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Process of Making Gas Stove Spuyer with TU-2A CNC Machine

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ABSTRACT

The TU-2A CNC machine is a turning machine tool that is controlled by a computer system through data (program input) in the form of letters and numbers. This machine is capable of producing a work piece with a complex shape and high accuracy, as well as the effectiveness of minimum production time. Gas stove nozzle is a form of work piece which in the manufacturing process is required to have a high level of effectiveness with high accuracy. The supporting factors in the manufacturing process are based on the selection of program functions and machining parameters (cutting speed, feeding, feeding speed and proper rotation of the main axis).In the process of making gas stove nozzles using a CNC TU – 2A machine, the parameter values used are cutting speed (Vs) 20 m/min, feeding 0.75 mm/put, feeding speed (s') 281 mm /min and the main axis rotation (n) 375 rpm.So from the parameters used, it is known that the total machining time per component (Σ tm) = 5.4 minutes, the total production cost per component (Σ Cprod) = Rp. 8,572, - and the total production time per component (Σ t prod) = 7.6 minutes. The greater the value of the Dept of cut, feed and feeding speed, the production time and production costs that occur will decrease until they reach t^{prod} = 2.6% and C^{prod} = 2.3%.

INTRODUCTION

The development of science and technology is increasingly advanced; this makes humans never stop working to develop new inventions to lighten their workload. It can be proven in the field of industrial technology on a large and small scale which initially only used human or animal power as a driving force, to modern technology now which almost entirely uses propulsion with robotics systems through computer program input [1-3].

One area of technology that continues to develop is the field of machinery, especially machine tools in a manufacturing process. Starting from simple machine tools and developing into a numerically controlled machine (Numerical Control: NC) that can solve the problem of making complex work pieces with high accuracy and productivity [4-5].

CNC machine is a machine tool with a numerical system. The use of facilities in CNC machining is very influential on the ongoing production process. In addition to the work pieces produced by CNC machines are obtained better, also the time required to complete a work piece for the same size and shape even complex sizes can be reduced to a minimum compared to working with manual or conventional machine tools which require more time relatively longer [6-9].

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In the competitive world of industry which is quite competitive, which requires a process with a high amount of capacity, accuracy, speed and ease of programming as well as a low purchase price, it encourages academics to be more active in conducting various research and inventions that cover the facilities owned by the machine. CNC, so that more benefits or uses can be obtained by using this machine. The advantages of these facilities are expected to increase the number of needs for the use of CNC machines among industries in the future [10-11].

This study analyzes matters relating to the process of making a product, namely the time and minimum production costs using the TU-2A CNC machine.

EXPERIMENTAL METHOD

The research process carried out is as shown in **Figure 1**.

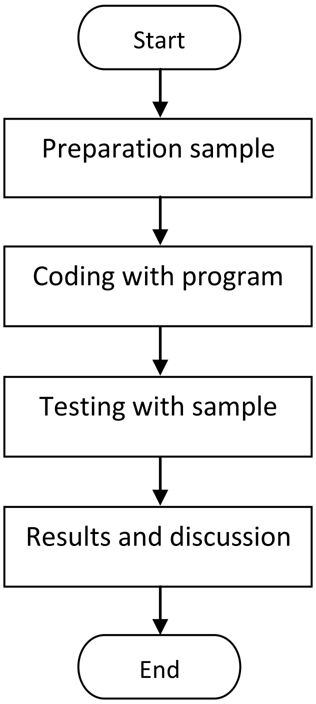

Figure 1. Flow chart of present work

The variables studied were the calculation of feeding speed, cutting speed, depth of cut and spindle rotation. Calculation of the minimum production time and cost of making gas stove nozzles.

Axis CNC machine is a turning machine tool with an automatic drive, where the drive is controlled by a set of electronic tools through a computer program in the form of numeric data, in the form of codes or commands, with a scale of use devoted to training or training at presented in **Figure 2**.

