ENHANCEMENT IN PRODUCTIVITY AND REDUCTION IN COST OF LAPPING OPERATION– A CASE STUDY

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Abstract: Generally productivity is defined as ratio between output and input. Productivity is nothing but reduction in wastage of resources like men, material, machine, time, space, capital etc. In our paper we have focused on improvement of machine productivity of medium scale manufacturing industry on the basis of work measurement approaches. The work cycle was recorded for lapping operation on two machines namely, lathe machine and simple lapping machine. The work cycle are divided into small measurable work elements. These elements were recorded on observation sheet. Observations have been recorded for different trails to analyze the operation effectively for identification of required and non-required elements. The time reduction of 23.40% is seen after analyzing the lapping operation on simple lapping machine compared to lathe machine. Also cost reduction in terms of monthly wage of worker reduces by Rs 12000 i.e. reduction in cost is equal to 54.54%

IndexTerms **– Paint Spray Gun; Cycle Time; Predetermined Motion Time System; Poka-Yoke Devices**.

I. INTRODUCTION

Basically productivity is quantitative relationship between what we produce and what we have spent to produce. It measures how efficiently the resources in a system are used in producing desired output. Hence our paper explains and proves that use of simple lapping machine can improve productivity by reduction in cycle time and cost. This can be achieved using work measurement process or work study. Work study is systematic examination of the methods of carrying out activities such as to improve the effective use of resources and to set up standards of performance for the activities being carried out. Work measurement involves assessing the time; a job should take to do. The study area includes lapping operation of carbide seat ring on lathe machine and simple lapping machine. To reduce the time required for lapping operation on lathe machine, the operation is carried out on simple lapping machine. To observe the reduction in time, the time study technique is used. By observing the time study graph is plotted

II. KEYWORDS

Paint Spray Gun: A device consisting of a container from which paint is sprayed through a nozzle by an air pressure from a pump.
Cycle Time: Total time from the beginning to the end of a process.
Lapping Paste: Lapping paste is mixture of hard abrasive particles in a suitable base & used for controlled removal & are used for close mating of surfaces and for removing rust and brightening of metal surface. The lapping paste used is DIAMOND COMPOUND of tier-3 paste (D-3).
Predetermined Motion Time System: A procedure that analyses any manual activity in terms of basic or fundamental motions required to perform it. The main use of PMTS lies in the estimation of time for the performance of a task before it is performed.
Poka-Yoke Devices: It is a Japanese word which refers to "mistake-proofing". These devices are used to reduce human errors.

III. NEED OF LAPPING ON SEAT RING

Paint Spray Guns are one of the most important reasons for fascinating and uniform layer of paint on cars**.** The carbide seat ring is an important part of Paint Spray Gun. As the name suggest it is a carbide ring on which a steel needle rests. The contact point between the needle and the seat ring must have high surface finish in order to avoid leakage of paint through gun. This high surface finish can be achieved by lapping operation in less time. Carbide and Seat Needle assembly are as shown below.

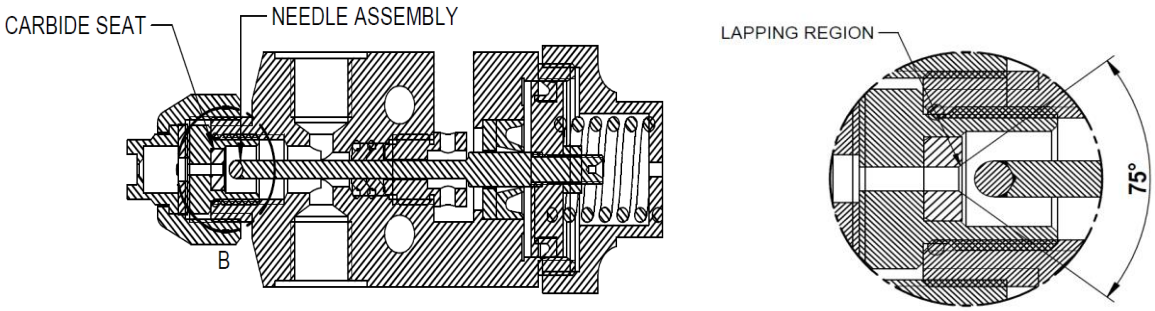

Fig-1: carbide seat ring and needle

IV. Objectives of the Study

- To reduce the cost of production
- To study the operation of lapping by using time study techniques
- To eliminate the time consuming element from the production cycle
- To optimize the cycle time and reduce the production

V. General Process for Lapping

The Lapping operation of Seat Ring consists of mounting the ring on a fast rotating spindle of lathe by means of three jaw chuck or by means of fixture on simple lapping machine as suggested in this paper. Lapping operation of the mounted carbide ring is performed by rotating the spindle shaft and pressing the lapping tool against the carbide ring in a direction horizontal to spindle axis. ***Lapping paste*** (D-3) is used in between the contact of lapping tool and the carbide ring to ensure micro-finish.

