ISSN 2250-3153

Machining Time Required For Taper Grinding and Its Cost Analysis in G17-22U Grinding Machine

Jubin James*, Bobby John*, Sijo M.T**

*Department of Mechanical Engineering (Production and Industrial), SCMS School of Engineering and Technology
** Asst. Professor Mechanical Engineering, SCMS School of Engineering and Technology,

Abstract- An attempt is made to solve problems in the process flow in an alternator production plant. The plant had to outsource their partially machined shaft for tapper grinding for a certain rating of alternator. A small study was conducted for identifying is there any opportunity to do the operation within the plant. Next approach was to solve the problem with in the plant's available resource, with high quality and law cost. Machining time and labour cost was calculated. Finally the profit of the company for a certain period of time is calculated within the available data's. This attempt helped us to know about the production process of different rated alternators, working of different departments in the firm, problems faced by a company.

Index Terms- labour cost, machining time, plunge grinding, taper grinding,

I. INTRODUCTION

An alternator producer at kasaragod produces different Varity of alternator for different ratings and application, were 25kw training lighting alternators used in AC coaches for Indian railway is one among them. Its shaft has to be passed over different operations like turning, threading, tapper grinding, end drilling etc. The plant has the capacity to do most of operation except taper grinding. Presently the plant has to outsource the shaft to outside plant for the taper grinding. presently the plant have a grinding machine of G 17-22U, which means it is a universal grinding machine that can machine a job up to 220mm diameter shaft. The grinding machine G17-22U was installed 20 years before when the plant was started. At beginning stage the plant had no expectation of producing 25 KW alternators. So the available grinding machine in the plant does not have a provision for tapper grinding. All other ratings of shaft do not need a tapper grinding except 25KW and 18.5KW alternators. The shaft normally reaches the grinding machine after the operation in CNC35, were the turning operations are completed. In the case of 25 KW alternator the shafts are out sourced for tapper grinding. In a single transportation there can be nearly 20 to 30 number of shaft were the plant have to spend nearly 10000 rupees for the transportation and 225 rupees for the machining operations.

The grinding machine G17-22U have a tilting head stoke ,but don't have tilting tail stoke .To replace tail stoke with a new one or to have a new universal titling table is expensive so we suggest for an external fixture at the tail stoke .This fixture helps to hold the shaft for proper taper grinding.

Cylindrical grinding machine

This machine is used to produce external cylindrical surface. The surfaces may be straight, tapered, steps or profiled. Broadly there are three different types of cylindrical grinding machine as follows:

1. Plain centre type cylindrical grinder
2. Universal cylindrical surface grinder
3. Centre less cylindrical surface grinder

Plain centre type cylindrical grinder

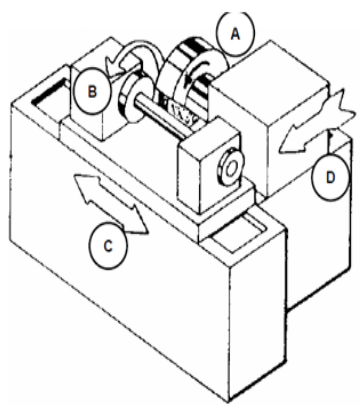

Figure 1; Traverse grinding machine

Figure above illustrates schematically this machine and various motions required for grinding action. The machine is similar to a centre lathe in many respects. The work piece is held between head stock and tailstock centers. A disc type grinding wheel performs the grinding action with its peripheral surface. Both traverse and plunge grinding can be carried out in this machine as shown in Fig 2 and 3.

