

MODIFICATION OF THE DUST COLLECTOR TOOL ON A 3 AXIS CNC ROUTER MACHINE FOR WOOD WORKING

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Abstract

Based on the results of research in Majalengka Regency, it was found that there were 200 semi-finished wood processing secondary industries, spread over 26 sub-districts with the type of wood used being dominated by teak, mahogany, these types of wood are used for semi-finished materials in the form of frames, doors, windows, cabinets, sideboard and chairs. There is also production of wood that is native to Indonesia, namely wood carving. Wood carving has its own uniqueness because it is a human creation based on an aesthetic sense according to what the human himself wants. Wood carving works of art are usually created using sculpting techniques. The creation of works of wood carving with the arrangement of elements so that meaningful elements are formed and one must have creative sculpting skills to produce works that are good, attractive and have meaning and high aesthetic value as well as being useful in people's lives.

Keywords: Craftsman business, wood processing, wood waste

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Introduction

Geographically, Majalengka Regency is located in the eastern part of West Java Province, namely West side between 1080 03' – 1080 19' East Longitude, East side 1080 12' – 1080 25' East Longitude, North side between 6036' – 6 0 58' South Latitude and South side 60 43' – 7 0 03' south latitude, with its boundaries.

Based on the results of research in Majalengka Regency, it was found that there were 200 semi-finished wood processing secondary industries, spread over 26 sub-districts with the type of wood used being dominated by teak, mahogany, these types of wood are used for semi-finished materials in the form of frames, doors, windows, cabinets, sideboard and chairs. There is also production of wood that is native to Indonesia, namely wood carving. Wood carving has its own uniqueness because it is a human creation based on an aesthetic sense according to what the human himself wants. Wood carving works of art are usually created using sculpting techniques. The creation of works of wood carving with the arrangement of elements so that meaningful elements are formed and one must have creative sculpting skills to produce works that are good, attractive and have meaning and high aesthetic value as well as being useful in people's lives (M Ade Riawan, Bayu Wiro K dan Fais Hamzah 2017).

One of the causes of the productivity of the manufacturing industry in SMEs (Small and Medium Enterprises) in Indonesia is because the production process is still carried out manually by human hands. By procuring modern machine tools such as Computer Numerical Control (CNC) machines, it is hoped that SMEs will be able to produce products with special geometries with high accuracy, increase the efficiency of the production process and improve the quality of production results so that they will not be unable to compete with imported products from from various countries (Zoro Zulfikar dan Syafri 2017).

The workings of this CNC-based wood router machine in cutting, engraving or marking are using drill bits of various shapes that are adjusted to the needs that will move automatically, in the woodworking cnc router machining process, the results of the machining process produce dust which is scattered as a result of the processing. wood machining interferes with the breathing and view of the operator and makes the workplace dirty and even the dust produced will damage the electronic components of the 3 axis cnc router machine (erstivan Fattah adharto, hanif ghufuron, ikhsan tri kuncoro, indrianto 2017).

According to the Final Project report made by Erstivan Fattah Adhartio, Hanif Ghufron, Ikhwan Tri Kuncoro and Indriyanto entitled DESIGN OF 3AXIS CNC ROUTER MACHINE EQUIPMENT TO SUPPORT CREATIVE INDUSTRIAL PRODUCTION IN PEKALONGAN. With the specifications of the tool, including a blower motor with Power 380/220 V and producing a speed of 13,000 rpm with a volume of 2.8 m³ and dimensions of 20mm x 20mm x17mm as a place to store debris generated from the CNC router machine. Some of the obstacles experienced by creative industry entrepreneurs are Mr. Achmad Syaikhudin the owner of the "Erriesa Griya Print" souvenir business during the production process, including:

- Dust that is scattered as a result of the wood machining process interferes with breathing and views of the operator and makes the workplace dirty and even the dust produced will damage the electronic components of the 3-Axis CNC router machine.
- Installation and removal of workpieces from the machine table is less efficient and takes a long time.

In the design of making a drawing of a wood cnc router machine using fusion 360 software, one of the software developed by Autodesk which has 3d modeling and design features using mm units, makes the results of the images more efficient which makes it easier for readers to assist the process of making a cnc router machine. The design of a wood cnc router uses a portable model, and requires a chuck that does not damage the material and cutting tools, and is able to withstand the cutting force of the wood material so that it does not come off during the machining process. For innovation, use additional vacuum cleaners to speed up production and minimize wood chips and flying dust.

Research Method

Tool design

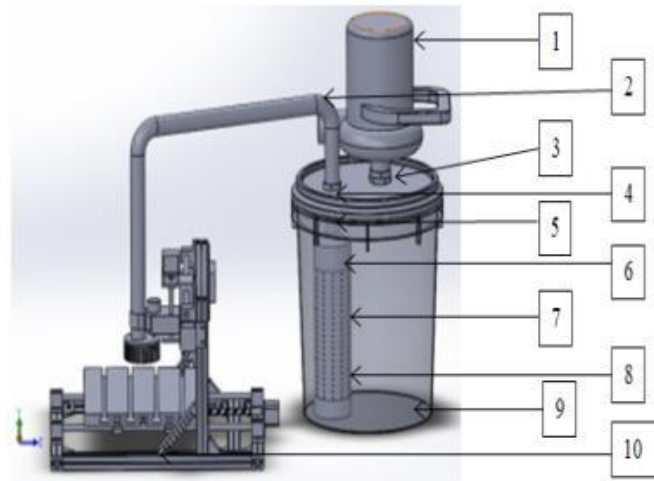


Figure 1 Drawings of a dust collector design and a cnc router machine

Information:

