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PRODUCTIVITY ANALYSIS OF MANUALLY OPERATED AND POWER OPERATED SHEET BENDING MACHINE: A COMPARATIVE STUDY

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ABSTRACT
The paper deals with manufacturing of pipes using manually operated sheet bending machine and power operated sheet bending machine. Specially discussion are made on productivity analysis of manually and power operated sheet bending machine considering time required to complete one pipe, total expenditure required to manufacture one pipe, number of operators and labors required during both operations, etc. It also discusses limitations of the manually operated sheet bending process over power operated sheet bending machine.

Keywords **-** Productivity, Manufacturing, Analysis, Output, Input

1. INTRODUCTION
The development of a nation depends on the achievements in Science & Technology. It also depends upon how these indigenous technological innovations are used in various industries so as to benefit the common man. All over the world, the use of technology is taking place at a rapid rate in many areas, which results in increased labor output, reduction in cost and increase in efficiency of the system. An attempt is made to introduce a technology in industries which produces sheet metal pipes of various diameters and thicknesses. There are many industries spread all over India, which are engaged in production of sheet metal pipes. Presently, these sheet metal pipes are produced by manually operated sheet bending machines. Present, manually operated sheet bending machine has less productivity. The manual process causes fatigue to labors, lowers the efficiency of labors and there by lowers the working efficiency of sheet bending operation. Therefore, to increase the productivity, the industry requires some short of automation.

1.1 Manual Operated Sheet Bending Machine

Fig.1: Manually operated Sheet Bending Machine Showing Spur Gears and Handle Arrangement

In industries, sheet bending machine is operated manually. In this operation, the labor rotates the roller with the help of small lever. For that a wheel is attached with the shaft of gear. This gear is again attached with two other gears which are connected with the two rollers. Here the outer wheel is designed such that, hallow pipe must grip the wheel. Handles are welded to the outer side of wheel. Here hallow pipe grip the wheel and it is rotated clockwise and anticlockwise in direction. In this the gear is attached with wheel, rotates the two other gear and these gears rotate the two rollers. When these two rollers are rotated, because of friction between rollers & sheet inserted in between upper one roller and lowers two rollers, upper roller is also rotated. Now upper roller is set according to the thickness of the sheet. For this purpose in both side of body where rollers end are placed, screw arrangement are given which tight or loose the work piece. In this process the sheets are rotate in clockwise & anticlockwise direction in number of times according to the length of sheet & thickness of sheet.

1.2 Power Operated Sheet Bending Machine

Fig.2: Power Operated Bending Machine Showing Roller and Adjustable Screw Arrangement

Fig.3: Product of Power Operated Bending Machine

Construction of the power operated sheet bending machine is similar to manual operated sheet bending machine. Except this machine is power operated machine so that it requires motor, gear bore, and gearing arrangement. Here motor supplies the power to the gear box. Now this gear box transmits the power to the gears and at last it transmits to the roller. In the process the sheet is insert in between the lower rollers and upper roller than with the help of screw given at both of machine is lowering by revolving with rod. Now this screw roller at the end, and when screw rotates in downward direction then roller is also lowered their position. Now much distance the upper roller should came or the setting of roller is depends upon the thickness & diameter of sheet which is to be bend in the machine. Once the setting of screw is over, operator start the machine, the sheet passes towards the other side of the machine. After the one pass, again the setting of screw is to be done if requires and next pass is again start; it is restricted up to the cylindrical pipe is made. After getting a cylinder pipe, some positions of pipe is welded called tacking. After the welding, the welded position of pipe is passing through the roller. Then this pipe is removed from the machine by removing the base after removing the screw the side body is tilled to the side. Before tilting the body, one rod is inserted in between the upper roller and lower roller, and then the body is tilled and removes the pipes from the machine.

2. Productivity Analysis

Increase in productivity is the key factor for prosperity at all levels. It is the relationship between the result obtained and the factors employed to achieve the result. Productivity is the relationship between outputs to input. It is an indication of an enterprise capability. In case of the defined machine, the output highly depends upon the working skill of the employed persons. If he is having long experience of working over the machine then definitely his rate of making pipes would be higher than the rate of person who is new to machine.

As per the definition of productivity, we have a simple relation for it and it is given by

$$Productivity = \frac{Output}{Input}$$

To directly compare the productivity in terms of capital required, we take the ratio of output in terms pipe manufactured per hour to the inputs in terms of capital assets employed.

