Journal of Basic and Applied Engineering Research
Print ISSN: 2350-0077; Online ISSN: 2350-0255; Volume 2, Number 4; January-March, 2015, pp. 244-247
© Krishi Sanskriti Publications
http://www.krishisanskriti.org/jbaer.html

Metal Foil Forming: A Brief Review

Anu Choudhary

M.Tech Scholar Department Of Mechanical Engineering G B Pant Engg. College, Pauri (Garhwal)
E-mail: choudhary.anu0711@gmail.com

Abstract—*This paper presents a review of current industrial research and development in Metal foil forming. Metal Forming has played a central role as societies have developed. There are considerable changes have occurred in metal forming in the last decade, the record of these changes can be found in keynote papers presented by the members of the Scientific Technical Committee of Forming. In the important developments in metal forming the key note papers are given as excellent reference. Foil Sheet forming at elevated temperatures (warm forming) and manufacturing with light-weight materials now are actively used in production processes. The sheet metal parts have become larger due to the demand to decrease the costs of light weight structure, sheet metal parts have become larger. Therefore work-pieces and their forming processes are more complex and difficult not only due to the size but also because of the use of tailored blanks. In a material based approach to the manufacture of lightweight components, the use of light metals keeping the same workpiece geometry reduces the weight of the component. Although the density of aluminium is a third that of steel, it has only one third of the tensile modulus and the strength. As the use of light metals must not decrease product properties such as strength, specific properties of the material must be taken into account. There are various process of forming which have been taken into consideration in this review papers and they can be used accordingly as per the requirement.*

1. INTRODUCTION

In the metal forming process the metal is stretched by external forces so as to give it the required shape. There are various process which are used for forming .Metal Forming has played a central role as societies have developed. Groche et al [1] show bulk metal forming has played a significant role in manufacturing development.

With the advent of the industrial revolution many changes occurred [2]:

- The ‘‘vital revolution’’, which was the product of advances in European agriculture, enabled larger populations to be fed;
- There was a dramatic population increase due to the ability to feed larger populations;
- Industrialization became widespread, causing urbanization.

Miniaturization of various industrial components and products including precise devices and information processing devices is progressing, and accordingly, the metal forming of very thin small components using very thin sheet metals or metal foils has become increasingly important [3]

2. DEFINATION

Forming can be defined as the process in which the desired size and shape are obtained through the plastic deformation of the material. This is very economical process as the desired shape, size and finish can be obtained through this process by using various process as per the requirements. Depending on the geometry of the lightweight structure and the material used, different joining processes can be applied. Joining by forming is an alternative to established resistance or arc welding techniques especially in case of limited fusion weldability [4].

3. VARIOUS FORMING PROCESS

3.1 Sheet metal bending

Bending of sheet metal is a common and vital process in manufacturing industry for so long. It is the deformation on the surface over the axis, creating a change in the parts geometry. Similar to the other metal forming processes, bending changes the shape of the work piece, while the volume of the metal remain same. Bending produce the change in the thickness of the sheet also. Most of the sheet metal bending operations involves a punch-die setup, but not always. The tool being used should be specific to the bending process and the angle of

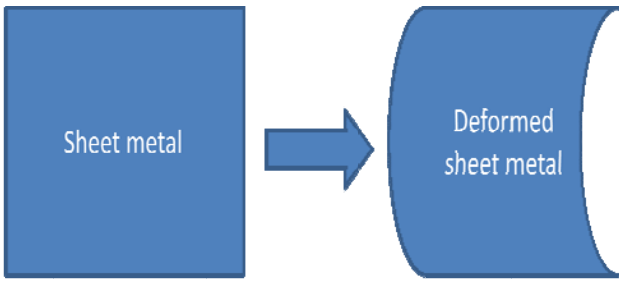

Fig. 1: Sheet metal bending

bend. Sometimes it takes a series of different punch and die operations to create a single bend or may be many progressive operations also.

3.2 Deep drawing

In deep drawing of metal foils, there are two important issues to overcome; considerable decrease in the limiting drawing ratio, and easy occurrence of wrinkles of deep-drawn products. When a metal foil is deep drawn, the development of wrinkling and a decrease in the limit drawing ratio should be simultaneously suppressed. In this study, the effect of sheet thickness of metal foil on the limiting drawing ratio and blank holding force was investigated. In addition, the influence of the loading ways of blank holding force on the limiting drawing ratio was examined.

