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Design and manufacture of wax pattern making machines with drill chisels for layer deposition manufacturing processes

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ABSTRACT

Layer Deposition Manufacturing (LDM) is a new method in Rapid Prototyping. Layer Deposition Manufacturing is used for complex, hollow or complex production and object processes. The LDM process can be done manually, namely by creating a print cavity on Win. The goal to be achieved from this research is to make a pattern making machine with drill chisels to make molded cavities in wax in the Layer Deposition Manufacturing process. This research is based on existing literature as a theoretical basis. The stages carried out in this study began with designing a pattern making tool, searching for tool components and materials, making tools, assembling and testing the tool to determine machine performance. Tests were carried out using a drill chisel diameter of 2 mm and 3 mm and a wax thickness of 5 mm and 10 mm.

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1. INTRODUCTION

A series of machines designed to process raw materials into products with added value for a particular functional characteristic. In this design the method used is LDM (Layer Deposition Manufacturing). they mostly make mold cavities still using a knife or kater so it is quite complicated and takes quite a long time. Therefore, a special tool for making wax patterns is needed manually, in order to produce quality, fast, easy to make and affordable products. This study intends to design and manufacture a wax pattern making machine for the LDM process.

This method can be used to create products or prototypes from drawings resulting from the design process. This method is relatively cheap, easy, geometric accuracy is quite high and can be used to make products with quite complicated geometric complexity. This technology can be applied in various types of handicraft industries such as pottery, gibs, fiber and acrylic industries

2. RESEARCH METHOD

Engineering is the design and construction of machines to process raw materials into products with high added value and a machine is designed for certain functional characteristics. According to the Mechanical Technology book translated by Snati Djafrie, that there are three basic criteria that underlie economic production, namely a. A simple functional design and has adequate aesthetic quality. b. The selection of the right material is based on consideration of its physical properties,

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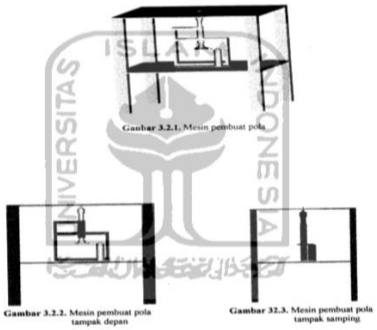
appearance, price, and manufacture or machining. c. Selection of a manufacturing process capable of producing products with accuracy and surface finish that meet requirements and at the lowest possible price.

The three criteria mentioned above are factors that must be considered in a production process which incidentally consists of quite long stages. So that production is carried out more efficiently. This design focuses on the following aspects: a. The tool is designed to be easy to operate. b. Using ingredients that are already on the market and easy to get.

The criteria above are factors that must be considered in the process of making pattern making machines which in the manufacturing process adjust to the characteristics and materials used, so that later maximum results will be obtained.

Based on the limitations of the problem by paying attention to the aspects above, the specifications of the tools made are as follows: a. The method used in the pattern making process is to make a mold cavity on the wax sheet with a drill chisel. b.Capacity of wax sheets with A4 size.


Gambar 3.2.1. Mesin pembuat pola

Gambar 3.2.2. Mesin pembuat pola tampak depan

Gambar 32.3. Mesin pembuat pola tampak samping

2.1 Machine Parts.

1 Machine Frame

The machine frame functions as a bean holder and a motor mount for the wax pattern making machine. The machine frame is made and must be able to support the load or force generated when the machine is running.

2 Tables


Gambar 3.4 Meja.

3 Workplaces

In the design of the work mat consists of three layers. The top layer is made of glass with the intention of facilitating the pattern making process. The thickness of the glass is 5mm, the thickness of the mattress is 5mm and the thickness of the wood is 20mm.

Gambar 3.5 Alas kerja.

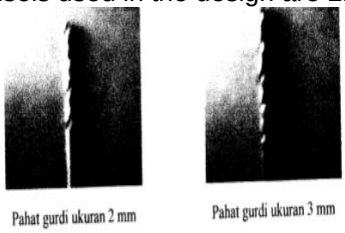
4 Tool clamp

This chisel clamp functions as a drill chisel clamp. The way to install a drill chisel using a key is by tightening the clamp head of the drill chisel.