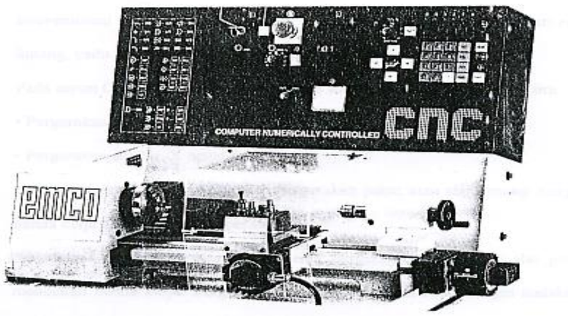

Figure 2. TU-2A CNC Machine [6-7]

The usability of this machine is the same as conventional lathes in general, except that the movement of slashing or slinging can be controlled manually through a computer program. The main movement of this machine is divided into two types of movement, namely:

1. The movement of the axis (Axis) X, and
2. Y axis movement.

RESULTS AND DISCUSSION

Cutting tool is a tool used as a cutter during the process of cutting metal or work pieces. In practice, the use of cutting tools is required to be able to have high criteria and abilities during the cutting process. These criteria include:

1. Ability to high temperature.
2. High resistance to friction.
3. High resistance to cracking.
4. Low coefficient of friction

Cutting tools with good workability are very suitable for cutting in the mass production process, because in mass production it can be seen the influence of the quality of the cutting tool. The materials of cutting tools/chisels vary and each material has its own advantages. Below are the materials of cutting tools/ chisels that are commonly used in the metal cutting process, including:

1. High Carbon Steel.

This cutting tool material has a good ability to be hardened with appropriate heat capabilities and its hardness will approach the hardness of steel at high speeds. The tool material will be less hardened at 300 °C and is not suitable for high speed feeding or heavy work. Cutting tools with this material are most suitable for working with soft work piece materials and are specifically for small types of cutting tools.

2. High Speed Steel

This material has a good ability to be hardened and its cutting edges are maintained well up to a temperature of 650 °C. This type of material is often called red hardness steel because it is able to maintain its hardness up to high temperatures, so it is able to cut hard metals. The chemical composition contained in this steel is tungsten (18%) and chromium (55%).

3. Cast Alloy not Iron

To get a cutting tool with this material is done by the process of casting and grinding. The material of this cutting tool has high heat resistance up to a temperature of 925 °C. However, this material is more brittle than high speed steel (HSS). Its metallic properties are between high speed steel (HSS) and carbide steel.

4. Carbide Steel

Carbide steel contains tungsten (94%) and Cobalt (6%). This type of steel is best suited for work pieces made of cast iron and all other materials except steel. The inability to use a carbide type cutting tool to cut the chisel is due to the steel chippings when cutting will stick or stick to the carbide surface. This material is able to withstand temperatures up to 1250 °C.

In choosing a cutting speed, two certain criteria are used, including:

1. Minimum Production Cost.
2. Minimum Production Time.

Optimum cutting speed results in minimum production costs at constant cutting speeds as in cylindrical turning. Figure 5 shows the effect of cutting speed on production costs. The parameters that affect the size of the cutting speed are basically the same as the parameters in determining the feeding value, namely the type and hardness of the material /work piece, type of cutting tool, rotation, and diameter of the work piece and the use of the type of tool material in shown **Figure 3**.

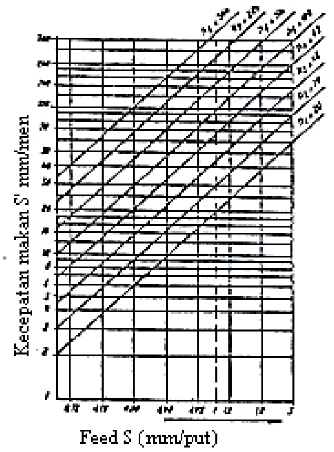

Figure 3. Diagram of the relationship of S', S and n

To calculate the price of cutting speed can be used the following formula:

$$V_s = \frac{\pi \cdot D \cdot n}{1000} \text{ (m/min)} \qquad (1)$$

or

$$n = \frac{V_s \cdot 1000}{\pi \cdot D} \text{ (rpm)} \qquad (2)$$

Where, Vs is the appropriate cutting speed for the metal being machined, D is the diameter of the work piece and n is the rotation of the principal axis.

The relationship between cutting speed and work piece diameter produces a spindle rotation diagram (main axis) in the form of a straight line equation with a direction coefficient tg α= p, as shown in **Figure 4 - 6**.

