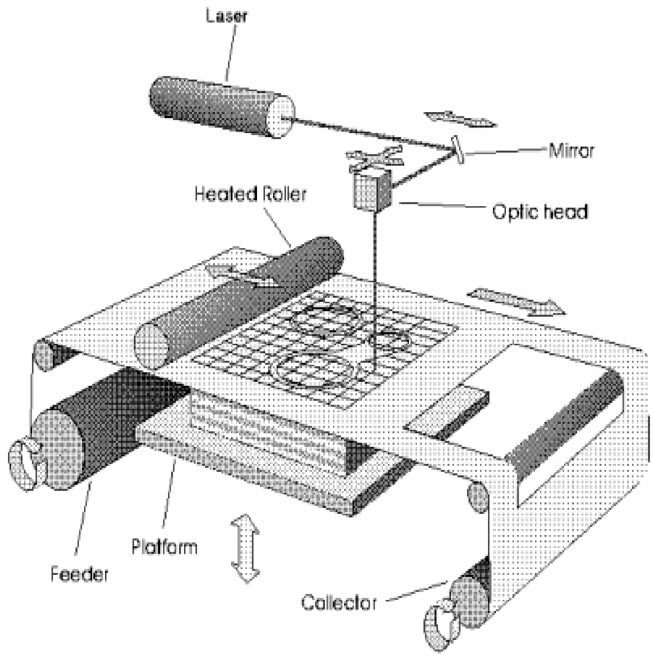

Figure 1.2: Schematic diagram of laminated object manufacturing

1.2.3: Selective Laser Sintering:

SLS is developed by Carl Deckard for his master's thesis at the University of Texas; Selective laser sintering was protected in 1989. The technique, showed in Figure 1.3, utilizes a laser beam to selectively fuse powdered materials, like nylon, elastomeric and metal. Parts are based upon a platform that sits just underneath the surface in a bin of the heat-fusible powder. A laser traces the outline of the first layer, sintering it together. The platform is brought down by the height of the following layer and powder is reapplied. This process persists until the part is finished. Excess powder in each layer assists with supporting the part during the build. SLS machines are made by DTM of Austin, TX. [1]

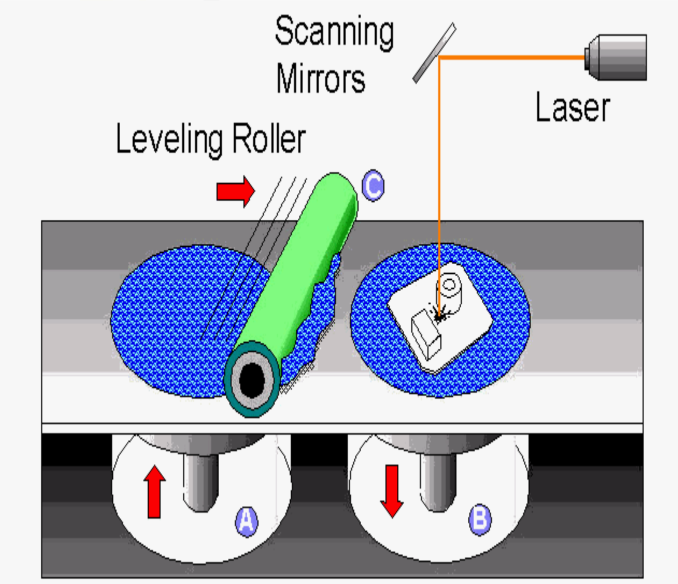

Figure 1.3: Schematic diagram of selective laser sintering

1.1.4: Fused Deposition Modeling:

In this method, filaments of heated thermoplastic are extruded from a tip that moves in the x-y plane. Like a baker decorating enhancing a cake, the controlled extrusion head deposits very thin beads of material onto the build platform to form the first layer. The platform is kept up with at a lower temperature so the thermoplastic rapidly solidifies. After the platform brings down, the extrusion head deposits a second layer upon the first. Supports are worked the route, attached to the part either with a second, more fragile material or with a perforated junction. **[1]**

