DESIGN AND CONSTRUCTION OF MANUAL Phi Khon Nam Mask PRESSING MACHINE

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ABSTRACT

The objective of this study was to design and to develop a manual Phi Khon Nam mask pressing machine based on a production problem faced by the community enterprise of Ban Nasao, Chiangkhan district, Loei province which produces the handmade Phi Khon Nam masks, each taking 30 minutes. A manual mask pressing machine was developed. The materials used for making the products were rice bran, saw dusk, and crushed coconut shells. The structure of mask manual pressing machine is 206 millimeters wide, 306 millimeters long and 560 millimeters high. Its extrusion mechanism functions through control of 2 levers, one for pressing and the other for pushing work pieces out of the mold. The mold is 47.40 millimeters wide, 60 millimeters long, and 27 millimeters high developed by CNC machine using Raster roughing of SolidCAM programing. The G-code was used to control the CNC machine. The results of the test showed that the Phi Khon Nam extruding using the fifth formula; plaster 35%, rice bran, 18 %, saw dust 7 %, and latex glue 39 % provided the most efficient outcome. The masks extruded were strong and not brittle. The study also found that the pressing machine increased the production capacity, comparing with the existing one; it can extrude each mask within 45 seconds, and thus reducing production time upto 98 %.

KEYWORDS: *Phi Khon Nam Mask, Pressing Machine, Production Capacity*

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INTRODUCTION

Loei is a province of wonder, filled with natural and cultural attractions, as well as long-standing traditions, each of which has its own unique activities, according to a belief in each area. This has drawn a vast number of visitors to the province to experience such traditions, which in turn has generated further employment and income for communities. A good example of this is a community enterprise in Ban Nasao, Chiangkhan district, Loei province which produces handmade souvenirs, mainly 'Phi Khon Nam' masks, as shown in Fig. 1.

Fig. 1. Handmade souvenirs: miniature 'Phi Khon Nam' masks

However, this enterprise is facing with the following issues in the production : 1) it is difficult for producers to make items in large numbers to satisfy increasing demand as particular skills are needed, 2) raw materials, mostly from softwood, have run out or become less available in the area, 3) the production process takes a long time (30 minutes per piece). To solve the problem concerning the production, this research was conducted to design and to develop a pressing machine for the mask production. A working prototype of the machine was designed to have an extrusion mechanism which functions through manually controlling of 2 levers: one for pressing and the other for pushing work pieces out of the mold, and to work with work pieces made from waste raw materials available in the area: rice bran, saw dusk, and crushed coconut shells.

MATERIALS AND METHODS

A development of the working prototype for a manual pressing machine, in this research, put an emphasis on low cost design and easy creation. The structure, mechanism, and its working principle are shown in Fig. 2.

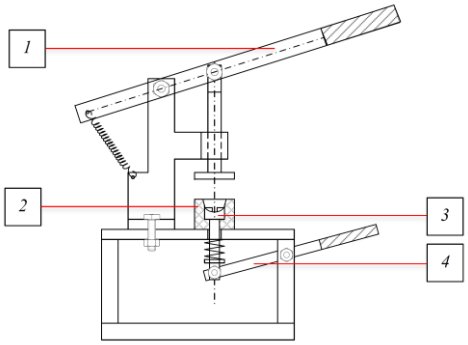

Fig. 2. Structure and mechanism of the prototype

Mold design

The structure of the machine was designed with a dimension of 206 mm wide, 306 mm long, and 560 mm high. The extrusion mechanism functioned through manually controlling of two levers, for pressing and for pushing a work piece out of the mold (illustrated in position 1 and 4). A mold for the mask was designed in a form of a single die, consisting of a cavity mold (shown in position 2) and a core mold (shown in position 3), for the extrusion process. Designed with a dimension of 47.5 mm wide, 60 mm long, and 27 mm high, this mold was easy to be dismantled for cleaning and repair. The single die designed is shown in Fig. 3.

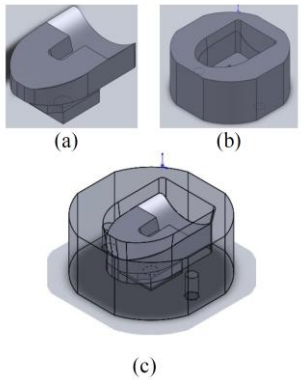

Fig. 3. (a) core mold (b) cavity mold
(c) a working prototype of a mold

CAD/CAM technology

In this research, SolidCAM program was used for design and development of the working prototype of a single die, and of G-code based on raster roughing, a word address format in program which employs alphabets to control functions of a CNC machine so as to mill metal and machine a mold as designed. Based on the standards of ISO and those of the American National Standard Institute, each alphabet was followed by a different number. Further, the SolidCAM program can determine spindle speed (rpm) and feed rate (m/min) of a cutting tool suitable for each type of metal milling or machining. This thus saves time to create a die and reduces loss of work pieces to be milled as well as loss of cutting tools. The die milling process in this research is demonstrated in Fig. 4.

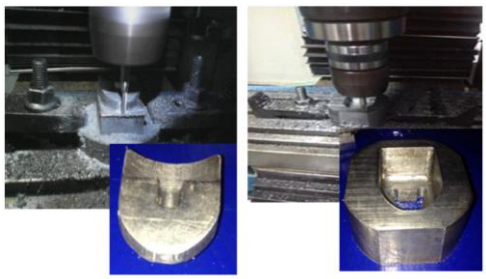

Fig. 4. Metal milling with CAD/CAM technology using a CNC machine (a) core mold
(b) cavity mold

RESULTS AND DISCUSSION

This research conducted two experiments, focusing on determining a mixing ratio of raw materials best suitable for the extrusion process and the production capacity of the prototype.

As a mixture of raw materials directly impacts the overall production, this research conducted an experiment by using the trial and error method. According to the experiment, the formula, comprising plaster 35%, rice bran 17.86 %, saw dust 7.4 %, and latex glue 39.29 %, was the most suitable for extrusion to produce fine work pieces, hard but not brittle, as shown in Fig. 5.

Fig. 5. Extrusion of work pieces

To determine the production capacity of the working prototype, the experiment was carried out by collecting data through process timing from extrusion to work piece pushing out, with no consideration of raw material mixing step which takes approximately 5 minutes. The result demonstrated that the machine was able to extrude a work piece at an average time of 45 seconds per piece, resulting in reduction of the overall production time and improvement on the production capacity, as compared to the traditional extrusion method. In other words, it reduced the production time up to 98%.

CONCLUSION

This research was conducted in order to design and to develop a pressing machine to resolve issues involving making of 'Phi Khon Nam' masks operated by the souvenir producing community enterprise of Ban Nasao, Chiangkhan district, Loei province. A machine was designed in a form of a single die with the extrusion mechanism to produce work pieces, made from waste materials mainly available in the area: rice bran, saw dusk, and crushed coconut shells. The mechanism functions through manually controlling of two levers, for pressing and for pushing work pieces out of the mold. The mold was designed and developed through the use of SolidCAM program. Together with this, G-code, based on raster roughing, was created to control functions of a CNC machine so as to mill metal and machine a mold as designed. An experiment was then carried out to obtain the best mixture for the extrusion step, and the results indicated that the formula, comprising plaster 35 %, rice bran 17.86 %, saw dust 7.4 %, and latex glue 39.29 %, was the most suitable for extrusion to produce fine work pieces, hard but not brittle, as shown in Fig. 5. Moreover, the research findings suggested that the working prototype developed was able to reduce the production time and improved the production capacity, as compared to the existing method.

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