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Investigate the Suitable Cutting Clearance for Plywood in Blanking Process

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ABSTRACT

Plywood is a manufactured wood panel made from thin sheets of wood veneer. It is one of the most widely used wood products. It is flexible, inexpensive, workable, re-usable, and can usually be locally manufactured. Plywood is used instead of plain wood because of its resistance to cracking, shrinkage, splitting, and twisting/warping, and its general high degree of strength. Although it has the properties that can be processed by stamping but until now plywood is super rare to be stamped processed. The objective of this study is to investigate whether plywood can be stamped by using suitable cutting clearance. The process of stamping for this plywood is basic blanking process. The size of die opening will be the reference for the cutting clearance. Punch will have to be machined with varies of diameters. Every punch will be tested to the fixed size die until get the best result. So, the result then is verified for the finishing properties, burr produced and repeatability of the same result. If the result is acceptable, this will show that plywood is able to be machined just like steel. Although it has the properties that can be processed by stamping but until now plywood is rare to be stamped. The objective of this study is to investigate whether plywood can be stamped by using suitable cutting clearance. The process of stamping for this plywood is basic blanking with round shape. The size of die opening will be the reference for the cutting clearance. Punch will have to be machined with varies of diameters. Every punch will be tested to the fixed size die until get the best result. So, the result then is verified for the finishing properties, burr produced and repeatability of the same result.

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INTRODUCTION

Plywood stills not a common material for stamping process, and metal is commonly used due to its properties. The used of plywood in pressing tool still undergo many observations and research as a replacement for any other expensive materials. The used of plywood may save the cost and also reduces the probability of any conflicts. Thin plywood (3.0 mm in thickness) is chosen rather than normal thicker in order to get suitable cutting clearance. The plywood properties may lead to different outcomes for overall process of the study. Plywood layers (called veneers) are glued together with adjacent plies having their wood grain at right angles to each other. Cross-graining has several important benefits: it reduces the tendency of wood to split when nailed at the edges, it reduces expansion and shrinkage equating to improved dimensional stability, and it makes the strength of the panel consistent across both directions. There are usually an odd number of plies so that the sheet is balanced this reduces warping. Because of the way plywood is bonded (with grains running against one another and with an odd number of composite parts) it is hard to bend it perpendicular to the grain direction. There are many types of plywood which has been classified by its characteristics and purposes of using it. Different thickness refers to different aspects of study.

Suchy et al. defines the stamping process by alteration or deformation of sheet metal material in many ways. Parts may be blanked, pierced, drawn, formed or embossed, just to name a few basic operations. Each of these processes exerts its influence upon the structure of the material: the part and the scrap metal cutting is a process used for separating a piece of material of predetermined shape and size from the remaining portion of a strip or sheet of metal. It is the most extensively used processes throughout die and sheet metal work (J R Paquin., 1962).

2. Methodology:

This project has been started with designing of the blanking tool and then followed with tool fabrication. Controlling the size for the punch is the important aspect during fabrication works as shown in Fig. 1. Computer

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Numerical Control Wirecut machine has been used to cut various sizes of punch. To stamp the plywood sheet, tool has been set on the 60 ton press machine. Six different sizes of punches with clearance 0.01mm, 0.03mm, 0.05mm, 0.07mm, 0.09mm and 0.110mm has been used. By using the camera (Nikon D5100), pictures have been taken for the blank (product) and data has been recorded.

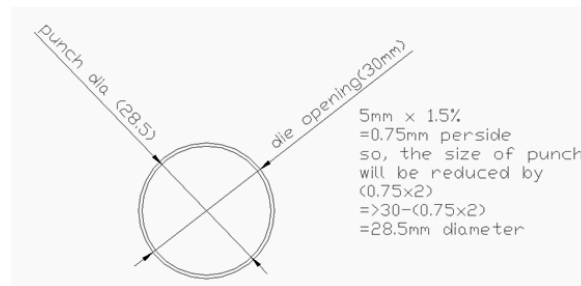


Fig. 1: Cutting clearance and die opening.

