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A Comprehensive Study on Advanced Laser Cutting Technology in Leather Industry

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ABSTRACT

Leather cutting serves a crucial role in modifying the shape of leather products. Nowadays, there is a clear difference in cutting technologies applied to leather. Industrial leather processing serves the purpose of mass production of leather items in order to satisfy the demand of essential products like clothes, shoes, bags, etc. these demands from technology to be economically efficient, fast, adaptive and to provide maximum possible results with minimum possible cost. Manual cutting with use of scissors and special knives are used in leather crafting. This allows producing individual unique items whose value is not determined not only by functionality but also based on more visual effects and design features. Currently computerized technologies are applied for leather cutting, which includes- Plasma Cutting, water jet cutting machine, automatic blade cutting, and Laser Cutting. Use of Die Cutting in collaboration electro-mechanical technology has grown significantly during recent years due to number of advantages over conventional cutting methods; flexibility, high production speed, possibility to cut complex geometries, easier cutting of customized parts, and less leftovers of leather makes computerized Cutting more and more economically attractive to apply for leather cutting. This paper studies the leather cutting through laser technology operations understanding through practical applications and also through various research works and provides the theoretical data for Design calculations, fabricate & automate the leather blanking machine in such a way that the required length of leather blank of accurate size can be cut with keeping cost minimum for a sponsored company. Hence by adopting modern laser technology we can derive more variety leather designs, achieving accuracy economically.
Keywords : Plasma Cutting, Laser Cutting, and water jet cutting machine, visual effects, Automation, die-cutting.

I. INTRODUCTION

Leather is a material which has been used for centuries. It can be said that all this time constant development of leather treatment techniques, tools, methods has been going on. Thus, from stone knifes and bone needles, technology evolved into industrial cutting, dyeing, pressing and slitting machines with basically the same purpose – to convert leather surface and shape into desired product. Leather cutting serves a crucial role in modifying the shape. Nowadays, there is a clear difference in cutting technologies applied to leather. Industrial leather processing servesthe purpose of mass production of leather items in order to satisfy the demand of essential products like clothes, shoes, bags, etc. This demand from technology to be economically efficient, fast, adaptive and to provide maximum possible results with minimum possible cost. Manual cutting with use of scissors and special knifes is used in leather crafting. This allows producing individual unique items whose value is not determined by functionality but based more on visual effects and design features. It is known that **laser technology** enables cutting of a great variety of material from metals to non-metallic materials. Laser energy can be applied directly on desired objects with easy control of its power and intensity. Leather is suitable material for laser cutting. This makes laser an attractive tool for leather cutting. It provides high quality cutting, easy change of cutting geometry and production in short time but on the other hand requires high initial investments and requires special knowledge of laser operation. Beside that it has thermal effect on leather that might be an issue in some applications. This study investigatesthe most beneficial applications of laser cutting of leather, describes its advantages and drawbacks and provides an overview on potential use of laser as industrial or craftsmen cutting tool.

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II. BACK GROUND AND JUSTIFICATION

2.1 Laser cutting of leather

CO_2 laser cutting and engraving machines are widely used to cut or engrave the leather materials, mostly in shoes,bags, cloth or other industries. Generally, the cutting speed can reach 5-30 mm per second, the engraving speed may reach 600 mm per second (Anon., 2015).The economy of the laser cutting process mainly depends on two productivity aspects: nesting and cutting sequence. Nesting is a process of positioning of parts to be cut on given material with the main aim to minimize waste. Nesting is often done based on operator experience and it becomes a challenge in case of large production volumes. Besides that, it does not guarantee the most efficient utilization of material. Nesting software is used nowadays to enhance material utilization and improve flexibility. Cutting sequence targets the optimal cutting procedure for minimum cycle time. The objective of cutting sequence is to find the shortest path to accomplish cutting procedure (Umar Sherif et al., 2014). The challenges with nesting and cutting sequence occur in leather cutting due to irregular shapes, contoursandquality zones of natural leather. Such problems are especially common in automotive industry for instance in cutting of large pieces of car seats (Alves et al., 2012). The role of nesting software increases when leather cutting isapplied in industrial scale (Elamvazuthi et al., 2009). Lasers are also reported to be applied for cleaning of leather surface. Nd: YAG lasers with wavelength of 1064, 532 and 266 nm were applied for this purpose. Laser irradiation was applied to historical leather artefacts in order to remove pollution substances and recover original leather color (Batishche et al, 2007, Simileanu et al., 2009).