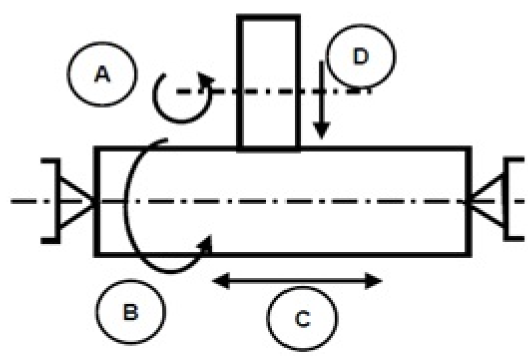

Figure 2; Traverse grinding

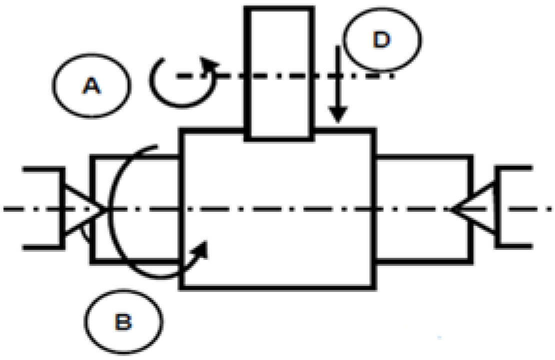

Figure 3; Plunge grinding

In cylindrical grinding, the work piece rotates about a fixed axis and the surfaces machined are concentric to that axis of rotation. Cylindrical grinding produces an external surface that may be straight, tapered, or contoured. The basic components of a cylindrical grinder include a wheel head, which incorporate the spindle and drive motor; a cross-slide that moves the wheel head to and from the work piece; a headstock, which locates, holds, and drives the work piece; and a tailstock, which holds the other end of the work. Internal diameter or "I.D." grinders finish the inside of a previously drilled, reamed, or bored hole, using small grinding wheels at high RPM.

2 Problem Analyses:

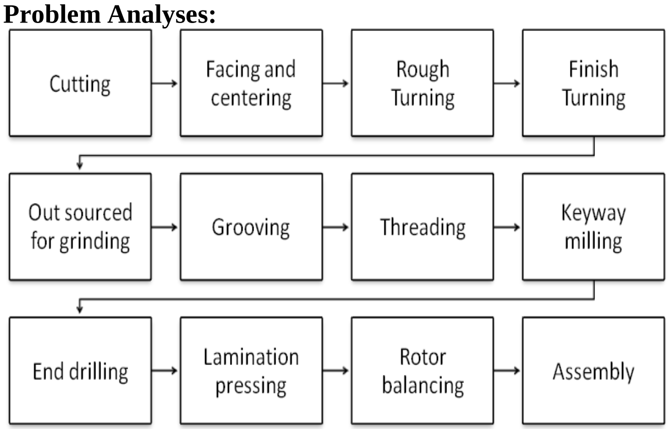

Figure 4: Present shaft flow for 25kw alternator

This plant have a G17 22 universal grinding machine presently used only for straight grinding . 25kw alternator require 2 taper grinding at two ends with a length of 95mm. larger diameter is 55mm and small diameter is 45mm.total length of the shaft is 936mm.normaly the shaft is supported horizontally in the grinding machine with the help of head stoke and tail stoke. the shaft is reached to here after the operation in CNC depend on the shaft diagram. The portion to be grinded have a stoke of .5mm which is to be removed by grinding. for normal grinding operation the wheel and the job should be in parallel so tilt the head stoke so that both job and wheel are parallel.G17 machine have provision to rotate about 90 degree but zero at tail stoke. So at the tail stoke if a special type of fixture is attached the job can be supported easily and taper grinding can be carried out.

2.1 Idea for solving the problem

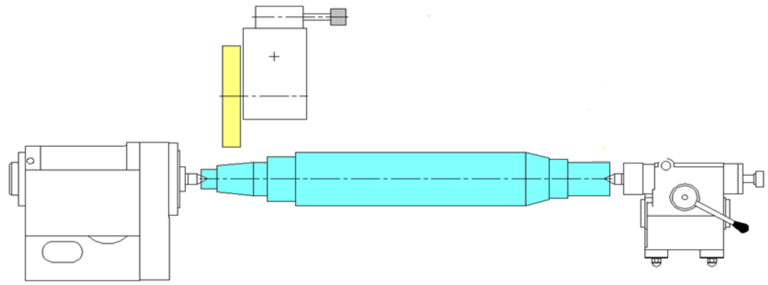

Figure 5;25kw shaft hold between head and tail stoke (front view)

Fig shows present situation if 25 KW is fixed for grinding operation in g17 grinding machine .this machine can tilt the head stoke but not the other like tail stoke and wheel

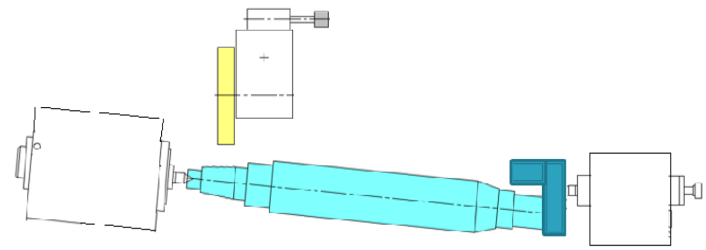

Figure 6; 25kw shaft hold between head stoke and fixture supported at tail stoke (top view)

Fig 6 shows a rough idea of fixture used for tapper grinding .G17 grinding machine have a grinding wheel of width 65mm.If this type of arrangement is there the portion to be grinded will be parallel to the wheel so that proper grinding can be carried out.