1. Hand Blower
2. Flexible hose
3. Watermur pvc soligen 1 inch
4. Vlok scok 3x1 inch pipe fitting PVC
5. Pipe 1 inch
6. Vlok scok 3x1 inch pipe fitting pvc
7. Pipe 3 inch
8. Cloth filter

- 9. Bucket 25 kg
- 10. CNC router

Research Stages

- Study literature
- Identification of problems
- Tool design
- Tool making
 - o Tools and materials
 - o Tool assembly
- - Testing
 - o Preparation of test equipment
 - o Testing using a dust collector
 - o Testing without a dust collector
- Data processing
- Data analysis

Results and Discussion

Tool testing

Specifications of the dust collector system:

$$H = 0,65 \text{ [m]}$$

$$g = 9,81 \text{ [m/s}^2\text{]}$$

$$D = 0,001 \text{ [m]}$$

$$L_{\text{selang}} = 10 \text{ [m]}$$

$$V_{\text{tangki}} = 25 \text{ [L]}$$

Measurement of Density Gas Mixture of Air + Dust

Density measurements are carried out to calculate the suction power of the dust collector system. The method we use is by sucking air + dust during the machining process and storing it in a plastic bag to measure its volume and mass. The formula used is as follows

$$P = \frac{m}{V}$$

where :

m : massa [kg]

ρ : massa jenis [kg/m³]

V : volume [m³]

3.2 Tools & Materials

1. Blower on dust collector system.
2. Plastic bag.
3. Digital Balance.
4. Measuring cup.

3.3 Measurement Step

1. Put plastic on the disposal shelter on the blower.
2. When the wood machining process occurs, turn on the blower until the plastic is fully expanded.
3. Remove it from the plastic blower and tie off the plastic end.
4. Weigh plastic (air gas + dust) with a digital balance.

5. Just weigh the plastic to find out the mass of the plastic with a digital balance.
6. Weigh the inhaled dust with a digital balance.
7. Measure the volume of plastic (air gas + dust) with a measuring cup.
8. Just measure the volume of the plastic with a measuring cup.
9. Record the results

Measurement results

Plastic mass = 1.04 [gr]

Plastic mass (air + dust) = 4,04 [gr]

Gas mass of air + dust = 4,04 – 1.04 = 3 gr = 0.003 [kg]

Dust mass = 2,96 [gr]

Air Mass = 3 – 2,96 = 0.04 [gr]

Plastic volume (air + dust) = 782.8942 [ml]

Plastic volume = 6.67 [ml]

Volume of air + dust = 782.8942 - 6.67 = 776.2242[ml] = 0.000776[m3]

Measurement analysis

From the data obtained, the density can be searched :

$$P = \frac{m}{V}$$

$$P = \frac{0,003}{0,000776}$$

$$P = 3,8659 \text{ kg/m}^3$$

So based on the practical measurements that have been carried out, it is obtained that the density value of the gas mixture of air + dust sucked in the dust collector system is equal to 0.5154 kg/m³.

Calculation of suction speed

To determine the suction speed of the blower, you can use the angular velocity equation with linear speed as shown in the formula below:

where :

v : airflow speed (m/s)

ω : angular velocity (rad/s)

r : radius (m)

known :

$\omega = 16000 \text{ rad/s} = 266,66 \text{ rad/s}$ (based on specifications)

r = 0,025 m (based on measurements)

$$\begin{aligned} v &= \omega \cdot r \\ &= 266,67 \times 0,025 = 6,66 \text{ m/s} \end{aligned}$$

Blower Suction Capacity

To determine the capacity of the inhaled air and dust mixture, get the formula below:

$$Q = v \cdot A$$

where :

Q = Capacity (m³ /s)

v = Air flow rate (m/s)
 A = Hose cross-sectional area (m²)

Known :

$v = 6,66$ m/s (based on calculations)
 $A = 0,0254$ m (based on measurements)

$$Q = 6,66 \times \frac{\pi}{4} (0,0254) = 0,00337467 \text{ m}^3/\text{s}$$

Calculation of Suction Power

Calculate the power required for the dust collector system to suck up the air and dust mixture so that the dust collector system can suck it optimally.

$$P = \rho \cdot g \cdot Q \cdot H$$

(Dietzel, 1992 : 362)

where :

P = Required power (W)
 Q = Suction Capacity (m³/s)
 ρ = density of gas mixture of dust + air (kg/m³)
 g = gravity 9,81 (m/s)
 H = Suction Height (m)

Diketahui :

$Q = 0,003374$ m/s (based on calculations)
 $H = 6,66$ m (based on calculations)
 $\rho = 3,8659$ kg/m³ (based on calculations)
 $g = 9,81$ m/s²

$$\begin{aligned} P &= \rho \cdot g \cdot Q \cdot H \\ &= 0,003374 \times 9,81 \times 3,8659 \times 6,66 \\ &= 0,8523 \text{ W} \end{aligned}$$

Blower Motor Power Calculation

The power generated by the blower motor according to the specifics contained in the blower tool, obtains 450 watts of power according to the specifications on the tool.

Conclusion

1. Sawdust that has accumulated in the storage tank can be reused into many things such as planting media, bedding for keeping hamsters, mixed materials for making furniture, fuel, and so on.
2. From the results of the machining process carried out by the cnc router machine with the type of zigzag feeding test using wood material with an initial weight of 34 grams, and after the machining process the results are obtained with a weight of 31 grams. Then the weight obtained from the suction process of wood chips using a dust collector obtained a result of 4 grams and obtained quite good results.

Reference

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