There are many industries that use leather for manufacturing their products. Being the versatile material that it is, leather is capable of retaining its shape and design in all kinds of cutouts. Whether you desire to make large cutouts or small ones, our laser leather cutting and engraving machines will help you get the right shape, pattern and cut in the least possible time.

We take immense pride in the laser technology employed by our leather cutting and engraving machines. Laser cutting experts use the simplest of processes to craft the most beautiful leather products for all industry verticals. By using leather cutting technology and engraving methods, you can meet the leather specific requirements of your clients without any concern. Be it for your tablet covers, address card holders, footwear, laptop bags, fancy hold-alls, or anything else – laser cut leather is what you should seek right away.

The precise and accurate processes used in our laser technology applications lead to no distortion or damage of any original material. Laser leather cutting processes can be tailor made to help leather manufacturers craft the best designs and patterns.

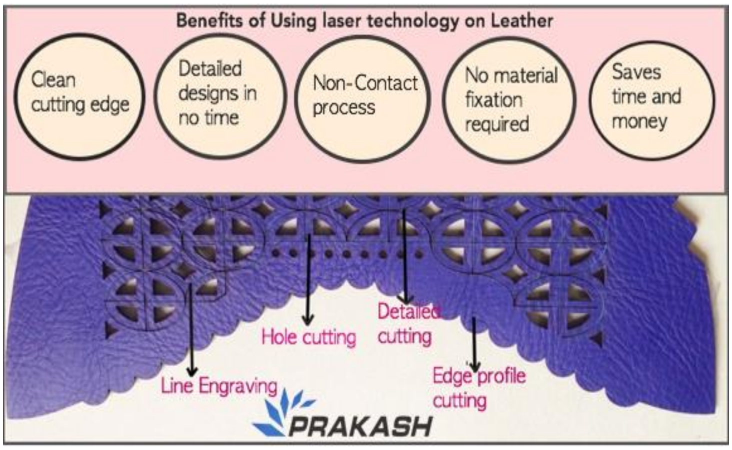


Figure 1: benefits of using laser technology on leather

2.2 Laser Cutting and Leather Products

Gone are the days when markings on leather were courtesy time-consuming banding / pressure stamping processes that involved the production of physical stamps, considerable work, and high processing expenses. The advent of laser technology has made the task considerably easier and far more impactful. Customizable to the core, laser technology is helping leather manufacturers create tailor-made designs and patterns to suit all client requirements – however big or small.

Ways in which Leather Impacts the Effects of Laser

The color and type of leather used affect the laser marking result. For instance, light-colored leather supports laser in the best possible way. While stained or tanned leather leads to an impactful appearance and contrast, dark colored leather highlights all kinds of engraved graphics distinctly. Whether it is about creating a subtle look or making graphics and cuts more prominent via the right laser inputs, there is no dearth of possibilities with this technology.

Benefits of Low Power & Costs

The process of laser marking on leather products uses very low power. Just a few moments of trial and error are enough for getting the appropriate settings for the laser cutting machine. As laser applications are computer controlled, they do not involve much manual work, thereby increasing work overall work efficiency and reducing overall labor costs.

No End to Leather Marking Possibilities

Graphics, texts, photos and all other kinds of impressions work equally well on leather products. Third-party software programs, with presets for smarter and new ideas for leather laser marking, are factoring in many new features, leading to impressive results!

