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An Implementation of Six-Sigma in Aluminum Pipe Welding

Ibraheem Sabry, Ahmed M El-Kassas** and M El-Wakil****

ABSTRACT

Six-Sigma is the one of the most sturdy management tool used to realize process privilege. Six-Sigma is a problem-solving methodology that decreases cost and refinement customer goodwill and very decreases waste in all the process implicated creation and delivery of the product and service. Six-Sigma process embraces collection of datum, measurement, and statistics to find out the different types of factors and parameter. This work focuses experimental surveillance on providing a clear connotation of an aluminum pipe welding by using (define, measure, analysis, improve, control) technology under Six-Sigma in order to increase tensile strength and hardness (decrease leakage)problem in aluminum pipe welding. By taking various pipe welding parameter in a machining process the pipe welding strength and hardness increased.

Keywords: *Six Sigma; DMAIC; Pipe Welding; Tensile Stress; Hardness.*

1.0 Introduction

Six sigma is a well-structured methodology that concentrates on decreasing variation, measuring defects and beneficent the quality of products, processes, and services. Six Sigma methodology was primarily progressing by Motorola in the 1980s and it targeted a difficult aim of 3.4 parts per million defects [1].Six Sigma has been on an unbelievable run over 25 years, manufacture important savings to the under the most line of many large and small organizations [2].

Major organizations with a path record in quality have adopted Six Sigma and alleged that it has converted their organization [3]. Six Sigma was first inserted in manufacturing processes; today, however, marketing, purchasing, billing, invoicing, insurance, human resource and customer call answering functions are also implementing the Six Sigma methodology with the aim of constantly decreasing defects during the organization's processes[4].The industries service are assorted and the features are different from manufacturing industries.

Thus, the use of Six-Sigma in service industries and its advantage are confined to some particular types of services like health care and banks. Quality management has been a significant management strategy for realize competitive feature and progression. conventional quality connotation like Statistical Quality Control, Statistical Process Control, Zero Defects and Total Quality Management, have been key players for many years; While Six-Sigma is a more modern beginning quality amelioration to earning publicity and approval in many industries decrease of refuse and boost the quality. Six-Sigma, tool up a framework in which all these tools can be complete with management support. Apply the Six-Sigma technique on the aluminum pipe welding process for the solve leakage problem in aluminum pipe used by arc welding low voltage, high current process.

This paper presents the step-by-step application of the Six Sigma (acquaint, Measure, Analysis, progress, and monitoring) approach to eliminate the defects in an aluminum pipe welding process This has helped to decrease defects in the process and thereby progress productivity.

2.0 Research Methodology

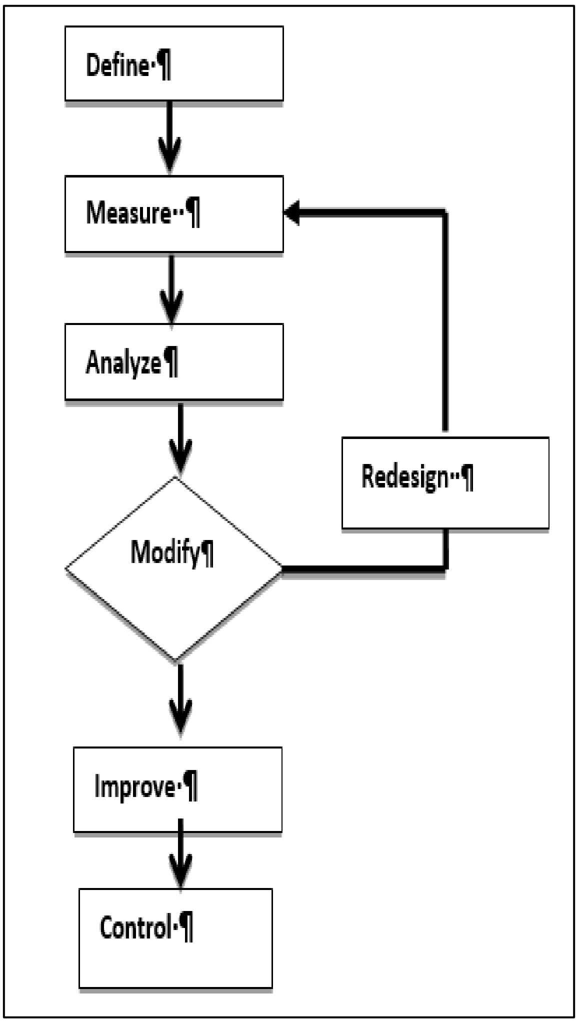
This department expounds the methodology adopted for this case study. Scientific implementing