Gambar 3.6 a.) Pengunci pahat
b.) Kunci pahat gurdi

5 Chisels

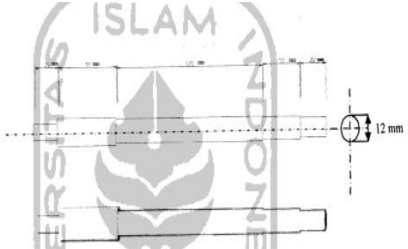
The chisel used is a drill chisel. The chisel functions as a workpiece cutter or as a mold cavity maker on wax patterns. The chisels used in the design are 2mm and 3mm in diameter.



Gambar 3.7 Pahat Gurdi.

6 Shafts

In this design the shaft functions to continue the rotation generated by the motor. The shaft on the pattern making machine is the shaft that receives the load by the rotating parts. Shaft length 250 mm. The shaft used is S30C steel.



Gambar 3.8 Poros.

7 Bearings or Bearings

In this section serves as the rotating shaft and at the same time as the foundation of the shaft. To install it, you need a bearing housing as the foundation. For pattern making machines, the bearings used are rolling bearings. In this bearing rolling friction occurs between the centered and stationary parts through the rolling elements.

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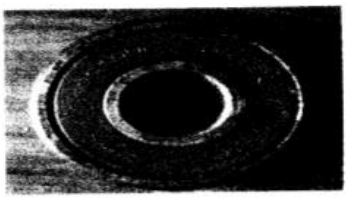
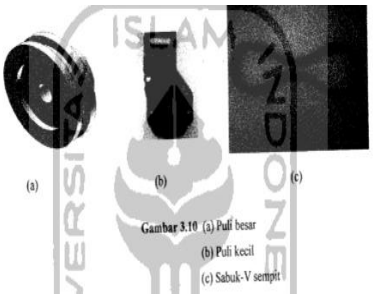


Gambar 3.9 Bantalan Gelinding

8 Pulleys and Narrow V-Belt

In this section the pulley has a function to change the rotation speed. The design uses two pulleys (large and small) with diameters of 76.2 mm and 8 mm. See Figure 3.10. (a, b) The narrow V-belt has a function as an intermediary between the rotation of the drive pulley and the shaft pulley. See Figure 3.10. (c).



Gambar 3.10 (a) Puli besar
(b) Puli kecil
(c) Sabuk-V sempit

9 Drive Motors

The driving motor is used with a power of 1/16 HP with a rotation of 6000 rpm, 220 V, with an AC current which functions as a driving source for the wax making machine.

Gambar 3.11 Motor penggerak

The best measurement results can be achieved by choosing the right measuring instrument and method of measurement. In testing the tool using the direct measurement method. The measuring tools used are calipers with an accuracy of 0.02 mm and a triobor with an accuracy of 0.005 mm.

3. RESULTS AND DISCUSSIONS

3.1 Pattern Testing Results

After getting the pattern making machine, the resulting machine is tested with several tests to determine the performance of the machine. In testing there is a dimensional error, the dimensional error is obtained from the equation:

a. Testing the dimensions of the length and width of the rectangular pattern.

Tests were carried out on 3 rectangular patterns cut with a pattern making machine. The measuring instrument used in the test uses a vernier caliper with an accuracy of 0.02 mm. From the tests carried out, the test results obtained from each rectangular pattern as shown in Table 4.1.

Tabel 4.1. Hasil pengujian pola persegi panjang

Ø Pahat (mm)	Tebal Lilin (mm)	Warna Pual / produk	Persegi Panjang 1 (mm)				Persegi Panjang 2 (mm)				Persegi Panjang 3 (mm)			
			P	L_a	L_b	L_c	P	L_a	L_b	L_c	P	L_a	L_b	L_c
2 mm	5 mm	Biru	38,59	22,03	22,01	21,90	38,50	22,00	22,05	22,04	38,49	22,04	22,02	22,04
	10 mm	kuning	38,57	22,05	22,04	21,9	38,59	22,02	22,01	22,03	38,57	22,05	22,03	22,02
3 mm	5 mm	Kuning emas	38,52	21,90	21,90	22,00	38,54	22,03	22,03	22,02	38,56	21,90	21,90	21,90
	10 mm	Merah	38,50	22,00	22,01	21,90	38,58	22,01	21,90	22,02	38,52	21,90	22,00	22,01

Dari data di atas dapat diketahui selisih antara cetakan (mal) dan pola persegi panjang seperti pada Tabel 4.2.