VI. Lapping Operation on Lathe Machine

The study illustrated in this paper not only aims at reducing the cost of production but it also helps in elimination of time consuming element in the lapping operation of carbide ring. Initially ***cycle time*** for lapping operation of carbide ring on lathe machine was studied and then the work cycle for said operation was divided into measurable elements. For each element of the lapping operation, cycle time was noted down on the observation sheets. These times were analyzed and average cycle time was calculated.

Fig-2: lapping on lathe machine

Sheet No. 1 illustrates the details of elements and breakpoints in the lapping of carbide ring. Each element time was noted down through stopwatch on the time study sheet. The same sheet was used for number of observations based on the accuracy of the observer to record the time required for each element.

Sheet No. 2 illustrates the time study sheet. It includes the rating (R) which is the step in the work measurement in which the analyst observes the worker's performance and records a value representing that performance relative to the analyst's concept of standard performance. Rating is based on the British standard on the scale of 0-100 where, 0 for no activity, 50 for very slow activity, 75 for steady activity, 100 for standard activity, 125 for very fast activity and 150 for exceptionally fast. For this *the*

Predetermined Motion Time (PMT) is calculated for each element which helps in finding out performance rating of worker. PMT for each element is given below:
Element A: 9.12 Sec
Element B: 43.31 Sec
Elements C: 135.13 Sec
Element D: 5.55 Sec
Time study sheet was prepared by collecting time data by lap-time method of stopwatch for each element. The recorded time was converted into basic time by multiplying it to rating factor. Basic time is the time required for carrying out element of the work at standard rating.

Table-1: elements and time study of lapping operation on lathe machine

Part : Seat ring	Sheet No: 1
Material : Tungsten Carbide	
Size : OD=35 ;ID=19	
Operation : Internal Degree Lapping	
Machine :Lathe Machine	

Elements and Break Points

(A) Picking the job from the input tray and placing it on the three jaw chuck and tightening it

(B) Aligning the job in three jaw chuck.

(C) Lapping Operation

Break Points : Lapping paste not available

(D) Removing the job from the chuck and placing it on the output tray

Break Point : Improper tackling

TIME STUDY SHEET

Operation : Internal Degree Lapping Sheet No : 2

Machine : Lathe Machine Dt. : 05 - 07 – 2019

Element Description	R	WR (Sec)	ST	BT	Element Description	R	WR (Sec)	ST	BT
A	106	8.6	8.6	9.12	A	99	9.23	9.23	9.14
B	105	49.87	41.27	43.33	B	88	58.2	48.97	43.09
C	103	181.19	131.3	135.25	C	97	196.8	138.6	134.44
D	107	186.39	5.2	5.56	D	98	202.45	5.65	5.54
				193.26					192.21

Element Description	R	WR (Sec)	ST	BT	Element Description	R	WR (Sec)	ST	BT
A	88	10.34	10.34	9.1	A	110	8.32	8.32	9.15
B	114	48.37	38.03	43.35	B	96	53.29	44.97	43.17
C	106	176	127.6	135.29	C	95	196.25	142.96	135.81
D	91	182.13	6.13	5.58	D	106	201.47	5.22	5.53
				193.32					193.66

Legends:
R: Operator rating
WR: Working time (cumulative time in sec)
ST: Subtracted time (in sec)
BT: Basic Time

Basic time can be calculated by

$$\textit{Basic Time} = \textit{Subtracted Time} \times \frac{\textit{Rating}}{\textit{Standard Rating}}$$

VII. LAPPING OPERATION USING SIMPLE LAPPING MACHINE

Fig-3 simple lapping machine

Construction

The spare motor is fixed on a table which is supported by columns made up of cast iron. The table of lapping machine is also made-up of CI to avoid damping. Rotor shaft is made hollow having internal threads. The fixture has external threads. The fixture and shaft are joined using threaded joint.