2.3 Some Laser machinery manufacturer

1. Trotec laser machinery and equipment manufacturer.
2. Man tech laser machinery manufacturer
3. Gobs
4. Reinle
5. WWH
6. ALPHA LABER
7. CTR
8. Lectra
9. PRAKASH

III. OBJECTIVES

To explain about leather cutting through laser technology process to provide relevant examples of laser cutting products and also discuss elaborately laser cutting technology and its advantages in leather industry to compete in the global leather market.

IV. METHODOLOGY

CO2 laser systems are being put to use for cutting intricate designs and patterns on high-quality leather used for manufacturing shoes, footwear, bags, belts, and so forth. Requiring little space for work completion, this laser aided marking process gives off a typical odor that makes proper ventilation a necessity. Also, because of the use of laser inputs, the requirements of personnel, human interaction, and supporting facilities are greatly reduced. These marking processes lead to very few man-made errors, high quality metrics, and a low production period.

4.1 Laser cutting working principles

Most laser cutting is carried out using CO2 or Nd: YAG lasers. The general principles of cutting are similar for both types of laser although CO2 lasers dominate the market for reasons, which will be discussed later in the paper.

The basic mechanism of laser cutting is extremely simple and can be summarized as follows:

1. A high intensity beam of infrared light is generated by a laser.
2. This beam is focused onto the surface of the workpiece by means of a lens.
3. The focused beam heats the material and establishes amuch localized melt (generally smaller than 0.5mm diameter) throughout the depth of the sheet.
4. The molten material is ejected from the area by pressurized gas jet acting coaxially with the laser beam (N.B. With certain materials this gas jet can accelerate the cutting process by doing chemical as well as physical work. For example, Carbon or mild steels are generally cut in a jet of pure oxygen. The oxidation process initiated by the laser heating generates its own heat and this greatly adds to the efficiency of the process.)

5. This localized area of material removal is moved across the surface of the sheet thus generating a cut. Movement is achieved by manipulation of the focused laser spot (by CNC mirrors) or by mechanically moving the sheet on a CNC X-Y table. ‘Hybrid’ systems are also available where the material is moved in one axis and the laser spot moved in the other. Fully robotic systems are available for profiling three dimensional shapes. Nd: YAG lasers can utilize optical fibers rather than mirrors but this option is not available for the longer wavelength CO2 laser.

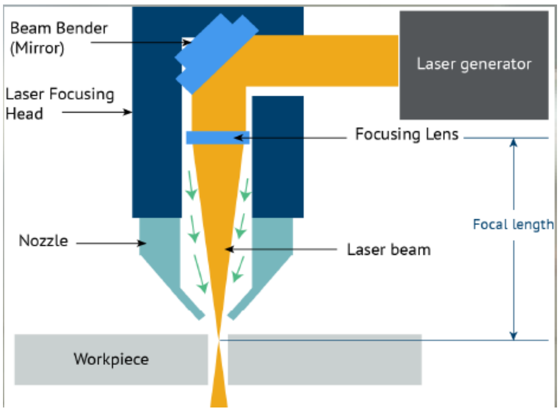


Figure 2. A schematic of laser cutting**.**

The lens mount or the nozzle (or both) can be adjusted from left to right or into and out of the plane of the sketch. This allows for centralization of the focused beam with the nozzle. The vertical distance between the nozzle and the lens can also be adjusted.[1] T. F. Lam, W. S. Sze and S. T. Tan, Mar, 2007.[2]J. Heistermann and T. Lengauer. E., (1995). [3] Schneider, F., Petring, D., Poprawe, R. Increasing Laser Beam Cutting Speeds, ICALEO 99, San Diego. [4] Powell, J. (1999).