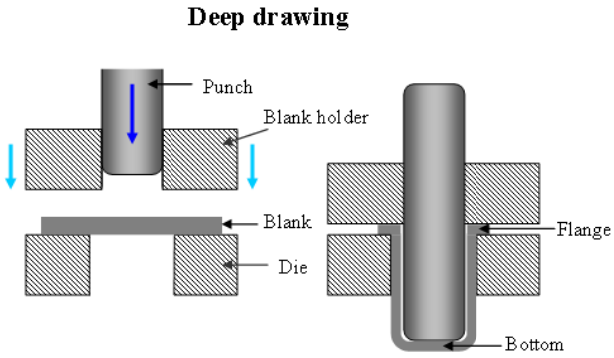

Fig. 2: Deep Drawing[5]

3.3 In-mould Decoration

Metal plays a very important role in auto-industries which increases the market attractiveness of their product as per the latest trends in the market. It is a new process which is quite attractive in the market for producing many automotive parts.

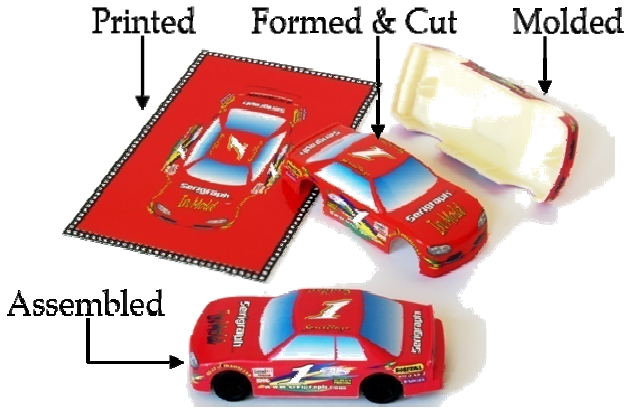

Fig. 3: In-mould decoration[5]

In-mould process with metal foils holds great potential for all the cases where the additional functions and processes can be easily integrated.

3.4 Embossing

The process of embossing is extremely simple and cost effective. It is one of the cheapest ways to enhance the look and feel of any surface be it paper, cloth or metal even. There are several things that need to be attended to in an embossing project. The metal dies to be used, the surface to be used, the creation of the artwork and the embossing details of course.

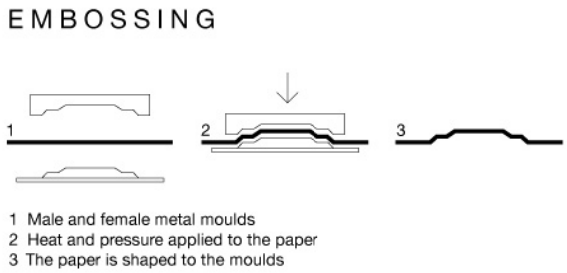

Fig. 4: Embossing[5]

There are three types of metals that are used for embossing dies. Depending on the shape of the image, the texture to be created and the length of the run you can select the metal.

- Magnesium dies are used for easy embossing projects that have short runs. The designs are large and uncomplicated. Magnesium also allows for special hand tooling.
- Brass dies are the most popular embossing dies. They are very flexible and give the embosser leeway to create fine lines, sculptured images, combo foil stamping and embossing. They are also very good for images requiring extensive hand tooling. You can make brass dies by machines or by a semi-photographic process. The photograph is transferred onto the die to use as a guide for drawing.
- Copper dies are used as an in between to magnesium and brass. However copper dies do not permit hand tooling.

3.5 Vacuum forming

Vacuum is a simplified version of thermo-forming, whereby a sheet of plastic is heated to a forming temperature, stretched onto a single-surface mold, and forced against the mold by a vacuum (suction of air). The vacuum forming process can be used to make a wide variety of products such as product packaging, speaker casings and car dashboards.

