Automation of Piston Rod Welding in a Hydraulic Cylinder

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Abstract: **Welding is a fabrication or sculptural process to joining the two metals in various modern manufacturing industries. In design of Automation in Hydraulic piston rod welding machine, Metal Inert Gas Welding (MIG) is used. The need for automation welding especially to increase production rate, economic growth of the industry and also to reduce the unskilled labours. The present paper focuses on how to weld the piston rod and bush for the hydraulic cylinder. To weld these two components it is necessary to hold the rod in a chuck and bush is made tack welding to the rod.**

Keywords: **MIG welding, C clamp, Roller, Piston rod and Bush.**

I. INTRODUCTION

The word automation is derived from Greek words "Auto" (self) and "Matos" (moving). Therefore it is the system that "move by itself". Automation in the manufacturing industry is the process of integrating industrial machinery to automatically perform tasks such as welding, material handling, packing, palletizing, dispensing and cutting.

The need for automation in welding is especially to increase the production rate, accuracy, speed, repeatabletask and to reduce the operative cost and manpower.In automation, machines can operate even under extreme temperatures or in atmospheres that are radioactive or toxic. In automatic welding process are much less likely to get into accidents compare to manual welding process. Manual adjustments may be made between welding

operations but not during welding. In this automatic welding equipment that automatically controls one or more of the welding conditions. The welder manipulates the welding gun to create the weld while the electrode is automatically fed to the arc.

1.1 Electrode Used

M.S wire with copper coated is used for Sub-Area welding process and Metal Inert Gas Welding process and many other applications. It provides high quality welds on carbon steels. Uniform copper coating, smooth feeding, stable arc and minimum spatter under optimum welding conditions. Mild steel wire rod 6 or 8mm diameter available in coil bundle then it undergoes pickling process. For cleaning M.S Wire it is dipped into water tank and the cleaned wire rod is drawn on heavy duty drum type drawing machine. The wire is then passed through copper coating tank for copper layer as per standard requirement. Here ER70S-6 AUTOMIG electrode is used. It can be use with various gas mixture such as 100% CO, 98/2-Ar/CO. The higher level of de-oxidizers makes it suitable for applications where dirt, rust or mill-scale is present. The typical applications are pressure vessels, Tanks, Frame and general fabrications. It is widely used in high-speed robotic and automatic welding and semi-automatic applications.

1.2 Chemical and Mechanical Properties

Table 1: Chemical component and Mechanical properties of Electrode

Chemical properties	
Element	**Composition**
C%	0.070
Mn%	1.480
Si%	0.850
Cr%	0.020
Ni%	0.012
V%	0.005
Mo%	0.004
Cu%	0.145
S%	0.012
P%	0.015
Mechanical properties	
Test	**Result**
Ultimate Tensile strength (MPa)	579
Yield Strength (MPa)	477

II. AIM OF THE WORK

Due to the Fact that standards and quality in piston rod welding, all joints are required to be uniform and it is difficult for the welder accompany with these requirements. The need of automatic piston rod welding machine that weld in that location with higher accuracy, greater weld quality with lower

cost are became one of the most important requirement in a market.

1. The time required to complete the welding process with reduction of workers, with increase in productivity and profits.
2. Defects are compared with manual Welding and automatic Welding process.

III. LITERATURE REVIEW

Antony Maria Thomas Benny, et. al. (2017) discussed about the stress distribution in various parts of the components.They concentrate on static loading condition and carried out testing in UTM to determine breakage/failure of cylinder rod joint and chemical analysis by OES method to determine the chemical composition and its parameters.

Akshay.MP, et. al. (2017) discussed about the semi automated arc welding process. It was concluded that compare to manual welding process, semi automated leads in high production rate with better accuracy and it take less time compare to the unskilled labour.

Faiz F. Mustafa,et. al. (2016) discussed about the strength of welding in different shapes in an automatic welding process.It was concluded that the best welded quality by performing three forms of welding like line, zig-zag(triangle), zig-zag(square) and then workpiece undergoes Ultimate Tensile Strength (UTS) and Ultimate BendingForce (UBF), zig-zag(triangle) form is best way to weld compare to other two forms.

Labesh Kumar, et. al. (2017) discussed about the parameter for improving Welding Strength in Mig Welding process. Welding is carried out in different welding current and welding voltage and workpiece goes through a UTM to determine tensile strength. It was concluded that increasing in welding speed and decreasing the current increase the ultimate tensile strength of welded joint.

Gautam Kocher, et. al. (2012) discussed about welding feed rate between the nozzles and plate fixed in the various angle and various length.It was concluded that the welding angle is 57.51° at 94.83mm/min increases the welding speed and accuracy.

V. S. Gavali, et. al. (2016) describes about the automation welding process of the automobile components and the experimentally validated the design. They have altered the existing method by employing in the work and concluded by saying that productivity increases with great extent through this machine and further, said that due to uniform circular speed of welding that torch welding is uniform with no microcracks.