4.2 Laser cutting Specification and Technical Parameter

Table 1. Laser cutting Specification

No	Specification	
1	Working Table	1800*1000 (mm)
2	Laser power	60-150 (W)
3	Weight	437 (kg)
4	Cutting speed	25(m/min)
5	Engraving speed	60 (m/min)
6	Location precision	±0.1 （mm）

Technical Parameter

Table 2. Technical Parameter

1	Processing area	1800*1000mm
2	Max running speed	36/min
3	X/Y location precision	0.1mm/m
4	Machine gross power	≤1250W
5	Running Temperature	0°C-40°C
6	Blowing System	lower blowing system(upper blowing system is available)
7	Formats	CDR、BMP、PLT、GPEG、DXF、DST
8	Applied Materials	cloth, leather, textile, computerized embroidery cutting,

		cases, bags,etc

[1] ParagKohli and Ms. ShalviGarg, ‘Jun. 2013**.** **[2]** Mr. ChetanP. Sable1, Prof. P. D. Kamble2, Mr. Dhiraj D. Dube3, May 2014. **[3]** M. Kostina a,*, T. Karaulova a, J. Sahno a, M. Maleki b, Mar. 2012.

4.3 MACHINE FEATURES

- Especially for genuine leather cutting. Suitable for all kinds of genuine leather and hides products cutting processing industries.
- Laser cutting with smooth and precise cutting edge, high quality, no distortion.
- It adopts high-precision digital system that can accurately read the contour of leather and avoid poor area and do rapid automatic nesting on sample pieces (users can also use manually nesting).
- Simplify the complex processing of genuine leather cutting to four steps:

1. Inspection 2. Reading 3. Nesting 4. Cutting

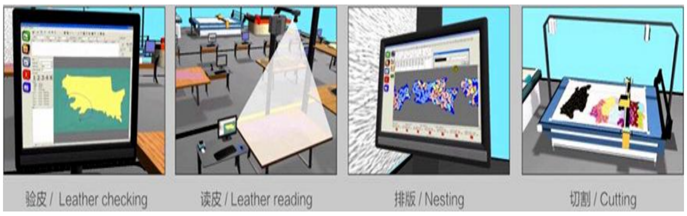


Figure 3. Leather cutting to four steps

- During the time of nesting, it can also project the same pieces, display sample cutting position on the leather and improve the utilization of leather.
- Equipped with large area recognition system, projection system and auto-nesting software.
- It is applicable to car seat cover, sofa and other large-size leather goods precision cutting.

1. Rajendran Natarajan, Ph.D. Dissertation: Jan, 1990.
2. Hügel H., Mar,1991.

4.5 METHODS

There are many different methods in cutting using lasers, with different types used to cut different material. Some of the methods are vaporization, melt and blow, melt blow and burn, thermal stress cracking, scribing, cold cutting and burning stabilized laser cutting.

Vaporization cutting

In vaporization cutting the focused beam heats the surface of the material to boiling point and generates a keyhole. The keyhole leads to a sudden increase in absorptivequickly deepening the hole. As the hole deepens and the material boils, vapor generated erodes the molten walls blowing eject out and further enlarging the hole. Non melting material such as wood, carbon and thermoset plastics are usually cut by this method.

Melt and blow

Melt and blow or fusion cutting uses high-pressure gas to blow molten material from the cutting area, greatly decreasing the power requirement. First the material is heated to melting point then a gas jet blows the molten material out of the avoiding the need to raise the temperature of the material any further. Materials cut with this process are usually metals.

Thermal stress cracking

Brittle materials are particularly sensitive to thermal fracture, a feature exploited in thermal stress cracking. A beam is focused on the surface causing localized heating and thermal expansion. This results in a crack that can then be guided by moving the beam. The crack can be moved in order of m/s. It is usually used in cutting of glass.

Stealth dicing of silicon wafers

The separation of microelectronic chips as prepared in semiconductor device fabrication from silicon wafers may be performed by the so-called stealth dicing process, which operates with a pulsed Nd:YAG laser, the wavelength of which (1064 nm) is well adopted to the electronic band gap of silicon (1.11 eV or 1117 nm). Further information: Wafer dicing.