**Corresponding Author: Department of Production Engineering, Faculty of Eng., Tanta University, Egypt*
(E-mail: ibraheem.sabry@yahoo.com)
***Department of Production Engineering, Faculty of Eng., Tanta University, Egypt*
****Department of Production Engineering, Faculty of Eng., Tanta University, Egypt*

on innovating a system or refinement to the existing one needs to start with some framework and outline. This framework and outline of implementing were imaginary so as to procure answers to research questions in the research design [6].

DMAIC (Define, measure, analysis, improve, control) method was implemented.

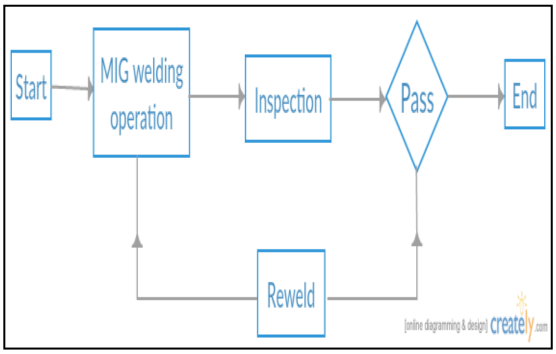
Fig 1: Improve Tools-Tasks-Deliverables



2.1 Define

Acquaint the problem: acquaint phase is the first phase (critical phase) of the Six-Sigma that is the leader of the project and differentiate chart of aluminium pipe welding process out of the run down phase differentiate the high-level view of process and grasp need of customer in this phase run down the problem of aluminium pipe welding pipe leakage problem show at the influx of fluid so differentiate leakage so this problem is the main problem of pipe.

Fig 2: Flow Chart Used to Define the Process.



2.2 Measure

Chart of the current process: How does the process presently perform measurement is the critical during the life of the project in measure phase combine the aluminum pipe welding datum related to the welding parameter then measure the datum and set start point and baseline of the process and differentiate the projection and the testing, purification aluminum pipe welding and received more elaborate welding implement process consider in the measure phase show fig.2.

2.3 Improve

Progress and prove the solution: In Improve phase after datum measure and datum analysis and comprehension problem then differentiate conception for solve decrease aluminum pipe leakage problem. Progress parameter changes related to the MIG welding show fig. 3.

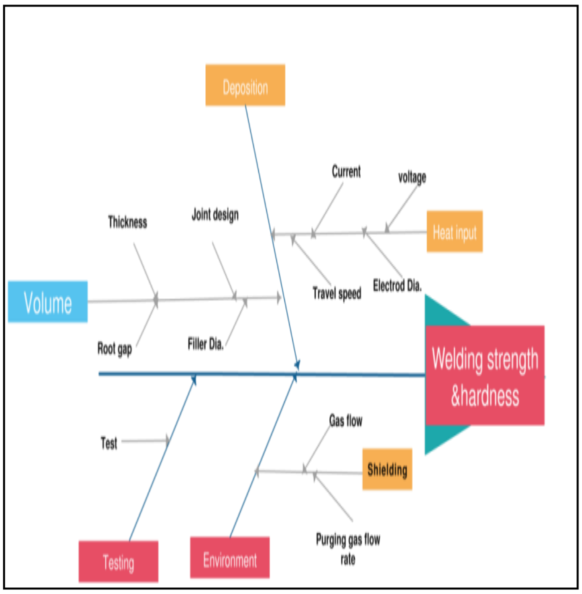
- Improvement welding process technique
- Welding material dimension
- Welding speed
- Weld material thickness
- MIG welding used co2 and argon gas

Above parameter changes to start arc welding process and received datum there datum visual Tick on the figure and chart and received better result and then solved my leakage problem in aluminium pipe welding [7-11].

2.4 Control

Preserve the solution: Monitoring phase is a mini version of AIC technique. In Monitoring, phase checks the market value of the product and launch product in the market aprocess management. Monitoring phase is the last process in the DMnd received customer. All process and technique apply on the aluminum pipe welding then forward aluminum pipe in Monitoring phase [5-6].