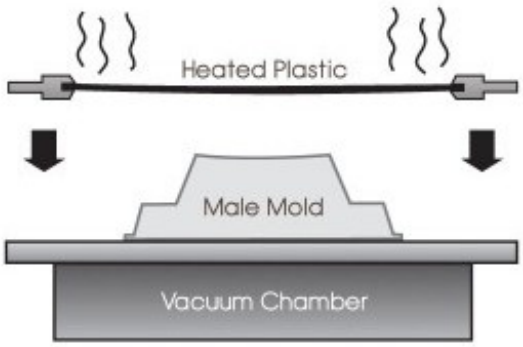

Fig. 5: Vacuum forming[5]

3.6 Nano-energetic performance

The combustion wave speed of the energetic material was evaluated using fiber optics to track the flame front. For each experiment, a Lexan tube of 3.2 mm inner diameter and 0.8 cm3 volume was filled up with energetic material (~5% theoretical maximum density) and inserted into an aluminum block instrumented with fiber optic photo detectors to facilitate the combustion wave speed measurement. The tube was open-ended in all the experiments. The four optical fibers (Thor labs M21L01) leading to photo detectors (Thor labs DET210) were installed at 1 cm spacing on the block. The data were obtained using a Tektronix oscilloscope TDS460A. A schematic of the experimental setup used to determine the combustion speed is shown in Fig. 6. We used an electric spark to initiate the ignition in all the experiments. As an energetic reaction is triggered, the oscilloscope records a voltage signal with respect to time for photo detectors.

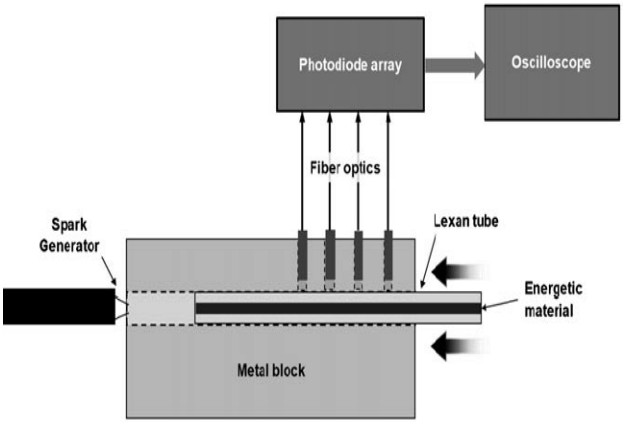

Fig. 6: Experimental set-up for the system[5]

The combustion wave speed of the energetic material was determined based on the time interval between the responses of two adjacent photo detectors [6]. The combustion wave speed was also measured using the "On-Chip Diagnostic" method [7]reported earlier by our group. This method is based on time varying the resistance of a sputter-coated thin platinum film, in which the resistance of the film changes as the energetic reaction propagates over it.

3.7 Micro-blast wave assisted metal foil forming

The energy of micro-blast wave emanating from the open end of a polymer tube is used to deliver micro-particles for bio-medical applications. The occurrence of shock waves is commonly associated with supersonic flight and is an integral part of high-speed flow analysis. Shock waves can also be used for innovative applications in various fields such as medicine, biological sciences and industry. Menezes et al. [8] have developed a device to deliver micro particles using shock waves generated by laser ablation for bio medical applications[12]. A polymer tube coated with explosives acts like a shock tube to generate micro blast wave. Small amounts of micro explosive and traces of Aluminium is uniformly coated on the inner wall of this polymer tube. When the micro explosive is electrically triggered from one end of the polymer tube, a detonation wave is generated inside the tube. When this detonation front is allowed to escape from the opened of the polymer tube, a micro-blast wave is generated. The schematic representation of formation of micro blast wave at the open end of the polymer tube is shown in Fig.8. Since the amount of energy expended in the generation of the blast wave from the open end of the polymer tube is very small they are referred here as micro-blast waves.