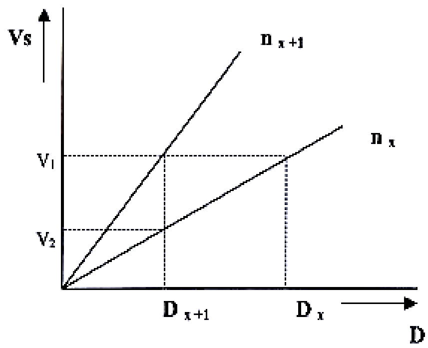

Figure 4. Diagram relationship for Vs and D.

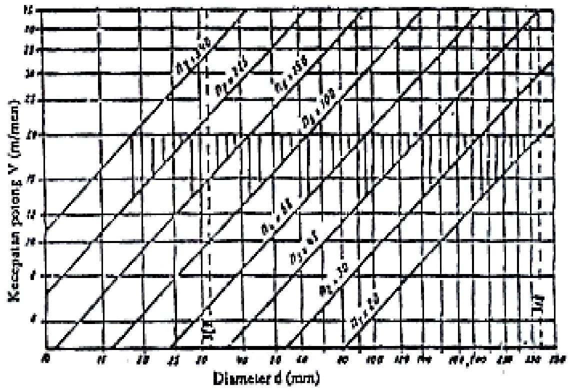

Figure 5. Relationship diagram Vs, D and n

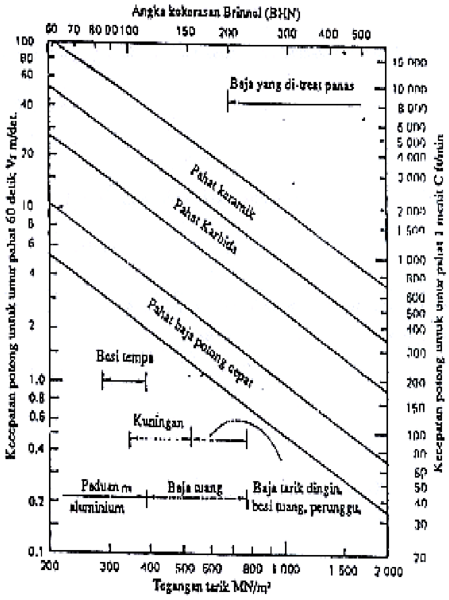

Figure 6. Speed relationship diagram cut and hardness of the work piece

The depth of cut is an important parameter that must be considered in the efficiency of production time in addition to cutting speed and feeding. Parameters that affect the depth of feed include the type and hardness of the work piece, type of cutting tool/chisel, cutting speed, feed and rotation of the main axis (spindle). **Table 1** shown the cutting speed, feed and feed depth for single-edged carbide tools.

Table 1. Feed and feed depth for carbide tools

Material	Feeding Depth (mm)	Feed per Round (mm/put)
Brass	0.50 – 2.30	0.75 – 2.30

To get other cutting prices, see **Figure 7**.

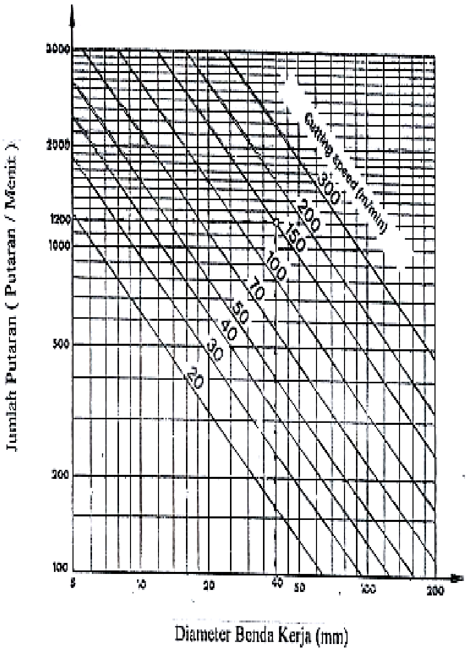

Figure 7. Cutting price chart based on work piece diameter

The results of the calculations with formula by (1) and (2) obtained are as in **Table 2** and Figure **8-11**, and **Figure 12** is presented of the shape of the work piece.