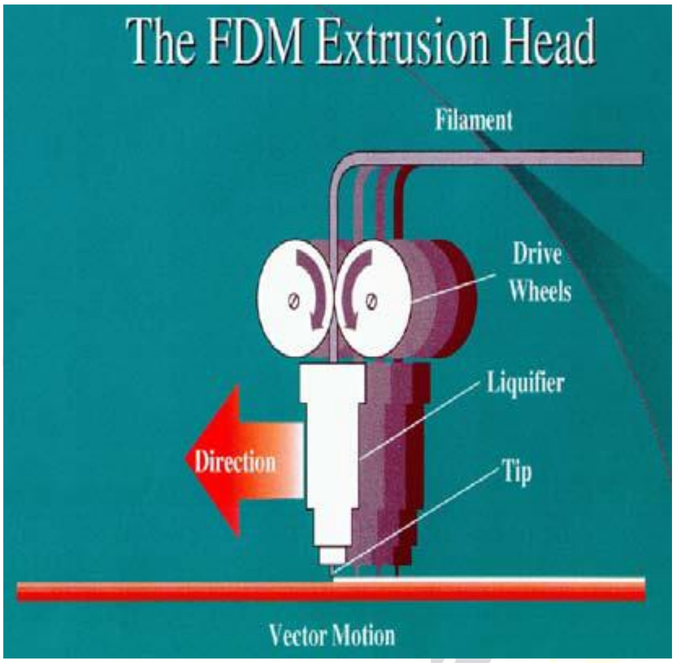

Figure 1.4: Schematic diagram of fused deposition modelling

2. Literature Survey

This literature study was based on the manufacturing techniques, selection of proper material used for the design and development of the disposable Razor Tool for Barber. Also, a correlation study was done between the existing tools and disposable razor tool to be developed.

Abdulhameed, O et.al. were worked on the Additive Manufacturing: Challenges, trends and applications. This work incorporates the idea of Additive Manufacturing (AM) and its significance is discussed. 3D printing technology and the material utilized in it was examined. An AM working with item improvement choice, the Importance of AM in item advancement in assembling perspective is likewise expressed. Added substance fabricating is a new pattern underway cycles inferable from its numerous advantages. It very well may be characterized as the way toward delivering parts through the affidavit of material in a layer-by-layer style. It's anything but a subject of extreme examination and audit by numerous specialists. The advancement of added substance production as a noticeable innovation and its different stages are talked about. The significance of part orientation, build time estimation, and cost computation has additionally been explored. **[2]**

Vinod G. Gokhare et.al. were studied A Review paper on 3D-Printing Aspects and Various Processes Used in 3D-Printing. The researchers examined how the cycle of 3D printing functions, which sort of material was utilized in 3D printing machines, and how it will be helpful in the manufacturing industry. It likewise investigates the various process involved in 3D printing technology. **[3]**

Chandrasekhar Kalnad, was reviewed A review on 3D printing. In This reviewed work, examine about the how 3D printing technology works with CAD software and states the importance of the CAD in this rapid Prototyping Technology. **[4]**

Rodriguez, J.F et.al. were introduced the work on the Design of Fused-Deposition ABS Components for Stiffness and Strength. The researcher expresses the Acrylonitrile-Butadiene-Styrene (FD-ABS; P400) segments made by combined testimony technique tried for its solidness and strength under a given arrangement of stacking conditions. A numerical model of the underlying framework is connected to an inexact minimization calculation to discover the settings chose to produce boundaries, which advances the mechanical presentation of the part. The system is exhibited by amplifying the heap conveying limit of a two-separated cantilevered FD-ABS shaft. **[5]**