Sharmistha Singh, et. al. (2016) carried out the analysis of hardness in Metal Inert Gas welding and described about the Metal Inert Gas welding techniques, and they further said that welding torch positions and wire diameters. They concluded that by saying the strength is high at 12.5 m/min and 250A current, This shows that the weld joint has more strength than the mild steel who's UTS is 497.35 Mpa.

Satyaduttsinh P. Chavda, Tushar M. Patl, et. al. (2013) presented the technique used for obtaining optimal process parameters with the use of experimental data. The aim of their paper "A Review on Parametric Optimization of MIG Welding for Medium Carbon Steel Using FEA-DOE Hybrid Modeling" is to review the optimizing process parameters of MIG welding process and compare the experimental results with FEA for optimizing parameter.

S. N. Shindeet. al, (2014)reviewed the construction & design feature for welding fixture and made consideration of the following parameters: that is properly positioning of the work piece which will help the welder to easily access the area to be weld and also reduces welder fatigue. It also ensures safety to the welder. When a weldment is a cylindrical, it is eligible to be supported when rotated. Small turning rolls idlers and jack stands with rollers can support the cylinder during rotation. These don't help offset loads centre of gravity away from the center of the table out towards the edge of the table or further.

IV. PROBLEM IDENTIFICATION

The efficiency of piston can be improved by increasing Weld strength, in hydraulic cylinder piston, rod experiences more tensile strength,in the manual process due to lack of concentration it leads to increase in pores, lack of penetration of filler material into the workpiece.

So by increasing the weld strength automation can be made. Implementation of this system leads to increase in production rate.

V. SPECIFICATIONS

Table-1Specification of piston rod

PISTON ROD	40×582
MILD STEEL BUSH	60×40×73
MIG WELDING WIRE DIAMETER	1.2 mm
GREASE PIN DIAMETER	20

VI. EXPERIMENTAL WORK

6.1 MIG Welding Process

Gas metal arc welding mentioned by it sub types Metal inert gas (MIG) welding process, is a semi automated or automatic arc welding system in which non stop electrode is feed into the workpiece in which protecting gasoline are feed through a welding gun.

The basic principle of MIG welding is, an arc is maintained between the end and consumable electrode wire and the workpiece. A regular voltage and direct current source is used in GMAW.It is preferred for its versatility and relative ease of adapting in automation of robot. The different equipment parts of MIG Welding is explained. The equipment consists of (1) Power Source, (2) Induction motor, (3) Double worm Gear Box, (4) Chuck, (5)Electrode bobbin, (6)Rod feeder, (7)Controller, (8)Welding gun, (9)Workpiece, (10)Shielding gas supply, (11)Workpiece Stand. The purpose of the feeder is to supply the electrode cord into the welding gun, with the help feeder electrode wire can either pushed or pulled. Here protecting gas plays a vital role to protect welding area from atmospheric gases includes nitrogen and oxygen, that may purpose for fusion defects, insufficient weld penetration or cause an erratic arc. Argon is commonly blended with other gases such as helium and nitrogen.

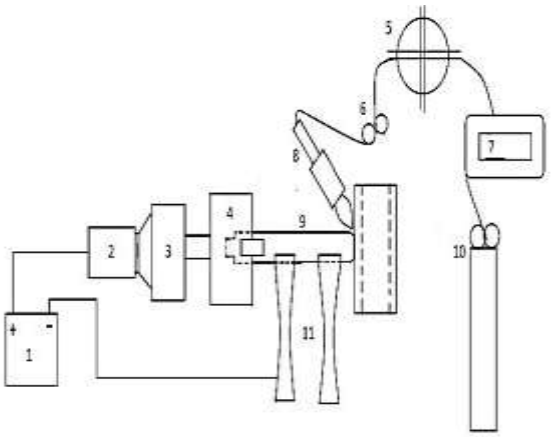
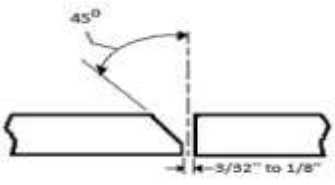


Fig. 1Experimental Setup

6.2 Welding Process Using Automatic Machine

In the beginning, the groove of piston wants to join by U and V groove depending on the thickness of the base metal. The included angle of the rod is 45 degrees. Here Bevel angle is equal to the groove angle because bush is placed perpendicular to the rod as shown in the Figure1. Initially Tack welding is made between the two pieces and then Root pass Welding Was done before the fill pass, fill pass takes most part welding time and usually consisting of number of layers depending upon its strength requirements.



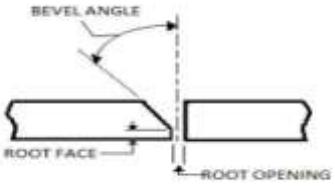


Fig-2: Joint Specifications for Piston Rod Welding.