Reactive cutting

Also called "burning stabilized laser gas is cutting", "flame cutting". Reactive cutting is like oxygen torch cutting but with a laser beam as the ignition source.

4.6 CO2 LASER CUTTING LEATHER SYSTEM

The CO2 laser (carbon dioxide laser) is generated in a gas mixture, which mostly consists of carbon dioxide (CO2), helium and nitrogen. Such a laser is electrically pumped using an electric discharge.

CO2 lasers typically emit at a wavelength of 10.6μm. Those used for material processing can generate beams of many kilowatts in power. The wall-plug efficiency of CO2 lasers is about 10%, which is higher than for most lamp-pumped solid-state lasers (eg ND:YAG lasers), but lower than for many diode-pumped lasers.

A CO2 laser can cut thicker materials (>5mm) faster than a fiber laser of the same power. It also produces a smoother surface finish when cutting thicker materials.

Laser cutting of sheet metals historically started with CO2 lasers. Most CO2 laser cutting machines are three-axis systems (X-Y, two-dimensional positioning control with a Z-axis height control). There are, however, a number of ways of achieving the X-Y movement: either moving the laser head, moving the workpiece or a combination of both. The most popular approach is known as a 'flying optics' system, where the workpiece remains stationary and mirrors are moved in both X and Y axes. The advantages of this approach are that the motors are always moving a known, fixed mass. This can often be much heavier than the workpiece, but it is easier to predict and control. As the workpiece is not moved, this also means that there is no real limit to sheet weight. The disadvantage of flying optics is the variation in beam size, as a laser beam is never perfectly parallel, but actually diverges slightly as it leaves the laser. This means that without controlling the divergence, there may be some variation in cutting performance between different parts of the table, due to a change in raw beam size. This effect can be reduced by adding a re-collimating optic, or some systems even use adaptive mirror control. The alternative is a 'fixed optic' system where the laser head remains stationary and the workpiece is moved in both X and Y axes. This is the ideal situation optically, but the worse situation mechanically, especially for heavier sheets. 1.Golnabi H. and Mahdieh M. H., March 2006.

For relatively light sheet weights, a fixed optic system can be a viable option, but as the sheet weight increases, accurately positioning the material at high speed can be a problem.

The third option is known as a 'hybrid' system, where the laser head is moved in one axis and the material moved in the other axis. This is often an improvement over fixed optics, but still suffers from difficulties with heavier sheet weights.

The laser-active medium in a CO_2 laser is a mixture of CO_2, N_2 and He gases, where CO_2 is the laser-active molecule. The stimulation of the laser-active medium is accomplished by electrical discharge in the gas. During the stimulation process, the nitrogen molecules transfer energy from electron impact to the CO_2 molecules. The transition from energetically excited CO_2 molecules (upper vibrational level) to a lower energy level (lower vibrational level) is accompanied by photon release leading to emission of a laser beam. The CO_2 molecules return to the ground state by colliding with the helium atoms, which comprise the major share of the gas mixture, and the CO_2 molecules in the ground state are then available for another cycle. The stimulation of the electrical gas discharge in the gas mixture is accomplished by either direct current or radio frequency stimulation. In direct current stimulated lasers, gas discharge betweenelectrodes allows the electrical energy to be directly coupled into the laser gas while the radio frequency stimulated lasers are characterized by capacitive incoupling of the electrical energy needed for gas discharge.

There are different designs of the CO_2 laser that use different modes of gas flow and cooling enabling effective beam delivery over a wide range of output power. The CO_2 laser technology includes the following designs: Transverse flow (cross-flow) laser, Fast-axial flow laser, Diffusion-cooled slab laser and Sealed-Off laser. They can be operated in either the CW mode or pulsed mode. The beam power and beam quality of the transverse flow (cross-flow) CO_2 laser (multi-mode,) are favorable for laser welding applications.