Specifications

- Phase: 3 Phase Induction Motor
- Voltage: 450 V
- Max RPM: 1415

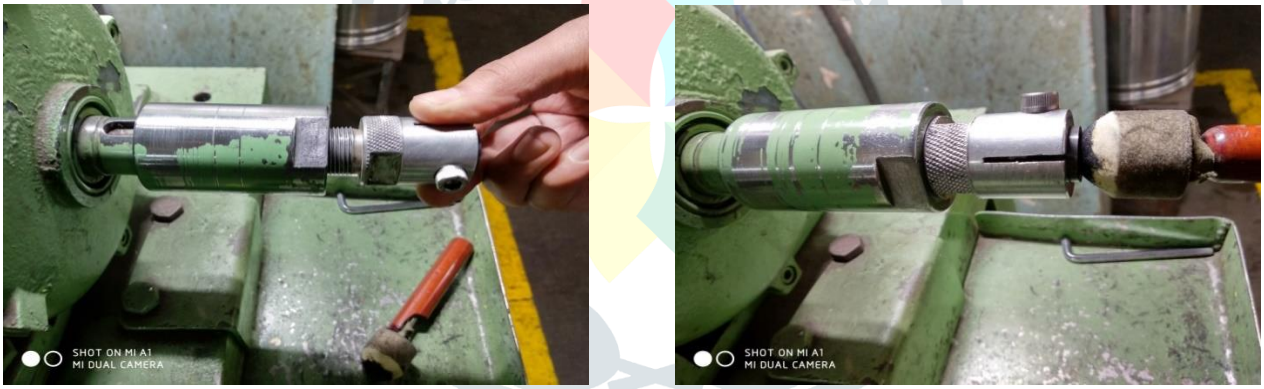

Fig-4: lapping on simple lapping machine

Following the same methodology lapping operation was performed on the custom made lapping machine assisted by fixtures for holding the carbide ring and time study sheet was prepared by following elements and break points chart. PMT for each element is given below:

ELEMENT A: 8.71 sec
ELEMENT C: 5.61 sec
ELEMENT B: 133.91 sec

Table-2: elements and time study of lapping operation on simple lapping machine

Part : Seat ring	Sheet No: 3
Material : Tungsten Carbide	
Size :OD=35 ;ID=19	
Operation : Internal Degree Lapping	
Machine : Lapping Machine	

Elements and Break Points
(A) Picking the job from the input tray and placing it on the fixture and tightening it Break Points : Improper tackling (B) Lapping Operation Break Points : Lapping paste not available (C) Removing the job from the chuck and placing it on the output tray Break Point : Improper tackling

TIME STUDY SHEET

Operation : Internal Degree Lapping Sheet No : 4

Machine : Lapping Machine Dt. : 05 - 07 – 2019

Element Description	R	WR (Sec)	ST	BT	Element Description	R	WR (Sec)	ST	BT
A	105	8.28	8.28	8.694	A	86	10.10	10.1	8.686
B	106	134.04	125.8	133.306	B	103	140.3	130.2	134.106
C	100	139.64	5.60	5.60	C	102	145.8	5.50	5.61
				147.6					148.4

Element Description	R	WR (Sec)	ST	BT	Element Description	R	WR (Sec)	ST	BT
A	109	8.01	8.01	8.7309	A	103	8.46	8.46	8.7138
B	94	149.73	141.7	133.217	B	97	146.04	137.94	133.8018
C	106	155.03	5.30	5.618	C	93	152.41	6.01	5.5893
				147.56					148.10

VIII. RESULTS:

COST REDUCTION:

As the cost is one of the main factors which affect production, there should be motto of reducing it in order to have economical production. In production, labor cost highly influences the cost of production. As we know the worker working on lathe machine must be skilled and trained. Thus the skilled labor increases labor cost. In our case, the salary given to skilled and experienced worker adds up to around Rs 22000 per month working on lathe machine for lapping operation.

The worker working on simple lapping machine need not to be skilled and experienced as the margin of error is very less as the fixture is made up using concept of ***POKA-YOKE***. Hence the labor salary in this case is around Rs. 10000 per month. Thus we have saved Rs. 12000 resulting in economical production after using simple lapping machine. Addition to this we are getting one of the lathe machines available for other production operations which will help in increasing productivity.

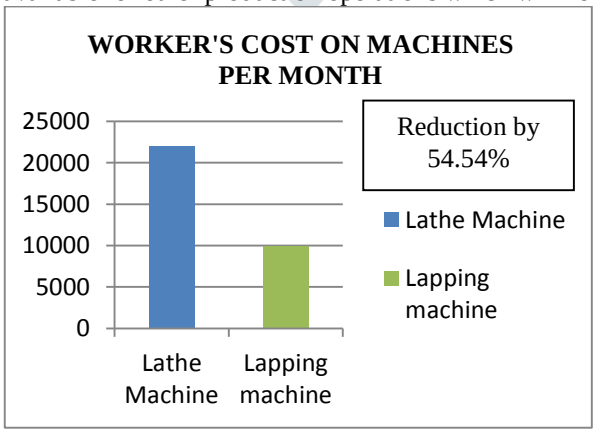

Fig-5 comparison of cost on lathe and lapping machine.