The most common type of MIG wire for welding mils steel is ER70s-6.The wire diameter used in welding was about (1.2mm).Here Argon is used as the shielding gas. The primary purpose of using shielding gas is to prevent exposure of weld pool to surrounding. The reason behind of choosing Argon as a shielding gas because it is heavier than air and typically need lower flow rates than mixtures. The voltage setting varies depends on size of the electrode, thickness of the metal and gas which is used.

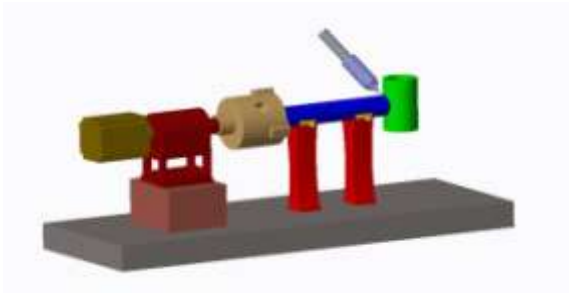


Fig-3Automatic Piston Rod Welding Machine

Welding Parameters

Welding Current - 330A

Welding Voltage - 29V

Welding Speed– 5rpm.

Deposition Rate - 300mm/min.

Wire Feed -13.8m/min.

VII. RESULT AND DISCUSSION

Analysis of collected experimental data is performed for investigating the effect of process parameter by comparing the manual and automated process. Experimental setup is made and welding is carried in piston rod. The purpose of this setup to increase the production rate, defects and to increase the quality weld.

7.1 Comparison of Defects Between Manual and Automatic Process

Comparison is made between manual and automatic process is shown in chart-1.Defects that occur during the

manual process is less compare to automatic process. In manual welding process defects are higher due to the lack of guideless about the welding process. Rejection rate is increases day by day. It causes serious damage to revenue of the company.

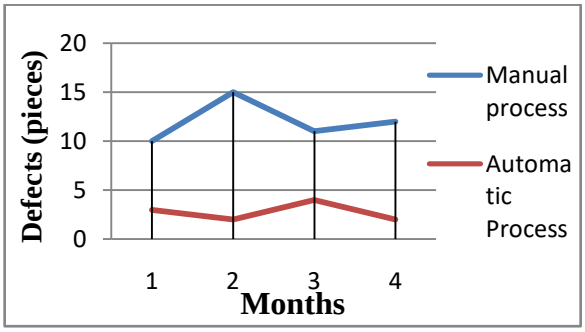


Chart-1: Graph between Defects in Different Month in Welding Process

7.2 Effects of Automatic Process

Increase in production rate and increased productivity with more efficient use of material at a better product quality. Compare to the manual process it leads higher production rate during short period of time is shown in chart-2. It results in greater control and consistency in product quality.

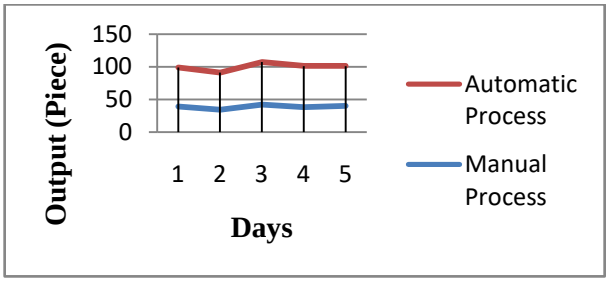


Chart-2 Graph between Production Volume in Different Days in a Welding Process.

7.3 Effect of Process in Welding Time

The effect of welding time compare to manual process, Automatic process take less time to complete one specimen to weld. Series of analysis is made in welding time of a piston rod is shown in chart-3

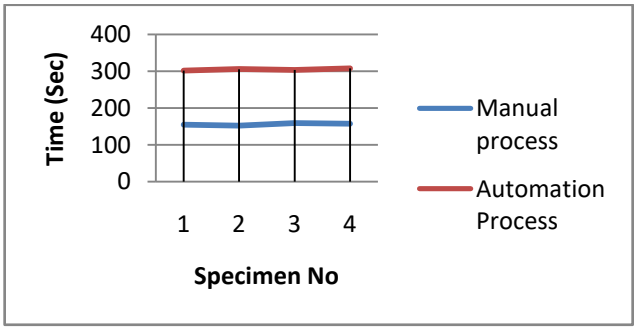


Chart-3 Variation in Welding Time in Manual and Automatic process.

VIII. CONCLUSION

An experimental study has been done to determine the profit by implementing the Automatic MIG welding process for a piston rod in a hydraulic cylinder for a mild steel specimen. The conclusion may be drawn from the above chart 1,2,3 compare to manual welding process ,automatic process gives better results. Hence it can be concluded that in semi-automatic process leads increase in productivity with a better product quality in a short period time.

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