There are different designs of the CO_2 laser.

1. Fast-axial flow CO_2 laser
2. Diffusion-cooled (slab) CO_2 laser
3. Sealed-Off CO_2 laser

4.6.1 Fast-axial flow CO_2 laser

The fast-axial flow lasers have different designs based on different beam paths. The different beam paths of the fast-axial flow laser designs include triangular beam path, rectangular beam path and beam trajectory planes oriented at a 45° angle to each other. Due to their physical principle, the fast-axial flow lasers provide a better beam quality than cross-flow lasers. a fast-axial flow laser design with an optical resonator that consists of a rear mirror and a diamond outcoupling mirror. The beam trajectory of this fast-axial flow laser is mirror-folded in four paths and forms two planes oriented at a 45° angle to each other. Three of the four paths, all consisting of quartz glass tubes, contain a total of 12 electrode pairs for radio frequency excitation of the laser gas mixture passing through the tubes. Turbines generate the laser gas flow and the laser gas flows through a heat exchanger before and after passing through the turbine. The cooling water, which passes through the heat exchanger in a separate closed loop, cools down the laser gas. The performance stability of the fast-axial flow laser is directly related to the thermal stability of the supplied laser gas therefore the temperature regulation for the water loop must be highly constant. Alinearly polarized laser radiation is emitted through the resonator construction eliminating the need for additional polarization optics outside the resonator.1. Rajaram N., Sheik-Ahmad J. and Cheraghi S. H., Dec, 2003. Balbi M., Silva GOct.-Nov.-Dec. 1982.

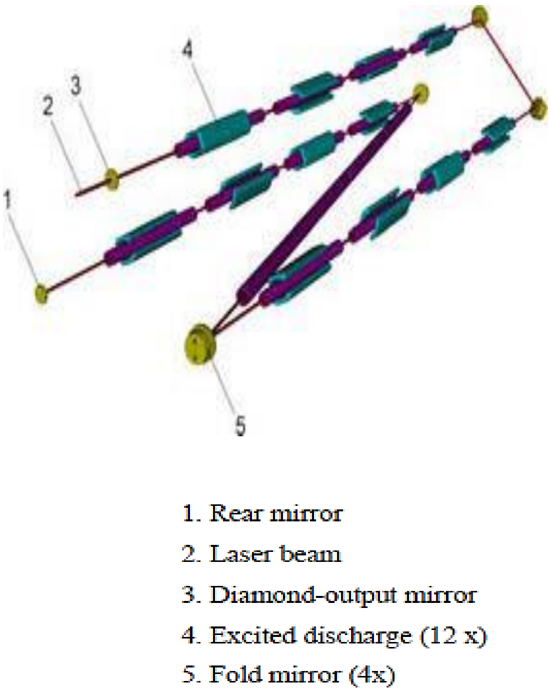
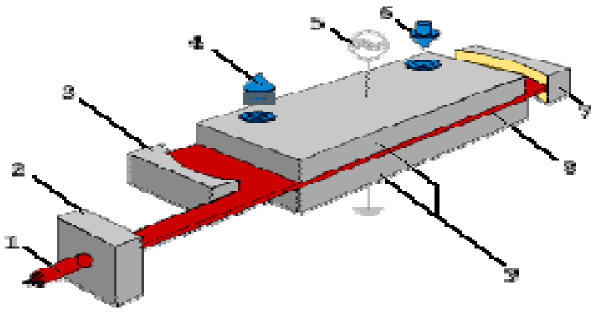


Figure 4. Fast-axial flow CO2 laser

4.6.2 Diffusion-cooled (slab) CO_2 laser

The diffusion cooled (slab) CO_2 lasers, available in a power range between 1 and 5 kW, have a highly compact design. These lasers are equipped with large-area copper electrodes and radio frequency gas discharge takes place between the electrodes. The narrow inter-electrode spacing allows effective heat removal from the discharge chamber via the directly water-cooled electrodes giving rise to comparatively high power density. Heat transport is exclusively by diffusion hence the name “diffusion-cooled laser”. The unstable resonator consists of rotation-parabolic mirrors, allowing outcoupling of a laser beam with extremely good focusing properties. External, water-cooled, reflective beam shaping components are used to convert the originally rectangular beam to a rotation symmetrical beam with a beam quality of . The major advantages of this type of laser include the compact and almost entirely wear-resistant design, and the practically negligible gas consumption.