Agnieszka Łagoda et.al had made the investigation on Strength Parameters of the ABS Materials Used in 3D Printing. An alternative technology is 3D printing technology that uses ABS material (poly (acrylonitrile-co-butadiene-co-styrene)). In this work was done a comparison between materials and their mechanical parameters have been determined. The model analysis of this material was carried out and the obtained values of resonance frequencies were compared. **[6]**

Cantrell, J.T. et.al were examined worked on Experimental Characterization of the Mechanical Properties of 3D Printed ABS and Polycarbonate Parts. In this paper, shear modulus and shear yield strength varied by up to 33% in ABS specimens signifying that tensile properties are not indicative of shear properties. Raster orientation in the flat build samples reveal anisotropic behavior in PC specimens as the moduli and strengths varied by up to 20%. Similar variations were also observed in shear for PC. Changing the build orientation of PC specimens appeared to reveal a similar magnitude of variation in material properties. **[7]**

TP Mpofu et.al were worked on The impact and application of 3D printing technology. The researcher shows that, the 3D printing also known as Additive manufacturing technology has been dubbed the next big thing and be as equally wide spread as cellular telephone industry. 3D printers print objects from a digital template to a physical 3-dimensional physical object. The printing is done layer by layer (Additive manufacturing) using plastic, metal, nylon, and over a hundred other materials. 3D printing has been found to be useful in sectors such as manufacturing, industrial design, jewellery, footwear, architecture, engineering and construction. **[8]**

Maniraj. P et.al. were investigated work on New Product Development of Innovative Shaving Razor by Rapid Prototyping. The ergonomic design is done by impressing a clay model with hand to form a pattern, which fits with the human hands. The shape and size of the pattern is retrieved by using the Reverse Engineering Technique. Selective laser sintering process is used to fabricate the parts. All the parts are assembled together manually. This innovative razor has ergonomics design on the handle and uses the standard blades for shaving. Thus, it will be economical and fits with the human beings who use them**. [9]**

Divyathej M V et.al. were analyzed the work as Analysis of mechanical behavior of 3D printed ABS parts by Experiments. In this work, the mechanical properties and behavior of a 3D Printed object is to be studied by varying parameters such as layer thickness, orientation etc. Various tests such as tensile test, compression test, flexural test and impact test to determine failure characteristics of such materials will be conducted. Based on experimental results, stress–strain relationship and failure criterion can be proposed. Then the strength and mechanical properties of a 3D printed specimen is compared with the product made out of conventional manufacturing method i.e.; through Automated Injection

Molding process. Test results and microscopic observations confirmed that 3D Printed products have anisotropic structure and have advantages over conventional manufacturing processes. **[10]**

K. Cowley et.al were reviewed the Article on The biomechanics of blade shaving. This study aims to explore and quantify the forces that act upon the skin and hair during the shave and suggests that careful management of these forces is essential in optimizing the shaving process. Various razor features are discussed and their impact on the resulting biomechanical forces is considered. Recent data are included comparing a basic low-tier disposable razor with a more technologically advanced premium system razor and show significant differences in both subjective shave attribute scores and resulting blood flux in the skin.**[11]**

M. M. Padzi1 et.al were worked on Fatigue Characteristics of 3D Printed Acrylonitrile Butadiene Styrene (ABS). The dog bone shape part was produced based on ASTM D638 standard and the tensile test has been carried out to get the mechanical properties. Fatigue test was carried out at 40%, 60% and 80% of the tensile strength. The moulded part shows higher fatigue cycles compared to 3D printed part for all loading percentages. Fatigue lives for 40%, 60% and 80%, were 911, 2645 and 26948 cycles, respectively. The results indicated that 3D printed part has a lower fatigue life, which may not suitable for industrial applications. However, the 3D printed part could be improved by using various parameters and may be introduced in low strength application. **[12]**