Table 2. Values of t $_{prod}$ and C $_{prod}$ with several variables

Depth of cut (mm)	Feed, s (mm/put)	Velocity Cemetery (mm/minute)	t_{prod} (minute)	C_{Prod} (Rp)
0.50	0.75	281	7.6	8,572
0.60	0.80	300	7.5	8,495
0.70	0.85	319	7.5	8.482
0.80	0.90	338	7.5	8.482
0.90	0.95	356	7.5	8.482
1.00	1.00	375	7.4	8.395

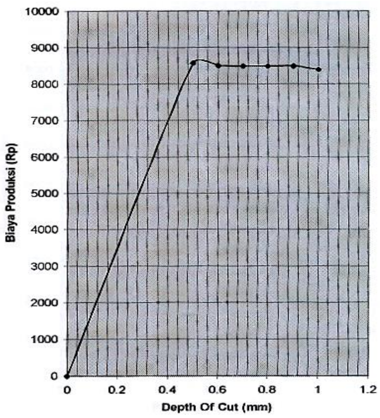

Figure 8. Relationship diagram depth of Cut and production cost

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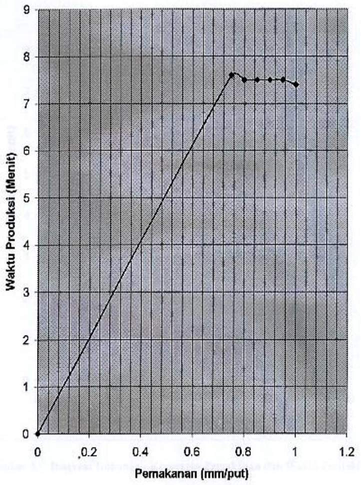

Figure 9. Relationship diagram Depth of cut and production time

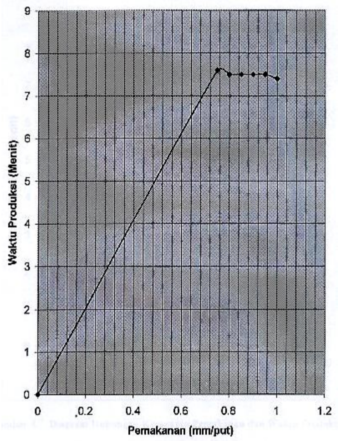

Figure 10. Feeding relationship diagram and production time

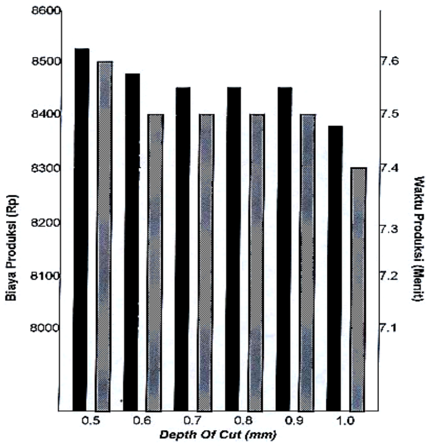

Figure 11. Depth of cut relationship diagram on production costs and time

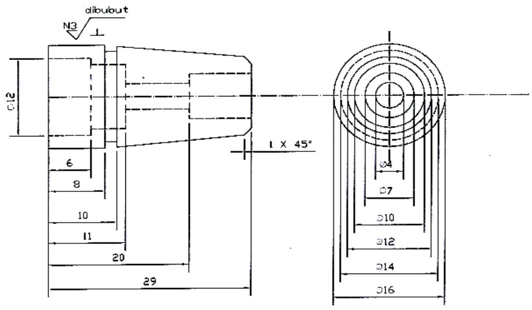

Figure 12. Shape of the work piece

CONCLUSION

From the process of making a gas stove *nozzle* with a TU-2A CNC machine, it can be concluded that:

1. The TU-2A CNC machine is a Turning type machine tool (lathe) which is controlled by a computer system through input (input) data in the form of programs in the form of numbers and letters (numeric). This machine has 2 directions of movement of the cutting tool, namely the radial direction (perpendicular to the main axis or better known as the X axis) and the axial direction (parallel to the main axis or often referred to as the Z axis movement).
2. It can be seen the value of production time (t_{prod}) and the value of production costs (C_{prod}) resulting from changing the amount *of Depth of Cut, Feed* and Feeding Speed. The greater the value of Depth of Cut, *Feed* and Feeding Speed, the production time and production costs that occur will decrease until they reach t_{prod} = 2.6% and C_{prod} = 2.3%.

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