- Standard working period in a day is assumed to be 8 hours.
- Manufacturing cost per kg. = Rs.6.00 (full welding)
- Manufacturing cost per kg. = Rs.3.50 (with tacking)
- Weight of the sheet = 62 kg

$$Manufacturing\ Cost\ of\ pipe = Weight\ of\ plate \times Cost\ per\ kg$$

$$Manufacturing\ Cost\ of\ pipe = 62 \times 3.5$$

$$Manufacturing\ Cost\ of\ pipe = Rs.217$$

Data required for productivity analysis of manually operated sheet bending machine is given in table.

Table 1: Initial Data for the analysis

PARAMETERS	QUANTITIES	
	Manual Operated Machine	Power Operated Machine
Thickness of sheet	5 mm	5 mm
Width	1000 mm	1000 mm
Diameter	500 mm	500 mm
Labor required	07 Nos.	03 Nos.
Operator required	01 No.	01 No.
Time required	40 min.	20 min.
Cost of welding rod	Rs. 4/ piece	Rs. 4/ piece
Electricity consumption	1 unit	4 unit
Labor salary / day	Rs. 50	Rs. 50
Operator salary / day	Rs. 100	Rs. 100

Table 2: Expenditure for Making One Pipe on Machine

PARAMETERS	QUANTITIES	
	Manual Operated Machine (Rs)	Power Operated Machine (Rs)
Labor charge	29.16	6.25
Operator charge	8.33	4.16
Welding rod	4.00	4.00
Electricity consumption	5.50	27.50
Overhead Expenses	9.39	8.38
Miscellaneous cost	2.00	2.00
Total (Rs.)	**58.38**	**52.29**

Productivity of the machine is calculated by using following equation as:

$$Productivity = \frac{Manf.Cost\ of\ pipe\ in\ Rs/piece\ of\ pipe \times No.of\ pipes\ Manf./\ day}{Expenditure\ per\ pipe \times No.of\ pipes\ Manf/day}$$

2.1 Productivity of Manually Operated Sheet Bending Machine:

Since time required for manufacturing the one pipe is 40 minutes, total number of pipes manufactured in a day is 12.

Using above equation, Productivity of Manually operated sheet bending machine is calculated as

$$Productivity = \frac{217 \times 12}{58.38 \times 12}$$

$Productivity = 3.71$ ---------- For Manually operated sheet bending machine

2.2 Productivity of Power Operated Sheet Bending Machine:

Since time required for manufacturing the one pipe is 20 minutes, total number of pipes manufactured in a day is 24.

Thus, Productivity of Power operated sheet bending machine is calculated as

$$Productivity = \frac{217 \times 24}{52.29 \times 24}$$

$Productivity = 4.14$ ---------- For Power operated sheet bending machine

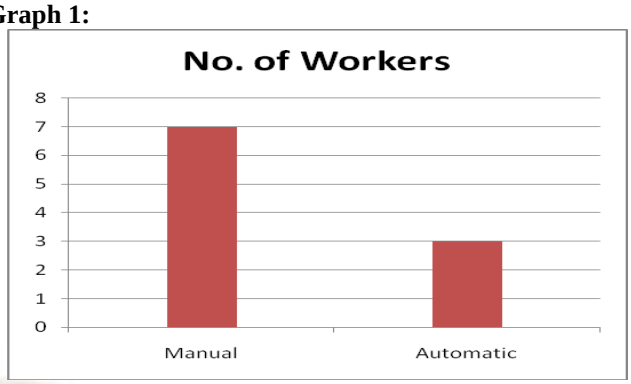
3. Limitations of Manually Operated Sheet Bending Machine over Power Operated Sheet Bending Machine

1. It can easily bend-Up to 12 mm thick plate.
2. Width of the sheet is also limited up to 1500 mm.
3. Heavy work is not possible.
4. Because of labour operated machine, process is not fast or continuous.
5. Time required for the operation is very high.
6. Production rate is very low.
7. Quality of pipe produced by the machine is not good.
8. Productivity is very low.