Fig 3: Cause and Effects Diagram for Welding Defects



3.0 Result and Discussion

In the context of quality improvement, to make the most impact we want to select the few vital major opportunities for improvement.

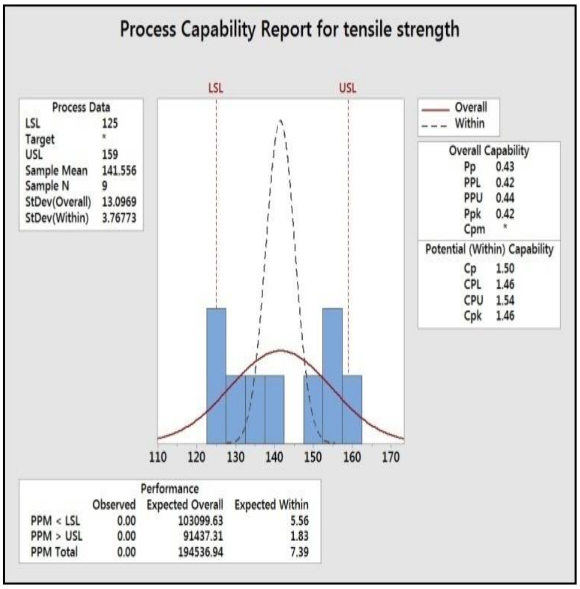
This figure visually emphasizes the importance of reducing the frequency of controller misbehavior.

In aluminium pipe Welding product, solve strength and hardness (leakage) problem with Six-Sigma technology, used arc Welding low voltage high current process and density of material 2.70 g/cm3 then cooling system from water then used co2 and argon for the reduced corrosion in aluminium Welded pipe and electrode angle 90 degree, changes the different parameter in pipe welding process then increased the tensile strength and hardness. Plot the graph by changing the parameter.

When we are changing the thickness (variable) then improve the welded pipe strength and hardness show below in fig.4and fig.5

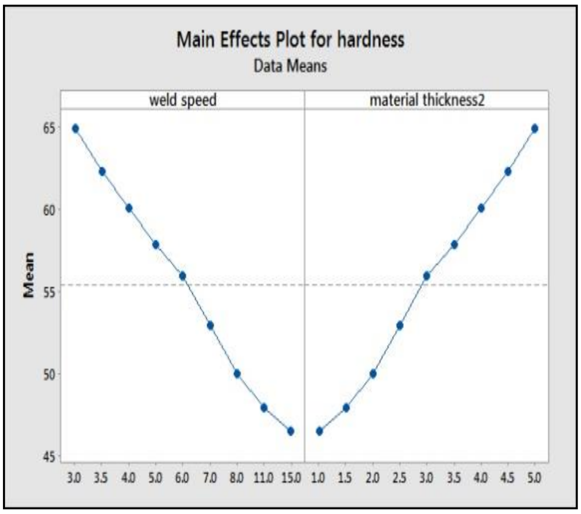
In this fig.4 we are changing the thickness material then variable slowly tensile strength increase and hardness of welded pipe are increased so solve the leakage problem. The maximum received tensile strength=160 Mp and maximum received hardness 65 (VHN).

Fig 4: Main effect plot for tensile strength by weld speed and material thickness



In this fig.4 and fig.5, changes the tensile strength and hardness with welding speed, in arc welding used low voltage high current. In arc welding, high speed strip converted into the pipe so create defect because strip material shape perfectly no change in pipe shape so at the testing time pipe create leakage problem because material porosity problem from the high welding speed and reduced tensile strength of welded pipe, And reduced welding speed increased tensile strength.

Fig. 5: Main Effect Plot for Hardness by Weld Speed and Material Thickness



As shown in the figure 4 and figure 5, welding speed reduced than` increased tensile strength and not created porosity at the arc welding process, low voltage high current (19V, 115 Amp.) strip converted into the pipe shape so automatically reduced the leakage problem in welded pipe.

The indices for process capability discussed are based on the assumption that the underlying process distribution is approximately belled shaded or normal.

Yet in some situations, the underlying process distribution may not be normal. The tensile strength and hardness for process capability study should attempt to encompass all natural variations. To assess the process capability for the tensile strength of welding aluminum pipe of 9 randomly selected pipes.