Tapper angle calculation
Large diameter (D) =55mm
Smaller diameter (d) =45mm
Tapper length (9l) =95mm

$$\text{Tapper angle} = \frac{D-d}{2L} * \frac{630}{11}$$

$$= \frac{55-45}{2*95} * \frac{630}{11}$$

$$= 2.86^{\circ}$$

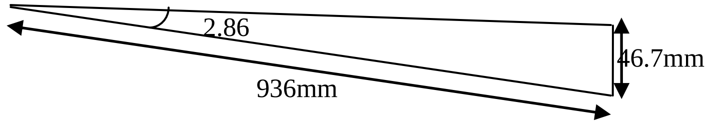

Figure 7; Eccentricity of the shaft after fixing

The above fig 6 shows that the center of new fixture should be 46.74mm apart from the current setup.

2.2 Overall Production Time
Machining time

Time required for cylindrical grinding (T) =

$$\frac{\text{Length of cut x Number of cuts}}{\text{Feed/rev x R.P.M}}$$

Length of cut = length of tapper + over travel
= 95 + 130

= 225mm

Feed/rev = $\frac{W}{4}$ (W=width of grinding wheel)

= 65/4

= 16.25mm

R.P.M of job = 78 R.P.M

Assuming depth of cut = 0.0025mm

Total stoke to be removed = $\frac{D-d}{2}$

= 0.5/2

= 0.25mm

number of cut required = 0.25/0.0025

= 100 cuts

Time required for cylindrical grinding (T) = $\frac{225 \times 100}{16.25 \times 78}$

Machining time = 17.75 min

Besides machining time following time allowance must be given due consideration

1. Set up time

Time for setting and fixing the job and tool. It also include time for studying, blue prints, gauge setting fixture setting etc. For this case time for job setting = 1min, fixture setting = 2min, time for study = 3min ,clearance= 2min

set up time =8 min

2. Operating time

Time taken for actual operation

a. Handling time

Time consumed in all physical movement by the operator to prepare the job for machining and disposing off the job after machining

Handling time = 2 min

b. Machining time

Total time consumed by the machine for machining of the job. Machining time depend on cutting speed, depth of cut , feed

Machining time =17.75 min

3. Unloading time

Time for removing the job from machine

Unloading time =1min

4. Miscellaneous time

a. Tool changing and re sharpening (5%-10% of machining time)

10/100*17.75=1.78min

b. Checking and inspection (5%-30% of machining time)

30/100*17.75 = 5.33 min

c. Fatigue allowance (5% of machining time)

5/100*17.75 =.89 min

d. Personal allowances (5% of machining time)

5/100*17.75 =.89 min

e. Cleaning and disposal (15%- 20% of machining time)

20/100*17.75 =3.55 min

Time for a single tapper = 8 + 2 +17.75 + 1 + 1.78 + 5.33 + .89 + .89 + 3.55 = 38.41min

Each shaft require two tapper grinding

Total time required for two tapper = 38.41*2

= 76.82 min

Total working hours =7 *60

= 420 min

Total no of product can be prepared = 420/76.82

= 5.46 no;

For deciding the actual working norms they have to passed after discussion and meeting with management and worker .After the meeting it is expected to have 4 jobs to be machined in each shift

2.3 Labour costing

Labour costing includes

1. Direct costing (cost can be allocated to a single product)
2. Indirect costing (cost cannot be allocated to a single product)
3. Labour welfare relevant cost (incentive D.A, etc)
4. Labour losses (cost paid at ideal time)

Labour cost include fixation of wage rates and standard time for particular activity .we have already calculated the time for the activity which is about 76.82 min for each shaft. normally the working hour for a shift is 8 hours but there will be an idle time which is almost 1hour.

Labour cost = Net hourly rate X No. of hours worked on the product

Net hourly rate = $\frac{\text{Wages paid + other expenses}}{\text{Effective hour worked}}$

In BHEL electrical machines limited a worker is paid Rs.10000 per month including rs.140 as dearness allowance. In addition to this Rs100 per month is paid as H.R.A .a bonus @20% is given at the end of the year. the employer contribute P.F @ 8% and insurance premium @ 2% of wage The employee are entitled to and availing one day leave for every 10 days work. Total number of working days for E.L calculation is taken as 300.Industry provides a subsidiary of Rs 18000 to its canteen. If 300 employees work 8 h a day with 10% normal idle time