1. Laser beam
2. Beam shaping unit
3. Output mirror
4. Cooling water
5. RF excitation
6. Cooling water
7. Rear mirror
8. RF excited discharge
9. Wave-guiding electrodes

Figure 5. Diffusion-cooled (slab) CO2 laser

4.6.3 Sealed-Off CO_2 laser

The Sealed-Off CO_2 laser is based on sealed gas laser expertise of the diffusion-cooled Slab laser technology. The Sealed-Off CO_2 lasers are maintenance-free, completely sealed and require no external gas, making them robust and highly reliable. These lasers are available with output powers of upto 600 W and are typically used for cutting of non-metals (paper, glass, plastics) and metals, rapid prototyping and marking applications.1. Gabzdyl J. T., October 1996.

4.7 SOME ADVANTAGES OF A LASER CUTTING:

1. Lower power consumption: a typical blanking press or turret punch consumes 50kW of power in total. A 4kW laser system uses 10kW of power total typically.

2. Safety: A blanking press has a large blade that moves rapidly up and down, and doesn't necessarily have safety features to prevent a hand getting caught in it. A fiber laser is required to be enclosed by a light tight box which means they are designed to run without human intervention during cutting.

3. Material Scrap savings: Due to a cutting tool requiring material on either side of the cut, a border of at least 1/2 inch is required. For a laser, if parts share a common outline, they may be cut with a single cut, with no scrap. A minimal scrap skeleton may also be cut, as small as 1/16 of an inch or even less for some materials.

4. Cutting properties: a blanking die can only cut materials up to a maximum tensile strength. A laser can cut any strength of material, as long as the material can be melted.

5. Low maintenance: A blanking press or turret punch has expensive tools that must be sharpened and stored regularly as different parts are cut. A laser can change parts by changing programs, and requires relatively inexpensive replacement parts like lenses and nozzles.

6. Flexible operation: A traditional blanking line has a tool for each part that is a fixed design that is very high investment, typically costing somewhere on the order of $50,000 per tool, depending on the shape. A turret punch is somewhat better in that you can program any shape that can use that set of smaller shapes to make something, but if you want to change a dimension on a hole or something of that nature, design change is limited to the tools available, or a new tool must be purchased and it must replace an available slot on the turret. These tools are less pricey, but still require regular maintenance, which is a somewhat specialized task, so the labor costs will be higher. A laser can change the cutting profile on the fly, and typically takes less than an hour to reprogram; costing approximately

$60 to apply a change, and that is a high estimate of the cost.

7.Improved edge quality: Since presses and punches are shearing through the material, which literally stretches the edge until it breaks, the top side of a part typically has a rounded over edge, while the bottom has a bunch of stretched ribbons that are very sharp. These are sometimes required to be cleaned off with an abrasive, which is a secondary process that adds to price. A laser, when properly focused and set for a material, cuts a part with an edge with a mirror-like surface, the top edge remains square, and the bottom edge is smooth to the touch.

8. Faster changeover: A blanking press requires 30 minutes to change between cutting different parts, as the dies must be swapped out. A laser can change programs instantaneously, leading to time savings and allowing for smaller production runs to have a decreased price.