The upper left box reports the process data including the lower specification limit, target, and the upper specification limit.

These values were provided by the Minitab program. The calculated values are the process sample mean and the estimates of within and overall standard deviations.

Table 1: Process Data Using Tensile Strength

LSL	125
USL	159
Sample Mean	141.55
Sample N	9
StDev(Within)	13.0969
StDev(Overall)	3.76773

The report in Figure 6 shows the histogram of the data along with two normal curves overlaid on the histogram.

One normal curve (with a solid line).The histogram and the normal curves can be used to check visually if the process data are normally distributed. To interpret the process capability, the normality assumption must hold.

In Figure 8 There is a deviation of the process from the target value of 165MPa. Since the process mean is greater than the target value, the pipes produced by this process exceed the upper specification limit (USL).

A significant percentage of the pipes are outside of .The potential or within process capability and the overall capability of the process is reported on the right hand side.

For present study, the values are Potential (Within)

Fig 6: Process capability for tensile strength

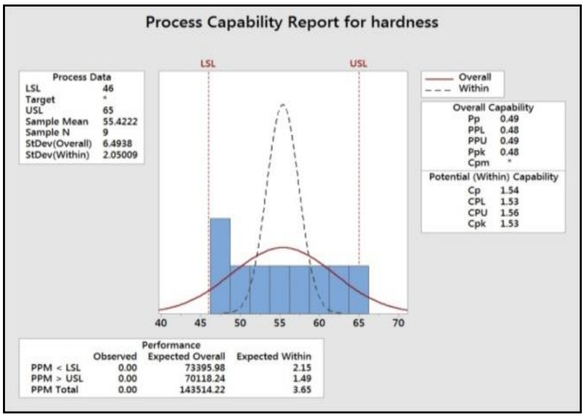


Table 2: Overall Capabilities

Capability	Overall Capability
Cp 1.5	Pp 0.43
CPL 1.46	PPL 0.42
CPU 1.54	PPU 0.44
Cpk 1.54	Ppk 0.42

The value of Cp=1.5 indicates that the process is capable (Cp > 1). Also, Cpk = 1.46 is less than Cp=1.5. This means that the process is cantered and excellent . Cpk=1.46 is an indication that an improvement in the process is warranted.

Higher value of Cpk indicates that the process is meeting the target with minimum process variation. For this process, Pp = 0.43 and Ppk = 0.42. A comparison of these values indicates that the process is off-centre.

In Figure 7 There is a deviation of the process from the target value of 65. 7MPa. Since the process mean is greater than the target value, the pipes produced by this process exceed the upper specification limit (USL).

A significant percentage of the pipes are outside of .The potential or within process capability and the overall capability of the process is reported on the right hand side. For our case, the values are Potential (Within)

Table 3: Overall Capabilities Using Hardness

Capability	Overall Capability
Cp 1.5	Pp 0.49
CPL 1.53	PPL 0.48
CPU 1.56	PPU 0.49
Cpk 1.53	Ppk 0.48

Table 4: Process Data Using Hardness

LSL	46
USL	65
Sample Mean	55.422
Sample N	9
StDev(Within)	6.4938
StDev(Overall)	2.05009

Fig 7: Process Capability for Hardness

The value of Cp=1.54 indicates that the process is capable (Cp > 1). Also, Cpk = 1.53 is less than Cp=1.54. This means that the process is centered and exeelent . Cpk=1.53 is an indication that an improvement in the process is warranted. Higher value of Cpk indicates that the process is meeting the target with minimum process variation. For this process, Pp = 0.49 and Ppk = 0.48. A comparison of these values indicates that the process is off-center.

4.0 Conclusions

From the From the present theoretical result of aluminum pipe welding with Six-Sigma technique, and use of co2 and argon gas and changes the welding speed and flow rate gas then increase strip thickness, and reduce welding speed to increased tensile strength hardness and check the tensile strength and hardness pipe but maximum optimization result show in relation between thickness and tensile strength. the hardness in the figure to solve the aluminum pipe welding leakage problem at the flow of fluid in the aluminum pipe, improve customer satisfaction. The Root causes, effects ampere, volt, weld speed and material thickness in tensile strength and hardness for MIG welding with the priorities. This analysis will be very much useful as a reference guide of MIG welding in aluminum 6061 pipe material.

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