Wages paid to worker per year = 10000* 12

= 120000

H.R.A paid per year = 1200

Share of P.F paid @8% of 120000 = 9600

Insurance premium 2% of 120000 = 2400

Bonus 20% of 120000 = 24000

Subsidy to canteen = 18000

Total expense = 120000 + 1200 + 9600 + 2400 + 24000 + 18000

= 175200 Rs

No. of working hours /day = 8 hours

Total no. of working day/year = 300 days

Total no. of working hours/year = 2400 hrs

Leave = 30*8

= 240 days

Remaining time = 2160 hrs

Nominal idle time for year = 270 hrs

Effective no. of working hours = 2160 -270

=1890 hrs

Net hourly rate = $\frac{175200}{1890}$

= 92.69 Rs

Labour cost for a day = 92.69*7 = 648.88 Rs

Labour cost for machining one 25Kw shaft = 648.88/4

= 162.22 Rs

Indirect labour cost =50 Rs

Total labour cost =212.22 Rs

Production cost

Cost of operation per shift =

Wattage/1000 x rate/kWh x hours used

= 2/100*7*5.5
= 69.82 Rs
Cost of operation per pieces =17.45 Rs
Miscellaneous cost =20 Rs
Total cost =249.67 Rs

3. RESULTS AND DISCUSSION

Now the plant is spending 225 Rs for labour cost since they are out sourcing the shaft for tapper grinding. Up and down transportation require almost 7500 Rs. There can be an unexpected time delay, problems in quality maintenance and inventory cost. If the process is carried within the firm this operations can be completed for Rs 249. There will not be any time delay and reduce inventory cost.

3.1 FINANCIAL BENEFITS

Number of shaft nearly outsourced at a time = 25
Amount for transportation = 7500 Rs
Machining cost = 225 Rs
Transportation cost for a single shaft = $\frac{7500}{25}$
= 300 Rs
Total cost spend for a single shaft = 300 + 225
= Rs 525
Total cost = 525 * 25
= 13125 Rs
If the same operation is carried under the plant = 249.67 Rs
Total cost for completing the 25 pieces = 25 * 249.67
= 6241.75 Rs
Cost for preparing the fixture = 2000
(including the machining cost)
Life time for the fixture = 3 years
Expected number of order within 3 years = 200 no.
Total cost for the company in machining 200 pieces
= 8*6241.75 + 2000
= 49934 + 2000
= 51934 Rs
If it was out sourced =525 * 200
= 105000 Rs
Total cost saved within 3 years =105000 - 51934
= 53066 Rs