RESULT AND DISCUSSION

Almost all sizes of punches produced inconstant cut edge condition (inconstant result). The bottom layer of the plywood shows the sign of wreckage, while the top layer of plywood shows the lease condition of wreckage. Fig.2 shows the conditions of the cut edge of the blank.



Fig. 2: Smallest cutting clearance (left) & biggest cutting clearance (right).

Smallest clearance (0.01mm) shows the minimum sign of wreckage at the bottom layer and efficient cutting condition at the top layer of wood. While at the biggest clearance (0.11mm), the rate of wreckage at the bottom layer show the maximum condition and it defect the structure of the plywood. Based on Troubleshooting Punching and Cutting Operations, 2006, stated that normal clearance typically results in one-third burnish and two-third fracture. While excessive clearance may result in die-roll at the point of punch entry and a large burr on the underside of the part. There is very little shear or burnish. The fracture is rough as well as having a large taper on the cut edge (Smith & Associates., 2006).



Fig. 3: Condition of cut edge at the bottom layer.

Fig. 3 shows the overall condition of bottom layer of plywood that shows the condition of wreckage. This is due to penetrating of punch into the plywood before the punch starts to cut. Due to properties of the wood is different compare to common blanking material such as aluminium so the penetrating stage will affects more to the bottom layer of the plywood. The top layer is less affected by the penetrating stage because of the force of the compressive force form the punch is then decreased when reach the adhesive layer of the plywood as the adhesive layer is the most elastic material among the wood layer. Small cutting clearance looks can improve cut edge condition.

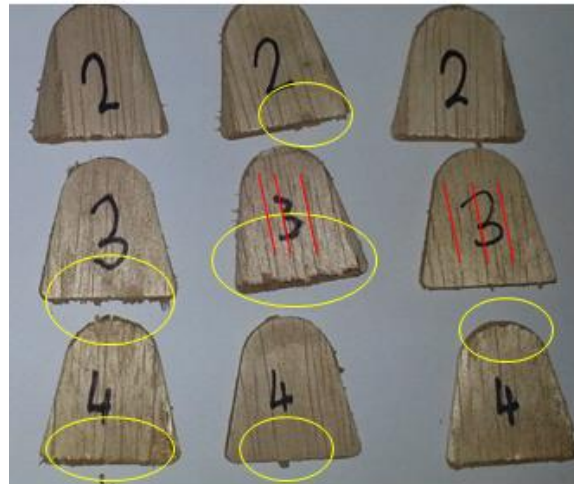


Fig. 4: Blister on opposing the grain direction.

The yellow circles show Fig. 4 the sign of defect at the edge blank. The red lines show the direction of wood grain. Cutting against the direction of the wood grains will result the edge of the blank shown lease sign of defect. This prove the plywood will show the sign of defect such as blister and torn out at the cutting edge if the cutting direction is against the wood grains.

Based on Bending Strength and Stiffness of Plywood stated that the tensile and compressive strengths of wood perpendicular to the grain are very low. There are indications that the proportional limit in compression perpendicular to grain is reached at a deformation about 2-1/2 to 3 times as great as that at proportional limit in compression parallel to grain. (Madison, Wi., 1964)

Conclusion:

As the results it can be concluded that this plywood is not suitable for normal or common design of blanking process because it produce inconsistent result or product. It is because of the structure of wood layer is inconsistent built. The natural properties of wood are that it has the lining grains. The basic rule of cutting wood is we need to follow the direction as the wood's grain lining to get better edge of cutting. As the profile of punch and die of the press tool plywood is not cutting directly to the wood's grain, then the edge blank will fracture. The other reason that causes the result is the multi-layer of plywood's structure itself. From the layers, there are three different shear strengths to cut through and produced 3 edges blank conditions. Furthermore the brittle structure of plywood that is different from common sheet metals and that is why the bottom layer of wood can't withstand the force from the punch and lead to fracture of the structure so, the surface of finish will be definitely rough. These might be the reasons why plywood is not widely used in stamping process.

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