International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 11 | Nov 2018 www.irjet.net p-ISSN: 2395-0072

# Material Removal Rate (MRR) Study in Time Reduction Pneumatic Shaper Machine

**Sibin babu[1], Shamnad N[2], Praveen D Dethan[3]**

*[1] PG Student, SNIT, Adoor, Kerala, India*
*[2]B-Tech, TKMIT, karuvelil, Kerala, India*
*[3]Asst.Professor & PG Coordinator, Mechanical Dept., SNIT, Adoor, Kerala, India*

---

**Abstract -** *A shaper is a machine tool used to machine a single job by using a single point cutting tool and hence it cannot be used for high production rates. This paper presents an investigation on the shaper for high production and comparing the material removal rate between conventional shaper machine and time reduction pneumatic shaper machine. The shaper machine has an idle stroke during its return motion. This project will uses the idle stroke as cutting stroke and hence increase the production rate. This can be achieved by addition of clapper box with a tool such that the arrangement on tool holder has one tool clamped on the clapper box individually. Return stroke would be a rough cutting stroke for the job compared to the forward stroke. The pneumatic source of power with control accessories is used to drive the ram to obtain the forward and return strokes.*

***Key Words*: Material removal rate, Pneumatic cylinder, Solenoid valve, Clapper box arrangement, Air compressor**

## 1. INTRODUCTION

A shaper is a type of machine tool uses linear relative motion between the work piece and a single-point cutting tool to machine a linear tool path. Shapers are mainly classified as standard, horizontal, universal, vertical, geared, crank, hydraulic, contour and traveling head, with a horizontal arrangement most common. The vertical shaper is essentially the same thing as a slotter, although technically a distinction can be made if one defines a true vertical shaper as a machine whose slide can be moved from the vertical. Small shaper machine have been successfully made to operate by hand power. As size increases, the mass of the shaper machine and its power requirements increase and it becomes necessary to use a motor or other supply of mechanical power. The shaper machine has an idle stroke during its return motion. This project uses the idle stroke as cutting stroke and thereby reduces the overall machining time. This can be achieved by an addition of clapper box with a tool such that arrangement on tool holder has one tool clamped on the clapper box individually. This stroke would be a rough cutting stroke for the job, compared to the forward stroke.

The material removal rate (MRR) increases when the Machining time reduces and hence increases the production rate. This paper presents an investigation on the shaper for high production and comparing the material removal rate between conventional shaper machine and time reduction pneumatic shaper machine.

## 2. COMPONENTS AND DESCRIPTION

The parts that are effectively employed in the time reduction pneumatic shaping machine are Solenoid valve, Flow control valve, Electronic control unit, Flexible hoses, Clapper box and dead weight arrangement, Air compressor.

### 2.1Pneumatic Cylinder

An pneumatic cylinder is an operative device in which the state input energy of compressed air i.e pneumatic power is converted in to mechanical output power. Mechanization is defined as the replacement of manual effort by mechanical power. Pneumatics is an attractive medium for low cost mechanization particularly for sequential operations. Many factories already have a compressed air system, which is capable of providing both the power or energy requirements and the control system (although equally pneumatic control systems may be economic and can be advantageously applied to other forms of power).The main advantages of an pneumatic system are usually economy and simplicity, the latter reducing maintenance to a low level. It also have outstanding advantages in terms of safety.

Pneumatic systems operate on supply of compressed air, which must be made available, in sufficient pressure to suit the capacity of the system. The main part of any facility for supply of compressed air is by means using reciprocating compressor. A compressor is a machine that takes in air at a certain pressure and delivered the air at a high pressure. The cylinder is a double acting cylinder one, which means that the air pressure operates alternatively. The air from the compressor is passed through the regulator which controls the air pressure to required amount by adjusting its knob.

### 2.2 SOLENOID VALVE

The solenoid valve is one of the important parts of a pneumatic system. This valve is used to control the direction of air flow in the pneumatic system. The directional valve does this by changing the position of its internal movable parts. This valve was selected for speedy operation and also for the modification of the machine into automatic machine by means of using a solenoid valve. A solenoid is an electrical device that converts electrical energy into force and straight line motion.

### 2.3 FLOW CONTROL VALVE

A flow control valve regulates the flow or pressure of a fluid. Control valves normally respond to signals generated by independent devices such as flow meters or temperature gauges. Control valves are fitted with actuators and positioners. Pneumatically-actuated Diaphragm Valves are widely used for control purposes in many industries, although quarter-turn types such as ball, gate and butterfly valves are also used.

### 2.4 AIR COMPRESSOR

An air compressor is a device that converts power into potential energy stored in pressurized air (i.e., compressed air). By one of several methods, an air compressor forces more air into a storage tank, increasing the pressure. When the tank pressure reaches its upper limit the air compressor will shuts off. The compressed air will held in the tank until called into use. The energy contained in the compressed air can be used for a variety of applications. When tank pressure reaches its lower limit, the air compressor turns on and re-pressurizes the tank. The main function of the air compressor is to compress the air up to the required air pressure.