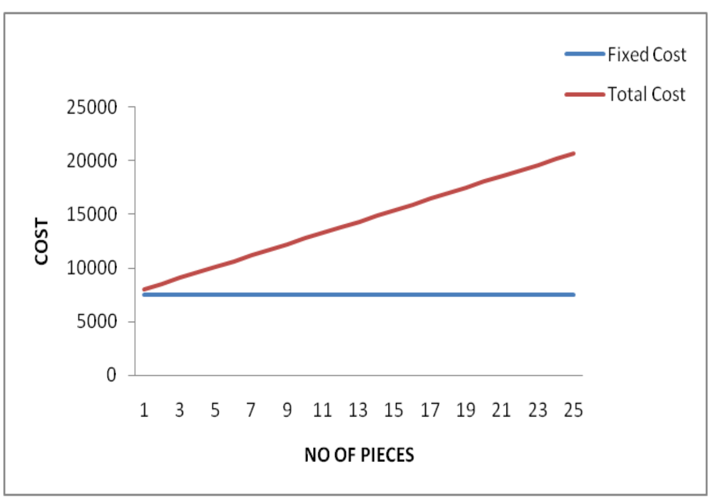

Figure 8; Fixed and total cost if outsourced

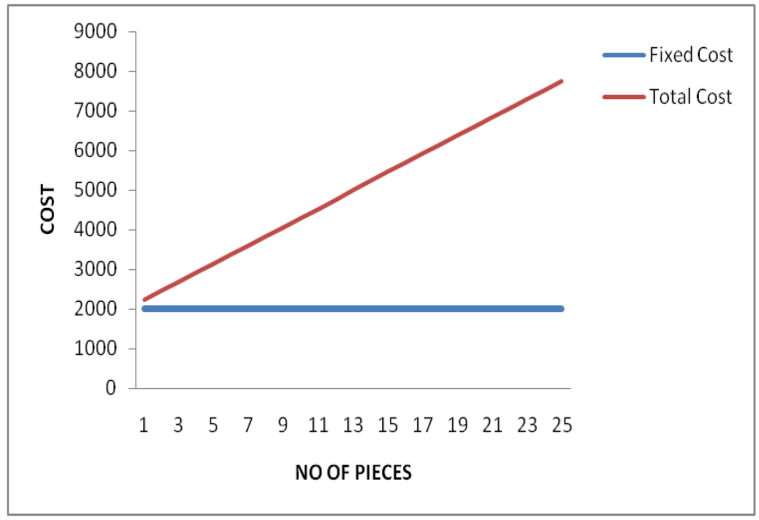

Figure 9; Fixed and total cost if not outsourced

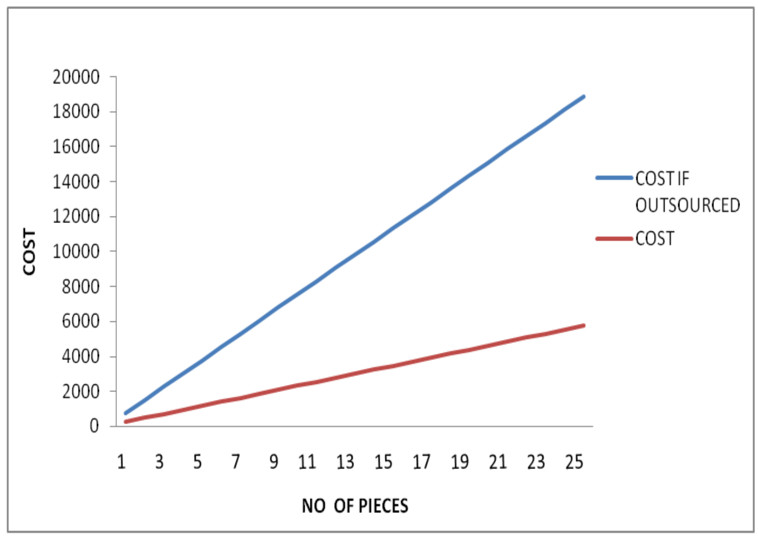

Figure 10; Cost comparison of outsourcing and not outsourcing

3.2 EXPECTED SHAFT FLOW

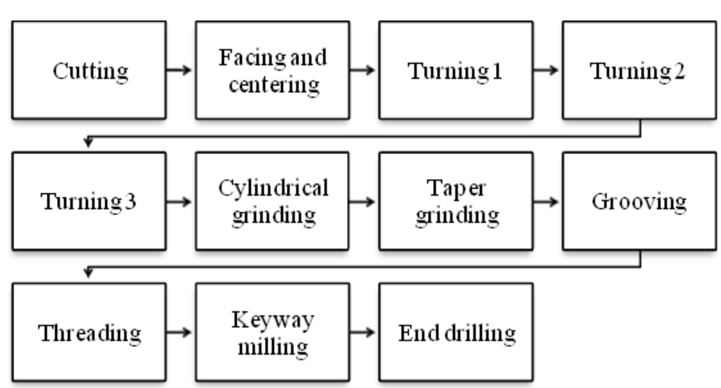

Figure 11; Expected shaft flow

CONCLUSION

Although BHEL EML is a recently incorporated joint venture company, with all its constraints it has made its own mark in the highly competitive and dynamic market, BHEL EML is recognized as the quality product manufacturer in its play ground. It has maintained an upper hand in terms of trust among customers and still holds the monopoly in certain fields. In very short span of operation BHEL EML has made major strides in this vital sector and has acquired a solid reputation for superior quality, high efficiency, reliable performance after sales service and quick serviceability

In my training i could suggest a proposal which brings about 53000 Rs saving for the company after all constrain in the company. This proposal could help the company not to outsource their products to outside for tapper grinding result in smooth process flow and fast output.

APPENDIX

G17 -grinding machine center height170mm.
22U - grinding machine center distance 220cm

ACKNOWLEDGMENT

.We would like to thank all the staff members in BHEL eml at kasaragod and SSET karukutty

REFERENCES

[1] Annual report of BHEL EML

[2] Mechanical estimating and costing by S.C Jain Edition 2002

[3] Basic principle, purpose and application of grinding Version 2 ME, IIT Kharagpur

[4] Monitoring force in precision cylindrical grinding Jeremiah A. Couey a, Eric R. Marsh a, Byron R. Knappb, R. Ryan Vallance c Precision Engineering 29 (2005) 307–314

AUTHORS

First Author – Jubin James, graduated in Mechanical Engineering from Kannur University, Post Graduate Student in Production & Industrial Engineering at SCMS School of Engineering and Technology, affiliated to Mahatma Gandhi University, Kerala, India, jubin24@gmail.com

Second– Bobby john, graduated in Mechanical Engineering from Kerala University, Post Graduate Student in Production & Industrial Engineering at SCMS School of Engineering and Technology, affiliated to Mahatma Gandhi University, Kerala, India

Third Author – Sijo M.T, Assistant Professor in Mechanical Engineering Department, in SCMS School of Engineering and Technology, Kerala, India