Mateusz Galeja et.al presented work on Static and Dynamic Mechanical Properties of 3D Printed ABS as a Function of Raster Angle. One of the most crucial parameters of FDM printing is the raster angle and mutual arrangement of the following filament layers. Presented research work aims to evaluate different raster angles (45°, 55°, 55°, 60° and 90°) on the static, as well as rarely investigated, dynamic mechanical properties of 3D printed Acrylonitrile butadiene styrene (ABS) materials. Configuration named 55° was based on the optimal winding angle in filament-wound pipes, which provides them exceptional mechanical performance and durability. Also, in the case of 3D printed samples, it resulted in the best impact strength, comparing to other raster angles, despite relatively weaker tensile performance. Interestingly, all 3D printed samples showed surprisingly high values of impact strength considering their calculated brittleness, which provides new insights into understanding the mechanical performance of 3D printed structures. **[13]**

King C.Gillete was patented and invented certain new and useful improvements in Razors of which the following is a specification. His invention is particularly applicable to razors of the safety type, the use of which as heretofore constructed involves a considerable amount of trouble, time and expense on tile part of the user in keeping the blades. A main object of his invention is to provide a safety-Razor in which the necessity of honing or stropping the blade is done away with, thus saving the annoyance and expense involved therein, and to this end. He secures this blade to a holder so constructed as to provide a rigid backing and support for the blade, as well as a handle. **[14]**

Sharidan Stiles, has patented and invented a personal shaving razor. A hand-held razor has single or multiple blades of a smaller dimension than is typical and features an ergonomically advantageous handle allow more detailed shaving and hair removal. Embodiments include a shaving head that is an integrated disposable razor or is part of are place able razor blade cartridge. A personal styling razor, comprising a handle portion having lower, middle and upper longitudinal portions and a head portion having a razor blade and attached to said upper longitudinal portion wherein said lower longitudinal portion extends along a first axis, said middle longitudinal portion extends along a second axis and said upper longitudinal portion extends along a third axis and wherein said first and third axes form a control angle that is less than ninety degrees and said razor blade has a width of less than or equal to one inch size of the pattern is retrieved by using the Reverse Engineering Technique. Selective laser sintering process is used to fabricate the parts. All the parts are assembled together manually. This innovative razor has ergonomics design on the handle and uses the standard blades for shaving. Thus, it will be economical and fits with the human beings who use them. **[15]**

On the basis of literature survey it is clear that, the new manufacturing techniques like additive manufacturing can be used for the design and development of disposable razor tool. The 3D printing technology is having very much impact, cost effective, strong, lightweight and same time posses the excellent mechanical properties.

3. Conclusion

The work proposes a novel design for Razor Disposable tool to provide a cost effective solution to the barber. The three designs namely RP1, RP2 and RP3 of Razor Disposable tool are simulated using Kisslicer CAD software. The RP1, RP2 and RP3 are fabricated using 3D printing technology. HIPS material is used for manufacturing which provides good compressive strength, due to which least stress will be induced in material with uniform deformation. The uniform deformation of material at force of 0.080 KN/mm is measured using UTM. The material used is biodegradable which makes this razor tool more environmental friendly, which can also be recycled if required. This product will provide the barber ease in handling, cost affordable solution and hence can be a milestone in Barber.

4. Future Scope

Rapid prototyping is beginning to change the manner in which industrial design and fabricate of the product by utilizing various materials. On the Horizon, however, are several future advancements that will be helpful to build the products like dispensable stylist razor devices are as per the following,

1. One such improvement is increased speed of the rapid prototyping machine. "Rapid" prototyping machines are still slow by some standards faster computers, more complex control systems, and improved materials, RP manufacturers are dramatically reducing build time.
2. Improvement in accuracy and surface finish. Improvements in laser optics and motor control should increase accuracy in all three directions of the Razor tool Models
3. For the Razor instrument Product, need to development in polymer and non-polymer materials. The material will be having great properties like high strength; withstand high temperature, biodegradable, and significantly having less cost. Also, metal and composite materials will enormously grow the scope of items that can be made by rapid manufacturing.
4. Another significant advancement is increased size capacity with regards to mass production with less time.

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