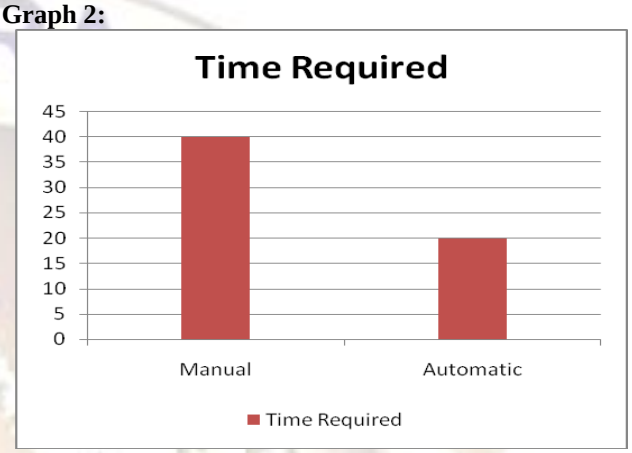
4. Conclusion:

Comparative study of manually operated sheet bending machine and power operated sheet bending machine has been done. Also, productivity of both the machines has been calculated. From the results, it is cleared that, productivity of power operated sheet bending machine is higher. Based on the results, following graphs can be drawn. All graphs showing below are drawn by comparative study of various parameters required for manufacturing of one pipe using manually operated and power operated sheet bending machines.

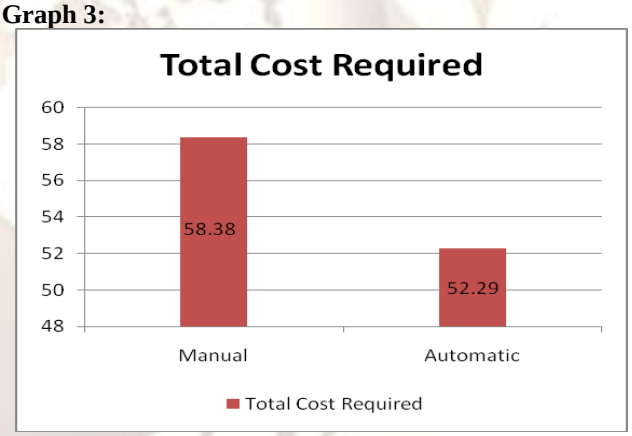
Graph 1:



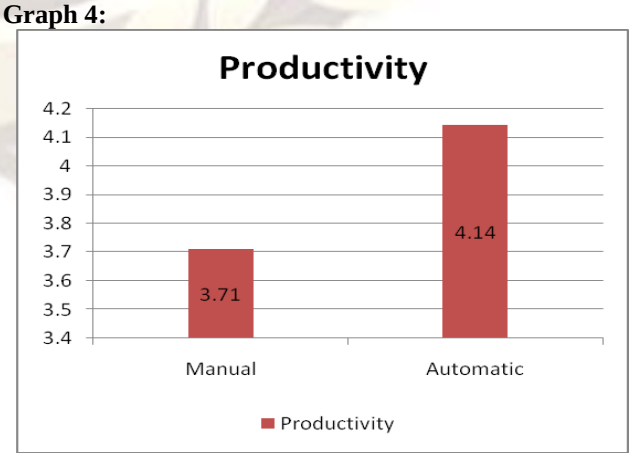
Graph 2:



Graph 3:



Graph 4:



From the graphs, following conclusions can be drawn.

1. Workers required for manufacturing metal pipes using power operated machine is 233.33% lower than manually operated machine.

2. Time required for manufacturing metal pipes using power operated machine is 50% lower than manually operated machine.

3. Total cost for manufacturing metal pipes using power operated machine is 10.43% lower than manually operated machine.

References:

[1] Jong Gye Shin, Tac Joon Park & Hyunjune Yim " Roll Bending", Tran, ASME, J. Mechanical Design, 123 May 2001, PP 284-290
[2] Bernard W. Shaffer And Eric E. Ungar , " Mechanics of the sheet Bending process", Tran, ASME, J. Applied mechanics, march 1960, PP 34-40
[3] K. L. Elkins, R. H. Sturges, " Spring back analysis in Air bending", Tran, ASME, J. Manufacturing science and engineering, 121, Nov. 1999, PP. 679-688
[4] C. C. Weng And R. N. White, " Residual stresses in cold- Bent thick steel plates", Journal of structural Engineering, 116 (1990), no.1, PP. 24-39
[5] L. P. Pomrehn, P. Y. Papalambros, "optimal design with application to gear design," Tran, ASME, J. Mechanical design, 117, sept. 1995, PP. 419-424
[6] J. Shigley, " Design of machine elements", Tata mc-Graw Hill Publication
[7] R. L. Mitchell "Introduction to work study", Universal book corporation, third revised edition.
[8] Amitabh Ghosh, Asok Kumar malik "Manufacturing Science" Affiliated East –West press pvt. Ltd., 2002
[9] K. L. Elkins, R. H. Sturges, " Spring back analysis in Air bending", Tran, ASME, J. Manufacturing science and engineering, 121, Nov. 1999, PP. 679-688