TIME REDUCTION:

Thus it is observed that the element 'B' of lapping on lathe is eliminated as the time required for aligning the carbide on the custom lapping machine is comparative very less. The cost incurred for lapping on lathe machine is also higher as compared to simple lapping machine. The cost of unskilled labor is lesser than skilled labor which adds to the cost reduction. Since

custom made lapping machine was used for lapping operation, a spare lathe machine was available for other various production operations.

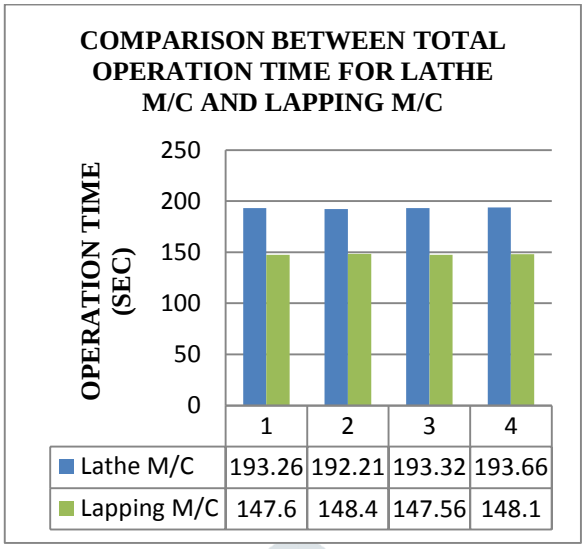

Fig-6 operation time on lathe vs. lapping machine.

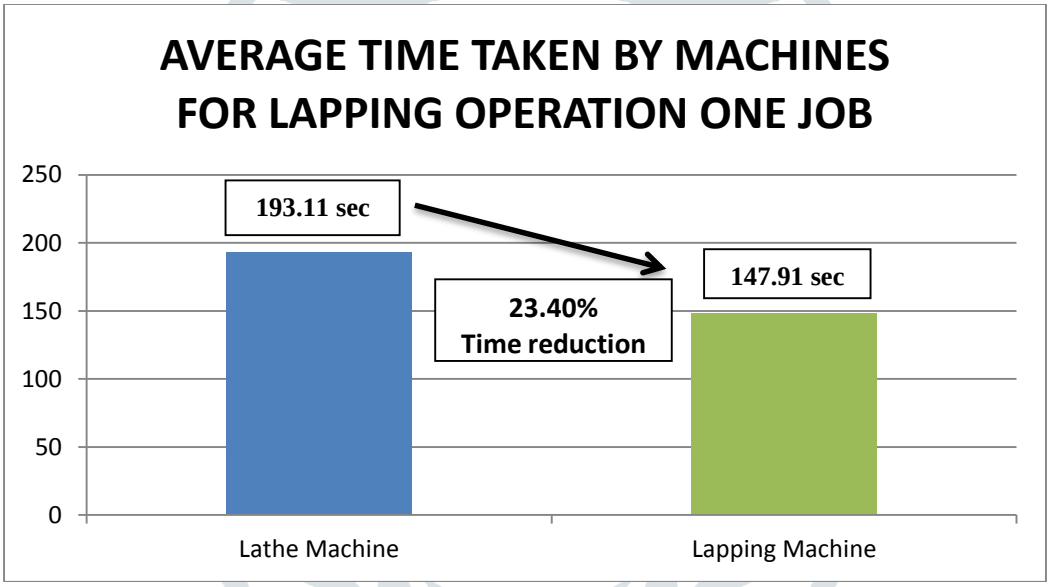

Fig-7 Time reduction in cycle time on lapping machine.

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IX. CONCLUSION

The research paper concludes that work cycle of lapping operation on lathe machine is higher. In order to reduce this cycle time, the lapping machine is made by spare motor. The time study of various elements of operation is carried out on both machines and analyzed. It is observed that the reduction in time is around 23.40% on lapping machine compared to lathe machine. Also the cost incurred on lapping machine is less since unskilled labor can be employed for the process. Hence the cost reduction was observed to be about 54.54% on monthly basis. Hence ***as the cost and time are inversely proportional to productivity, the productivity increases as the cost and cycle time reduces.***

X. ACKNOWLEDGMENT

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XI. EFERENCES

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