Selisih cetakan dan pola = dimensi cetakan – dimensi pola

Tabel 4.2 Selisih cetakan pola persegi panjang (mm)

Ø Pahat (mm)	Tebal Lilin (mm)	Warna Pual / produk	Selisih Persegi Panjang 1 (mm)				Selisih Persegi Panjang 2 (mm)				Selisih Persegi Panjang 3 (mm)			
			P	L_a	L_b	L_c	P	L_a	L_b	L_c	P	L_a	L_b	L_c
2 mm	5 mm	Biru	-0,09	-0.03	-0.01	0,10	0,00	0,00	-0.05	-0.05	0,01	-0,04	-0.02	-0.04
	10 mm	kuning	-0,07	-0,05	-0,04	-0,01	-0.09	-0.05	-0.01	-0.03	-0,07	-0,05	-0,03	-0,02
3 mm	5 mm	Kuning emas	-0,02	0,10	0,10	0,00	-0.04	-0.03	-0.03	-0.02	-0,06	0,10	0,10	0,10
	10 mm	Merah	0,00	0,00	-0,01	0.10	-0.08	-0,01	0,10	-0,02	-0,02	0,10	0,00	-0,01

From the data above, it can be seen that the average value of the dimensional test results from the cutting results with a chisel diameter of 2 mm and 3 mm as shown in Table 4.8 below:

Tabel 4.8 Hasil rata-rata pengujian dimensi pola lingkaran

Ø Pahat (mm)	Tebal Lilin (mm)	Warna Pola/produk	Diameter rata-rata pegujian kebulatan (mm)
2 mm	5 mm	Biru	35,95
	10 mm	Kuning	35.98
3 mm	5 mm	Kuning emas	35,97
	10 mm	Merah	35,99

From the data in Table 4.8 it is known that when cutting patterns with different chisel diameters, there is a deviation in the diameter of the wax pattern from the original pattern. In cutting with a tool diameter of 2 mm, the diameter deviation is 0.05 mm at a thickness of 5 mm wax and 0.02 at a thickness of 10 mm wax. In cutting with a tool diameter of 3 mm, the diameter deviation is 0.05 mm at a thickness of 5 mm wax and 0.01 mm at a thickness of 10 mm wax.

4. CONCLUSION

From the research conducted, a tool for making mold cavities with a drill chisel on a wax pattern has been successfully made for the Layer Deposition Manufacturing process. The Layer Deposition Manufacturing method is a suitable method for making products with quite complex geometrical complexity with more accurate, easy and fast results. Tool testing was carried out using a drill chisel with chisel sizes of 2 mm and 3 mm, with these chisels a rectangular mold cavity was made with a length of 38.5 mm and a width of 22 mm using A4 size wax (210 mm X 297 mm) with a wax thickness of 5 mm and

10mm. After testing the tool, it can be concluded that from the data obtained there are deviations in the dimensions of length and width for the rectangular pattern. In cutting with a chisel diameter of 2 mm, the length dimension deviation is 0.03 mm for a 5 mm wax thickness, while the width dimension deviation is 0.01 mm for a 5 mm wax thickness and 0.04 mm for a 10 mm wax thickness. In cutting with a tool diameter of 3 mm, the length dimension deviation is 0.04 mm at a thickness of 5 mm wax and 0.03 mm at a thickness of 10 mm wax. While the deviation of the width dimensions is 0.01 mm at 5 mm thick wax and 0.03 at 10 mm thick wax. Deviations in the circular

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pattern In cutting with a tool diameter of 2 mm, the diameter deviation is 0.05 mm at a wax thickness of 5 mm and 0.02 at a thickness of 10 mm wax.

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