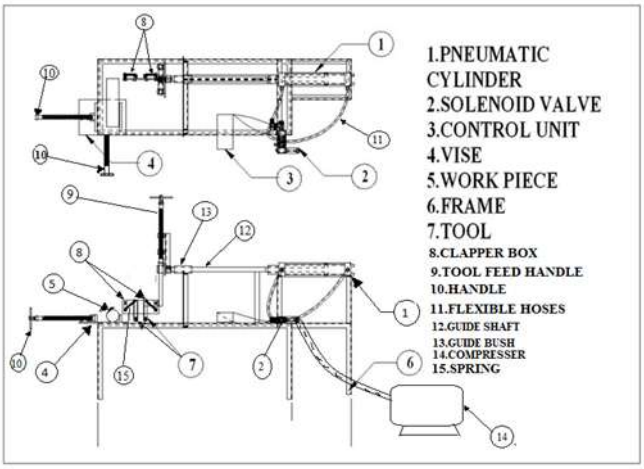


Fig -1: line diagram

### 3. WORKING PRINCIPLE

Starting with air compresses, its function is to compress air from a low pressure (usually atmospheric) to a higher pressure level. The compressed air goes to solenoid valve through flow control valve. The flow control valve is used to control the air flow to the cylinder. This flow is adjusted manually by the nap is fixed above the flow control valve, then this air goes to the 5/2 solenoid valve. The 5/2 solenoid valve having one input port, two output port and two exhaust port. The workpiece mounts on a rigid box-shaped table in front of the machine. Table motion can be controlled manually. The ram slides forward and return on the work. The pneumatic source of power with control accessories is used to drive the ram to obtain the forward and return strokes.

### 4. MATERIAL REMOVAL RATE (MRR)

The material removal rate can be defined as the volume of material removed divided by the machining time. Another way to define MRR is to imagine an "instantaneous" material removal rate as the rate at which the cross-section area of material being removed moves through the workpiece. Material removal rate is the volume of material removed per minute. For example roughing cuts are used to remove large amount of material from the workpart as rapidly as possible, so their MRR is high. In manufacturing process MRR stands for Material removal rate, meaning the volume of material being removed in a unit of time (ex. cm3/min). It has great importance in the economy and feasibility of manufacturing processes.

Material Removal Rate (MRR)=((Initial Weight-Final Weight) Of W/P Material)/(machining time*density of work material)

### 4.2 MATERIAL REMOVAL RATE IN CONVENTIONAL SHAPER MACHINE

| | |
|---|---|
| Workpiece Material | : Nylon |
| Initial Weight Of Workpiece | : 0.291kg |
| Final Weight Of Workpiece | : 0.286kg |
| Machining Time | : 18.10min |
| Density Of Workpiece | : 1.15 X $10^{-6}$ Kg/$mm^3$ |

Material Removal Rate (Mrr)=((0.291-0.286))/(18.10 X (1.15 X 10^-6))

=240.211mm3/Min

#### 4.3 MATERIAL REMOVAL RATE IN TIME REDUCTION PNEUMATIC SHAPER MACHINE

| | |
|---|---|
| Workpiece Material | : Nylon |
| Initial Weight of Workpiece | : 0.286kg |
| Final Weight Of Workpiece | : 0.281kg |
| Machining Time | : 15.5min |
| Density Of Workpiece | : 1.15X10-6 Kg/$mm^3$ |

Material Removal Rate (Mrr)

=((0.286-0.281))/(15.5 X (1.15 X 10^-6))

=<u>280.5$mm^3$/min</u>

### 5. RESULTS

- Material Removal Rate In Conventional Shaper Machine = 240.21$mm^3$/min
- Material Removal Rate In Time Reduction Pneumatic Shaper Machine = 280.5$mm^3$/min

## 6. CONCLUSION

The main objective is to reduce the machining time, so that we can increase the production rate. By the emerging of this technique, the machining time can be reduced and quick response is achieved. The optimization problem is then solved recursively by adding a cutting tool which allows the removal of the material in return stoke. From the experiment we found that the material removal rate higher for time reduction pneumatic shaper machine as compare to conventional shaper machine. Thus the material removal rate increases the machining time will be reduced.

## REFERENCES

[1] Dr. Toshimichi Moriwaki ,Recent trends in the machine tool technologies, vol III, 2006

[2] Heinrich Arnol November( 2001): Innovation in the machine tool industry happens incrementally volII

[3] Research, Industrial Systems (2009-05-20). Manufacturing and Investment Around the World: An International Survey of Factors Affecting Growth and Performance. ISBN9780-906321-25-6,2009

[4] M.Y. Noordin, V.C. Venkatesh, "Application of response surface methodology in describing the performance of coated carbide tools when turning AISI 1045 steel", Journal of Materials Processing Technology 145 (2004) 46–58,; received in revised form 28 June 2003; accepted 2 July 2003.

[5] Natarajan, U., Arun, P. and Periasamy, V. M.: On–line Tool Wear Monitoringin Turning by Hidden Markov Model (HMM),Institution of Engineers (India) Journal(PR), 87, 31–35,2007

[6] Fu, P. and Hope, A. D.: A Hybrid Pattern Recognition Architecture for Cutting Tool Condition Monitoring,Technology and Applications, 24, 4, 548–558,2008

[7] Research, Industrial Systems (2002-05-20). Manufacturing and Investment Around the World: An International Survey of Factors Affecting Growth and Performance. ISBN978-0-906321-25

[8] Manufacturing & Investment Around TheWorld: An International Survey Of Factors Affecting Growth & PerformanceISR Publications/Google Books, revised second edition, 2002

[9] Haci Saglam, Suleyman Yaldiz, Faruk Unsacar, The Effect of Tool Geometry and Cutting Speed on Main Cutting Force and Tool Tip Temperature, Materials and Design,2007, 28, 101–111