The ignition of the reactive explosive compound (HMX)

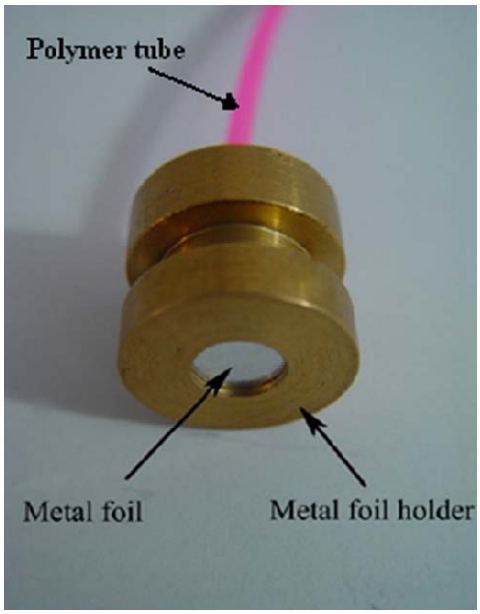

Fig. 7: Showing polymer tube[11]

is done from one end of tube.

Recently Jagadeesh [9,10] has used thin metal foils (_100 mm) to transfer the momentum from shock wave loading to carry out very interesting bio-medical applications including needleless drug delivery and DNA transfer in biological targets.

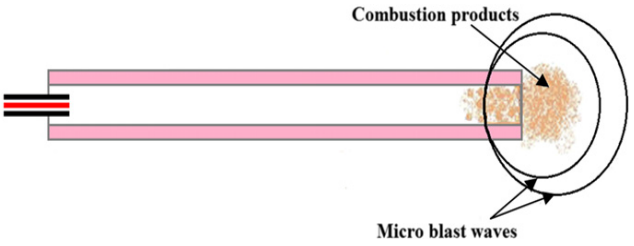

Fig. 8: Polymer tube for emanating the blast wave[11]

4. CONCLUSION

This paper reviwed the various forming process used in the present world as per the requirements and the working of the latest experimental set ups being used for the forming process. It can be from drawing, deep drawing, bending to nano-energetic materials and micro-blast wave assisted metal foil forming which are the most widely preferred ways of forming are the latest methods which are more benificial to the automotive and aerospace industries.

REFERENCES

[1] Groche, P., Fittshe, D., Tekkaya, E.A., Allwood, J.M., Hirt, G., Neugebauer, R., 2007, Incremental Bulk Forming, Annals of CIRP, 55/2, p. 636.

[2] Hause, S., Maltby, W., 1999, Western Civilization, A History of European Society_, Wadsworth Publishing Company, Belmont, CA.

[3] M. Geiger, M. Kleiner, R. Eckstein, N. Tiesler, and U. Engel, Microforming, Ann. CIRP, 50-1 (2001) 1-18.

[4] Hahn, O., Bangel, M., 2002, Clinchen von Stahl und Aluminum in Hybridbauweise, UTF Science III, Meisenbach, Bamberg, 21–24.

[5] Error! Hyperlink reference not valid. by image In-mould_decoration/vaccum_forming/deep_drawing.png/embossing/ In-n d

[6] K. B. Plantier, M. L. Pantoya, A. E. Gash, Combustion Wave Speeds of Nanocomposite Al/Fe2O3: The Effects of Fe2O3 Particle Synthesis Technique, Combust. Flame 2005, 140, 299.

[7] S. Bhattacharya, Y. Gao, S. Apperson, S. Subramaniam, E. Talantsev, R. V. Shende, S. Gangopadhyay, A Novel On-Chip Diagnosis Method to Detect Flame Velocity

[8] Menezes V, Takayama K, Ohki T, Jagadeesh G. Laser-ablation-assisted micro- particle acceleration for drug delivery. Appl PhysLett2005;87.

[9] Jagadeesh G, Apparatus and method for delivering biologically-active sub- stances or micro-medical devices to a target, US Patent Application No. 12480514, 2010 (under consideration).

[10] Jagadeesh G, Apparatus and method for genetically transforming cells, US Patent Application No. 12480508, 2010 (under consideration)

[11] S.R. Nagaraja a,n, S.G.Rakesh a, J.K.Prasad b, P.K.Barhai b, G.Jagadeesh c, Investigations on micro-blast wave assisted metal foil forming for biomedical applications, International Journal of Mechanical Sciences 61 (2012) 1–7

[12] Jiang Z, Takayama K, Moosad KPB, Onodera O, Sun M. Numerical and experimental study of a micro-blast wave generated by pulsed-laser beam focusing. Shock Waves 1998;8: 337–49. deration).