One slight negative to laser cutting lies in its method of profiling a shape. A blanking press cuts one whole part outline at a time. A turret press cuts one hole or edge for a part at a time. A laser must trace the entire part outline to cut a part. This slows the process somewhat, and causes the time to part completion to be longer. Still, for every 2 blanking lines, 3 laser lines can produce the same output. This means that since a blanking press costs $10 million, and a similar laser costs $2million, the investment in an additional machine still results in a lower price.**[1]** IrraivanElamvazuthi, Susana Kamaruddin and MohdShahrulAzmi, Dec, 2009.**[2]** S.S. Lavhate, Saurabh R. Keskar, Vishal P.Unhale, AvinashSangale, April 2014.**[3]** ParagKohli and Ms. ShalviGarg, Jun, 2013.

V. DISCUSSION

Computer Aided Design / Computer Aided Manufacture (otherwise known as CAD/CAM), allows for minimal wastage of any material. One of the biggest problems with other material manufacturing processes is that they can be quite wasteful. They require a great deal of human input which, more often than not, can suffer from lack of precision.

As CAD only requires a person to input the specific details onto a computer, there is very small chance of human error. The computer will also automatically ensure that there’s minimum wastage so you get the most out of the material.

Another big advancement in laser cutting technology is gas lasers. They are able to make precise cuts without causing any excessive heat release in the environment. This type of laser is compatible with CAD/CAM, ensuring it can still have high degrees of intricacy.

One of the most recent and biggest developments within the laser cutting industry is the introduction of fiber and CO2lasers. What makes these devices so unique is how efficient they are. Compared to Nd: YAG lasers they save 70% of electricity, making it a technology with one of the lowest running cycles.

Something that has been a large concern when it comes to laser technology is how much gas they consume. The average fiber and CO2laser uses 45% less gas; a measurement that’s more eco-friendly than previous cutters. Efficiency is 200% more than a standard Nd: YAG, something that has a notable impact on both short and long term benefits.

VI. CONCLUSION

Laser cutting of leather was carried out using CO2 laser with the wavelength of 10.6 μm. Dependence of lasercutting speed and power was found linear. Increase of laser power by two times resulted in twice higher cutting speedwithout decrease of cutting quality. Laser cut edge quality was examined based on micrographs. Comparison of laser cut and mechanically cut leather edges revealed that laser cutting causes carbonization of cut edge which was the most distinctive difference among cutting methods. Thermal effect of laser beam on cut edge was seen different depending on leather color. Laser cut edge of dark and especially brown leather can be considered as the most suitable for laser cutting whereas light colored leathers can have easily noticeable laser cut edge. Generally, it can be said that laser cutting is the most suitable for cutting of complex geometries as it provides high flexibility, easy set up and nesting, fast change of geometries and high adaption ability to different material properties (such as thickness). These properties make laser an attractive tool for designers. On the other hand, high flexibility, easy set up and nesting together with high cutting speeds and constant cutting quality reveal potential for industrial applications. Easy applicability of nesting and cutting sequence software together with laser technology is another aspect which implies potential in industrial applications. However, carbonized cut edge may be a limiting factor in this case. Removal of carbonized marks and odor of smoke after laser cutting require special arrangements which are not very much suitable for large volume production. It can be concluded that artworks, design and prototypes are the areas where advantages of laser technology can be fully utilized whereas disadvantages can be avoided with relatively simple measures. Industrial scale production can benefit from laser technology as well, but implementation of laser cutting is more difficult and cost consuming. Economic benefit, which is probably one of the most important aspects, should also be considered.

Laser cutting is a process that allows us to process materials, create detailed designs, precise cuts and other services. Thanks to how versatile this process is, there are a number of ways that it's become more **eco-friendly.**The process with advanced laser technology is obviously considered as a best environmentally friendly technique, which uses less energy compared to other related process.

VII. CONCLUSION

The proposed payment system combines the Iris recognition with the visual cryptography by which customer data privacy can be obtained and prevents theft through phishing attack [8]. This method provides best for legitimate user identification. This method can also be implemented in computers using external iris recognition devices.

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